a handbook of COSMETICS

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Preface

A thought to bring out a Handbook of Cosmetics has been in the mind since 1950 when one of the authors (BMM) started teaching a course on Perfume and Cosmetics to the B.Pharm. students of the then Birla College, Pilani. The course was discontinued from 1964 when Birla Institute of Technology and Science was formed. However, a course named, 'Cosmetic Science' has been reintroduced. Importance of the book on Cosmetics has been felt ever since. In the last 20 years or so the use of cosmetics has been continuously increasing so much so that many colleges/universities have introduced courses in cosmetics. This book intends to provide a hand book on cosmetics which may be introduced in colleges.

The cosmetic products are classified and arranged according to their site of application and function. Though a general manufacturing procedure is given but for special type of products, specific and separate procedure is also given. Basic aspects of quality control and evaluation of products are also mentioned in each chapter.

There is in the market good literature already existing. The subject matter is mainly from the student angle, and it is hoped that it will fulfil that purpose besides providing handy literature to anyone interested in the design and manufacture of cosmetics. Any suggestion by the readers will be appreciated.

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CHAPTER-1

An Introduction

The word 'cosmetics' arises from a Greek word '*kosmeticos*' which means to adorn. Since that time any material used for beautification or improvement of appearance is known as cosmetic. The urge to adorn one's own body and look beautiful has been an urge in the human race since the tribal days. Earlier both males and females were equal competitors for improvement of appearance. Males decorated themselves with animal parts and vegetable leaves etc. while women did so by wearing any coloured stones or flowers round their neck and the wrists. At a later stage they employed coloured earth for faces and bodies and still later coloured ointments. Bangles and necklaces made of baked earth also became common in the early civilization as well as shells of various kinds obtained from nature. In digging up ancient Egyptian tombs much light has fallen on the ancient practices of beautification. Pharaohian tombs have revealed that coloured earths were like malachite green. The copper ore was used as eye shadows. Lamp black was common too for eyes. For dyeing of hairs red was also practised. The dancing ladies applied ointments perfumed with materials like myrrh to head so that when they danced the perfumed ointment would flow down their bodies emitting pleasant smell all over. The history also records that when Jehu went to the town of Jezebel she painted her face and looked out from window. The use of cosmetics in ancient Egypt reached heights with the famous queen Cleopatra who tried to beguile Caesar and Antony the Romans when they visited Egypt. Shakespeare has summarized it by this line, "Had Cleopatra's nose been longer, the shape of the world would have been different." The women of the world feel inspired when they have a mental feeling that they are looking good. Hence, the practice of adornment or improvement of appearance continued unabated across the centuries. Various kinds of natural materials were used for the purpose. The practice of use of cosmetics must have grown to an appreciable extent because the British Parliament enacted a Law in 1770, which still stands unrepealed and is as follows:

"That all women of whatever age, rank, profession or degree whether virgins, maids or widows that shall from and after such Act impose upon, seduce and betray into matrimony any of His Majesty's subjects by the scents, paints, cosmetics, washes, artificial teeth, false hair, Spanish wool, iron stays, hoops, high heeled shoes, bolstered hips, shall incur the penalty of law in force against witchcraft and like misdemeanours and that such marriage upon conviction shall stand null and void."

It is interesting to note that even materials like high heeled shoes, artificial denture etc. are classed as materials of adornment. One wonders how many females were so prosecuted and their marriages nullified. It was an act of distinction between male and female subjects. Maybe the circumstances prevailing then were such that law was considered essential.

In modern days cosmetics are the rage and are considered to be essential commodities of life. The role of cosmetics in everyday life met greater acceptability after World War II. It was realized by social and medical scientists that cosmetics not only adore but they exercise psychological effect on users and specially on the skin. They keep the skin supple delaying the onset of wrinkling. They are also helpful in skin infections and prevention of sunburns.

In the last 3-4 decades the use of cosmetics has increased exponentially not only among in females but the male population also indulges in their use. Hair dyes, powders, creams are as popular with males as with females. Most countries have now laws to control, manufacture, labelling, sale etc. of cosmetics in such a way that use of cosmetics harmful to health is prevented. In India Drugs Act has been renamed as Drugs and Cosmetics Act and contains some sections to exercise control over cosmetics.

The cosmetics in general are external preparations and are meant to be applied to external parts of the body. In other words they may be applied to skin, hair and nails for the purposes of covering, colouring, softening, cleansing, nourishing, waving, setting, mollification, preservation, removal and protection. The cosmetics may be classified into 4 main groups namely—

(1) Cosmetics for Skin
(2) Cosmetics for Hair
(3) Cosmetics for Nails
(4) Cosmetics for Hygiene (Dental, Bathing, etc.)

All cosmetics are formulated as solids, semi-solids or liquids. Their formula design is very akin to drug dosage forms.

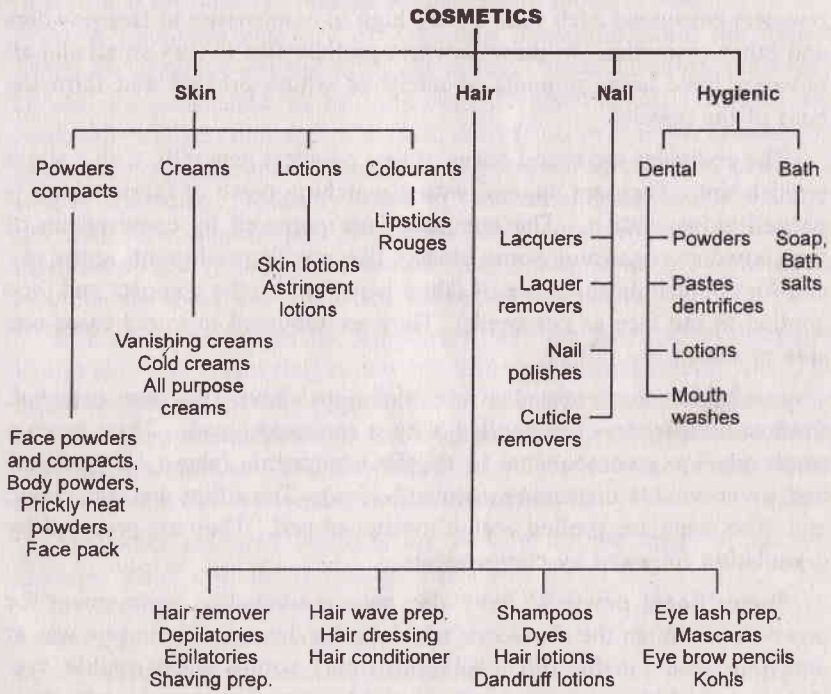

Fig. 1-1 Classification of cosmetics

Cosmetics for the Skin

The skin covers vast area of body and cosmetics are applied to many parts, the most important part being the face. The skin cosmetics are formulated in the form of solids, semi-solids and liquids. The solids consist of powders with different degrees of flow and angle of repose or of compacts. The semi-solids may be emulsions or simple admixtures and liquids are both monophasic and biphasic. The solid products consist of face powders, body powders, compacts and moulded products like lipsticks. Face powders which are applied to the face consist of many ingredients besides covering agents like zinc oxide or titanium dioxide. They remove oily appearance and give the face a smooth, dry and peach-like finish. The face powders as per their covering power are classified as light, medium or heavy powders. Some face powers are slightly tinted on the pink side. Face powders are packed in elegant plastic boxes with lids.

The other category of powders consist of body powders or talcum powders which are applied to various parts of the body as well as to face and possess a good degree of slip or spreadability. The quantity of body powders consumed each year is very high in comparison to face powders and other cosmetics. In these powders particle size is very small and all powders have large amounts of additives which provide and form the base of the powder.

The compacts are round cakes of face powders generally with a slight pinkish tint. They are applied with a matching piece of fabric which is packed along with it. The compacts are prepared by compression of face powders containing some binders like mucilage of gums, soaps etc. and for application the piece of fabric is rubbed on the compact and then applied to the face as per needs. They are mounted in round cases one side of which is a mirror.

In addition to compacts, 'Cake Make ups' have also been patented. Such cakes are dry and applied with a moistened pad. They contain some oily/waxy components (1 to 25%), pigments (about 10%), fillers and water-soluble dispersing agents (1-13%). The fillers are talc, chalk, etc. The same are applied with a moistened pad. They are prepared by granulation followed by compression.

Some 'liquid powders' have also been marketed as replacement for powders to whiten the shoulders, neck etc. for dances. Phenazone was at one time used for this (20% solution) tinted with a water-soluble dye. But use of phenazone on skin has raised eyes of dermatologists, their application is also a handicap. Hence, liquid powders came into vogue. These are prepared with addition of glycerine (15%) to a face powder base consisting of chalk, zinc oxide etc. They also contain about 60% water and viscosity is imparted by 0.5% of methylcellulose. The colours may be shades of red, yellow or brown pigments.

An important category of skin cosmetics are the colouring agents which are used generally for coloration of lips, cheeks, eyelids (eye shadows) and mascaras for eyelashes and eyebrow pencils. In colorants, lipsticks are used by masses while other products are used very selectively. Lipsticks impart an attractive colour and looks to the lips. Lips can also be made to look wider or narrower if it is applied intelligently and artistically. The base which is coloured to produce lipsticks consists of a judicious blend of oily and waxy materials, the important ones being beeswax, carnauba wax, ceresin, paraffin wax, vaseline, etc. The formula of each individual manufacturer varies. Some lipsticks include some zinc oxide (2%) or titanium oxide (1%) to impart some covering

power. Most lipsticks are prepared by moulding. To give a glossy finish they may be exposed momentarily to small flame for the material to melt and set quickly. This is said to impart glossy finish.

Next important category of colouring preparations are the rouges which are generally applied to cheeks to make them look rosy since rosy cheeks are considered to be indicators of good health. Rouges are marketed as solid compacts or as wax, anhydrous or hydrous creams and also as liquids. Compacts containing binders are prepared by compression or moulding. Generally soaps of ammonia-stearic acid and starch are used. The colours have to be certified colours only under Drugs & Cosmetics Act. In rouges an opaque base is more desirable. The bases may contain about 5% zinc oxide for imparting opacity.

In cream-type rouges the anhydrous ones are prepared by vaseline, kaolin etc. The cream rouges may be vanishing or cold cream type. The liquid rouges are not very popular but all the same are marketed to some extent. They are prepared in mucilaginous solutions of hydrocolloids like methylcellulose (2%) in water to which colour, preservatives, perfumes etc., besides wetting agents are added.

The other coloured products are mainly for the areas of the eye amongst which commonly used products are:

(1) Mascaras (eyelashes)
(2) Eyeshadows (for eyelids)
(3) Eyebrow pencils (for outline of eyebrows)
(4) Kohls (eyelid inside)

Mascaras are used for darkening and increasing apparent length of the eyelashes so as to increase brightness and expressiveness of the eyes. Mascaras are marketed as cakes, creams or liquids. These products should be evenly applicable, should be non-sticking, should dry rapidly and be absolutely non-irritant and non-toxic. The colours used are bone black, carbon black or oil black. Fine powders of silver and aluminium are also used though the same are costly now.

The most important and popular category of skin cosmetics are the various kinds of creams and milks. The first cream in the world is said to have been prepared by Galen in Rome for the royal ladies of the Roman Empire. It was a beeswax-borax type. It was a superior product to the perfumed ointments which were applied until then. The water in the cream improved its elegance, application and also had cooling effect. Nowadays there is a plethora of formulae for creams and milks, all of which are emulsion type. The creams and milks are mostly o/w type products, but some w/o type products are also there. They are vanishing

or cold cream type. The cold creams have larger proportions of hydrophobic materials while vanishing type have comparatively less. In cold creams the oily materials range from 60 to 70% while vanishing creams contain 15 to 25%. Formula of all creams necessarily has one or the other emulgents. The non-ionic emulsifying agents are very much in use because of their wider compatibility. The milks/lotions are liquid at room temperature. Milk creams are semi-solids otherwise composition wise they are same. These products are marketed under a variety of names as given below:

(1) Cold creams
(2) Cleansing creams
(3) Cleansing milks
(4) Cleansing lotions
(5) Vanishing creams
(6) Foundation creams
(7) Emollient creams
(8) Skin conditioning creams
(9) All purpose creams
(10) Moisturizing creams

Sunburn Protection and Skin Tanning Preparations

Exposure of body to sunlight in moderate amounts may be beneficial but excessive exposure causes damage to various extents. It may cause:

(1) Irritability and depression
(2) Inflammation
(3) Sepsis
(4) Malignant growth
(5) Movement of melanin from base layer to stratum corneum
(6) Release of dilators causing erythrema
(7) Sunburns and skin diseases

Ultraviolet part of sunrays is held to be most detrimental for the skin. For sunburns many compounds are in the market which when applied as powders or as liquids screen the skin from sunlight by scattering it. Powders like kaolin, calcium carbonate, magnesium oxide, talc etc. of suitable particle size are used. The compounds used as sun screens should be non-toxic, effectively absorb or reflect erythemogenic light without undergoing chemical change, must not decompose in moisture and perspiration and should not be absorbed through skin.

The sunscreen preparations are marketed as oil, lotions, powders, creams or only as solutions of dyes. Sunscreens also speed up skin

tanning. Western people or people with light skins like their skins to look slightly tanned. Increased tanning is also believed to take place after ingestion of some materials like methoxsalen or extracts of *Anmi magus*.

Hair Preparations

Hair preparations may be functionally categorized into:

(1) Preparations for dressing and setting of hair
(2) Preparations for cleansing
(3) Tonics
(4) Preparations for hair removal
(5) Preparations for colouring
(6) Preparations for application to areas like eyebrows, eyelids, either for colouring or upkeep.

The hair dressing includes brilliantines as helps in combing of hair, hair wave products, hair setting and fixing products. The most important hair dressing used in India is the hair oil based on vegetable or mineral oils occasionally claiming to contain herbals. Brilliantines are waxy having preparations consistency of vaselines. Hair creams which are emulsions are more common dressings in the western world.

Curly hair probably looks more attractive than straight. Earlier hair waving was achieved by hot iron or boiling in water. These gave permanent curls. Then waving was done by chemical components like ammonium hydroxide with borax.

Many thiol compounds have also been suggested for waving hair. Reducing agents are also said to be helpful. These days cold waving methods are more common like pin perms, rollers etc. Some reducing lotions may also be used.

Shampoos which are meant for cleansing of hair and scalp are becoming very popular in place of soaps used earlier for the purpose. With the advent of synthetic detergents, particularly the non-ionic type, there has been a boom in shampoos. Most shampoos are clear liquids. But now cream and solid shampoos are also available.

Hair Tonics are suspicious products in the eyes of public, scientific as well as non-scientific, because of the word 'tonics'. The preparations under this group include some perfumes for application to hair as sprays, some glossening agents, preparations for dandruff, seborrhoea, baldness etc. Many products are advertised as growth promoters but such claims are suspiciously looked upon.

Hair Removers consist of depils and epils which remove the unwanted hair by dissolution of hair shafts or help it in pulling out. Shaving creams which assist in hair removal by blades/razors by softening the hair shaft of faces in males may also be distantly classified in this group.

Hair Dyes have become very common. Somehow grey hair has been associated with old age. Nobody likes the black hair to turn grey on his or her head and many people continuously use hair dyes for younger appearance. Since hair dyes contain coal tar compounds which act as allergens for some persons, hence, before using such dyes a test must be run as per instructions to test one's sensitivity to such compounds. The earlier metallic dyes which were temporary colouring agents are not in use in India.

The preparations used on eyebrows, eyelashes and eyelids are very special products. The trade in them is of a very small order.

Cosmetics for Nails

The nails, in particular the nail plates of the fingers of hands and feet, have been subjects of decoration. The main decoration is in terms of shine or colour. The shine or polish is done by application of some abrasive materials like stannic oxide or powdered silica and rubbing with a chamois leather. Wax polishes with abrasives are also common. The most popular nail dressing is the coloured nail lacquers or polishes which give a coloured coating to the nail plates. Generally they consist of nitro celluloses, plasticizers, solvents and colours.

The nail polishes or lacquers should be finely ground to distribute the dye and should have hardness and plasticity. Colour should not alter on keeping and when applied. Even drying should take place within a few minutes.

Enamel Removers have also come into market. They consist of mainly solvent capable of nitrocellulose dissolution. They may be marketed as such or as creams.

Nail Creams are in fashion too. They are applied to brittle nails. Cold, vanishing or all purpose creams can also be applied.

Nail Bleaches are employed to remove stains of tobacco or other stains by oxidation or reduction. For oxidation hydrogen peroxide, chlorine compounds, perborates or peroxides are used. For reduction sulphites with dilute acid are suitable.

Nail White products are used for giving white edges. They are marketed as pastes or creams containing zinc oxide, titanium oxide, kaolin, colloidal silica etc.

Cuticle Removers are used for beautifying nails and are available in market. The shedding of outer dead cells by skin gives some grooves around nails which detract the nail beauty. These are removable by use of alkaline solutions in water by small plugs of cotton. Potassium hydroxide is best for this purpose.

Dental and Oral Care Preparations

Such products are normally considered as hygienic products but since appearance of teeth and good breath are considered to be overall ingredient of a cosmetic personality, all kinds of products for cleansing of teeth and mouth washes are generally formulated and marketed by cosmetic companies. For design of such products one must be familiar with tooth and gum structures. The teeth are the grinders located at the point of entry of food materials in the body. The food which is being cut or chewed by the teeth, its small particles get lodged into various junctions between the teeth and between teeth and gums. These food crumbs if not removed regularly may become pockets for microbes to grow. Hence their dislodgement and removal is very essential for the safety, longevity and appearance of the teeth. Historically teeth were cleaned by use of stems of some trees. The fibres of stems provided abrasive action and trees like Neem had antiseptic elements also. Messwah was another such tree popular in India. The common tooth ailments are tartar accumulation, gingivitis, dental caries and other minor kinds of dental eating away by bacteria. So any product, paste, cake or powder must have abrasive and antiseptic action besides good taste, flavour etc. and medication, if necessary. The common types of dental preparations are:

(1) Tooth pastes
(2) Tooth powders
(3) Dentifrices

The tooth pastes and powders are similar in composition except that tooth paste is made pasty by addition of suitable additives. They basically contain:

(1) Abrasives
(2) Fillers
(3) Antiseptic compounds
(4) Surface active agents/soaps

(5) Glycerine, hydrocolloids
(6) Flavouring agents
(7) Taste imparters
(8) Colours

The dentifrices are solid cakes and for application to teeth they may be taken on tooth brushes in a moist state.

The mouthwashes are mainly solutions of antiseptic substances with various other additives. The same are not very popular.

To get a comprehensive idea of the cosmetics the chart presented on page 3 of this book may be useful.

On the whole cosmetics are important group of consumer materials. Their flavours or smells are very significant in their selection by the common man.

Evaluation and Quality Control

The cosmetics are very important. All the products should be evaluated for their performance, ingredients, etc. It is also necessary to check whether the products have any sensitivity or toxic effects.

CHAPTER-2

The Skin

Since most of the cosmetic preparations are meant to be applied on skin for beautification, protection or other purposes, basic knowledge of the skin and its functions is very much important for designing cosmetics meant for specific purpose of the skin.

The skin, the heaviest single organ of the body, combines with the mucosal lining of the respiratory, digestive and urogenital tracts to form a capsule which separates the internal body structures from the external environment. It not only physically protects the internal organs and limits the passage of substances into and out of the body but also stabilises temperature and blood pressure with its circulation and evaporation system.

For an average six-foot, 70-kg human, the skin surface area is 1.9 m^2 and weighs about 2100 gms. A typical square centimetre of skin covers 10 hair follicles, 12 nerves, 15 sebaceous glands, 100 sweat glands, 3 blood vessels with 92 cm of nerves and 3×10^6 cells.

Normally the skin is very smooth. However, due to aging and exposure to heat and cold, sunrays, pressure and abrasion, dust and microbial infection, etc. the smoothness may be lost and the skin becomes rougher and thicker. Aging also produces wrinklels on the skin surface.

pH of the skin varies from 4 to 5.6 and refers to the pH of the film of aqueous and other soluble materials present on the surface of the skin. Sweat and fatty acids secreted from sebum influence the pH of the skin surface. It is suggested that acidity of the skin helps in limiting or preventing the growth of pathogens and other organisms.

Functions and Compositions of Skin

Skin performs several functions including containment of body fluids and tissues; protection from external stimuli like chemicals, light, heat and cold, radiation etc.; reception of stimuli like pressure, heat, pain; biochemical synthesis; metabolism and disposal of biochemical wastes; regulation of body temperature; controlling of blood pressure.

Skin contains several chemical substances with specific functions like keratin, lipids, fatty acids, proteinase, etc.

Keratin is produced from polypeptides in the cytoplasm of epidermal cells by a high energy system at the granular layer of normal human skin.

Sebum is the product of the sebaceous glands and consists of triglycerides, free fatty acids, waxes, sterols, squalene and paraffins. Free fatty acids are responsible for bactericidal and fungicidal activities.

Skin also contains two essential fatty acids, called linoleic acid and arachidonic acid, which play an important role in regulating the barrier functions.

Skin synthesizes on steroid, vitamin D_3, that subsequently gets converted to the hormone calcitriol which is important to normal calcium metabolism.

A proteinase has been isolated which is believed to play a role in modulating the inflammatory response to cellular injury.

Anatomy and Physiology

The human skin comprises of three distinct but mutually dependent tissues (Fig. 2-1), the stratified, avascular, cellular epidermis and an

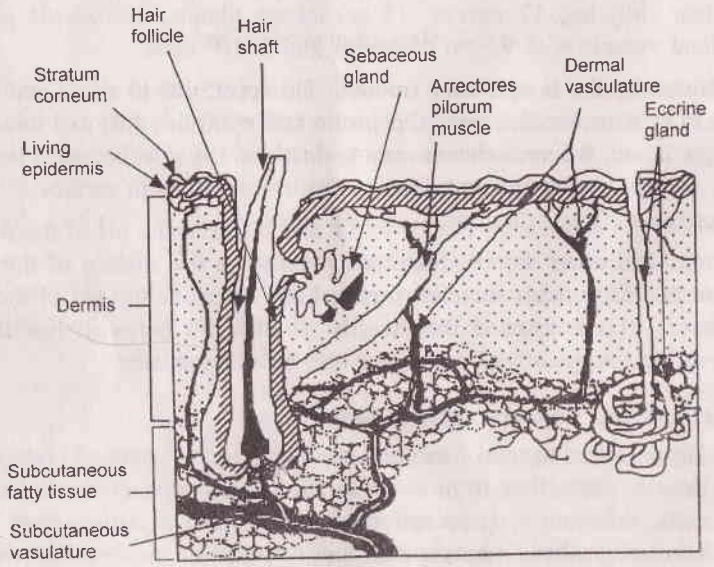

Fig. 2-1 Schematic cross-section of the skin

underlying dermis of connective tissue. At the bottom of the dermis lies the fatty, subcutaneous layer.

Human skin displays two main types. Hairy skin encloses hair follicles and sebaceous glands, but there are no encapsulated sense organs. Glabrous skin of the palms and the soles is made of a thick epidermis with a compact stratum corneum, but the integuments lack hair follicles and sebaceous glands and the dermis supports encapsulated sense organs.

A. The Epidermis

The multilayer envelope of the epidermis varies in thickness, depending on cell size and the number of cell layers, ranging from about 0.8 mm on the palms and the soles down to 0.06 mm on the eyelids.

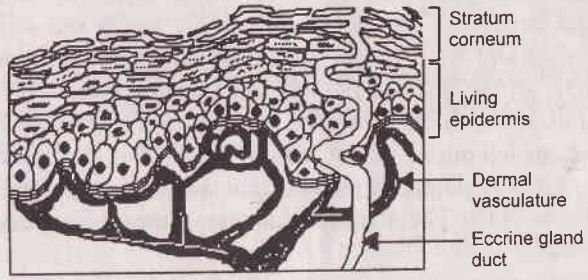

Fig. 2-2 Magnification of epidermis

Cells which provide epithelial tissue differ from those of all other organs in that as they ascend from the proliferative layer of basal cells they change in an ordered fashion from metabolically active and dividing cells to dense, dead, keratinized protein. Downward, the epidermis comprises of five distinct and separate layers:

(1) The horny layer (Stratum corneum) : At the final stage of differentiation, epidermal cells construct the most superficial layer of the epidermis, the stratum corneum. Human beings owe their ability to survive in a non-aqueous environment to the almost impermeable nature of this refractory horny layer. On the general body areas the membrane provides about 10-15 layers of much flattened, keratinized dead cells, stacking them in highly organised units of vertical columns. The horny layer may be only 10 μm thick when dry, but swells in water to several times this thickness. However, at friction surfaces of the body like palms and soles the thickness may be as high as several hundred micrometres. When dry it is a very dense tissue, about 1.5 gm/cm^3.

Each thin polygonal cell measures approximately 0.5 to 1.5 μm thick, with the diameter ranging from 34 μm on the forehead to 46 μm on the thigh axilla.

At normal relative humidities, a normal stratum corneum can take up moisture upto 15-20% of its dry weight. But in water logged condition water content of some areas of the body can be several times of the dry weight. When occlusive dressing or creams are applied over skin, the stratum corneum can become highly hydrated due to prevention of natural evaporation of water. By this process some substances may become more soluble in it as well. Conversely as the stratum corneum dries out it becomes brittle. Thus the ultradry, inelastic tissue tends to split when stretched causing conditions like chapped lips, windburn and dishpan hands.

One can distinguish two types of horny layers by anatomic site, function and structure. The horny pads of the palms and soles adapt for weight bearing and friction and the membranous stratum corneum over the remainder of the body is flexible but impermeable. The horny pads are at least 40 times thicker than the membranous horny layer. Holbrook and Odland carried out an ultrastructural analysis of the stratum corneum to find out the regional differences in the thickness (cell layers) in humans (Table 2-1). The methods that were utilised for measurement of the layers were:

(a) Scotch tape stripping to remove cell layers. The number of strippings were correlated with the number of cell layers.

(b) Treatment of paraffin embedded and frozen biopsies with alkali to cause swelling, hence better visualization and more accurate counting.

(c) Application of standard chemical fixation, paraffin embedment and staining procedures for histological sections. Thickness was measured with a micrometer eyepiece.

TABLE 2-1
Regional Differences in the Thickness and Cell Layers of the Stratum Corneum

Body Region	*Thickness of S.C. (μm)*		*Number of Cell Layers*	
	Mean	*Range*	*Mean*	*Range*
Abdomen	8.2	6.9-9.8	18.0	15.0-20.9
Flexorforearm	12.9	8.1-16.2	21.6	16.7-30.0
Thigh	10.9	7.7-15.3	19.3	14.3-22.7
Back	9.4	8.2-11.3	15.8	14.0-21.1

Human beings constantly shed the outermost layers of the stratum corneum as lipid-soaked horny flakes with an average daily loss from the whole body surface of 0.5 to 1.0 kg.

The stratum corneum plays a crucial role in controlling the percutaneous absorption of chemical substances. The selective permeability of its elegant structure provides a central theme in many aspects of design of cosmetics.

(2) Stratum lucidum : In the palm of the hand and the sole of the foot, an anatomically distinct, poorly staining hyaline zone forms a thin, translucent layer immediately above the granular layer. This region is the stratum lucidum. The cells are non nuclear.

(3) Stratum granulosum (granular layer) : This layer is above the keratinocytes. They manufacture basic staining particles, the keratinohyaline granules. This keratogenous or transitional zone is a region of intense biochemical activity and morphological change. The dynamic operation manufactures the keratin to form the horny layer by an active rather by a degenerative process.

(4) Stratum spinosum (prickly cell layer) : The cells of this layer are produced by morphological and histochemical alteration of the cells of basal layer as they moved upward. The cells flatten and their nuclei shrink. They are also called polygonal cells, prickle cells, because they are interconnected by fine prickles. Each prickle encloses an extension of the cytoplasm, and the opposing tips of the prickles of adjacent cells adhere to form intercellular bridges, the desmosomes. These links maintain the integrity of the epidermis.

(5) Stratum germinativum (basal layer and dermoepidermal junction) : The basal cells are nucleated, columnar and about 6 μm wide, with their long axis at right angles to the dermoepidermal junction, they are connected by cytoplasmic intercellular bridges.

Mitosis of the basal cells constantly renews the epidermis and this proliferation in healthy skin balances the loss of dead horny cells from the skin surface. Thus the thickness of epidermis remains constant.

The basal cells also include melanocytes which produce and distribute melanin granules to the keratinocytes required for pigmentation, a protective measure against radiation. Below the basal cell layer lies the complex dermoepidermal junction, which constitutes an anatomic functional unit. The junction serves the three functions of dermal-epidermal adherence, mechanical support for the epidermis, the control of the passage of cells and some large molecules across the junction.

The barrier function of the junction can be considered in terms of three species, small molecules, large molecules and cells. There is no evidence that the junction significantly inhibits the passage of water, electrolytes, and other low molecular weight materials.

B. The Dermis

The dermis, as indicated in Fig. 2-1, is the non-descriptive region lying in between the epidermis and the subcutaneous fatty region. It consists mainly of the dense network of structural protein fibres i.e. collagen, reticulum and elastin, embedded in the semigel matrix of mucopolysaccharidic 'ground substances'. It is about 0.2 to 0.3 cm thick. The elasticity of skin is due to the network or gel structure of the cells. It also consists of the epidermis and reticular layer, which is the main structural body of the skin. Beneath the dermis, the fibrous tissue opens out and merges with the fat containing subcutaneous tissue. On the other hand, the upper layer of the dermis is formed into ridges or papillae projecting into the epidermis, which contains blood vessels, lymphatics, and nerve endings. Only the nerve fibres reach into the germinative zone of the epidermis.

C. Subcutaneous Tissue

This layer consists of a sheet of fat-rich areolar tissue, known as the superficial fascia, attaching the dermis to the underlying structures. The subcutaneous layer is quite elastic. Large arteries and veins are present only in the superficial region. The rest of the portion contains a limited number of capillaries and novital organs.

D. Skin Appendages

The skin is interspersed with hair follicles and associated sebaceous glands, like pilosebaceous glands and in specific regions two types of sweat glands, eccrine and apocrine glands. Collectively, these are referred to as the skin appendages.

Hair follicles are distributed over the entire skin surface except soles of the feet, the palm of the hand, the red portion of the lips, and selected portion of the sex organs. It consists of concentric layers of cellular and non-cellular components and is placed at an angle. Smooth muscle fibres, arrectores pilorum, attach the hair to the dermal connective tissues. The hair shaft is formed by a process of cellular division and migration of the cells similar to that which forms the stratum corneum. Hairs are thus formed of keratinized cells compacted together into plates and scales.

Each hair follicle is associated with one or more sebaceous gland which are referred as the acid mantle of the skin. In some selected region of the skin these exist in the absence of the hair follicle. Their size varies from region to region (200 to 2000 μm) and is highest in nose. It secretes oily material, sebum, which lubricates the skin and stratum corneum and also maintains the pH of the skin at 5.

(1) Eccrine sweat glands : Eccrine glands or salty sweat glands are distributed over the surface of the body. They consist of simple, coiled tube as shown in Fig. 2.1 and have a density from 100 to 200 glands per cm^2 of the body surface depending on the body region. The secretion is dilute aqueous solution of salt and some other minor components and it has a pH of about 5. The principal function of the gland is heat control. It secretes dilute aqueous solution of salt and due to this it regulates the body temperature.

(2) Apocrine glands : Apocrine glands are present only in the selected region of the body viz. axillae (armpits), in anogenital region and around the nipples. They are ten times larger than eccrine glands and secretes a milky substance containing protein, lipoprotein, lipids and diverse proteins. The secretion is mainly stimulated due to emotional stress and sexual stimulation.

(3) Sebaceous glands : Sebaceous glands are responsible for the secretion of sebum, which constitutes the majority of the fatty layer covering the skin and hair. The sebaceous glands are found in various parts of the body like face, shoulders, upper chest and scalp, but are not found on the palms and soles. They are available 500-1000 per square centimetre.

(4) Hair : The hair shaft is basically the product of synthesized protein following cell division at the root of hair follicle. The number of hair per unit area varies at different parts of the body. The rate of growth also varies from site to site and varies between 0.2 to 0.4 mm per day.

Common Disorders of the Skin

As we mentioned earlier that cosmetics are basically for beautification and masking, prevention or overcoming common disorders, it is necessary to have a knowledge of common disorders of the skin. Design and application of any skin cosmetics will be guided by the nature and site of disorders. Common disorders of skin can be classified as follows:

A. Pigmentary Disorders

This is due to disorder in pigmentation on the skin and it can be of hyperpigmentation or hypopigmentation in nature.

(1) Hyperpigmentation : This is the disorder due to abnormal pigmentation which occurs on a small area of the skin, mainly in Caucasians. This disorder is due to an increased local synthesis of melanin in the epidermis. This can be further stimulated by exposure to UV or X-irradiation. Various conditions are termed as ephelides, lentigens, moles, ochronosis.

(2) Hypopigmentation : Synthesis of lesser amount of melanin in part of skin can cause hypopigmentation, which is called vitiligo, a patchy depigmentation of the skin afflicting a considerable number of non-Caucasians. It can also occur in Caucasians. A decrease or total absence of melanocytes in the depigmented areas has been observed.

B. Disorders of the Sebaceous and Sweat Glands

Disorders or malfunctions of sebaceous and sweat glands can cause various skin disorders like acne, prickly heat, etc.

Acne like pimples, blackheads, whiteheads and boils are caused by the disorders of hair follicles and sebaceous glands and mostly occur in face, neck and upper portion of chest and back.

Miliaria, most common of which is prickly heat or strophus, is caused by the disorder of sweat glands and commonly occurs in neck and large areas of the skin.

C. Skin Scaling Disorders

Skin scaling can be due to dandruff and psoriasis.

(1) Psoriasis : This is a skin disease characterized by the formation of scaly red patches, particularly on the extensor surfaces of the body, mainly elbows and knees. The site is covered with silvery scales which on removal show a small bleeding point.

(2) Dandruff : This is characterized by flaking of stratum corneum and mostly occurs on scalp. The reason suggested for this condition can be microbial infection, immunological or normal disorder at the surface of stratum corneum.

(3) Effects of aging on skin : Aging affects the characters and functions of the skin. Cosmetics are used to partially repair, mask or overcome such changes. Various changes caused by aging are thinning of epidermis making older people more prone to injury and skin infection, reducing the sensitivity of the immune system causing further skin damage and infection, change in colour, lower melanin level makes it more sensitive to sun exposure, dry and scaly skin due to less secretion, cold skin due to low blood supply, decrease in elasticity of the skin and occurrence of wrinkles.

Skin : Its Nutrition and Care

To ensure the maintenance of normal condition of skin various steps or practices should be adopted. They include cleansing, freshening or toning, moisturising, nourishing and protecting the skin. For aging skin further care is required for overcoming the changes that have occurred or for masking the skin characters.

Advent of more and more knowledge about skin physiology and biochemistry has given the cosmetic manufacturers more avenues for better skin care. Several creams are available for specific functions, overcoming specific disorder of skin in special cases.

Nutrients of skin Various substances are essential for maintenance of normal condition and function of skin. Some of these are systemically supplied and others are synthesized by various mechanisms in the skin from raw materials. These include:

(1) Proteins : Proteins are major components synthesized in epidermis and hair follicle from amino acids. The amino acids are supplied by the blood by the breakdown of the dietary proteins at the digestive systems.

(2) Lipids : Lipid is another important substance synthesized in the skin by the sebaceous glands in the epidermis. Sebum is lipid secreted from the sebaceous glands and is made from mainly fatty acids. Lipids produced at the epidermis have a role in barrier function and structural integrity of the stratum corneum, and are made from acetate, amino acids, long chain fatty acids and carbohydrates.

(3) Melanin : Melanin is synthesized from the amino acid tyrosin and is responsible for pigmentation at the skin.

(4) Energy supply substances : The synthesis of proteins, lipids and melanin requires the supply of energy at the skin cells and is made available by energy processes like oxidative phosphorylation of glucose or other monosaccharides.

(5) Water : This is most important for normal function of the skin and movement of other nourishing substances and metabolites.

(6) Others : Apart from the above substances various other substances like protein hormones, steroid hormones, corticosteroids and vitamins are also essential for normal maintenance of the skin.

The above substances are required to be supplied as skin preparations if they are not available through normal systemic process.

Supply of these nourishing substances requires penetration through skin to reach the proper site. It is very important for the designer to ensure the cutaneous permeation of any such substances. The percutaneous permeation of amy chemical entity will depend on various factors like:

(a) Physico-chemical properties and concentration of the permeant
(b) Composition and characteristics of the vehicle
(c) Condition of the skin

For poorly penetrable substances, some additive can be incorporated to enhance the penetration of the permeants. These are called 'Penetration Enhancers'. Various substances are used as penetration enhancers like dimethyl formamide (DMF), dimethyl sulphoxide (DMSO), ozone, alcohols and surfactants. Their funtions are attributed to their role to temporarily change the barrier systems of the skin by various mechanisms.

Skin care preparations Various products are available and marketed for the care of skin. They are used for beautification, skin care, masking or repairing of skin defects, etc.

(1) Powders, face powders, compacts etc.
(2) Skin colorants like lipstick, rouge, eye mascara etc.
(3) Various creams for care of skin.
(4) Sunscreen preparations for skin protection.

CHAPTER-3

Powders and Compacts

One important category of skin care preparations is powders and compacts. They are widely used for face and body care, not only by women but also by men. There are body powders, which are also known as dusting powders or talcum powders, face powders and compacts. Medicated powders are used for prickly heat or preventing microbial growth on skins. There are also powders such as deodorant powders, foot powders used for specific purposes.

Fundamentally powders differ from liquid skin care preparations in their physical characteristics and their most important cosmetic properties are determined exactly by these characteristics. Very fine particle size produces large surface area per unit weight which covers a large surface area of the body and results in strong light dispersion.

The powders should have the following characteristics:

(1) The powder must have good covering power and so hide skin blemishes.
(2) It must adhere perfectly to the skin and not blow off easily.
(3) It must not be completely dissipated in a few minutes to avoid re-powdering.
(4) The finish given to the skin must be preferably of a matt or peach-like character.
(5) Shine on or around the nose must be completely eliminated.
(6) The powder must be absorbent.
(7) There must be sufficient slip to enable the powder to spread on the skin by the puff without producing a blotchy effect.
(8) The constituents of the powder must be such that a clown-like effect is impossible. The preference should be rather towards one of transparency.

Raw Materials for Powders and Allied Preparations

The primary consideration in the manufacture of powders is the

selection of proper raw materials. Quality of the basic ingredients is very important to achieve the intended quality of the finished products and the effect to be obtained from the products. So, the quality of the raw materials plays an important role in the ultimate powder formulation. The knowledge of various raw materials and their characters, role, should be well known before judicious selection of materials.

The main substances used to impart all the necessary qualities are kaolin, zinc oxide, zinc stearate, titanium dioxide, calcium carbonate, magnesium carbonate, purified talc (talcum), magnesium stearate etc. Apart from the above, various colours and perfumes are also used to impart intended colour shade and odour.

The raw materials to be used for manufacturing powder should be of good quality:—

(1) The materials should not be hard. If the materials are crystals in nature they must not have any sharp edges or points. These can damage the skin.

(2) Solubility of the materials in water and fat mixture must be nil or least.

(3) The materials must be non-irritating and non-toxic to the skin.

(4) The materials must be chemically neutral and should not interact with each other.

The raw materials generally used in manufacturing of various powders are classified and discussed according to their functions:—

(1) Materials imparting covering character
(2) Materials imparting adhesion character
(3) Materials imparting slip and softness
(4) Materials imparting absorbency characters
(5) Materials imparting peach-like finish
(6) Frosted-look materials
(7) Colouring substances
(8) Perfumes

All the materials are not required for every preparation. According to the need and purpose of the product raw materials are selected. Some of the items are essential for every preparation such as covering materials, absorbents, adhesives, slips.

(1) Materials for imparting covering character : One important character expected from the materials used in powders, particularly face

powders, is the ability to cover small skin imperfections, enlarged pores, etc. They should be in finely powdered form. Generally, the covering power per unit weight is stronger if the specific surface area of the powder is higher i.e. the particles are finer. The efficiency of the covering agent can depend on the medium in which it is dispersed. Covering power is better on dry skin than moist skin. Titanium dioxide is the best covering agent. It is widely used in face powders. Covering power of titanium dioxide is 1.6 times more than the zinc oxide on dry skin and 2.5 times more on moist and greasy skin. It is mostly physiologically inert. Its sunscreen properties are, however, inferior to zinc oxide.

Zinc oxide is also a very good covering agent. Though finer particles have better covering power, but covering power of zinc oxide particles diminishes if the particle size is below 0.25 μm. In moist environment covering power of zinc oxide is 37% of that of dry powder and much less in oily environment. Zinc oxide has very good sunscreen properties as it has a protective effect against ultraviolet rays.

Kaolin, zinc stearate, magnesium stearate and rice starch are other substances used as covering agents. However, they are not as good as titanium dioxide and zinc oxide. But combination of the above materials, in different proportions, can be used to make products of varying covering ability.

(2) Materials imparting adhesion character : These substances impart adhesion character. Not only to the skin surface but also to the powder puff, which facilitates taking powder from its container. This character is essential to cling the powder to the face or other skin surface.

The materials primarily used for imparting adhesive characters are metal soaps primarily zinc stearate and magnesium stearate, talc, magnesium and calcium salts of myristic acid.

Magnesium stearate has better adhesive property than zinc stearate and is more preferred in face powders. But zinc stearate is more predominantly used in talcum powders. Super quality magnesium and zinc stearates are available with excellent colour, texture and minimum of odour. They also give a velvety softness to the product. As they are waterproof, they maintain the complexion intact in inclement weather. Magnesium stearate is used 3-10% in face powders.

Stearates of lithium and calcium are also available for use for the same purpose. Lithium stearate, in particular, has also got good covering properties and fluffy texture.

Magnesium and calcium salts of myristic acid are also used for their adhesion properties. Magnesium myristate has better adhesion character and a better texture.

Cosmetic quality talc, which is a purified hydrated magnesium silicate has adhesion properties. Though it is available in various countries, Italian product is the best and used for both face powders and body powders.

The adhesion character of the powders can be increased by incorporating 1-2% cetyl alcohol, stearyl alcohol, glyceryl monostearate, petrolatum, lanolin or similar fats.

(3) Materials imparting slip and softness : Slip is the quality of easy spreading and application of powder to produce a characteristic smooth feeling on the skin. This character is mainly obtained by using talc, zinc and magnesium stearates, and aluminium hydrosilicate.

Talc is purified hydrated magnesium silicate ($3MgO$, $4SiO_2$, H_2O). The proportion of Mg and Si can vary. Talc is produced by different countries but Italian, French and some Indian varieties are of very good quality and most suitable for powders specifically face powders. Sometimes talc contains pathogenic spores, particularly tetanus, so properly sterilized products are used in powder preparations. Talc is distinguished by its great softness and slip and is almost neutral if adequately purified. It is not to be used in open skin as in wounds it can cause talcum granuomae. Talc cannot absorb any water.

Aluminium hydrosilicate is a valuable basic material for powders. It is smooth and fatty. It should be prepared properly by treating with acid, washing with water and then dried. It also has certain cooling effect. It absorbs fatty secretions and small amounts of water. It is completely non-toxic.

Other substances used for softness and slip are zinc stearate, magnesium stearate, zinc undecanate, magnesium undecanate. The undecanates, in particular, are soft and have excellent slip but are expensive. Properly purified stearates are extensively used.

(4) Materials imparting absorbency characters : Powders should have ability to eliminate shiny skin in certain facial areas by absorbing sebaceous secretions and perspiration. This character can be imparted by incorporating material with high absorptive capacity in face powders, dusting powders, baby powders, deodorant powders, foot powders etc. Face powders should also have a certain absorbency to prevent smudging of make-up by perspiration. The materials which impart this property

are colloidal kaolin, starch, bentonite, precipitated chalk (calcium carbonate), magnesium carbonate.

Colloidal kaolin is a fine, soft, white powder. It has a good absorbent capacity for aqueous and fatty substances and good covering power also. It is non-toxic and non-irritating and inert. It has less slip property.

Bentonite is mainly aluminium silicate and fine grey whitish powder. It has extraordinary swelling power and can swell upto 12 times of its own volume. Its use in cosmetics is comparatively less.

Magnesium carbonate has good absorbency character for both water and fats. It has good covering power and adhesion character. Thus, perfume oils are first mixed with magnesium carbonate which is then added to other ingredients. It is less alkaline. Calcium carbonate is a fine, soft, white powder and has good absorbent power for water and fatty substances. But it has alkaline reaction with skin. So, it is preferred less than magnesium carbonate.

Various starches, like rice, wheat, corn, potato etc., are comparatively less used nowadays. It has good moisture absorbing and swelling ability. It produces a sticky character but is completely non-toxic.

(5) Materials imparting peach-like finish : The peach-like finish given to the skin, particularly by face powders, can be achieved by use of rice starch. Though other starches are also used, but mainly maize starch is employed. Starches should be used after drying for few hours to get better effect.

Occasionally speciality materials like silica or powdered silk are included in face powders. Silica is used in very finely divided form with fluffy character. Powdered silk is obtained by partial hydrolysis of silk protein and the hydrolysate is then ground to fine powder. This should not be used in excess of 30 per cent.

(6) Frosted-look materials : The recent trend of translucent, shiny look has given rise to raw materials which help create this effect. Earlier, guanine was used extensively for pearl lustre but due to its cost and uncertain supplies it has been replaced by bismuth oxychloride. Metallic powders have also been used to impart lustre, e.g., mica, aluminium, bronze.

(7) Colouring substances : These are substances mainly used in face powders and compacts but not in dusting or baby powders. Various inorganic and organic pigments and certified organic lakes are used.

Various synthetic or natural inorganic pigments used are iron oxides for yellows, reds, and browns and ultramarine for green and blue. Toxic lead and arsenic compounds are not used.

Organic lakes and pigments produce better brilliance but should be selected from certified dyes.

The organic pigments must not bleed in oil or water and should be light-fast. Choice of colour is mainly users' taste. Various colours with various shades are used to fulfil the satisfaction of the users. The colour of the thin film of the pigment may be different from the colour effect given by the powder viewed in bulk.

(8) Perfumes : Perfume is an essential component of powders. Users put more importance to perfume. But it should not be over emphasized at the time of manufacturing. Normally the products are perfumed lightly, particularly face powders and compacts. The odour must be fragrant and pleasant. Various perfumes or fragrance which are used, either flowery fragrance or synthetic odour. Selection of proper fragrance is very vital for the products. Sometime combination of fragrances gives a better appeal.

Compatibility of perfume with other constituents of the formulation is to be checked properly before use. Constituents of powder preparation may change the character of fragrance.

POWDER PRODUCTS

(1) FACE POWDERS

Face powder is an indispensable article of a lady's cosmetic range. From the mask-like covering in ancient times to the natural look which is the choice of the present day, face powders have been and still remain one of the basics of the cosmetic industry.

A great deal of changes have taken place in face powder fashion during the last couple of decades. Tinted, shiny, enhanced by our modern cosmetics, the woman of today is able, with only modest effort, to be more attractive than she has ever been in the past.

A face powder is basically a cosmetic product which has as its prime function the ability to complement skin colour by imparting a velvet finish to it.

A good face powder should produce a smooth finish to the facial skin, masking visible imperfections of the face and shine due to moisture or grease from perspiration or secretion of sebaceous and sweat glands or from preparations used on the skin. The powder must produce a

lasting effect, so that frequent application is unnecessary. The preparation should make the face pleasant to look and touch. The degree of opacity can vary from opaque, in case of clown make-up, to almost transparent. It must adhere to the skin and be reasonably resistant to the mixed secretions of the skin.

Since no single material can have all the required properties desired in a face powder, a mixture of different substances is normally employed to get the following essential characteristics of a good product—

(a) Covering power : The ability to mask skin imperfections such as skin shine, enlarged pores and minor blemishes.

(b) Slip : The character of spreading over the skin without dragging, and giving the characteristic of smooth feeling.

(c) Adhesiveness : The ability to cling to the face.

(d) Absorbency : The ability to absorb skin perspiration and oily secretion without showing the effect of such absorption.

(e) Bloom : The ability to impart a velvety, peach-like finish to the face skin.

(f) Colouring : To impart a colour effect according to the need.

(g) Perfuming : To produce a pleasant odour. The proportion of various ingredients used can be altered to have slight variation in the properties of the powder and their effect, but, as a practice, face powders are classified in to three categories depending on the nature of the skin and correspondingly covering ability required from the products.

(i) Light type
(ii) Medium type
(iii) Heavy type

Skin to be powdered can be classified into three categories: dry, normal or moderately oily, and very oily.

(i) Light type : Dry skin requires light powder, a powder of slight covering power as dry skin secretes virtually no oil and little moisture. They normally contain large quantity of talc.

(ii) Medium type : Medium powders, having comparatively higher covering power, are applied to normal or moderately oily skins, which are shinier due to skin secretions. They contain somewhat lesser talc and balanced by zinc oxide.

(iii) Heavy type : Heavy powders have more covering power and are used for extremely oily skins which have a great deal of shine

and thus require great covering power. They normally contain still lower quantity of talc and high quality of zinc oxide.

General preparation : The preparation of powders is simple as it is simply a matter of dry mixing of finely powdered materials. Add the perfume with part of the absorbent materials like calcium carbonate or with magnesium carbonate and keep it aside for some time. Mix the colour with part of the talc properly and add the other powders and then the perfume mixture. Mix and sieve the powder mixture using a silk mesh or an old washed nylon cloth.

Formulae of Face Powders

POWDER WITH REDUCING COVERING POWER

Formula 1

Zinc stearate	5.0 gm
Zinc oxide	10.0 gm
Calcium carbonate (light)	20.0 gm
Talc	57.3 gm
Titanium dioxide	2.0 gm
Magnesium carbonate (light)	5.0 gm
Colour	0.2 gm
Perfume	0.5 gm

LIGHT POWDER

Formula 2

Talc	63.0 gm
Kaolin	20.0 gm
Calcium carbonate (light)	5.0 gm
Zinc oxide	5.0 gm
Zinc stearate	5.0 gm
Magnesium carbonate	1.0 gm
Colour	0.5 gm
Perfume	0.5 gm

Formula 3

Zinc stearate	7.0 gm
Zinc oxide	10.0 gm
Calcium carbonate (light)	20.0 gm
Talc	62.3 gm
Colour	0.3 gm
Perfume	0.4 gm

Formula 4

Talc	79.0 gm
Zinc oxide	5.0 gm
Zinc stearate	5.0 gm
Rice starch	10.3 gm
Colour	0.3 gm
Perfume	0.7 gm

MEDIUM POWDER

Formula 5

Talc	39.7 gm
Kaolin	39.5 gm
Calcium carbonate (light)	5.0 gm
Zinc oxide	7.0 gm
Zinc stearate	7.0 gm
Magnesium carbonate	1.0 gm
Colour	0.2 gm
Perfume	0.6 gm

Formula 6

Zinc stearate	5.0 gm
Zinc oxide	15.0 gm
Titanium dioxide	2.0 gm
Precipitated chalk	15.0 gm
Rice starch	15.0 gm
Talc	47.2 gm
Colour	0.3 gm
Perfume	0.5 gm

Formula 7

Zinc stearate	15.0 gm
Zinc oxide	17.5 gm
Calcium carbonate	20.0 gm
Talc	47.0 gm
Colour	0.2 gm
Perfume	0.3 gm

HEAVY POWDER

Formula 8

Magnesium stearate	5.0 gm
Kaolin (light)	20.0 gm
Zinc oxide	15.0 gm

Calcium carbonate (light)	39.0 gm
Talc	20.0 gm
Colour	0.5 gm
Perfume	0.5 gm

Formula 9

Titanium dioxide	5.0 gm
Zinc oxide	15.0 gm
Magnesium stearate	5.0 gm
Calcium carbonate (light)	15.0 gm
Kaolin (light)	25.0 gm
Talc	34.0 gm
Colour	0.4 gm
Perfume	0.6 gm

(2) COMPACT FACE POWDER

Compact face powder, introduced in 1930 in America, has become very popular because of its ease of application and storage convenience. A compact powder is a dry powder which has been compressed into a cake and is usually applied with a powder puff.

The composition of a compact powder is more or less same as that of loose powder, but its effect may slightly differ. The binders contained in compact powder give it increased adhesion. Due to the effect of compaction the average particle size may be larger in compact than in loose powder. The materials of compact powder must compress easily and remain compact, not to break under normal conditions of use. At the same time the powder must adhere easily to the powder puff.

The pressure for the compaction is very important. The powder must come off easily when rubbed with a powder puff. Very low pressure may lead to breaking of the cake during use, and too high a pressure will result in a very hard glazed cake which will not pay off easily. For achieving all these a suitable binding agent is incorporated in the formula along with other common ingredients of powders.

Binding agents : The binders used in compact powders are several in number. They can be classified into five types—

(a) Dry binders
(b) Oil binders
(c) Water-soluble binders
(d) Water-repellant binders
(e) Emulsion binders

(a) Dry binders : They are metallic stearates like zinc stearate, magnesium stearate. The use of dry binders needs increased pressure for firm compacting.

(b) Oil binders : Oils such as mineral oil, isopropyl myristate, and lanolin derivatives are widely used as binding agents for making compact powders.

(c) Water-soluble binders : Aqueous solutions of gums such as tragacanth, karaya, and arabic are used. Also aqueous solutions of synthetic or semisynthetic gums like polyvinylpyrrolidone (PVP), methyl cellulose and carboxy methyl cellulose have found use in making compact powders. A preservative is essential in gum medium to prevent microbiological growth in the preparations.

(d) Water-repellant binders : These are widely used in compact face powders and include mineral oil, various fatty esters, and lanolin derivatives in combination with a considerable amount of water to aid in the formation of a smooth, solidly pressed cake. A wetting agent may also be incorporated to help to uniformly distribute moisture throughout the powder.

(e) Emulsion binders : To avoid the problem encountered in using water repellant binders along with water and their uniform distribution and to prevent loss of moisture, emulsion type binders are being used preferentially. The use of emulsion type binders prevents loss of moisture and helps in easy manufacturing preventing the problem of lumping that may occur when oils alone are incorporated. Emulsion binding agents may employ soaps like triethanolamine stearate, non-ionic emulsifiers and glycerol monostearate in mineral oil-water combination.

Methods of Preparation

Basically three methods of preparation of compact face powders are adopted.

(1) Wet method : In this method basic materials, colours and binders are kneaded into a paste with water, pressed into moulds and air-dried slowly. It is not much used as it can produce cracks and other faults.

(2) Dry method : In dry preparation the materials and binders are compressed by simple pressure in special presses under controlled conditions. The binders can be a mixture of ammonia, stearic acid and starch or stearic acid and starch or a mixture of sodium stearate or triethanolamine stearate with lanolin and cetyl alcohol.

(3) Damp method : In this method the base powder, colour and perfume are mixed uniformly. The mixture is then wetted down with liquid binders like aqueous mucilages or mucin rich o/w emulsion binders and blended until the proper plasticity of the mass is attained. The powder is then screened and compressed by machine and dried at elevated temperature. This method is a widely accepted method and is used commercially.

FORMULAE OF SOME BINDERS

Formula 10

Gum Arabic	1.0 gm
Glycerol	5.0 gm
Water	94.0 gm
Preservative	q.s.

Formula 11

Gum tragacanth	2.0 gm
Glycerol monostearate	6.0 gm
Mineral oil	4.0 gm
Sorbitol	5.0 gm
Water	83.0 gm
Preservative	q.s

Formula 12

Gum tragacanth	2.0 gm
Glucose	5.0 gm
Water	93.0 gm
Preservative	q.s.

Formula 13

Mineral oil	1.0 gm
Polyoxyethylene stearate	2.0 gm
Water	97.0 gm
Preservative	q.s.

Formulae of Compact Face Powders

Apart from the formulae mentioned in face powders, which can be converted to compact by using suitable binder, the following additional formulae are suggested. As the amount of binder, colour and perfume will vary according to need, they are not mentioned in specific amount.

Formula 14

Talc	69.0 gm
Kaolin	18.0 gm
Titanium dioxide	8.0 gm
Zinc stearate	5.0 gm
Colour	q.s.
Binder	q.s.
Perfume	q.s.

Formula 15

Talc	79.0 gm
Calcium carbonate	9.0 gm
Zinc oxide	7.0 gm
Zinc stearate	5.0 gm
Colour	q.s
Binder	q.s.
Perfume	q.s.

Formula 16

Talc	60.0 gm
Kaolin	12.0 gm
Chalk, precipitated	12.0 gm
Titanium dioxide	12.0 gm
Zinc stearate	4.0 gm
Colour	q.s.
Binder	q.s.
Perfume	q.s.

Formula 17

Talc	62.0 gm
Kaolin	11.0 gm
Zinc oxide	14.0 gm
Zinc stearate	5.0 gm
Magnesium carbonate	8.0 gm
Colour	q.s.
Binder	q.s.
Perfume	q.s.

Formula 18

Talc	70.0 gm
Mica	20.0 gm
Titanium dioxide or mica	10.0 gm

Colour	q.s.
Binder	q.s.
Perfume	q.s.

Formula 19

Talc	54.0 gm
Synthetic pearl	10.0 gm
Titanium dioxide	30.0 gm
Zinc stearate	6.0 gm
Colour	q.s.
Binder	q.s.
Perfume	q.s.

(3) BODY POWDERS

Amongst the various cosmetics, body powder is one of the widely consumed cosmetic preparations. Body powders are also known as talcum powders or dusting powders. They are used for multiple purposes. The main use of body powders or talcum powders is to absorb moisture or perspiration specifically after bathing particularly in warmer countries. These also provide good slip, a cooling effect and efficient lubrication, and prevent irritation of skin due to chafing. The very fine particle size of these covers cause a large surface area per unit weight and can cover a large body area which results in strong light dispersion and therefore visual covering of the skin underneath. The surface covered by the powders is much more than the surface uncovered which leads to a cooling effect if the ingredients of the powder have good heat conductivity. These fine powder particles with light weight adhere to the skin by the stickiness of the fat film. Normally, they contain covering material, adhesives, absorbency material, slip, antiseptics and perfumes.

Body powders consist mainly of talc, with small proportions of a metallic stearate, like zinc stearate, aluminium stearate, etc., and precipitated calcium carbonate (chalk) or magnesium carbonate (light). For antiseptic action boric acid, chlorohexidine diacetate, bithional etc. are used to suppress proliferation of microorganisms responsible for development of perspiration odour. Talcum powders containing antiseptic substances are also used for prickly heat and fungus infections.

Absorbency characteristic is imparted by the inclusion of kaolin, magnesium carbonate, precipitated chalk and starch. Slip will be conferred by talc, zinc stearate. The presence of kaolin, zinc oxide or

magnesium stearate contributes to adhesive characteristic. Colour is not used in body powders.

General Preparations

Mix the perfume oil with magnesium carbonate properly and keep it aside for some time. Mix other ingredients together properly and add the perfumed magnesium carbonate to this mixture. Mix properly, sieve and pack it in containers.

FORMULAE OF BODY POWDER

Formula 20

Talc	75.0 gm
Colloidal kaolin	10.0 gm
Colloidal silica	5.0 gm
Magnesium carbonate	5.0 gm
Aluminium stearate	4.0 gm
Boric acid	0.3 gm
Perfume	0.7 gm

Formula 21

Talc	70.0 gm
Calcium carbonate	25.0 gm
Zinc stearate	4.0 gm
Boric acid	0.3 gm
Perfume oil	0.7 gm

Formula 22

Satinex	6.0 gm
Talc	88.0 gm
Magnesium carbonate (light)	5.0 gm
Boric acid	0.3 gm
Perfume oil	0.7 gm

Formula 23

Zinc stearate	5.0 gm
Zinc oxide	5.0 gm
Magnesium carbonate (light)	15.0 gm
Talc	74.5 gm
Perfume	0.5 gm

Formula 24

Zinc oxide	4.0 gm
Calcium carbonate (light)	8.0 gm

Talc	87.5 gm
Perfume	0.5 gm

DEODORANT POWDERS

Formula 25

Zinc oxide	5.0 gm
Zinc stearate	5.0 gm
Chlorhexidine diacetate	0.3 gm
Calcium carbonate (light)	10.0 gm
Talc	79.3 gm
Perfume	0.4 gm

Formula 26

Zinc oxide	10.0 gm
Zinc stearate	5.0 gm
Bithional	0.5 gm
Calcium carbonate (light)	5.0 gm
Talc	79.2 gm
Perfume	0.3 gm

BABY POWDERS

Formula 27

Talc	87.0 gm
Magnesium stearate	5.0 gm
Magnesium carbonate (light)	5.0 gm
Boric acid	2.5 gm
Perfume oil	0.5 gm

Formula 28

Talc	70.0 gm
Kaolin	20.0 gm
Magnesium stearate	4.0 gm
Boric acid	2.5 gm
Satinex	3.0 gm
Perfume oil	0.5 gm

Formula 29

Talc	84.0 gm
Kaolin	10.0 gm
Boric acid	3.5 gm
Satinex	2.0 gm
Perfume oil	0.5 gm

MEDICATED DUSTING POWDERS

Formula 30

Sodium propanedioate	20.0 gm
Talc	78.0 gm
Boric acid	2.0 gm

FOOT POWDERS

Formula 31

Boric acid	10.0 gm
Kaolin	44.5 gm
Talc	45.0 gm
Menthol	0.5 gm

Formula 32

Boric acid	11.0 gm
Starch	20.0 gm
Talc	69.0 gm

Evaluation

Evaluation and assessment of various powder products particularly loose face powders, compacts are essential to judge the quality of the finished products. Intensive testings are done at different levels on the quality of the products. Tests must be thorough and must include tests for particle size, abrasiveness, apparent density, moisture content, limits for colour, etc.

Apart from the common test of content determination, extensive and controlled stability test are carried out to determine that the formulated product will remain stable for an extended period of time during shelf-life. For this purpose, if necessary, accelerated stability test can be carried out. Other tests which are done particularly for face powders and compacts the are the following—

(1) Shade control and lighting : This is to control and determine the variation of colour shade from batch to batch and with the standard. Proper test is to be done to prevent variation in shades. One such method is comparison of the appearance of the body of the powder with a standard when it is spread out and flattened on a white paper background. The other method of evaluation is comparison of the sample with the standard by skin tone or undertone. Powders should be applied by the same puff that is to be used for finished pack. This is the final judgement for the shade test. Artificial lighting is used for colour evaluation.

(2) Dispersion of colour : Colour should be homogeneously distributed in the powder base. There should not be segregation or bleeding of colour. This can be tested by spreading the powder on a white paper and checking it with a magnifying glass.

(3) Pay-off : The pay-off character, i.e., adhesion with the puff, of a compact or pressed powder should be tested on the skin. High pressure will make the cake so hard that the powder will not rub off the cake easily enough and thus there will be insufficient adhesion of the material to the puff. Too low pressure will make the cake soft and thus have a tendency to crumble and break.

(4) Pressure testing : Pressure applied to compact powder should be uniform to prevent air pocket and thus breaking or cracking. Uniformity of the hardness can be tested by penetrometer. Reading on hardness is checked at various points of compact tablet to see the uniformity of hardness.

(5) Breakage test : This is carried out by dropping the compact tablet of powder on a wooden surface several times from a height of 8 to 10 inches and checking the breakage or clipping of the compact. If the cake is unbroken it is indication of the resistance against travel and normal handling.

(6) Flow property : This is very important, particularly for body powders as they should come out easily from the container for easy application. This can be studied by measuring angle of repose of powder product by allowing to fall on a plate from a funnel and measuring the height and radius of heap formed. Also, the powder may be allowed to fall from a funnel and noting the time taken.

(7) Particle size and abrasiveness : Particle size can be determined by microscope, sieve analysis or by using sophisticated instruments and techniques. Abrasiveness can be studied by rubbing the powders on a smooth surface and then studying the effect on the surface using microscope.

(8) Moisture content and limits for colour : These can be estimated by using suitable analytical methods.

CHAPTER-4

Skin Colorants

Colouring skin, particularly skin of face and lips, is an ancient practice going back to prehistoric period. In present days, the use of such products has increased and choice of shades of colours, texture, lustre have been changed and become wider. This can be observed from the fact that lipsticks are marketed in hundreds of shades of colours to satisfy the demands of women.

Apart from normal daily life, skin colorants are also used for drama, circus, dance etc. The present chapter will basically discuss two specific skin colorants.

(1) Lipsticks
(2) Rouge

The skin colorants are also called as 'Beauty Aids' but they are different from other cosmetics. The sole purpose of skin colorants is alteration of appearance for enhanced attractiveness, whereas other cosmetics have other specific functions of maintenance or promotion of the skin health along with or without decorative functions.

Skin colorants or beauty aids must not damage the skin. Decorative preparations are used to hide small blemishes or symptoms of aging. They are also used to create a well-groomed appearance and demonstrate the desire to impress upon others. They are applied to attract opposite sex and to be noticed upon. The motives can be termed as psychological.

Manufacturers try to make these as decorative, pleasantly fragrant, coloured, non-tacky and harmless as possible. The main active ingredient in such preparations is dye but other materials are also essential to hold the dye in the preparations and for ease of application and auxiliary effects.

(1) LIPSTICKS

Lipsticks, also termed as lip cosmetics, are widely used by women. Lipsticks have become so popular in the last couple of decades that they

are now probably used more than any other single cosmetic product. Its popularity can be gauged from the fact that market has been flooded with plenty of products with hundreds of shades.

Lipsticks are basically dispersions of colouring matter in a base consisting of a suitable blend of oils, fats, and waxes suitably perfumed and flavoured, moulded in the form of a stick and enclosed in a case.

Lipstick is used to impart an attractive colour, and glossy and moist appearance to the lips, accentuating their good points and disguising the defects. By properly applying a lipstick broader lips can be made to look as narrow or narrow lips may be changed to look as broad lips. An intelligently applied lipstick can totally change the apparent facial appearance. It also helps to prevent cracking and chapping of lips which can lead to the bacterial infection. The base used for lipsticks also produces an emollient action.

Lip skin Skin of the lips is characterized by an exceptionally thin corneal layer. The stratum germinativum is strongly developed and the corium pushes papillae with a high blood content just below the surface. Lips do not contain any sweat glands but salivary glands are very much present on the inner surface. Saliva maintain the moisture of the lips. As sebaceous glands are present sparsely, the lips are almost entirely free from fat. In very cold or dry weather the corneal layer tends to dry out and produce cracked lips. Since the corneal layer of the lips is very thin, and further, cracked in dry condition, alien substances applied on the lips can quite easily penetrate to the stratum germinativum. This is always to be kept in mind while making lipsticks and selecting ingredients for it.

Characters A lipstick should have the following characteristics:

(1) It should cover the lips adequately with some gloss and last for long time.

(2) It should make the lips soft.

(3) The film must adhere firmly to the lips without being brittle and tacky.

(4) It should have a good degree of indelibility.

(5) It should have high retention of colour intensity without any change in shade.

(6) It should be completely free from grittiness and be non-drying.

(7) It should be non-irritating to the skin of lips.

(8) It should have a desirable degree of plasticity.

(9) It should have a pleasant odour and flavour.

Apart from the above, a lipstick should also have the following storage characteristics:—

(1) A smooth and shiny appearance.

(2) Freedom from bloom or sweating.

(3) A suitable degree of firmness during reasonable variations of climatic temperature.

(4) Retain plasticity without any tendency to dry out or crumble.

Composition The stick mainly contains a colour material dispersed and suspended in a suitable base made by blending oils and waxes in various proportions to yield the desired melting point and viscosity. The temperature of human body varies between 36°C to 38°C with lips having the higher side. The base of the lipstick must have a melting point appreciably higher than this, between 55°C to 75°C preferably about 62°C, for the product to withstand exposure to hot climates.

The basic raw materials required for formulating lipsticks can be classified as—

(1) Wax mixture
(2) Oil mixture
(3) Bromo mixture
(4) Colours
(5) Preservatives, fragrances, surfactants and other additives

(1) Waxes

Gloss and hardness of lipsticks are largely dependent on the characteristics and quantity of the waxes used. So, the composition of the wax mixture is of prime importance. Best characteristics can be obtained by using a mixture of waxes of different melting points and adjusting the final melting point by incorporating a sufficient amount of high melting point wax. Various waxy materials are used in lipsticks.

(a) White beeswax : It is an important and useful component of lipstick base with melting point of 62-64°C. It usefully binds oils and high melting point waxes. It is used in 3 to 10% of the total formula. It shrinks on cooling and thus helps preparation of moulded products. At higher concentration it produces a dull waxy appearance and causes the sticks to crumble during use.

(b) Candelilla wax : It has a melting point of 65-69°C and is used in 5-10%. A mixture of candelilla wax and beeswax is very good for

making lipstick. If candelilla wax is used a little in excess than beeswax the product gets a smooth and glossy appearance.

(c) Carnauba wax : It increases the melting point of the base and hardens the lipstick. It needs to be used in small amounts. It brings an attractive lustre to the product. It's melting point is 80 to 88°C.

(d) Ozokerite wax : It is also mainly used to increase the melting point of the base. It melts at 60-80°C and is used in 3-10%. If it is used in excess the sticks tend to crumble during application.

(e) Ceresin wax : it is also called paraffin wax or mineral wax. It's melting point is 60-75°C and is used in about 5% to increase melting point.

(f) Cetyl alcohol and cetostearyl alcohol : These two substances are used in small amounts, in 2-3%, in the lipstick for emollient action on the lip skin. The melting points are 45-50°C and 42-45°C respectively. At higher concentration (above 5%) they give a dull appearance to the lipstick which develops to a 'bloom' on storage. High concentration also leads to crystal formation, on storage, on the surface of the stick.

(2) Oils

The oil mixture is required to blend properly with the waxes to provide a suitable film on the applied lip skin. It also acts as a solvent for eosin dyestuffs or as a dispersing agent for insoluble pigments. An ideal mixture is one which enables the product to spread easily and produces a thin film with good covering power.

(a) Castor oil : Castor oil is used in many lipsticks because of its good qualities, though nowadays some other oils or solvents are being used. A refined grade castor oil is of good colour and is odourless and tasteless. Castor oil is a very good plasticising agent. An antioxidant is to be added to the castor oil against rancidification though it is not as prone to rancidification as other vegetable oils like olive oil or almond oil. High viscosity of castor oil makes the dispersion of pigments long stable during the mixing and moulding stages of manufacture. Normally, about 40-50% of castor oil is used. But when a higher proportion is used the proportion of high melting point waxes needs to be adjusted to get a high melting point base mixture.

(b) Tetrahydrofurfuryl alcohol and its esters : This alcohol and its esters like acetate, stearate, ricinoleate are also used in lipstick preparation. The acetate has very good solvent property for the eosin dye. But the volatile property of the solvent can lead to smudging of the outline by evaporation from the hotter inner surface and deposition on

the cooler edges. The acetate has an unpleasant taste and odour. But stearate and ricinoleate are good and non-volatile but their solvent property is a little less.

(c) Fatty acid alkaylamides : They are non-volatile and have no unpleasant taste or odour. They increase the stability of the lipsticks but do not have emollient action. They help in dispersing the pigments.

(d) Paraffin oil : It is used in not more than 5% to give a glossy appearance after application. In higher proportion the oil will come off the lips and run around the lips. It also acts as lubricant to facilitate removal of sticks from the moulds after pouring.

(e) Isopropyl myristate, isopropyl palmitate and butyl stearate : These are also used to facilitate smooth application. Due to their low surface tension they have a good wetting effect on insoluble dyes and pigments, and also act as mutual solvents for oils and waxes. Presence of binders is required to incorporate isopropyl myristate, otherwise it may separate out because of its low surface tension.

Apart from the waxes and oils, sometime fats are incorporated in the lipsticks to serve the purpose of giving more body to the film on the lips, smoothing the skin of the lips or softening it. It also helps in dispersion of insoluble pigments. The substances which are normally incorporated are cocoa butter (theobroma oil), hydrogenated vegetable fats.

The use of acetoglycerides has also been recommended in lipsticks to improve thixotropic properties of sticks and to maintain constant viscosity even in higher temperature. They also improve the plasticity of the film on the lips.

(3) Bromo Mixture

The bromo mixture is, essentially, a solution of the staining dyestuff in a fatty material to enable the dyestuff to remain either wholly or partially in solution. Apart from the fatty materials mentioned earlier, certain other fatty materials have a specific function as a constituent of bromo mixture. This is the portion of the product which imparts an indelible stain as distinct from the opaque film of colour given by insoluble pigments. As the present-day choice is the product with high staining qualities instead of the product which covers the lips with a thick film of vividly coloured materials, bromo mixture is widely used. The dyestuff of bromo mixture, known as bromo acids, consists of fluoresceins, halogenated fluoresceins and related water insoluble dyes. Originally the bromo acid name was given to acid eosin, tetrabromofluorescein. Bromo acid colours can be classified broadly

into two groups, those which are red and give a red or reddish-blue stain, and those which are orange, red and give a pink to yellowish-pink stain. In general, lipstick formulations are not high staining types, about 2-3% of bromo acid is used, normally, in castor oil and butyl stearate mixture.

Other solvents used are tetrahydrofurfuryl alcohol and esters like acetate, stearate and benzoate, glycerol derivatives like glyceryl monostearate, glyceryl monolaurate and diethylene glycol monostearate. Propylene glycol, triethylene glycol and polyethylene glycol are also used as suitable colour solvents.

A typical example of bromo mixture is given below:

Bromo acid	15 gm
Propylene glycol	200 gm
Propylene glycol monomyristate	100 gm

First a clear solution of bromo acid and propylene glycol is to be made by adding the bromo acid to propylene glycol. To this solution propylene glycol monomyristate is to be added. This blend gives a solution of bromo acid that easily mixes with mineral oil and castor oil and produces a homogeneous mass with waxes.

(4) Colours

The colour of the lipstick is most important from commercial and appealing points of view. Up to 1920 carmine was widely used as a lipstick pigment. As of today lots of dyestuffs and lakes are available to choose from.

The colour is imparted to the lips in two ways—

(a) By staining the skin with a solution of dyestuff which can penetrate the outer layer of the lip skin.

(b) By covering the lips with a coloured layer which serves to hide any skin roughness and give a smooth appearance.

The first requirement is met by soluble dyes and the second one is met by insoluble dyes and pigments which make the film more or less opaque. Modern lipsticks contain both to achieve the combined effect. The colours should be from the list of certified dyes under the Drugs and Cosmetics Act.

(a) Staining dyes : The most widely used staining dyes are fluorescein, eosin and often halogenated fluorescein, which have been mentioned under bromo acids. Fluorescein and its derivatives can produce sensitization or photosensitization leading to cheilitis (inflammation of the red portion of the lips).

Also their water solubility character poses problem for formulation. But when water soluble dyes are converted to the free sulpho acid form, they become water-insoluble, lipophillic and suitable for use as staining dyes.

(b) Insoluble dyestuffs and lake colours : These are the colouring agents which cover the thin layer over the lips. They consist of calcium, barium, aluminium and strontium lakes. Calcium and barium lakes prepared from azotype dyestuffs are also used. These are called lake toners. These dyestuffs are used in 10-15% depending on the shade and opacity of the film. Aluminium lakes are not usually preferred because of their lack of opacity, but they can be used in transparent lipsticks.

While making of lakes, the possibility of incompatibility with the base has to be considered.

Titanium dioxide is often used at levels up to 1% as white pigment for brightening the colour, obtaining pink shades, and giving opacity to the film on the lips. This substance should be added with great care to avoid formulation problems like oily exudation, streaking, dullness and coarse texture.

(5) Preservatives, Fragrances, Surfactants and Other Additives

It is very much essential to include a preservative in the product to prevent microbial growth. 0.1% propyl parahydroxybenzoate, in 0.1%, is used for this purpose. Higher concentration of 0.2% can cause a slightly burning sensation or can initiate an eosin allergic reaction. Other oil soluble preservatives also can be used but compatibility has to be considered.

Perfumes are an essential component to mask the odour of the fatty or wax base as well as to impart an attractive flavour. Perfumes are used in the concentration range of 2-4%. Special consideration is to be given to select perfumes free of irritating effect and without disagreeable taste and flavour. Since the users apprehend the perfume in the mouth and nose, flavour must be taken care of along with odour. Perfume should be stable and compatible with the other constituents of the lipstick base. The fragrances should not be very strong as to clash with or overpower other perfumes that may be used concurrently with the lipstick. Floral and light spicy fragrance are much used and acceptable. Perfumes of the fruit flavour type have been advocated as well. Also something edible can be used.

Normally antioxidants are also suggested to be incorporated in lipstick formulations to prevent rancidification of oily base during stor-

age. Combination of proper antioxidants are preferred for this purpose. Antioxidants commonly used in lipsticks are butylated hydroxyanisole (BHA), propyl gallate, butylated hydroxytoluene (BHT), citric acid, 2,5-di-tert-butylhydroquinone etc.

Surfactants are occasionally added to the lipstick. They are used to promote wetting and stabilize the dispersion of insoluble pigments in the base. But such additives may influence the consistency of the stick.

Some other materials have been suggested for use as additives to enhance the value of the make-up. Oil-soluble sun-screens are used to filter the suns rays and protect lips from sun blisters. A silicon fluid can be used as a fixative and to prevent colours from bleeding on the lips. Polyvinyl pyrolidone is known to form film on the lips and reduce tendency towards allergenic reaction and is used in 0.5 to 1%. It also helps in binding of dyestuff. Isopropyl linoleate is used to prevent drying effects.

General Preparation of Lipsticks

Successful preparation of lipstick shades depends largely upon adequate dispersion of the lake colours in the lipstick mass. It is advisable to prepare dispersions of the lake colours in castor oil. Dispersions are preferably prepared by milling, generally as 25% concentrations, in castor oil. Also ready-made dispersions are available in the market from manufacturers of cosmetic colours.

A **general outline** for the manufacture of lipsticks follows—

If a solvent is used for bromo acid, this solution is first prepared and set aside until required. If commercial colour pastes (as mentioned above) are not being used the lake colours are first dispersed by mixing with suitable quantity (as 25% w/w) of castor oil, and the colour paste obtained is passed through a triple roll mill until it is smooth and free from agglomerates and gritty particles. If titanium dioxide is used in the formula, the same is also made into a paste similarly and mixed with the colour mix. The colour mixture is then mixed with the bromo-acid mixture. All the ingredients of the base are identified and arranged in order of increasing melting point. The lower melting point fats and waxes are next melted together and mixed with colours and bromo mixtures at the same temperature. This mixture is re-milled until perfectly smooth. The preservative and antioxidant is dissolved in any remaining oil and added to the mix. The high melting point waxes are now melted and added to the bulk at the same temperature. The perfume is finally added and the mass stirred thoroughly but gently to avoid

entrapment of air. The mass should not be melted after the high melting point waxes have been added. Gentle stirring is continued until the mass is homogeneous and it is then poured in lubricated moulds.

Automatic ejection mould is preferable for large quantities and split moulds are satisfactory for small-scale production. The mould is lubricated with liquid paraffin or isopropyl myristate before pouring the mass. No excess lubricant should be left in the mould surface. The mixed mass should be poured into the mould at as low a temperature as possible to prevent settling down of colours. Also the moulds may be warmed before pouring the mass to avoid formation of ridges. After pouring the mass the moulds are chilled to achieve contraction of the waxes to facilitate easy removal of the sticks.

Automatic ejection moulds are fitted with a water jacket which is used to warm or chill the mould as required.

Lipstick Formulae

Several representative lipstick formulae are listed below. Each formula can be modified by a slight modification in proportions of oils and waxes and other ingredients to adjust proper melting point, spreadability, and thickness of the film on the lips according to the particular characteristics required. The formulae can vary in proportions of lake colours and bromo acids. Titanium dioxides may or may not be part of the formula depending on the requirement. Perfume, preservative and antioxidant should be added in proper quantity to achieve the best effect.

Formula 1

Castor oil	54.0 gm
Lanolin, anhydrous	11.0 gm
Candelilla wax	9.0 gm
Isopropyl myristate	8.0 gm
White beeswax	5.0 gm
Carnauba wax	3.0 gm
Ozokerite wax	3.0 gm
Eosin	2.0 gm
Lakes	5.0 gm
Rose flavour	q.s.
Antioxidant	q.s.
Preservative	q.s.

Formula 2

Beeswax	15.0 gm
Ozokerite wax	10.0 gm

Carnauba wax	5.0 gm
Ceresin wax	4.0 gm
Lanolin	5.0 gm
Lanolin, anhydrous	14.0 gm
Isopropyl myristate	10.0 gm
Diethyl sebacate	10.0 gm
Castor oil	15.0 gm
Eosin	2.0 gm
Colour lakes	10.0 gm
Antioxidant	q.s.
Perfume	q.s.
Preservative	q.s.

Formula 3

Carnauba wax	3.5 gm
Candelilla wax	7.5 gm
Ozokerite wax (white)	3.5 gm
Beeswax, yellow	4.0 gm
Paraffin	2.0 gm
Hexadecyl stearate	8.0 gm
Castor oil	15.4 gm
Lanolin oil	30.0 gm
Oleyl alcohol	15.0 gm
Tenox II	0.1 gm
Colour	10.0 gm
Perfume	1.0 gm
Antioxidant	q.s.
Preservative	q.s.

Formula 4

Castor oil	27.0 gm
Beeswax	20.0 gm
Paraffin oil	3.0 gm
Lanolin	5.0 gm
Cetyl alcohol	2.0 gm
Isopropyl myristate	3.0 gm
Ozokerite wax	10.0 gm
Carnauba wax	2.5 gm
Propylene glycol	11.0 gm
Propylene glycolmonoricinoleate	4.0 gm
Eosin	2.5 gm

Colour	10.0 gm
Perfume	q.s.
Antioxidant	q.s.
Preservative	q.s.

The above product is non-greasy type with good staining properties.

Formula 5

Castor oil	39.0 gm
Beeswax	5.0 gm
Lanolin	3.0 gm
Isopropyl myristate	2.0 gm
Ozokerite wax	5.0 gm
Carnauba wax	4.0 gm
Propylene glycol	6.0 gm
Candelilla wax	7.0 gm
Glycerin monostearate	3.0 gm
Acetylated monoglyceride (solid)	7.0 gm
Acetylated monoglyceride (liquid)	5.0 gm
Eosin	2.0 gm
Colour	12.0 gm
Perfume	q.s.
Antioxidant	q.s.
Preservative	q.s.

Formula 6

Carnauba wax	2.50 gm
Candelilla wax	6.00 gm
Ozokerite wax	2.50 gm
Beeswax	6.00 gm
Lanolin	8.00 gm
Castor oil	55.00 gm
Isopropyl myristate	4.00 gm
Halogenated fluorosceins	3.00 gm
Lake colours	12.00 gm
Propyl-p-hydroxy benzoate	0.20 gm
Perfume	0.80 gm

Formula 7

Castor oil	15.0 gm
Butyl stearate	5.0 gm
Abracol I.S.L.	7.0 gm
Emulsene 1212	2.0 gm

Beeswax	20.0 gm
Spermaceti	10.0 gm
Petroleum jelly	12.0 gm
Hydrogenated palm kernel oil	15.0 gm
Acid eosin	1.0 gm
Titanium dioxide	1.0 gm
Lake colour	12.0 gm
Perfume	q.s.
Antioxidant	q.s
Preservative	q.s.

(2) ROUGE

Rouge can be defined as the cosmetic preparations used to apply a colour to the cheeks. The colour can vary from the palest of pinks to the deep blue reds but the conventional rouge contains a high proportion of red or reddish brown pigments. The tint or colour may be achieved by using water-insoluble colours such as iron oxides and certain organic pigments or by using water-soluble organic colours which actually stain the skin. Products containing lower proportions of pigments or colours are used as toners for special highlighting effects. The pigments should be selected carefully to avoid problems like bleeding. A small proportion of a suitable bromo acid is often included to give a natural and attractive blushing effect.

Over the years lots of changes have occurred in rouge composition. Ancient people used to colour their cheeks with a root, seaweed or cinnabar. Later people started using red ochre, vermilion, cochineal or extracts of sandalwood or brazilwood. In the early twenties the liquid rouges, dry rouges or grease rouges basically containing caramine, eosin, etc. were used.

One of the oldest forms of rouge is the type known as cream rouge. In modern rouge preparations the pigments or colours are present in different form of carriers and accordingly can be classified into four types but dry rouge is the most commonly and widely used type—

(1) Powder rouges
(2) Anhydrous cream rouges/wax based rouges
(3) Emulsion cream rouges
(4) Liquid rouges

(1) Powder rouges : Powder rouges are normally marketed as loose powders and compressed powders or compacts. They contain pigments

and lakes in dry form, mixed with standard powder materials like talc, zinc stearate and magnesium carbonate. Compact rouges additionally contain a binder and are compressed in tablet form. Compact rouges are more popular than loose powder because they dust less on application and adhere better to the skin due to presence of binders.

According to the intensity of the pigment and the intended colouring effect of the powder, the pigment content is usually 5 to 20% of the powder mass. Pigments are, sometimes, wholly or partly replaced by lakes which produce more intense colour effect and are used in lesser quantities. Rouges, sometimes, additionally contain water-soluble dyes. Insoluble colorants remain on the skin, whereas, the soluble ones stain the skin tissue itself. Stain should be loose and non-permanent. Some illustrative examples of powder rouges and compact rouges are given below:

Preparation Add the perfume with magnesium carbonate or starch or other adsorbent, mix properly and keep it covered for half an hour. Mix the remaining powders thoroughly and sieve through fine muslin. Add the magnesium carbonate and then the required colour. Mix thoroughly and store in a suitable container.

POWDER ROUGES

Formula 8

Zinc stearate	14.5 gm
Rice starch	14.5 gm
Talc	55.0 gm
Pigments	14.0 gm
Perfume	2.0 gm

Formula 9

Magnesium carbonate (light)	8.3 gm
Precipitated chalk	16.6 gm
Zinc oxide	8.3 gm
Rice starch	12.4 gm
Talc	37.4 gm
Pigments	15.0 gm
Perfume	2.0 gm

Formula 10

Zinc oxide	8.5 gm
Lanolin	25.5 gm

Magnesium carbonate (light)	17.0 gm
Talc	34.0 gm
Pigments	13.0 gm
Perfume	2.0 gm

Formula 11

Kaolin	16.0 gm
Zinc oxide	12.0 gm
Magnesium stearate	2.0 gm
Zinc stearate	1.0 gm
Magnesium carbonate	3.0 gm
Talc	60.0 gm
Colours	6.0 gm
Perfume	q.s.

Compact rouges can be made by dry process or wet process. In dry process the powdered binder, such as tragacanth, acacia, is added in the mix and compressed. The binder is used as 1% of the total mass. As an alternative binding material small amounts of a lanolin derivative and isopropyl myristate can be used. Zinc oxide is also used, in 5-10%, to increase adhesion. Metallic stearates are also essential components of compact rouges as dry binders and to increase adhesion of the products to the skin.

In wet process the binding agent is prepared separately and is made of materials like tragacanth gum, a mixture of soap and tragacanth gum, and polyvinyl pyrrolidone. The binding agent is mixed with other materials and compressed to cake.

Formula 12

Talc	48.0 gm
Kaolin	16.0 gm
Zinc stearate	6.0 gm
Zinc oxide	5.0 gm
Magnesium carbonate	5.0 gm
Rice starch	10.0 gm
Titanium dioxide	4.0 gm
Colours	6.0 gm
Perfume	q.s.

Mix the perfume with magnesium carbonate and keep aside with cover. Mix other ingredients thoroughly. Add magnesium carbonate and mix. Add colour and mix and then compress.

Formula 13

Kaolin	5.0 gm
Calcium carbonate	5.0 gm
Magnesium carbonate	5.0 gm
Zinc stearate	5.0 gm
Talc	75.0 gm
Pigments	5.0 gm
Perfume	q.s.
Binder	q.s.

BINDER

Isopropyl myristate	50% w/w
Lanolin absorption base	50% w/w

Mix the binding materials together. Mix perfume with magnesium carbonate and add to the binding materials. Add to the remaining ingredients and mix well. Grind and compress into godets.

For compacts by wet process, any of the basic formulae of dry rouges can be mixed with the following binding agents:

Tragacanth	1.0 gm
Alcohol	2.0 gm
Water	97.0 gm
Methyl parahydroxy benzoate	0.2 % of the above

Mix the tragacanth with alcohol and then add water in a continuous stream and stir well. Allow to stand for 24 hours with stirring occasionally, and pass through muslin. Preservative is to be dissolved in water with heat before adding to the tragacanth.

Tragacanth	1.3 gm
Soap chips	4.0 gm
Water	94.7 gm
Methyl parahydroxy benzoate	0.2 % of the above

Prepare a concentrated solution of the soap chips with sufficient hot water and use this to prepare a tragacanth paste. Add the remaining water in a continuous stream and mix well.

Allow to stand for 24 hours with stirring occasionally, and pass through muslin before use. Dissolve the preservative in water with the aid of heat before adding to the soap tragacanth mix.

The binding agent is added, in sufficient amount, to the coloured powder mix to prepare a fairly damp paste. This is then pressed into godets by subjecting it to a gradually increasing pressure or moulded to a definite shape. The blocks are then dried at normal temperature in a

current of air. Undue heating should be avoided as it can split the product and can vaporize the perfume. During drying they are kept on blotting paper to absorb excess moisture. After drying they are trimmed with a special rotating knife to give a perfectly smooth finish to the surface. Then they are stuck with a suitable adhesive to the base of the container.

(2) Anhydrous cream rouges/wax based rouges : In this type the base is wax type. They resemble the lipstick but are normally of bigger size. In these rouges the colours are dispersed in a fat-oil-wax base. They have advantages over powder rouges. They form a continuous film on the skin which looks more natural than loose powder. As these bases are water-repellent they avoid the risk of perspiration and making the make-up run. The melting point of the base should not be below 40°C and is often 60°C or above. Occasionally these rouges are formulated as thixotropic preparation, so that, they can be solid in the container but liquefy when pressed on the skin and spread easily. To achieve the thixotropic character high melting point waxes are required to form a skeleton to accommodate the oil. Microcrystalline waxes or amorphous substances to prevent the sweating of the oils.

Formula 14

Beeswax	16.0 gm
Petrolatum (short fibre)	4.0 gm
Castor oil (semi-hydrogenated)	54.0 gm
Paraffin oil	11.0 gm
Lanolin (light)	5.0 gm
Lakes	10.0 gm
Perfume	q.s

Formula 15

Petrolatum (short fibre)	40.0 gm
Isopropyl myristate	35.0 gm
Lanolin (light)	5.0 gm
Glyceryl monostearate	12.0 gm
Lakes	8.0 gm
Perfume	q.s

Formula 16

Ceresin	32.5 gm
Petrolatum (short fibre)	13.5 gm
Paraffin oil	2.5 gm
Stearic acid	16.0 gm
Lakes	5.5 gm
Perfume	q.s.

Mix and grind the lakes together. Mix oils, fats, and waxes in increasing melting point and heat to just above the melting point of the highest melting wax. Stir pigments into the melt and grind the mixture a few times on a heated triple roller mill. Add perfume towards the end of process.

(3) Emulsion cream rouges : These are popular because of their ease of application and can be of the cold cream or of the vanishing cream type. From a dermatological point of view, these preparations are not so beneficial as in the presence of wetting and emulsifying agents solid dye particles can easily penetrate the skin through hair follicles and small fissures. If not removed soon it can also cause irritation. So, proper cleaning with cleansing cream is very important while using this type of rouges.

Water-soluble dyes are often used in these preparations to stain the skin. However, insoluble pigments are also used but must be as finely dispersed as possible. When water-soluble colours are used, it is necessary to incorporate sufficient quantity of hygroscopic substances like glycerol, glycols, sorbitol to prevent evaporation of water and darkening of the cream surface. The preparations can be made using beeswax-borax combination or by using a separate emulsifying agent.

Formula 17

Lanolin	4.0 gm
Cocoa butter	4.0 gm
Beeswax	14.0 gm
Liquid paraffin	26.0 gm
Cetyl alcohol	1.0 gm
Water	44.2 gm
Borax	0.8 gm
Colour	7.0 gm
Perfumes	q.s.
Preservative	q.s.

Formula 18

Petrolatum (short fibre)	20.0 gm
Beeswax	14.0 gm
Isopropyl myristate	30.0 gm

Cetyl alcohol	3.0 gm
Triethanolamine lauryl sulphate	0.4 gm
Borax	1.0 gm
Water	21.6 gm
Propylene glycol	12.0 gm
Lake	8.0 gm
Perfume	q.s.
Preservative	q.s.

Disperse the finely powdered colour base with the melted fats and oils. Prepare a solution of borax in water at about 75°C and mix with the first one slowly with stirring until emulsion is formed. Finally mill it. Preservative should be added to water.

Formula 19

A.	Arlacel C (Sorbitan sesquioleate)	2.0 gm
	Lanolin (anhydrous)	2.0 gm
	Mineral oil	16.0 gm
	Petrolatum (white)	30.0 gm
	Preservative (oil soluble)	q.s.
B.	Arlex	5.0 gm
	Brilliant red (c-10.013)	10.0. gm
	Water	35.0 gm
	Perfume	q.s

The above is a water-in-oil type rouge and provides a product which is soft and creamy and possesses excellent spreading properties. Since it is of the water-in-oil type, it has less tendency to dry out.

Mix the ingredients of 'A' and preservative together and heat at about 70°C. In a separate vessel heat ingredients of 'B' to 70-75°C and add 'B' to 'A' slowly with constant stirring to make an emulsion. Allow to cool and add the perfume at 35°C. Mill it.

Formula 20

A.	Stearic acid	14.25 gm
	Isopropyl myristate	2.25 gm
	Lanolin	3.25 gm
	Beeswax	4.50 gm
	Glycerol monostearate	7.00 gm
B.	Propylene glycol	4.75 gm
	Glycerin	3.00 gm
	Water	56.00 gm

C.	Pigments	5.00 gm
	Perfume	q.s.
	Preservatives (water soluble)	q.s.

Mix together the ingredients of 'A' and heat at about 70°C. Separately mix the ingredients of 'B' and heat to same temperature of 'A' mixture and add to 'A' slowly with constant stirring. Pigments are to be added to the semi-processed product, preferably as dispersed in part of propylene glycol. Allow to cool and add the perfume at 35°C.

(4) Liquid rouges : The liquid rouges consist of aqueous or hydro-alcoholic colour solutions. The colours selected must be highly substantive to the skin. Though they have some attractiveness but do not have as good appeal as the cream or dry rouges. Their application is easier. If applied skilfully they can produce very good effect. Normally a wick is attached at the neck of the container for easy application. It should have good viscosity for easy application and should also dry quickly.

Aqueous preparations are basically made by dissolving the colour in a viscous aqueous medium containing a gum or synthetic thickener. Glycerin is also incorporated sometimes.

Formula 21

Erythrosine	0.5 gm
Propylene glycol	20.0 gm
Ethyl alcohol	10.0 gm
Rose water	69.5 gm

The colour is first mixed with propylene glycol and then mixed with other ingredients to make a solution. It is then stored in a suitable container.

Formula 22

Sodium alginate	0.45 gm
Calcium citrate	0.15 gm
Wetting agent	0.20 gm
Water soluble dye	0.20 gm
Rose water	99.00 gm
Preservative	q.s.

The wetting agent, sodium alginate and dye are first dissolved in about 60 ml rose water. Calcium citrate is slurred in another 30 ml rose water and added to the first portion when thickening of the alginate solution started. Preservatives are added afterwards and volume made.

Then store in a suitable container. The viscosity can be altered by varying the proportion of alginate and calcium citrate.

Formula 23

Methyl cellulose	2.0 gm
Wetting agent	0.1 gm
Water	97.5 gm
Water-soluble dye	0.4 gm
Perfume	q.s.
Preservative	q.s.

This can be prepared by simple mixing. Perfume and preservatives are to be added later. Preservative can be dissolved initially in water. Methyl cellulose can be replaced by 0.4 gm tragacanth.

Evaluation

It is very essential to maintain a uniform high standard for lipsticks and rouges, for which several tests have to be carried out including identification and their individual proportions. Special tests are also to be carried out for lipsticks and rouges.

Tests for Lipsticks

The finished lipsticks are required to be subjected to various tests. Identification of ingredients and their quantity can be determined by normal chemical analysis tests, though it is not a very easy task as a variety of ingredients are present.

(i) Melting point : Determination of melting point is important and it is determined by capillary tube method by keeping the size of capillary, length of fill, and rate of heating constant. Another important test of similar nature is yield point or droop point. Droop point is the temperature at which the lipstick, lying flat in its case, will melt within the case and ooze out oil or flatten out. This is a indication of the limit of safe storage. Droop point should preferably be above 50°C for safe handling and storage. Melting point should be higher than the droop point.

(ii) Breaking point : This test is done to determine the strength of the lipstick. The lipstick is held horizontally in a socket ½ inch above the base and weight is applied on the lipstick, ½ inch away from the edge of the support. The weight is gradually increased by a specific value (say 10 gm) at a specific interval of 30 seconds and the weight at which the lipstick breaks is considered as the breaking point. The test should be done at a specific temperature (say 25°C) and the lipstick

should be stored at that temperature for at least 30 minutes prior to the test.

(iii) Thixotropy character : This is an indication of thixotropic quality and is done by using penetrometer. A standard needle of specific diameter is allowed to penetrate for 5 seconds under a 50 gm load at 25°C. The lipstick is kept at 25°C prior to the experiment. The depth of penetration is a measurement of the thixotropic structure. Penetration of 9 to 10.5 mm is indicative of a soft and thixotropic structure.

A product of high droop point with soft, thixotropic structure will assure good application characteristics.

(iv) Force of application : This is a test for comparative measurement of the force to be applied for application. Two lipsticks, end cut to get flat surface, are kept opposite way by mechanical holders. Lower lipstick, standing upright and fixed. Upper lipstick is moving downward, by mechanical means under a given weight, to the flat surface of the lower stick. A strip of smooth paper is attached to a dynamometer and is drawn between the two lipstick ends at a constant speed. The force required to pull the paper against a given specific weight is measured and compared with those made on other sticks of same diameter.

Alternatively a piece of coarse brown paper can be kept on a shadow graph balance and the lipstick can be applied, at 45° angle, to cover a 1 square inch area until fully covered. The pressure reading is an indication of force of application, though it may depend on the operator.

(v) Aging stability : The product is stored at 40°C and periodical observation of oil bleed, crystallization of wax on surface, and application characteristics is made.

(vi) Perfume stability : This is also done by storing at 40°C and periodically comparing, after bringing the temperature down; with a fresh lipstick.

(vii) Oxidative stability : Oxidative stability is predicted by standard determination of peroxide value after exposure to oxygen under given conditions.

(viii) Surface anomalies : This is studied by the surface defects, such as formation of crystals on surface, contamination by moulds, fungi etc. formation of wrinkles, exudation of liquid substances and of solid fatty substances.

(ix) Accelerated stability test : Accelerated stability test aging can be studied at higher temperature (45°C) or alternately keeping at 45°C and 0°C and observing the changes.

Tests for Rouges

Apart from general tests for identification and estimation, by some chemical or instrumental analysis, of ingredients, some other specific tests are to be carried out to evaluate and control the products.

(i) Melting point : Melting point is determined, specifically for cream rouges, by capillary tube method. The melting point preferably should not be below 50°C for good storage and application point of view.

(ii) Colour dispersion : Colour dispersion is checked under microscope and no particle, above 50 μ, should be there. Colour particles above 50 μ size may cause agglomeration and colour particles may be easily identifiable.

(iii) Aging stability : This is done by keeping the product at over 40°C for a one month period and noting the changes and comparing with fresh products. Also product can be periodically kept at 40°C, room temperature and in refrigerator for a specific period, about 2 weeks and noting the changes.

(iv) Container compatibility : As these products, particularly cream rouges, are marketed in plastic tube, compatibility of the product with plastic is to be checked. This can be studied at higher temperature (accelerated stability test) to predict the compatibility at normal shelf-life.

(v) Sedimentation of liquid rouges : This is to judge the sedimentation rate character of the liquid rouges, as sedimentation may be there. Viscosity of the product is important to have slow sedimentation.

CHAPTER-5

Skin Creams

Skin care is the age old necessity of mankind. This necessity lead to the continuous modification and invention of more and more skin care cosmetic preparations.

Skin care preparations are not new and dates back to earliest antiquity. The use of salves and unguents for preserving and beautifying the skin is a very old process. These were prepared, mainly, by digesting roots, flowers, leaves, gums, aromatic resins with fats and oils. The first notable change was made by the Greek physician Galen, during second century A.D., by addition of water to his salves. That preparation was considered to be the foundation of modern days cleansing creams and cold creams. Though over the centuries a continuous modification took place, but the basic concept remained unchanged. It has become so important that plenty of efforts and money are being continuously spent on research dealing with effect of various materials and preparations on the skin and to design better skin care preparations.

With the availability of wide spectrum additives, like emulsifying agents, etc., and development of various techniques, preparation of creams has become very simple. Mostly, the creams are emulsion type and consistency can vary from a liquid to a spreadable solid.

All the skin care creams can be classified on different basis—

(1) According to function, e.g. cleansing, foundation, massage, etc.
(2) According to characteristic properties, e.g. cold creams, vanishing creams, etc.
(3) According to the nature or type of emulsion.

The most widely accepted classification is based on function. According to the functions the creams can be classified as follows—

(1) Cleansing and cold creams
(2) Foundation and vanishing creams
(3) Night and massage creams
(4) Hand and body creams
(5) All-purpose and general creams

(1) CLEANSING AND COLD CREAMS

Keeping the body clean is the most important and primitive need on account of personal hygiene and beautification which leads to the need of cosmetics. Though the natural process of constant sloughing off of the uppermost horny cells maintains some cleanliness, but it cannot be regarded as adequate from the cosmetic point of view. Modern people demand a higher degree of cleanliness.

Cleansing cream or lotion is required for removal of facial make-up, surface grime, oil, and water and oil soluble soil efficiently, mainly from the face and throat. A good and properly formulated cleansing cream should be able to remove, quickly and efficiently, applied cosmetics as face powder, rouge, foundation bases, cake make-up, and lipstick. The excessive increase in eye make-up also necessitates use of cleansing products specially formulated to remove such make-up.

Although adequate washing with soap and water will perform the cleaning action but a cleansing cream has certain advantages. Washing with soap-water makes the skin look dry. The cleansing cream can readily remove the chemical substances of the facial make-up by dissolving or lifting away the greasy binding materials holding pigments or grime on the skin. Studies have indicated that solidified skin oil, sebum over sebaceous or pilosebaceous orifices are resistant to removal by scrubbing with soap and water, but can easily be removed by the use of various commercial cleansing creams, polyethylene glycol 400, and olive oil. Various fat solvents such as acetone, chloroform, glycerol, kerosene, white gasoline, dioxane, and 95% ethanol were found to be effective in removal of surface oil layer, but not the slid sebum plaques. This may be due to the superior efficacy of cleansing creams to dislodge and remove these plaques from the orifices of the sebaceous ducts.

Ease of application is an important feature of the cleansing cream and so most of these creams are liquids so that excess cream and soil are then easily removable with tissue. The resultant layer left on the skin must not be occlusive but should be sufficiently emollient to prevent drying. Cold creams on the other hand must primarily have an emollient action. It is also expected that they should produce a cooling sensation in use and the resultant oil film on the skin should be non-occlusive.

A cleansing cream should be easily applicable and spreadable. It should cause low irritation to the skin. In addition to the primary function of cleaning, a multipurpose character can be imparted by adding appropriate ingredients to bring abilities to soften, lubricate, and protect.

Characteristics

A good cleansing cream should have the following characteristics—

(1) It should effectively be able to remove oil-soluble and water-soluble soil and surface oil from the skin, specifically face and throat.

(2) As a cosmetic it should be stable and have a good appearance.

(3) It should melt or soften on application to the skin.

(4) It should spread easily without too much drag. During application, it should not feel greasy or oily.

(5) After evaporation of any water, the cream residue should not become viscous.

(6) Its physical action on the skin and pore openings should be that of flushing rather than absorption.

(7) A light emollient film should remain on the skin after use of the cream.

The method of use of cleansing cream is standard. The cream is to be applied to face and throat with fingertips. A rotating upward stroke of the fingers is used to spread the cream. A tissue paper or soft cloth is then used to remove the residue. In case of washable cleansing creams, the cream residues may be removed using tap water with or without prior use of tissue.

Types of Cleansing Creams

Traditionally, cleansing creams are classified into two categories—

(1) White, emulsified cold cream (beeswax-borax type).

(2) Translucent, liquefying type, anhydrous in character and consisting of a mixture of hydrocarbon oils and waxes.

As a result of the development of several newer and better emulsifying agents, nowadays many emulsion type cleansing creams are made without beeswax and borax.

(1) Beeswax-borax type : The beeswax-borax type is a most important formulation among cleansing creams. The typical creams are usually white, of high lustre, and free from graininess. The creams have a firm consistency. They liquefy on application to the skin and spread with ease. These creams contain high percentage of mineral oil for cleansing efficiency. Basically, they are oil-in-water type of emulsion. After the creams are rubbed on the skin, a sufficient quantity of water evaporates to impart a phase inversion to the water-in-oil type. The solvent action

of the oil, as external phase, imparts the cleansing properly.

In this beeswax-borax type preparation borax reacts with the free fatty acids present in the beeswax and produces soft soap which acts as the emulsifying agent and emulsifies the oil phase, containing beeswax, mineral oil, paraffin etc., in the aqueous phase.

General procedure for manufacturing : As these preparations are emulsion type, the total ingredients can be classified into oil phase and aqueous phase. Ingredients of oil phase should be taken in increasing melting point. The materials of least melting point should be taken and melt it. Add the other oil or wax gradually in increasing melting point and melt them with continuous stirring. Take separately the ingredients of aqueous phase and mix them and heat to same temperature as oil phase. Emulsifying agents should be added to specific phase. Mix the two phases with continuous stirring until a smooth cream is formed. Finally the product can be milled by triple roller mill. Preservative should be dissolved in the water before making cream. Perfume should be added after the primary cream is formed and cooled but before final milling.

BEESWAX-BORAX COLD CREAM TYPE

Formula 1

A.	Mineral oil	28.0 gm
	Isopropyl myristate	14.0 gm
	Acetoglyceride	2.5 gm
	Petroleum jelly	7.5 gm
	Beeswax	15.0 gm
B.	Borax	1.0 gm
	Water	32.0 gm
	Preservative	q.s.
C.	Perfume	q.s.

Heat first five materials (A) and next three materials (B) separately in glass containers at about 75°C. Add the second mixture to the first mixture slowly with continuous stirring until the thick stable emulsion is formed. Add the perfume when the temperature has fallen to about 35°C. Stir again, mill and store in a suitable container.

Formula 2

A.	Beeswax	2.0 gm
	Almond oil	50.0 gm
	Lanolin	0.5 gm

B.	Borax	2.0 gm
	Rose water	35.5 gm
	Preservative	q.s.
C.	Perfume	q.s.

Formula 3

A.	Beeswax	10.0 gm
	Mineral oil	50.0 gm
	Paraffin wax	5.0 gm
	Spermaceti	3.0 gm
B.	Water	28.4 gm
	Borax	0.6 gm
	Preservative	q.s.
C.	Perfume	q.s.

Formula 4

A.	Beeswax	9.0 gm
	Ceresin wax	4.5 gm
	Mineral oil	52.0 gm
	Lanolin	0.5 gm
B.	Borax	0.7 gm
	Water	33.3 gm
	Preservative	q.s
C.	Perfume	q.s.

Formula 5

A.	Wheat-germ oil	48.0 gm
	Spermaceti	15.0 gm
	Beeswax	15.0 gm
B.	Water	21.5 gm
	Borax	0.5 gm
	Preservative	q.s.
C.	Perfume	q.s.

Formula 6

A.	Beeswax	8.0 gm
	Mineral oil	49.0 gm
	Paraffin wax	7.0 gm
	Cetyl alcohol	1.0 gm

B.	Borax	0.4 gm
	Water	34.6 gm
	Preservative	q.s.
C	Perfume	q.s.

Formula 7

A	Beeswax	12.00 gm
	Mineral oil	50.25 gm
	Spermaceti	5.00 gm
	Ozokerite wax	5.00 gm
	Lanolin	2.00 gm
B	Borax	0.75 gm
	Water	25.00 gm
	Preservative	q.s.
C.	Perfume	q.s.

(2) Liquefying cleansing creams : These are translucent liquefying anhydrous type of cleansing creams of thixotropic character. They consist of a mixture of oils and waxes and have such consistency that they liquefy when gently massaged on the skin. The materials used for preparing these creams are mineral oil, paraffin, petrolatum, waxes. Occasionally vegetable oils, fatty acid esters, or lanolin are also incorporated in small amounts. Proportion of various materials should be decided properly and formulation should be done carefully. Thixotropic character is obtained by using a wax like paraffin. The proportion of mineral oils and wax is very important to avoid problems like separation, sweating, and granular appearance. The formation of a crusty surface can be avoided by substituting amorphous ozokerite and petrolatum for crystalline ones. The petrolatum also prevents bleeding of mineral oils.

For emollient character normally lanolin or its derivatives, cetyl alcohol, spermaceti and cocoa butter are incorporated. Sometimes an opaque appearance is preferred and can be obtained by incorporating agents like zinc oxide, titanium dioxide, magnesium stearate, zinc stearate, or hydrous lanolin. These substances are normally used at 2% concentration.

General procedure of manufacturing : Melt the waxes first. Add petrolatum and finally the liquid oils. Stir thoroughly, add the perfume after cooling to about 45°C. The melted mixture should be filtered. Finally it can be passed through a roller mill.

LIQUEFYING CLEANSING CREAMS

Formula 8

Mineral oil	80.0 gm
Petroleum jelly	15.0 gm
Ozokerite wax	5.0 gm
Preservative	q.s.
Perfume	q.s.

Heat all the oils and waxes together at 65°C. Cool with stirring. Add preservative and perfume after cooling at 40°C. Store in a suitable container.

Formula 9

Isopropyl myristate	25.0 gm
Mineral oil	25.0 gm
Petroleum jelly	30.0 gm
Paraffin wax	20.0 gm
Preservative	q.s
Perfume	q.s

Formula 10

White mineral oil	42.0 gm
White petroleum jelly	18.0 gm
Spermaceti	12.0 gm
Ozokerite wax	14.0 gm
Cetyl alcohol	14.0 gm
Preservative	q.s.
Perfume	q.s.

Formula 11

Mineral oil	62.5 gm
Petrolatum	18.75 gm
Paraffin wax	12.5 gm
Beeswax	6.25 gm
Preservative	q.s.
Perfume	q.s.

(2) FOUNDATION AND VANISHING CREAMS

Vanishing and foundation creams are widely used for various purposes. The names have been derived according to the functions. Vanishing creams are named so as they disappear when applied and rubbed into the skin. Whereas foundation creams serve as a foundation

base for the make-up acting as an adherent base for application of make-up powders. They also provide emollient action, and a protective action against environment by leaving a semi-occlusive residual film on the skin which is neither too greasy nor too drying. It can also be mentioned here that another nomenclature, 'Day Creams', is used as these preparations are used during the day in contrast to heavy night creams. All these creams must not damage the skin, should be stable and have a good consistency.

Normally these preparations are based on stearic acid but can be varied also. Some suitable additives may be incorporated to impart skin protecting properties. The formula can be modified suitably to make genuine skin conditioners with emollient or depth effect or cleansers of the massage cream type. The composition of stearate creams intended for daytime use (day creams) is usually very simple.

Vanishing Creams

They are called vanishing creams because they seem to disappear when rubbed into the skin. These preparations are stearic acid based and part of the stearic acid is saponified with an alkali and rest of the stearic acid is emulsified with this soap in a large quantity of water. After application the cream leaves a dry but tacky residual film which also has a drying effect on the skin. Because of this reason the stearic acid soap based creams are still favoured for use with greasy skin conditions and particularly in hot climates which cause perspiration on the face and where more emollient creams are not suitable.

Finest quality triple-pressed stearic acid of melting point of about 55°C is normally used. The high quality stearic acid provides an oil phase, which melts above body temperature and crystallizes in a suitable form, provides an invisible and non-greasy film and can produce a very attractive appearance. Normally 20-30% of free fatty acids is neutralized by using alkali, either potassium hydroxide or sodium hydroxide. Characters of the creams vary according to the proportion of the stearic acid present. The total proportion should not exceed 25%, and best preparations are obtained using 16-20% neutralization. The consistency and texture of the cream also depends on the amount of acid saponified and the nature of alkali used. Sodium hydroxide makes a harder creams than potassium hydroxide. The amount of alkali is required to be calculated on the basis of amount of free acid available.

Apart from potassium hydroxide, triethanolamine is also an excellent alkali to prepare good quality creams. Use of triethanolamine makes the

preparation easy and of viable nature. Borax can be useful to make a very white cream but the disadvantage is that the product has a distinct tendency to grain. Ammonia solution has a tendency to discolour creams made with it after some time.

Glycerin not exceeding 10% is also incorporated to maintain the consistency and enhance spreading ability. But, being hygroscopic in nature, it may absorb moisture after application, forming of minute globules of water. These problems can be overcome by using alternative glycols.

As the satiny appearance of vanishing creams is very much wanted, many substances are incorporated to attain the pearliness. The materials which are normally used to attain this are liquid paraffin, spermaceti, cocoa butter, starch, castor oil, and almond oil.

Since these creams contain a large quantity of water, preservatives are required to prevent microbial growth and enhance stability. For this purpose methyl parahydroxy benzoate (0.12%) and propyl parahydroxy benzoate (0.12%) combination is normally preferred. Also to prevent evaporation the product should be stored in airtight containers.

Perfume is another important additive for these creams. As in any other cosmetic preparations much attention is needed to select perfumes. Selection of proper flavour is very important to match with other cosmetic to be used. Improper perfume may discolour cream and thus indole, vanillin, eugenol, and must-ambrette should be avoided. Materials which can be selected are geranium, bois de rose, sandalwood, bergamot, patchouli, vetivert, ylang-ylang, lavender oils, terpineol, linalol, geraniol, cinnamic alcohol etc. Some resinoids are also good and can be considered.

General procedure of manufacturing : These preparations are emulsion type and have aqueous phase and oil phase. So ingredients of oil phase should be mixed gradually in increasing melting order, starting with melting of lowest melting point substance. Components of aqueous phase should be mixed together and warmed to about same temperature of oil phase and mix with oil phase with continuous stirring until a smooth cream is formed. Add perfume after cooling and mill further through triple roller mill.

Formula 12

A.	Stearic acid	20.00 gm
	Cetyl alcohol	0.50 gm
	Triethanolamine	1.20 gm

B	Sodium hydroxide	0.36 gm
	Glycerin	8.00 gm
	Water	69.94 gm
	Perfume	q.s
	Preservative	q.s

Formula 13

A	Lanolin	2.00 gm
	Cetyl alcohol	0.50 gm
	Stearic acid	10.00 gm
	Propylene glycol	8.00 gm
	Potassium hydroxide	0.40 gm
B	Water	79.10 gm
	Perfume	q.s.
	Preservative	q.s.

Formula 14

A	Stearic acid	12.0 gm
	Cetyl alcohol	0.5 gm
	Sorbitol syrup	5.0 gm
	Propylene glycol	3.0 gm
	Triethanolamine	1.0 gm
B.	Glycerin	0.3 gm
	Water	78.2 gm
	Perfume	q.s.
	Preservative	q.s.

Formula 15

A.	Stearic acid	15.00 gm
	Potassium hydroxide	0.50 gm
	Sodium hydroxide	0.18 gm
	Cetyl alcohol	0.50 gm
	Propylene glycol	3.00 gm
B.	Glycerin	5.00 gm
	Water	75.82 gm
	Perfume	q.s.
	Preservative	q.s

Formula 16

A.	Stearic acid	20.00 gm
	Cetyl alcohol	0.50 gm

	Sodium hydroxide	0.36 gm
	Triethanolamine	1.20 gm
B.	Glycerin	8.00 gm
	Water	69.94 gm
	Perfume	q.s.
	Preservative	q.s.

Formula 17

A.	Stearic acid	20.0 gm
	Potassium hydroxide	1.4 gm
B.	Glycerin	4.0 gm
	Water	74.6 gm
	Perfume	q.s.
	Preservative	q.s.

Take the ingredients of 'A' i.e. stearic acid, alkali and other materials, like lanolin, spermaceti etc., if required, and heat at 70°C in a container. Take ingredients of 'B' i.e. water, glycerin etc. along with preservatives and heat also at 70°C. Add the second mixture to the first one with continuous stirring. Cool with continuing stirring. Add perfume when the temperature is about 35°C. Mill it.

Foundation Creams

Foundation creams are applied to the skin to provide a smooth emollient base or foundation before the application of face powder and other make-up preparations. They help the powder to adhere to the skin due to possession of good holding power. They should spread well, be non-greasy and should leave non-occlusive film on the face. The humectant present in the preparation helps powder retention. Lanolin also does help in retention of powder.

Apart from the materials mentioned in vanishing creams, additionally mineral oil may be added to promote powder adhesion. The low surface tension of isopropyl myristate, butyl stearate, and similar esters results in closer adhesion of the film and softer feeling of the skin.

The foundation creams can be of two types—

(1) Pigmented creams which are coloured

(2) Unpigmented creams

General procedure of manufacturing : Heat ingredients of oil phase and aqueous phase separately to 75°C and mix the latter to the former slowly with continuous stirring. Cool while stirring. Add the

perfume when the temperature is about 35°C. Preservative should be added to water before mixing with oil phase. Finally a milling will give a good product.

Formula 18

A.	Lanolin	2.00 gm
	Cetyl alcohol	0.50 gm
	Stearic acid	10.00 gm
	Potassium hydroxide	0.40 gm
B.	Propylene glycol	8.00 gm
	Water	79.10 gm
	Perfume	q.s.
	Preservative	q.s.

Formula 19

A.	Liquid paraffin	1.00 gm
	Cetyl alcohol	1.00 gm
	Lanolin (anhydrous)	2.00 gm
	Glyceryl monostearate	18.00 gm
	Triethanolamine	1.58 gm
B.	Water	76.00 gm
	Sorbitol	2.00 gm
	Perfume	q.s.
	Preservative	q.s.

Formula 20

A.	Spermaceti	5.00 gm
	Glyceryl monostearate	20.00 gm
	Colours	3.00 gm
B.	Water	67.00 gm
	Glyceryl	5.00 gm
	Perfume	q.s.
	Preservative	q.s.

Formula 21

A.	Glyceryl monostearate	20.00 gm
	Mineral oil	5.00 gm
	Cetyl alcohol	2.00 gm
	Isopropyl linoleate	1.50 gm
B.	Glycerin	8.00 gm
	Water	71.00 gm

	Perfume	q.s.
	Preservative	q.s.

Formula 22

A.	Lanolin	1.00 gm
	Mineral oil	10.00 gm
	Stearic acid	2.50 gm
	Glyceryl monostearate	3.00 gm
B.	Glycerin	5.00 gm
	Triethanolamine	0.50 gm
	Water	78.00 gm
	Perfume	q.s.
	Preservative	q.s.

Foundation Make-up

As foundation cream is used as a base make-up to hold the powder make-up above it, the total make-up is a two-step process. The idea of foundation make-up came to overcome this two-step process and the trouble with it. Foundation make-up in various forms, particularly liquid, has become so popular that in some countries it has replaced the foundation creams and loose powder altogether. The reason being the liquid foundation make-up is much easier to apply than powder and a smooth appearance can be obtained. Though the presence of surfactants may make the colours or pigments penetrate the hair follicles and fissures of epidermis if not completely removed, still it has some popularity.

Formula 23

A.	Lanette wax	8.00 gm
	Stearic acid	8.00 gm
	Water	64.00 gm
B.	Glycerin	10.00 gm
	Powder base	10.00 gm
	Colour	q.s
	Perfume	q.s.
	Preservative	q.s

Heat components of 'A' to 85°-90°C. Mix colour and perfume with the powder base, then disperse this in the glycerin. Add 'B' to 'A' and mix thoroughly.

Formula 24

	Butyl stearate	1.00 gm
	Stearic acid	12.00 gm

Sorbitan monostearate	2.00 gm
Polyxyethylene sorbitan monostearate	1.00 gm
Propylene glycol	12.50 gm
Sorbitol liquid	2.00 gm
Talcum	8.00 gm
Titanium dioxide	2.00 gm
Iron oxide (red)	1.00 gm
Water	58.00 gm
Perfume	q.s.
Preservative	q.s.

Take the first four substances and heat it at about 70°C. Heat water and sorbitol liquid to same temperature and make emulsion. Add colour and perfume with talcum and then mix with propylene glycol and sorbitol liquid and mix with the emulsion, cooled at 35°C. Homogenize the whole preparation in an ointment mill.

Formula 25

A.	Stearic acid	15.0 gm
	Span 60	2.5 gm
	Isopropyl palmitate	2.0 gm
B.	Tween 60	1.50 gm
	Propylene glycol	10.00 gm
	Water	54.00 gm
	Dry powders (titanium dioxide, talc, inorganic pigments)	15.00 gm
	Perfume	q.s.
	Preservative	q.s.

Mix the pigment and talc to disperse the colour properly. Heat components of 'A' to 85°C and components of 'B' to 90°C in separate containers. Add 'B' to 'A' with continuous stirring. Cool slowly with stirring. Add perfume when the temperature comes down to 35°C. Preservative should be added in water of components 'B' before cream is made.

(3) NIGHT AND MASSAGE CREAMS

Skin nourishment is important and required to preserve the normal characters of the skin or as a treatment for dry skin. To supplement foods for the skin and to treat the dry skin various creams containing different ingredients are used. Though various creams are used, like nutritive, massage or emollient creams but they differ very little from

one another. The common feature is that they are generally applied on the skin and left for several hours, say overnight, and all of them assist in the repair of skin which has been surface damaged by exposure to various elements or exposure to detergent solution or soap. They normally contain high quantity of oily and fatty materials together with emollients such as lanolin or lanolin derivatives and are prepared either as oil-in-water or water-in-oil or as mixed emulsion systems. Skin acts as a barrier between the body and its environment maintaining a controlled dynamic equilibrium. Various stresses imposed by the environmental factors can cause changes or damage to the skin. The major function of these creams is to help to reverse these changes and maintain a normal healthy skin. They are easy to apply but not too easy to rub in. These creams are also not to rub in. They are sticky and greasy due to presence of oil/wax but this character can be avoided by using materials such as fatty acid esters, acetylated glycerides and other oils which have good spreading properties. The objective of using such creams is to cover the skin with a well dispersed, and consequently thin residual occlusive film which is not greasy or sticky. When this film is allowed to remain, the loss of moisture is slowed down comparatively.

As normally these creams are applied at night time, the time normally assigned to skin preservation and feeding, they are called night creams. But they can also be used in day time as a base for applying face powders. These preparations are also used to supplement hormones or vitamins to the skin and they may be termed as hormone creams or vitamin creams respectively.

Composition Emollient and moisturizing substances are one important component of these creams. To rectify the dryness and maintain the flexibility of the skin emollients are used. Emollient action can be achieved by two mechanisms.

(1) Prevention of water loss from the skin and thus building up of water content from within.

(2) Supplementing the water content of the skin by attracting the water from the atmosphere by means of a humectant material.

The mechanism of attracting water from the atmosphere and thus maintaining the water content of the skin is called moisturizing. All the moisturizing creams thus contain a humectant.

Most common substances used as humectants are glycerol and other polyhydric alcohols like ethylene glycol, propylene glycol and sorbitol. Solutions of sodium lactate, glucose, fructose, glucosamine, deoxyribose,

and ribose also show healing, soothing and keratoplastic activity on skin. Some synthetic components have been reported by some workers to have humectant property. The substances were furyl glycerine, sodium 2-pyrrolidone-5-carboxylate, allantoin etc. Fruit and vegetable extracts, bamboo extracts are also reported to have ability to hydrate and protect skin.

Lanolin and its derivatives, stearic acid, wool wax alcohols, wool wax steroids, beeswax, artificial preen gland oil, vegetable oils like groundnut oil have found use in these creams.

Various esters like isopropyl myristate, isopropyl palmitate, or isoalcohols are also incorporated.

Vitamins or hormones are incorporated in these creams for nourishment to the skin and they can thus be termed as vitamin creams or hormone creams. The vitamins which are used for this purpose are vitamin A, vitamin D, vitamin E or some water soluble vitamins. The name vitamin F has been given to a mixture of unsaturated fatty acids, including linoleic acid, linolenic acid and is arachidonic acid, and used in creams for treatment of skin. They are normally used as alkyl esters like isopropyl ester, etc.

Estrogen, progestin, pregnenolone and androgens are all claimed to have shown limited restorative effects on aged skin. Though there is fear that the hormones may be absorbed and can produce systemic side effects but as the concentrations at which they are used in these creams are very low, so the chances of side effects are not there. A suitable vehicle is required to dissolve hormone and for this purpose oil of persic, vegetable oils, benzyl benzoate, ethyl alcohol, propylene glycol may be used.

Suitable perfume is incorporated according to the choice or acceptability. As these preparations are emulsions and contain good amount of water, preservatives are also to be incorporated. Methyl parahydroxy benzoate in combination with propyl or butyl parahydroxy benzoate are widely used for this purpose.

If the preparations contain unsaturated esters or oils, antioxidant should be incorporated to prevent rancidification.

General procedure of manufacturing As these preparations are emulsion type, they contain two categories of ingredients, oil and similar substances and water and other water miscible ingredients. Both should be taken separately and heated nearly to same temperature to get all in liquid state. Mix the two with continuous stirring until cream is formed.

Perfume should be added after cooling and milled through triple roller mill.

The use of isopropyl myristate or isopropyl palmitate is recommended as they give additional body to the cream.

Formula 26

A.	Mineral oil	38.0 gm
	Petroleum jelly	8.0 gm
	White beeswax	15.0 gm
	Paraffin wax	1.0 gm
	Lanolin	2.0 gm
B.	Borax.	1.0 gm
	Water	35.0 gm
	Perfume	q.s.
	Preservative	q.s.
	Antioxidant	q.s.

Formula 27

A.	Beeswax	8.0 gm
	Mineral oil	15.0 gm
	Lanolin oil	7.5 gm
	Isopropyl palmitate	10.0 gm
	Acetylated glyceride	2.0 gm
	Lanolin	2.0 gm
B.	Borax	0.5 gm
	Water	35.0 gm
	Perfume	q.s.
	Preservative	q.s.
	Antioxidant	q.s.

Heat components of 'A' and 'B' separately to 75°C. Add 'B' to 'A' slowly with continuous stirring. Cool while stirring and add perfume when the temperature is about 35°C. Preservative should be added in water phase.

Formula 28

A.	Groundnut oil	15.0 gm
	Mineral oil (light)	20.0 gm
	Petroleum jelly	30.0 gm
	Lanolin	5.0 gm
	Beeswax	5.0 gm
	Borax	0.3 gm

B.	Water	24.7 gm
	Perfume	q.s
	Antioxidant	q.s
	Preservative	q.s

Formula 29

A.	Vegetable oil	21.00 gm
	Isopropyl myristate	8.00 gm
	Acetoglyceride S/C	7.50 gm
	Acetoglyceride L/C	5.00 gm
	Oleyl alcohol	3.00 gm
	Lanolin	2.50 gm
	Isopropyl linoleate	2.00 gm
	Stearyl alcohol	1.50 gm
	Stearic acid	1.00 gm
	Lecithin	1.00 gm
	Beeswax	8.00 gm
	Borax	0.25 gm
B.	Triethanolamine	0.50 gm
	Water	38.75 gm
	Perfume	q.s.
	Preservative	q.s

Heat components of 'A' and 'B' separately at about 75°C. Mix 'B' to 'A' with continuous stirring. Cool while stirring and add perfume when cooled to 35°C.

VITAMIN CREAMS

Formula 30

A.	Mineral oil	40.0 gm
	Beeswax yellow	15.0 gm
	Lanolin	0.5 gm
	Isopropyl myristate	5.0 gm
	Acetylated lanolin	0.5 gm
	Concentrated solution of vitamin A & D	1.0 gm
B.	Borax	1.0 gm
	Water	37.0 gm
	Perfume	q.s.
	Antioxidant	q.s.
	Preservative	q.s.

Formula 31

A.	Isopropyl linoleate	1.0 gm
	Mineral oil	31.0 gm
	Isopropyl palmitate	8.0 gm
	Lanolin	2.5 gm
	Beeswax	11.0 gm
	Microcrystalline wax	5.0 gm
B.	Borax	0.8 gm
	Water	40.7 gm
	Perfume	q.s.
	Antioxidant	q.s.
	Preservative	q.s.

Heat components of 'A' and 'B' separately to 75°C. and add 'B' to 'A' slowly with continuous stirring. Cool while stirring, adding perfume at about 35°C.

HORMONE CREAMS

Formula 32

A.	Acetylated lanolin	15.0 gm
	Isopropyl myristate	3.0 gm
	Mineral oil (heavy)	4.0 gm
	Hormone (in vehicle)	1.0 gm
	Beeswax	7.0 gm
	Cetyl alcohol	3.0 gm
	Stearyl alcohol	3.0 gm
	Emulsifying agent (o/w type)	15.0 gm
B.	Water	49.0 gm
	Perfume	q.s.
	Preservative	q.s.
	Antioxidant	q.s.

Dissolve requisite amount of estrogenic substance in a suitable solvent and use it in 'A'. Heat components of 'A' and water separately at 70°C. Slowly add water to 'A' with moderate but continuous stirring. Continue stirring while cooling and add perfume at 35°C.

FRUIT JUICE CREAMS

Formula 33

A	Sunflower oil	5.0 gm
	Glycerin	5.0 gm

	Orange juice or grape fruit juice	24.0 gm
	Emulsifying agent (emulsene)	16.0 gm
B.	Water	50.0 gm
	Perfume (orange oil)	q.s.
	Preservative	q.s.

Heat components of 'A' at 75°C, except juice. Heat water with preservative at same temperature separately and add to 'A' with continuous stirring. Cool while stirring. Add juice and perfume when the temperature is at about 35°C.

LANOLIN JUICE CREAMS

Formula 34

Lanette wax	12.0 gm
Myristyl alcohol	5.0 gm
Glycerin	6.0 gm
Lemon juice	20.0 gm
Water	57.0 gm
Oil of lemon	q.s.
Preservative	q.s.

Heat lanette wax and myristyl alcohol and mix together at 75°C. Heat water with preservative at same temperature but separately. Add water to first mixture with continuous stirring. Stir in the lemon juice and glycerin after emulsion is formed. Finally add lemon oil when temperature is about 35°C.

(4) HAND AND BODY CREAMS

Softness of the skin is very important and also wanted. Sebum, a substance which is secreted from the skin, acts as a natural lubricant and keeps the skin soft and conditioned. The film produced by secreted sebum also helps to keep the skin wet by preventing the evaporation of moisture. The repeated or constant contact with soap and detergent does the damage or causes removal of the film sebum.

Frequent removal of this sebum makes the skin dry, scaly and less protective against bacterial infection and can, ultimately, lead to dermatitis. Some natural moisturizing agents are also secreted by the skin. Controlled use of soap or detergent does not make the skin much dry and scaly, but frequent and prolonged use of soaps or detergents, drying winds and indoor atmospheres make the skin much dry and scaly. A protection is required to maintain the skin in normal condition.

In the initial stages glycerin and rose-water types of products were used for protection and were popular about 40 years back. Present day preparations are quite different and variable in nature. The preparations can be liquid creams, solid creams, lotions, jellies or non-aqueous types. Body creams normally contain less oil than hand creams.

The main functions of hand and body creams are expected to be:

(1) Replace water loss or reduce the water loss from the surface of the skin.

(2) Provide an oily film to protect the skin.

(3) Keep the skin soft, smooth but not greasy.

(4) Easy to apply.

Based on these needs different types of preparations are manufactured and can be used. The preparations should be very light and perfume should be minimum. To avoid greasiness the products are of low oil content. Preparations with water as continuous phase are far more used than preparations with oil as continuous phase.

Materials

Various materials, in variable proportions, are used in these preparations to obtain different functions.

The prevention of loss of water can be achieved either by using a humectant or by preventing evaporation from the skin by means of a semi-occlusive film of water immiscible oily or fatty material. The most commonly used humectants are propylene glycol, glycerin, and sorbitol. All these substances produce similar effects but the choice depends on intended viscosity of the finished products. In oil-in-water creams, glycerin normally produces a firmer consistency than sorbitol, and propylene glycol makes for an even softer consistency.

Different materials are used to form occlusive films and they can be either natural or synthetic film formers or may be oily substances. Several natural gums like karaya, acacia, tragacanth, agar agar, and some semi-synthetic or synthetic film formers like carboxy celluloses and polyvinyl alcohols, respectively, are used to help to prevent evaporation of water from the surface of the skin.

Mineral oil, waxes, lanolin and lanolin derivatives are used as film formers and for emollient or skin softening purpose. Also sterol, phospholipids, fatty acids, fatty acid esters, fatty alcohols are used. The amount of these substances should not be high to avoid greasiness of the film.

Incorporation of alkyl fatty acid esters helps to prevent drag and excessive oiliness. The alkyl fatty acid esters make the oil phase less viscous and so enable the skin to be covered with a thinner oil film than would otherwise be possible.

Sometimes a healing ingredient, like allantoin, urea, uric acid, is incorporated in hand and body creams to enhance granulation of the skin. A bacteriocide is incorporated to prevent bacterial infection of the skin.

In modern type of creams, alkyl esters of polyunsaturated C_{18} fatty acids, linoleic acid and linolenic acid are added to prevent scaling of the skin surface.

As these preparations are mainly oil-in-water type emulsions, on evaporation these leave the skin feeling relatively non-oily and non-sticky. Creams or lotions based on natural or synthetic film formers are not popular because on evaporation of water the preparations become sticky due to increase in concentration of gum. However, this can be prevented by presence of humectant.

Since these creams and lotions contain water and materials that are highly prone to decomposition by microbial contamination, they must be protected against such contamination and thus addition of preservatives is a must. The selection of preservatives should be such that they should protect against all types of organisms and should be compatible and non-toxic. Widely used preservatives for these creams are methyl, parahydroxy benzoate, propyl parahydroxy benzoate, and butyl parahydroxy benzoate. A combination of 0.1 to 0.2% methyl ester and 0.02 to 0.1% propyl ester is normally used. Methyl ester is dissolved in aqueous phase whereas propyl ester is dissolved in oil phase. Butyl ester may be used in place of propyl ester in same concentration.

Choice of a perfume for use in hand and body creams is based solely on aesthetic value. Proper perfume increases acceptance of the product. But perfume should not be excessive or too strong. Perfumes should be compatible with other ingredients and stabilize the preparations. Perfumes from different sources can be selected.

(1) Synthetic aromatics like phenylethyl alcohols, geranoil, pine, hydroxycitronellal, amyl cinnamic aldehyde.

(2) Essential oils like geranium bourbon, rose de mai absolute, lavender.

(3) Compounded perfume oils of a liliac type, light floral type are also used.

Psychology of colour is a fascinating thing. It gives an extra edge to the products from consumer acceptance point of view. Though colours are not used in hand creams but can be selected for hand and body creams. Various colours which are considered acceptable are red, blue, yellow or green in different shades.

These preparations can be of various natures—

(1) *Liquid creams* : Consistency is of liquid nature.

(2) *Solid creams* : Consistency is higher.

(3) *Non-aqueous type* : Not containing any aqueous media.

General procedure for manufacturing As these creams are also emulsion type containing oil phase and aqueous phase, they are prepared by melting or heating both the phases separately to same temperature and mixing with continuous stirring till cream is formed. Perfume is added after cooling the product. Finally milling is done for a good texture.

LIQUID CREAMS

Formula 35

A.	Isopropyl myristate	4.0 gm
	Mineral oil	2.0 gm
	Stearic acid	3.0 gm
	Emulsifying wax	0.275 gm
	Lanolin	2.5 gm
B.	Glycerin	3.0 gm
	Triethanolamine	1.0 gm
	Water	84.225 gm
	Perfume	q.s.
	Preservative	q.s.

Formula 36

A.	Glycerol monostearate	2.7 gm
	Cetyl alcohol	1.5 gm
	Silicone oil	1.5 gm
	Lanolin oil	2.0 gm
	Span 80	0.5 gm
	Tween 60	2.5 gm
B.	Sorbitol solution (70%)	10.0 gm
	Water	79.3 gm

Perfume	q.s.
Preservative	q.s.

Heat components of 'A' and 'B' separately. Mix 'B' to 'A' with continuous stirring. Cool while stirring. Add preservative with stirring when cooled to 35°C.

SOLID CREAMS

Formula 37

A.	Stearic acid	15.0 gm
	Isopropyl myristate	2.0 gm
	Potassium hydroxide	1.0 gm
B.	Sorbitol solution (70%)	18.3 gm
	Water	63.7 gm
	Perfume	q.s.
	Preservative	q.s.

Melt stearic acid and isopropyl myristate and potassium hydroxide with stirring. Keep it at 75°C. Heat components of 'B' at same temperature and mix with 'A' with continuous stirring. Add perfume when cooled to 35°C.

Formula 38

A.	Cetyl oleyl ethoxylate	9.0 gm
	Polyethyleneglycol 400 monostearate	14.0 gm
	Mineral oil	12.0 gm
	Silicone oil	1.0 gm
	Paraffin wax	8.0 gm
	Petroleum jelly	4.0 gm
	Isopropyl myristate	8.0 gm
B.	Water	46.0 gm
	Perfume	q.s.
	Preservative	q.s

Heat components of A and water separately at 75°C. Add water to A with continuous stirring. Cool with stirring adding perfume at 35°C.

JELLIES

Formula 39

Tragacanth	1.0 gm
Boric acid	1.5 gm
Glycerin	12.0 gm

Alcohol	12.0 gm
Water	73.5 gm
Perfume	q.s.
Preservative (only methyl parahydroxy benzoate)	q.s.

Dissolve preservative in glycerin with gentle heat if required. Mix the tragacanth with the alcohol and add the glycerin and perfume. Dissolve the boric acid in water and add the solution slowly, part by part, to the tragacanth paste, with gentle stirring.

Formula 40

Tragacanth	2.0 gm
Glycerin	10.0 gm
Titanium dioxide	0.2 gm
Water	87.8 gm
Perfume	q.s.
Colour	q.s.
Preservative	q.s.

Disperse the gum in little of glycerin and add water, containing predissolved preservative, to make a mucilage. Keep it for one day. Add other ingredients with stirring. Add perfume after milling. Colour may be dissolved in small amount of water or glycerin prior to addition to the main mass. Preservative can also be dissolved in glycerin.

NON-AQUEOUS TYPE

Formula 41

Paraffin wax	26.0 gm
Petroleum jelly	74.0 gm
Perfume	q.s.

Formula 42

Lanolin	9.0 gm
Ceresin wax	18.0 gm
Amber resin	4.5 gm
Paraffin wax	18.5 gm
Petroleum jelly	50.0 gm
Perfume	q.s.

Melt and mix the material in increasing order of melting point. Perfume should be added last after cooling the mixed mass at about 35°C.

In non-aqueous type preparations also, sometime, chlorophyll, mast mallow leaves, essential oils, turpentine oil, eucalyptus oil, etc. can be added.

(5) ALL-PURPOSE CREAMS

In recent times there has been a tremendous increase in the consumption of preparations which are normally known as all-purpose creams. These were also known as 'sports cream' as they were used by sportsmen in skiing and outdoor activities. They are somewhat oily but non-greasy type and can spread easily on the skin to give a protective film. They can also function, when applied excessively, as a skinfood or nourishing cream, or night cream or protective cream for prevention or alleviation of sunburn, or for the treatment of roughened skin areas. Also, when applied sparingly, they function as hand creams or foundation creams. Thus they are called as all-purpose creams.

So, the composition of these creams is such that it can act—

(a) As a foundation cream to provide a foundation base for make-up.

(b) As a cleansing cream and liquefy easily.

(c) As a hand cream and should have emollient character.

(d) As a protective cream and should form a continuous non-occlusive film.

(e) As a cream to smooth the rough surface of the skin.

Composition

These preparations are mainly based on wool alcohols, which consist of the alcoholic fraction obtained by saponification of the grease of the wool of sheep and contain not less than 28% of cholesterol. Its value as a water-in-oil emulsifier is due to the property of absorption of water. But this character can be lost due to oxidation and thus an antioxidant, like butylated hydroxyanisole, is to be used. If oxidation occurs water can be lost from the base and can seep out. As these preparations need to spread easily, microcrystalline wax can be used. Mineral oils, paraffin are used to get protective layer. Magnesium sulphate is used to enhance the stability of the creams by the presence of magnesium ions in aqueous phase. Methyl and propyl parahydroxy benzoates can be used as preservatives to prevent microbial growth. Suitable perfumes are also to be added. The preparations are normally water-in-oil but the

other types are also used as can be seen from the following formulae—

Formula 43

Wool alcohols	6.0 gm
Hard paraffin	24.0 gm
White soft paraffin	10.0 gm
Liquid paraffin	60.0 gm
Perfume	q.s
Antioxidant	q.s

Melt the above ingredients together and stir until cold. Add perfume when cooled to 35°C with stirring. An equal amount of water can be added to this base to form the cream known as hydrous ointment.

Formula 44

A.	Wool alcohols	2.5 gm
	Microcrystalline wax (m.p. 140°-145°F)	6.0 gm
	Mineral oil	21.0 gm
	Petroleum jelly	5.0 gm
B.	Glycerin	5.0 gm
	Magnesium sulphate	0.7 gm
	Water	59.8 gm
	Perfume	q.s
	Methyl parahydroxy benzoate	q.s.
	Propyl parahydroxy benzoate	q.s
	Butylated hydroxyanisole	q.s

Heat components of 'A 'and 'B' separately to 75°C. Add 'B' to 'A' with continuous stirring. Homogenize at about 45°C. Add perfume with stirring. Add preservative in water of 'B' before making cream.

Formula 45

A.	Hartolite	3.75 gm
	Cetyl alcohol	0.75 gm
	Microcrystalline wax	7.60 gm
	Liquid paraffin	19.70 gm
B.	Glycerin	2.60 gm
	Magnesium sulphate	0.70 gm
	Water	64.90 gm
	Perfume	q.s
	Preservative	q.s
	Antioxidant	q.s.

Heat and melt components of 'A' at 75°C and also heat components of 'B' to same temperature. Mix 'B' with 'A' with constant stirring. Homogenize and cool to 40°C and add perfume with stirring. The above is an example of o/w general purpose cream.

Formula 46

A.	Stearic acid	15.0 gm
	Lanolin	2.0 gm
	Beeswax	2.0 gm
	Mineral oil	24.0 gm
	Myrj 52	5.0 gm
B.	Sorbital solution	10.0 gm
	Water	42.0 gm
	Perfume	q.s
	Preservative	q.s
	Antioxidant	q.s

Heat and mix components of 'A' at above 75°C. Add preservative to water and sorbital solution and heat to 75°C. Mix 'B' to 'A' with continuous stirring. Cool and add perfume while stirring.

Formula 47

A.	Wool alcohol	1.0 gm
	Cholesterol	1.5 gm
	Petroleum jelly	7.5 gm
	Paraffin wax	5.0 gm
	Mineral oil	20.0 gm
	Sorbitan sesquioleate	1.0 gm
B.	Glycerin	5.0 gm
	Magnesium sulphate	0.5 gm
	Water	58.5 gm
	Perfume	q.s
	Preservative	q.s.
	Antioxidant	q.s

Heat components of 'A' and 'B' independently to 75°C. Add 'B' to 'A' slowly with continuous stirring. When temperature has come down to 45°C pass through homogenizer. Continue stirring to cool to 35°C and add perfume. Preservative should be added in water of 'B'.

Evaluation

As these products are used widely and for various parts of the body, stringent evaluation and quality control is essential.

Apart from general tests like quantitative and qualitative determination of ingredients, some other tests are important.

(a) **Rheology** : Rheology is very important as these creams are marketed in tubes or containers. The rheology or viscosity should remain constant. As these products are normally non-newtonian in nature, the viscosity can be measured using viscometers used for such liquids.

(b) **Sensitivity** : As various types of ingredients are used with occasional use of antiseptics, hormones, etc., there is a possibility of sensitization or photosensitization of the skin. This should be tested beforehand. This test is normally done by patch test on skin and can be either open or occlusive. The test sample is applied alongwith a standard market product at different places and effect is compared after a period of time.

(c) **Biological testing** : This is particularly essential for products containing antiseptics, hormones, vitamins, etc.

CHAPTER-6

Sunscreen Preparations

Sunlight reaching the surface of the earth contains visible rays (with wavelength between 400 mμ-740 mμ), rays with shorter wavelength (280 mμ-400 mμ) called ultraviolet, and rays with longer wavelength (750 mμ- 5300 mμ) called infrared. Ultraviolet rays, particularly with wavelength below 320 mμ, are responsible for most of the therapeutic as well as noxious effects that we attribute to sunlight. The overall beneficial effects as well as harmful effects of sun rays on the human body depend on the length and frequency of exposure, intensity of the sunlight and sensitivity of the individual concerned. Lower the wavelength, more the energy of the rays.

These rays stimulate blood circulation in the derma, cause the development of vitamin D from provitamins, through the activation of 7-dehydrocholesterol, contained in skin fat. Sunshine increases the formation of haemoglobin and may also promote a decrease in blood pressure. These rays are also supposed to shift the redox potential of the epidermal tissue towards more intensive reduction, which, in turn, is believed to lead to an activation of various vitamins, hormones, and enzymes and a favourable effect on the visceral nervous system. Sun-rays have been used in the treatment of tuberculosis of some glands, bones and skins and also in the treatment of skin psoriasis. Sunlight is also known to exert a beneficial influence on the autonomous nervous system and reduce the susceptibility to infections. Moderate exposure to sunshine produces better psychological feelings, sense of fitness and peace of mind. Sun rays cause thickening of the skin by producing melanin which increases the body's natural protective mechanism against sunburns.

On the other hand solar irradiation is damaging in case of excessive exposure. It can have short term and long term adverse effects. It may cause sunburn with symptoms of mild irritation to serious inflammation, from a slight erythema to blistering on skin. There can be shivering, fever and nausea, and sometimes pruritus. Release of histamine by the

affected cells is responsible for the dilation of blood vessels and erythema. Stimulation of the basal cells of the skin for proliferation can also occur. It is also known that excessive solar radiation not only leads to a disposition to cancer but to skin cancer itself. Excessive radiation also destroys vitamin D present in skin fat and produces some toxic peptide which in the long run cause the connective tissue of the corium to degenerate which is manifested in a coarsening of the skin relief and formation of wrinkles.

During the latent period preceding the appearance of effects of sunburns, photochemical degradation products formed by the effect of solar irradiation are believed to trigger off a series of free radical reaction leading to the formation of the biologically active substances which ultimately diffuse into the dermal blood vessels and produce the various adverse symptoms mentioned above.

The knowledge of long-term hazards of sun-rays has led to manufacturing of several cosmetic preparations to protect the skin from sun rays. Cosmetic preparations should protect the skin as effectively as possible from the noxious effects of radiation without reducing the beneficial effects. Protection against ultraviolet rays is also occasionally required in industry particularly drug industry, mountaineering, and armed forces. The knowledge of this effect has led to suggestion to incorporate sunscreens in make-up bases, face powders, creams and after shave lotions. 2,4-dihydroxybenzophenone in alcohol and silicone oil afford excellent protection for people highly photosensitive. Presently several cosmetic companies have launched cold or vanishing creams or lotions containing sunscreen agents.

Also preparations are used to achieve suntan faster to increase more production.

Protective Mechanism of the Skin

Mainly two factors are responsible for natural protection of skin against sunburn.

(1) Thickness of the stratum corneum
(2) Pigmentation of the skin

It has been reported that thickening of the stratum corneum occurs due to effect of solar irradiation by increasing mitotic rate of epidermal cells and thus making it more impervious to the passage of erythemogenic radiation.

Increase in melanin content of the epidermis also increases the protection power of the skin. UV radiation causes excess formation of

melanin which migrates upward towards stratum corneum and the skin surface and thus increases the resistance. Suntan preparations only facilitate this excess formation of melanin.

Principle of Effectiveness of Sunscreens

It is a fact that the exposure of unprotected skin to sunlight not only produces the desired therapeutic effect but also results in sunburn and the subsequent peeling off of the corneal layer is a cosmetic problem. In principle, this problem can be treated in different ways.

(1) A protective layer can be provided to the skin that prevents the UV-rays to reach the skin either by absorbing or by reflecting them. Some of the materials used in powders do actually reflect a certain amount of UV-rays and are thus incorporated in suntan preparations. Zinc oxide and titanium dioxide both have such property but the former is better than the latter. Preparations reflecting UV-rays are very effective and used widely. However, these preparations have the disadvantage of eliminating the beneficial rays along with the harmful ones.

(2) To incorporate substances in preparations to filter the sun-rays by absorbing medium range UV-rays (280 mμ-320 mμ) but allowing rays of higher wave lengths to pass. All modern suntan preparations are based on this principle and contain such substances.

(3) Biologically effective substances can be used effectively to prevent symptoms of inflammation without reduction of tanning. As already mentioned earlier that damage of the cells by sunburn liberates histamine in the tissues, attempts have been made to treat it with antihistaminic substances to avoid inflammation. Because of their anti-inflammatory action, hydrocarbons and fluorocarbons may be useful in treating sunburn but they are not recommended in suntan preparations.

(4) Substances that cause or accelerate tanning of the skin can be applied. Dioxyacetone causes tanning by forming a brown complex with the keratin of the corneal layer. 8-methoxypsoralene when taken 10-20 mg internally 2 hours before exposure to the sun, accelerates tanning and avoids sunburn.

SUNBURN PREPARATIONS

Cosmetic sunburn and suntan preparations may be classified into three groups:

(1) Sunscreen preparations
(2) Palliatives preparations
(3) Simulative preparations

(1) Sunscreen Preparations

These are the most important group of preparations. Sunscreens should either scatter the incident light effectively, or they should absorb the erythemal portion of the sun's radiant energy. Various factors other than the duration of exposure are also to be taken into account. For example, background is important. Snow has a better effect on the individual as it reflects a higher proportion of ultraviolet radiation than sand. Opaque powder materials, either used in dry state or in a vehicle, will serve to scatter the ultraviolet light falling upon them. Of them zinc oxide is most effective and superior to titanium dioxide. Other less effective substances are kaolin, calcium carbonate, magnesium oxide, talc, etc. Particle size of these substances in these preparations is also an important factor.

The ideal sunscreen agent should have the following characters—

(1) Absorb light preferentially over the range of 280 mμ-320 mμ.
(2) Be stable to heat, light and perspiration.
(3) Be non-toxic and non-irritant.
(4) Not be rapidly absorbed.
(5) Be neutral.
(6) Be readily soluble in suitable vehicles.

There are numerous substances which are suitable for use as sunscreens:

(1) Para-aminobenzoic acid, its derivatives and glyceryl esters, like ethylpara amino benzoate, glyceryl para-amino benzoate, etc.
(2) Salicylates, like amyl salicylate, phenyl salicylate, benzyl, menthyl, glyceryl, etc.
(3) Cinnamic acid derivatives, like benzyl cinnamate, menthyl cinnamate, etc.
(4) Dihydroxy cinnamic acid derivatives
(5) Trihydroxy cinnamic acid derivatives
(6) Certain hydrocarbons
(7) Dibenzalacetone and benzalacetophenone
(8) Dihydroxy-napthoic acid and its salts
(9) Coumarin derivatives
(10) Diazoles and triazoles
(11) Quinine salts
(12) Quinine derivatives

(13) Uric and violuric acids
(14) Tannic acid derivatives
(15) Hydroquinone etc.

Some other compounds also have been reported to be effective sun screens. They are hydrazines of ortho- or para-aminobenzaldehyde, and of ortho- and para-aminoacetophenones. Also acetylated amino-cinnamates, a reaction product of carbethoxyethyl-triethoxysilane with p-aminobenzoic acid, have been reported to be useful as sunscreen.

As all the above substances are of low molecular weight, they are quickly removed from the skin with water, necessitating repeated application. This led to the development of water-insoluble but alkali-soluble polymeric sunscreens. These polymers are produced by reacting at least two essential co-monomers.

(1) An ethylenically unsaturated compound, capable of absorbing ultraviolet radiation, like certain substituted acrylates, methacrylates, benzoates, ethers of 2,4-dihydroxybenzophenone, 2,2,4-trihydroxybenzophenone, and ethers of benzotriazole derivatives.

(2) An acidic co-monomer, an ethylenically unsaturated carboxylic acid containing at least one free carboxyl group like acrylic acid, methacorylic acid, itaconic acid, crotonic acid, etc.

These polymeric sunscreens have been found to be resistant to removal by fresh or sea-water. But they can be removed easily by a slightly alkaline solution like soap-water which converts water-insoluble polymer to water-soluble alkaline salts due to presence of free carboxylic acid group.

Different sunscreen agents are used in different concentration according to their effectiveness. Some are used in higher concentrations 6-8% and others at low concentrations like 2%.

Suitable base can be used to make a final product of an aqueous or alcoholic lotion, a fatty cream, oil, or an emulsion. The vehicle and selection of other components of the product may contribute to its effectiveness. Certain natural oils such as coconut oil, peanut oil, muster-seed oil and olive oil have a fairly high absorption ability of UV light, but mineral oil does not have such property. An antioxidant is to be incorporated if a natural oil is used to prevent rancidity.

Effective bases can be prepared by using mixtures of natural oils and mineral oils, or by blending these with fatty acid esters such as

isopropylpalmitate. Some effective protection from sunburn is also provided by white or yellow petroleum jelly and lanolin. All these preparations contain some perfume and preservative, if required. Occasionally colours are also used.

The product can be simple oil type, cream type, lotion type, aqueous solution type, gel type.

General Procedure for Manufacturing

These preparations can be aqueous or oily solutions, creams or emulsion, lotion and gel type, the general method will be different.

Solution types, aqueous or oily, can be prepared simply by mixing and dissolving the sunscreen and other ingredients in the vehicle, i.e., water or oil. Perfume should be added all of last.

Cream preparations are emulsion type and are prepared by taking ingredients of oil phase and aqueous phase separately and heating to liquefy or dissolve all ingredients and then mixing them together with continuous stirring till the cream is produced. Perfume should be added after cooling the cream to near room temperature and milling further.

Lotions can be solutions or emulsion type and can be prepared accordingly. Gels are highly viscous aqueous preparations. Thickening agent is dispersed in water separately. Other ingredients are mixed together and dissolved in water. Then the dispersion of thickening agent is mixed with others with stirring to prepare gel.

Some useful formulae are mentioned below:

OIL TYPE

Formula 1

Homomenthyl salicylate	8.0 gm
Mineral oil	92.0 gm
Perfume	q.s.

Formula 2

Homomenthyl salicylate	8.0 gm
Mineral oil	80.0 gm
Isopropyl myristate	12.0 gm
Perfume	q.s.

Formula 3

Isopropyl myristate	90.0 gm
Antiviray	10.0 gm

	Perfume	q.s
	Colour	q.s
	Preservative	q.s

Isopropyl myristate may be replaced by isopropyl palmitate. Preparation is simply by solution technique. Mix the perfume, colour, preservative with isopropyl myristate and sunscreen agent with oil and mix both together.

CREAM TYPE

Formula 4

A.	Homomenthyl salicylate	8.0 gm
	Non-ionic emulsifier (tween)	7.5 gm
	Mineral oil	2.0 gm
	Spermaceti	5.0 gm
B.	Glycerin	5.00 gm
	Water	72.50 gm
	Perfume	q.s.
	Methyl parahydroxy benzoate	q.s.
	Propyl parahydroxy benzoate	q.s.

Formula 5

A.	Antiviray	8.0 gm
	Stearic acid	1.7 gm
	Isopropyl myristate	6.0 gm
	Abracol PGS (emulsifying agent)	3.5 gm
B.	Triethanolamine	0.8 gm
	Water	80.0 gm
	Perfume	q.s.
	Preservative	q.s.
	Colour	q.s.

Formula 6

A.	Antiviray	5.0 gm
	Tween	7.5 gm
	Cetyl alcohol	1.0 gm
	Isopropyl myristate	15.0 gm
	Mineral oil	17.0 gm
B.	Glycerin	1.0 gm
	Water	54.5 gm
	Perfume	q.s.

	Methyl parahydroxy benzoate	q.s.
	Propyl parahydroxy benzoate	q.s.

Mix together the ingredients of 'A' and heat at about 70°C. In a separate vessel dissolve the preservatives in the glycerin with the aid of little heat. Add the remaining ingredients of 'B' and heat it to about 70°C. Add mixture of 'B' to 'A' slowly with continuous stirring. Stir until cool, adding the perfume at about 30°C.

LOTION TYPE

Formula 7

A.	Isopropyl myristate	2.0 gm
	Antiviray	10.0 gm
	Toilet spirit	88.0 gm
	Perfume	q.s.
	Colour (alcohol-soluble)	q.s.

Dissolve antiviray in isopropyl myristate. Dissolve perfume and colour in spirit. Mix both.

Formula 8

A.	Filtrosol A 1000	5.0 gm
	Mineral oil	10.0 gm
	Stearic acid	2.0 gm
	Paraffin wax	1.0 gm
	Beeswax	2.0 gm
	Petroleum jelly	5.0 gm
	Silicone fluid	8.0 gm
	Polyethylene glycol monostearate	5.0 gm
B.	Triethanolamine	2.0 gm
	Water	60.0 gm
	Perfume	q.s.
	Preservative	q.s.

Heat ingredients of 'A' to a temperature of about 70°C. Heat ingredients of 'B' to same temperature and add slowly to the mixture of 'A'. Stir until cool. Add perfume when the temperature comes down to about 35°C.

AQUEOUS SOLUTION TYPE

Formula 9

	Filtrosol B	7.0 gm
	Methyl cellulose	0.5 gm

Glycerin	2.0 gm
Ethyl alcohol	10.0 gm
Water	80.5 gm
Perfume	q.s

Dissolve filtrosol 'B' in ethyl alcohol and methyl cellulose in water and glycerin mixture. Mix the two parts. Methyl cellulose is added to increase the viscosity.

Formula 10

Filtrosol B	5.0 gm
Distilled extract of witch hazel	10.0 gm
Propylene glycol	10.0 gm
Water	75.0 gm
Perfume	q.s.
Water soluble dye	q.s.
Methyl parahydroxy benzoate	q.s.

Dissolve the preservative in propylene glycol and add the remaining ingredients. Mix well.

GEL TYPE

Formula 11

Carboxy vinyl polymer	2.0 gm
Propylene glycol	9.0 gm
Triethanolamine	1.5 gm
Filtrosol B	5.0 gm
Water	82.5 gm
Perfume	q.s.
Methyl parahydroxy benzoate	q.s.

Dissolve the sunscreen agent (filtrosol B) in a small portion of water. Dissolve carboxy vinyl polymer in the triethanolamine and gradually add the main proportion of water. Dissolve the preservative in the propylene glycol and add to the earlier mixture. Then add the solution of sunscreen agent. When the gel is uniform add the perfume.

(2) Palliative Preparations

These preparations are used for the relief of irritation and other problems resulting from sunburn. As sunburn causes damage to skin cells, in several cases it can be as serious as steam burn, there is always a possibility of secondary bacterial infection. So, all these preparations should also be antiseptic.

Palliative preparations are either aqueous solutions or oil-in-water emulsions and should be able to produce both protective and cooling effect to relieve the sunburn. These preparations should not be greasy or oily because they will retard the antiseptic effect as the antiseptics will not be able to mix with secretions to prevent bacterial growth.

These sunburn correctives are generally familiar as calamine or sunburn lotion. Normally they contain one or more of zinc oxide, zinc carbonate, zinc hydroxide, calamine, glycerin. Calamine is very useful and widely used in preparations. Calamine lotion also contains antiseptic such as zinc phenosulphonate (zinc sulphocarbonate), chlorinated bisphenols, and camphor or phenol which also acts as a mild analgesic. For severely burnt condition a local anaesthetic or analgesic may be incorporated for better effect. But selection should be done carefully as they may be absorbed from the broken skin. Rose water is used as a suitable vehicle and perfume for lotions for treatment of an inflamed or sensitive area of skin.

Formula 12

Calamine	15.0 gm
Zinc oxide	5.0 gm
Camphor	1.0 gm
Alcohol	10.0 gm
Glycerin	10.0 gm
Rose water	59.0 gm
Methyl parahydroxy benzoate	q.s.

Mix the calamine and zinc oxide to a smooth paste with the glycerin. Now add sufficient amount of rose water to make a cream. Dissolve the camphor in the alcohol and mix the cream and add water to volume. To get a favourable shade with calamine a small amount of ferric oxide may be added.

Formula 13

Zinc oxide	8.0 gm
Prepared calamine	8.0 gm
Polyethylene glycol 400	7.0 gm
Polyethylene glycol 400 monostearate	3.0 gm
Lime water	60.0 gm
Water	14.0 gm
Preservative	q.s.

Mix the powder materials thoroughly and add polyethylene glycol 400 monostearate and add lime water to make a cream, with stirring.

Add further lime water and make volume with water. Preservative can be dissolved in water.

Formula 14

Triethanolamine stearate	4.8 gm
Liquid paraffin	10.0 gm
Water	83.2 gm
Zinc phenosulphonate	2.0 gm

Mix triethanolamine stearate and liquid paraffin properly adding to water and heat it to 70°C with continuous trituration to achieve an emulsion.

Formula 15

A.	Calamine	10.0 gm
	Zinc oxide	5.0 gm
	Mineral oil/vegetable oil	25.0 gm
	Emulsifying wax	5.0 gm
	Camphor	1.0 gm
B.	Glycerin	5.0 gm
	Rose water	49.0 gm
	Methyl parahydroxy benzoate	q.s.
	Propyl parahydroxy benzoate	q.s.

Mix the emulsifying wax and mineral oil and heat it to about 70°C. Take water preheated at 70°C and add to the first mixture with continuous stirring to prepare a cream. Dissolve the preservative and camphor in the glycerin and mix the calamine and zinc oxide to a smooth paste. Add water to a creamy consistency and mix with previously prepared cream.

(3) Simulative Preparations

They are also termed as artificial suntan preparations. There is a good demand of such preparations to obtain a suntan. The purpose of enhanced colour may be to prevent skin damage by absorption of erythemal radiation or to indicate the well-being of the health. An artificial suntan normally is obtained by staining of the skin, whatever may be the purpose. Though several natural materials, like walnut juice, olive oil extract or cudbear and henna, were used from ancient times for skin stain, they are not favourable nowadays. Now mainly synthetic staining materials are used.

(a) Systemic suntan : Some substances have been found to increase pigmentation and thus producing suntan. The need to speed up the rate

of skin tanning led to try out such substances. Psoralens, the active constituents isolated from ammimajus, an ancient Egyptian folk-medicine, have been reported to enhance pigmentation and thus tanning. Amongst these alkoxypsoralens and particularly 8-methoxypsoralen has been extensively studied and a tablet formulation, for oral administration, of 8-methoxypsoralen have been marketed in USA. Ingestion of 10-30 mg of this substance led to increased pigmentation on exposure of skin to sunlight within 2-4 hours.

(b) Staining preparations : An artificial suntan can be obtained by staining the skin with some chemical substances. Chemicals like dihydroxyacetone, juglone, lawsone, erythrulose etc. are used to produce a semi-permanent stain.

(i) *Dihydroxyacetone* (1-3-dihydroxy-2-propanone) is a white crystalline powder with a characteristic odour and a sweet taste. It is a staining agent and it reacts with certain amino acids, present in skin keratin, and produces a brown stain within 3-6 hours after application. The colour is further increased by exposure to light. If application is not done properly it can produce an uneven staining. To get an even application and staining, it can preferably be formulated as emulsion. If it is used as solution, the preparation should include a glycol to stabilize the solution and provide a continuous film. As this stain cannot give any protection against sunburn, a sunscreen agent can be incorporated into the preparation to achieve a quick tanning effect and also for protection against sunburn. Dihydroxyacetone is used in 3.0 to 4.0% and pH of the solution is to be adjusted between 6.0-6.5. Higher concentration at lower pH produces patchy staining. At pH above 8.0 no colour is produced.

(ii) *Juglone* (5-hydroxy-1,4-naphthaquinone) or lawsone (2-hydroxy-1,4-naphthaquinone) in combination with dihydroxyacetone gives good staining. Juglone is obtained from walnut shells and lawsone is obtained from henna. 30% solution of dihydroxyacetone in 50% isopropanol also containing 0.035% juglone or lawsone is normally used as artificial staining preparation.

(iii) *Erythrulose* is also used as artificial staining agent in cosmetic preparation. It is butane-1,3,4-triol-2-one. It is used 0.5-10% according to the degree of browning required.

Staining substances are taken in a suitable solvent or vehicle system containing alcohol, propylene glycol, sorbitol etc. Preparations marketed are either solutions or cream type (emulsion). For cream

preparations suitable emulsifying agents or surface active agents should be selected. Also the preparations should have suitable perfumes and preservatives.

Formula 16

Dihydroxyacetone	4.0 gm
Ethanol (95%)	28.0 gm
Sorbitol syrup (70%)	3.0 gm
Boric acid powder	1.0 gm
Methyl parahydroxy benzoate	1.0 gm
Allantoin	0.3 gm
Water	60.7 gm
Perfume	2.0 gm

Dissolve the dihydroxyacetone in sorbitol syrup. Make the solution of other things in water and add alcohol and mix with first part. Adjust pH at 6.0 by addition of lactic acid.

Formula 17

Dihydroxyacetone	3.0 gm
Propylene glycol	6.0 gm
Alcohol	3.0 gm
Water	88.0 gm
Perfume	q.s.
Methyl parahydroxy benzoate	q.s.

Dissolve the preservative and dihydroxyacetone in propylene glycol and part of water. Add alcohol and perfume and remainder of water. Mix and adjust the pH at 6.0 with the addition of lactic acid.

LOTION TYPE

Formula 18

Sunscreen agent (water soluble)	10.0 gm
Dihydroxyacetone	3.0 gm
Propylene glycol	5.0 gm
Alcohol	25.0 gm
Water	57.0 gm
Perfume	q.s.
Methyl parahydroxy benzoate	q.s.

EMULSION TYPE

Formula 19

A.	Mineral oil	10.0 gm
	Non-ionic emulsifier (tween)	10.0 gm

B.	Dihydroxyacetone	3.0 gm
	Popylene glycol	6.0 gm
	Water	71.0 gm
	Perfume	q.s.
	Methyl parahydroxy benzoate	q.s.
	Propyl parahydroxy benzoate	q.s.

Mix together ingredients of 'A' and heat it to about 75°C. Separately dissolve dihydroxyacetone and preservatives in propylene glycol and part of the water. Add further water and heat to about same 75°C. Add 'B' to 'A' with continuous stirring to 35°C and add perfume when cooled.

Formula 20

A.	Sunscreen agent (oil soluble)	10.0 gm
	Non-ionic surfactant (tween)	2.5 gm
	Ethylene glycol monostearate	2.0 gm
B.	Propylene glycol	8.0 gm
	Dihydroxyacetone	3.0 gm
	Water	74.5 gm
	Perfume	q.s.
	Methyl parahydroxy benzoate	q.s.
	Propyl parahydroxy benzoate	q.s.

Mix together ingredients of 'A' and heat to 75°C. Dissolve the dihydroxyacetone and preservatives in propylene glycol and water. Heat it also to 75°C. Add 'B' to 'A' with continuous stirring. Cool while stirring to 35°C and add perfume.

Evaluation

As in any other preparations, identification and quantitative determination of various ingredients are essential for evaluation and quality control point of view. Apart from these routine tests some special tests are also necessary for these types of products.

(1) Spectrophotometric evaluation : This is basically to evaluate the UV radiation absorption ability of the sunscreen compounds. Using a UV spectrophotometer and taking specific concentration of the substance on the preparation, molar extinction coefficient or absorbency can be determined and compared with any other standard substance.

(2) Erythemal dosage : It is important to estimate the erythemally effective radiation or E-vitons/cm^2, transmitted by a suntan preparation. The erythemal energy is the product of the solar energy transmitted

through the film of suntan preparation and the effectiveness factor at that wavelength.

(3) Sunscreen index : This is evaluation of the relative screening activity of the sunscreen compounds. This is measurement of extinction coefficient ($E^{1\%}_{0.1\ cm}$) at 308 mμ wavelength and comparison with other. 308 mμ is the peak wavelength for effective sunburn.

(4) In-vivo skin testing : This is a direct test on animal skin, particularly rabbit, the site normally used is either backside or abdomen as these sites have maximum sensitivity. Preparations are applied on a specific site and exposed to radiation along with a control unprotected site, for a specific period of time. The effects are observed at the end of the period. Several factors or variables are to be taken care of during the test as they may influence the results. Such variables or factors are radiation source, size of the test field, etc.

CHAPTER-7

Hair

To study and design hair preparations it is very much essential to have knowledge of hair. Hair is one of the vital parts of the body and considered to be accessory structure of the integument along with sebaceous glands, sweat glands and nails. They are also known as epidermal derivatives as they originate from the epidermis during embryological development. Hair is an important component of the overall appeal of the human body. Presence of hair in odd place can make a negative effect, whereas hair on head is a part of overall attraction and beauty of a human being. So, people take a lot of care of hair to make an impact or appeal.

Hair and Hair Follicles

Before puberty the hair is mainly present on the scalp, the eyebrows and eyelashes, irrespective of sex. At puberty hair grows in other places like axillae, over the pubes in both sexes and in male as beard on the face. Though all mammals have hair but hair in man is different from others.

Hairs can be found nearly all over the surface of the skin except over some specific sites like the sides and soles of the feet, the palms of the hands, the sides of the fingers and toes, the lips, and portions of the external genitalia. There are about 50,00,000 hairs on the human body and 98 per cent of them are on the general body surface and about 1,00,000-1,20,000 are on the head. Population density of normal adult scalp hair is reported to be between 225 hair cm^2 on average with variable range of 175-300 hair cm^2. The rate of hair growth has been reported to be varying with sites. Scalp and chin have highest rate of growth. The rate of growth of scalp hair is between 0.27-0.40 mm per day. The growth rate of axillary hair is nearly same. The growth rate for hair on body surface is about 0.2 mm per day. Though the daily variations of temperature have no effect on the growth rate but the study indicated higher growth rate of beard in summer than winter. Also there is one study report which indicated that the growth of scalp hair in

women is faster than men. The growth rate of scalp hair is more in young and adults and declines in old age.

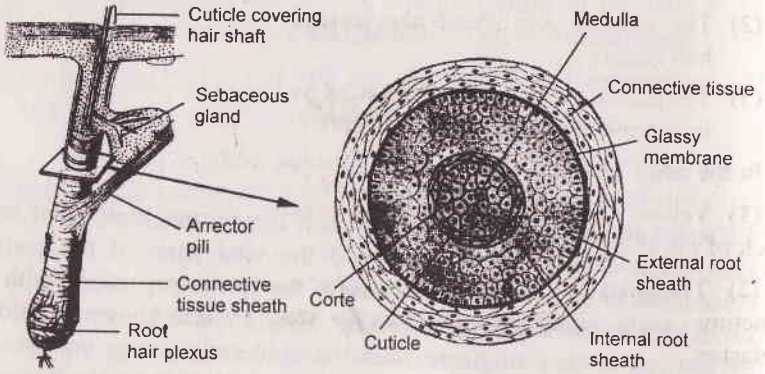

Fig. 7-1 Schematic structure of cross-section of hair

Hair production is a process of mutual involvement of both dermis and epidermis and originates from hair follicles. A schematic structure of hair is shown in Fig. 7-1. Hair follicles extend deep into the dermis, typically projecting into the underlying subcutaneous layer. The base of the hair follicle, called hair papilla, is a peg of connective tissue containing capillaries and nerves. Hair papilla is further surrounded by hair bulb which consists of epithelial cells. Hair production is a specialized cornification process. The epithelial layer involved in hair production is called the hair matrix. Basal cells near the centre of the hair matrix divide by mitosis producing daughter cells and are gradually pushed towards the surface. The new soft cells are funnelled up through the constricted follicle. The cells produced closest to the centre of the matrix form the medulla or core of the hair. Cells closer to the edge of the developing hair form the cortex which is relatively hard. Soft and flexible keratin is present in the medulla but the cortex contains hard keratin which gives the hair its stiffness. Coat of the hair is called cuticle which is formed by the dead cells at the surface of the hair. It contains hard keratin. The root of the hair is extended from the hair bulb to the point about halfway to the skin surface where internal organization of the hair is complete. The hair shaft is extended from this point to the exposed tip of the hair. The size, shape, colour and nature of the hair shaft are highly variable.

The cells of the hair follicle walls are organized into three distinctive concentric layers and include—

(1) The internal root sheath that surrounds the hair root and the deeper portion of the shaft.

(2) The external root sheath that extends from skin surface to the hair matrix.

(3) The glassy membrane, a thickened basement membrane wrapped in a dense connective tissue sheath.

In the adult integument there are two types of hair—

(1) **Vellums hairs :** These are the fine peach fuzz hairs located over much of the body surface.

(2) **Terminal hairs :** These are heavy, more deeply pigmented, and sometimes curly. Examples are hairs on head, including eyebrows and eyelashes.

Colour of hairs can vary from person to person. This reflects differences in structure and variations in the pigment produced by melanocytes at the hair papilla. Though these characteristics are genetically determined, but hormonal and environmental factors can influence the conditions of the hair. With increasing age, pigment production decreases and the hair colour lightens towards gray. White hair is the result of combination of a lack of pigment and the presence of air bubbles within the medulla of the hair shaft. But this change in colouration is gradual as the hair is dead and inert.

Apart from keratin, it also contains a small amount of uric acid. Colour is also varied according to the mineral content. In brown hair there is carbon, nitrogen, hydrogen, phosphorus, sulphur and water. Iron content is more in red hair. Normally carbon content is about 44% which is more than other elements.

Functions of Hair

Hair has several important functions—

(1) The hair on the head protect the scalp from ultraviolet light, cushion round the head, and insulate the skull.

(2) Eyebrows protect the eye from small foreign particles and insects. Also it diverts sweat from the eyes.

(3) Vivrissae, the hairs, guarding the entrances to nostrils and external ear canals filter the air and help prevent the entry of small insects and foreign particles.

(4) Body hair helps in evaporation of perspiration and draining of external water from the body.

(5) Hair is also part of sensing function. As, to check a root hair plexus of sensory nerves surrounds the base of each hair follicle, one can feel the movement of the shaft of even a single hair. This sensitivity acts as an early-warning system that may help to prevent injury.

It is responsive to several external stimulating conditions like rage, fear cold etc. and stands erect when stimulated erector pili pull on the follicles and force the hairs to stand erect.

Ailments of Hair

There can be some ailments to the normal health of hair and can cause trouble. There can be problem in pigmentation and thus changing the colour of the hair.

Baldness or alopecia is one important problem and can be of different kinds. Baldness can occur as a result of deficiency of diet, ill health or certain operations. Common baldness is of different type and occurs in maximum numbers. In this the hair is lost gradually and it usually starts at the crown and the temple. Common baldness is normally inherited. It can be passed on by the mother to her sons.

Dandruff is caused by skin irritation, disease or microbial infection. In the first one it occurs because the stratum corneum sheds large scales which are visible. This can be due to excessive brushing, or scratching, strong lotions and soft alkaline soaps used to wash the hair. These can harm the skin and break down the outer layer of the epidermis. The second form of dandruff is due to disease which causes the large scales to fall on the shoulders. The more the head is scratched, the faster these scales are produced.

Steps to Keep Hair Healthy

(1) Wash the hair with mild shampoos which are reinforced by active substances.

(2) After shampooing treat the hair with rinsing preparations and setting lotions in order to impart the gloss and firmness to it.

(3) Groom the hair with hair conditioners in order to make it elastic and protect it from deterioration after frequent permanent waving.

(4) Preserve the hair and its growth by constant attention, using hair lotions and hair treatment packs containing active substances.

Hair Care Preparations

To overcome ailments or other problems of hair and also for decorative or beautification purposes various hair care preparations are widely used. The need or demand of such products has increased over the years. It shares a high portion of cosmetic products marketed.

All the hair care products can be classified in the following way and will be discussed in the proceeding chapters accordingly.

(1) **Hair cleansers** : Various shampoos like clear liquids, liquid creams, solid creams or gels, anti-dandruff shampoos, oil shampoos, powders, dry shampoos, etc.

(2) **Hair dressings** : Anhydrous brilliantines, pomades, hair oils, hair creams, gum based hair dressings, hair lacquers, alcohol-based hair lotions, resin lotions, sprays.

(3) **Hair wavers, curlers and straighteners** : Hot waving, cold waving, tepid waves, roller and pin perms, instant perms.

(4) **Hair tonics** : Preparations containing various substances like sulphur derivatives, vitamins, etc.

(5) **Hair removers** : Depilatories, epilatories.

(6) **Hair dyes and bleaches (hair colorants)** : Various dyes and bleaching preparations.

(7) **Shaving preparations** : Soaps, creams.

CHAPTER-8

Hair Cleansing Preparations

Though there are different types of skin cleansers, but the hair cleansing preparations can be grouped into only one category and are called shampoos. They are basically water based products containing mainly surfactants. They may contain some additional substances. Water-based products have advantage of easy removal from hair by water. Oil-based products will require mechanically wiping out with cotton or tissue which is not easy. Shampoos are widely used and have a big share of the cosmetics market.

SHAMPOOS

Though earlier it was thought that a good shampoo not only cleans, rinses out dirt from the hair and imparts gloss to it, but also leaves hair manageable and non dry. But at present, the composition and purpose of shampoos varies so much that no definition can cover them all. This can be observed from the varieties of shampoo products available in the market.

A good shampoo should almost immediately form abundant foam irrespective of the type of water used or the nature of soil or fat to be removed from hair. Though foam formation is not related to the cleansing effect, but people psychologically always prefer a high foam product.

Some good shampoos are found to have side effects like drying effect on the hair. This leaves the hair too dry to handle or comb. So proper conditioning of the hair is also an important consideration. Some shampoos cause irritation to the eye and a lasting corneal cloud. These also should be avoided.

The functions of a shampoo are expected to be various. A good and accep able shampoo should have the following characteristics:

(1) It should effectively and completely remove dust or soil, excessive sebum or other fatty substances, loose corneal cells from the hair and other residual substances of hair dressings or settings or other materials.

(2) It should effectively wash the hair.

(3) It should produce a good amount of foam to satisfy the psychological requirements of the user.

(4) The shampoo should be easily removed by rinsing with water.

(5) It should leave the hair non-dry, soft, lustrous with good, manageability and a minimum of fly-away.

(6) It should impart a pleasant fragrance to the hair.

(7) It should not make the hand rough and chapped.

(8) It should not have any side effects or causes irritation to skin or eye.

The main problem of cleaning hair is removal of fat or grease which needs a good detergent. Availability of a wide range of synthetic detergents has led to a flood of products in the market. Detergent power or the removal of dirt involves—

(1) The ability of the detergent to wet both the dirt and the substrate hair fibre.

(2) Lowering of interfacial tension to such a level that displacement of dirt or grease materials becomes easy.

(3) Dispersion of dirt particles for easy washing and removal.

To select detergent(s) for using in shampoos, the following factors should be considered—

(1) Safety or non-toxicity
(2) Ease of distribution and lathering power
(3) Lustre imparted to hair
(4) Ease of combing wet hair
(5) Speed of drying
(6) Ease of setting dry hair

Composition of Shampoos

Surfactants are the main component of shampoos. Mainly anionic surfactants are used. Cationic, non-ionic and ampholytic surfactants have also some use.

The raw materials used in manufacture of shampoos are classified as:

(1) Principal surfactants which provide detergency and foam.

(2) Secondary surfactants which improve detergency foam and hair condition.

(3) Other additives which impart other characteristics to the shampoo products.

(1) Principal Surfactants

Anionic surfactants are mostly used as principal surfactants. They have very good foaming properties. Non-ionic surfactants have good cleansing activity but do not have sufficient foaming power. So, they are not much used as principal surfactants. Though cationic surfactants have good foaming character as well as some cleansing power but are not much used as they are toxic and cause damage to the eye. But at non-toxic low concentration they are used in hair conditioners. Soaps are not preferred as their solutions are alkaline and make hair dull. In hard water, they leave a deposit of calcium and magnesium salts on the hair shaft. However, they are cheap and therefore are used in low-priced shampoos. Ampholytics are generally not as good as anionics. Also they are more expensive. So, they are mainly used as secondary surfactants and as good hair conditioners. The various classes of principal surfactants used in shampoos are mentioned below.

Alkyl sulphates : Alkyl sulphates are most widely used anionic detergents, particularly lauryl and myristyl sulphates. They are sulphated derivatives of long chain fatty alcohols, C_{12} or above, obtained by catalytic reduction of fatty acids of coconut and palm kernel oils. Normally both of them are taken together as lauryl gives a greater volume of lather and myristyl gives greater richness. Sulphates of cetyl, octyl or decyl are not much useful. Various salts of lauryl sulphates like sodium lauryl sulphate, triethanol lauryl sulphate, monoethanol lauryl sulphate and ammonium lauryl sulphate are used. As magnesium lauryl sulphate is less hygroscopic it is preferably used in powder shampoos. Sodium lauryl sulphate, the most commonly used alkyl sulphate salt, has poor solubility in cold water but solubility increases with temperature and has good solubility at normal temperature of 35-40°C. Triethanolamine alkyl sulphate is present in most of the present day shampoos.

Alkyl polyethylene glycol sulphates (alkyl ether sulphates) : Sulphate derivatives of lauryl alcohol ether with polyethylene glycol or similar substances are good cleansers. Normally a chain of 2-3 ethylene oxide molecules is condensed. Sodium salts of these alkyl ether sulphates are more water soluble than sodium lauryl sulphate and thus a concentrated product can be made. They also have high foaming power. They can also act as solvents for non-polar additives normally required to be incorporated in shampoos. Though these substances are not good hair conditioners but as they are cheap additional conditioners can be easily added to compensate the deficiency.

Other anionic surfactants occasionally used are sodium salt of alkyl benzene sulphonates, paraffin sulphonates, fatty acid soaps. As fatty acid soaps have problem with hard water due to presence of calcium and magnesium, addition of sequestering agents like salts of EDTA or polyphosphates is required for stabilization.

(2) Secondary Surfactants

These are added to produce more foam and to improve the condition of the hair. They are mostly anionic or ampholytic detergents. There are several categories of detergents which are used only in conjunction with other detergents mentioned under principal surfactants.

These include dialkyl sulphosuccinates, monoalkyl sulphosuccinates, methyl taurides, fatty acid alkanolamides, acyl amino acids, acyl peptides, acyl sarcosins, monoglyceride sulphates, turkey red oil, and secondary alkyl sulphates. Some of them are used specifically in particular type of shampoos.

Monoalkyl sulphosuccinates are non-irritant to the eyes and thus may be used in body shampoos. Dialkyl derivatives like sodium di (ethylhexyl) sulphosuccinate and the di (tertiary) nonyl sulphosuccinate are very good wetting agents and are used where wetting and penetration action are required.

Methyl taurides, amides of methyl taurine, are amphoteric. They leave the hair in excellent condition because of the presence of the amide group. Though their foaming power is not very good but they are incorporated as hair conditioners.

Fatty acid alkanolamides, particularly monoalkanolamides such as monoethanolamides and isopropanolamides, are used along with lauryl sulphate to increase the solubility of lauryl sulphate and thus to increase lather.

Acyl amino acids are in ampholytic class and example is acyl β-aminopropionates where chain length of acid is of C_{12}-C_{14} for best foaming activity.

Acyl peptides are acyl polyamino acids produced by the reaction of acyl chloride and hydrolyzed proteins. They have excellent hair conditioning power. They are costly and have less foaming power.

Acyl sarcosins contain a CON group and have good hair conditioning effects. They are normally used along with alkyl sulphates or alkyl ether sulphates.

Secondary alkyl sulphates were used earlier but are not much used nowadays. They are good cleansers but have a strong characteristic

odour and have effect on hair. They also hydrolyze on storage. Occasionally, they are used along with alkyl benzene sulphonates and alkyl sulphates. Monoglyceride sulphates, like sulphated monolaurin, are same as lauryl sulphates and used in various commercial products.

Turkey red oils form a light coating over hair and are preferably used in oil shampoos. They have effective cleansing character but very low foaming effect. The important turkey red oils are sulphonated castor oil and sulphonated olive oil. Normally they are used in combination.

Alkyl phosphates are normally used in low foaming shampoos as they have low foaming power. They also have milder effects on hair. Some other anionic surfactants are also occasionally used in low foaming shampoos, as they are good cleansers but not a good foaming agent.

(3) Other Additives

Several additives are incorporated in shampoo products to achieve specialized characters and other purposes. They can be classified as—

(a) Germicides and anti-dandruff agents
(b) Conditioning agents
(c) Pearlscent agents
(d) Sequestrants
(e) Thickening agents
(f) Colours
(g) Perfumes
(h) Preservatives

All the above items are not essential for a shampoo but can be incorporated according to need and the specific purpose of the targeted population.

(a) Germicides and anti-dandruff agents : Germicides and/or anti-dandruff agents are incorporated to prevent microbial infection of scalp and to treat dandruff respectively. Common germicides used in soap can be used in shampoos also. There are quaternary ammonium compounds, such as benzalkonium chloride, cetrimide etc.; some phenol derivatives; tetramethyl thiuram disulphide, etc. Substances used as anti-dandruff agents are selenium sulphide, cadmium sulphide, zinc pyridinium-thiol-N-oxide, zinc undecylenate, sodium sulphacetamide etc.

(b) Conditioning agents : Conditioning agents are mainly fatty substances like lanolin, oils; natural products like herbal extracts, egg, amino acids, lecithin and polymeric substances. These substances give a special conditioning effect to the hair. If amino acids are incorporated into shampoos, after washing amino acid remains deposited on the hair

and scalp and produces a good conditioning effect on the hair. Also protein hydrolysates containing amino acids are incorporated, for conditioning effect.

(c) Pearlscent agents : Pearlscent agents are also used to give special conditioning to hair. They brighten the hair. For this purpose substituted 4-methyl coumarins particularly 4-methyl-7-diethylamino-coumarin and 4-methyl-5,7-dihydrocoumarin are used in 0.2-1% concentration and they act better at pH between 4.5-6. These substances reflect light. Fluorescent materials are also occasionally used.

(d) Sequestrants : They form a water soluble complex with Ca^{++} and Mg^{++} and thus prevent the formation of insoluble salts of soaps or detergents by these two divalent ions present in water. Sometimes calcium-salt dispersing agents are incorporated to disperse the salts formed by the divalents Ca^{++}, Mg^{++} etc. Sequestrants like sodium salt of EDTA (ethylene diamine tetra acetic acid) are used to entrap the interfering ions like Ca^{++} and Mg^{++} present in the water.

(e) Thickening agents : To make shampoo preparations viscous, for easy handling and minimize wastage while pouring, thickening agents are incorporated. The substances normally used for this purpose are alginates, polyvinyl alcohol, methyl cellulose, colloidal silicates, polyethylene glycol esters etc. Sometimes a suitable combination of surfactants also make the preparation viscous. Sulphated castor oil along with sulphated olive oil is one such combination.

(f) Colours : Colours are preferred by several people and thus suitable certified colours can be incorporated to produce a visually attractive impact. The colours should be water soluble.

(g) Perfumes : Perfumes are also incorporated to have an after-use fragrance on the hair. They also help to mask the odour of the other ingredients, particularly detergents. Various perfumes are used for this purpose. Perfumes are used in 0.3-1.0%.

(h) Preservatives : Preservatives are very important as most products are liable to attack by microbes. This leads to breakdown of the product, odour, discoloration and cloudiness. Water-soluble preservatives are to be used and p-hydroxy benzoic acid and its methyl ester, phenyl mercuric compounds, formaldehyde may be used.

Types of Preparations

According to the nature of the products the shampoo products can be classified as follow. The choice of products is based on the need of the

user.

(1) Powder shampoos
(2) Clear liquid shampoos
(3) Liquid cream or lotion shampoos
(4) Solid cream/gel shampoos
(5) Oil shampoos
(6) Miscellaneous including anti-dandruff, medicated shampoos

General Preparations

They are prepared by simple mixing process. In powder shampoos the ingredients are simply mixed and the perfume is added last.

In case of clear liquid shampoos the detergents are first dissolved in half of the water with little heat if necessary. Other ingredients are added to other part of the water and then mixed with the first part. The perfume is added last.

Other preparations can be made by simple mixing in a gradual manner, taking different ingredients at different stages.

POWDER SHAMPOOS

Formula 1

Sodium bicarbonate	50.0 gm
Disodium phosphate	20.0 gm
Soap powder	30.0 gm
Perfume	q.s.

Mix all the ingredients together and add perfume finally.

Formula 2

Henna powder	5.0 gm
Borax	15.0 gm
Sodium carbonate	25.0 gm
Potassium carbonate	5.0 gm
Soap powder	50.0 gm
Perfume	q.s.

Formula 3

Powdered cammomile flowers	5.0 gm
Borax	25.0 gm
Sodium carbonate	20.0 gm
Soap powder	50.0 gm
Perfume	q.s.

Mix all the ingredients together and add perfume finally to mixed mass and triturate further.

CLEAR LIQUID SHAMPOOS

Formula 4

Triethanolamine lauryl sulphate	45.0 gm
Coconut monoethanolamide	2.0 gm
Water	53.0 gm
Perfume	q.s.
Colour	q.s.
Preservative	q.s.

Formula 5

Triethanolamine lauryl sulphate	60.0 gm
Lauric isopropanolauride	2.0 gm
Water	38.0 gm
Perfume	q.s.
Preservative	q.s

Formula 6

Sodium salt of sulphated lauryl alcohol ether	40.0 gm
Water	60.0 gm
Perfume	q.s.
Preservative	q.s

The above three preparations can be made by simple solution. Perfume should be added last. Preservative should be dissolved in water.

LIQUID CREAM SHAMPOOS

Such shampoos are expected to be mild and emollient in action. Non-ionic stearates like propylene glycol stearate, polyethylene glycol 400 distearate together with insoluble metallic stearates are used for opacification.

Formula 7

Sodium amyl sulphate 30%	25.0 gm
PEG 400 distearate	5.0 gm
Magnesium stearate	2.0 gm
Water	68.0 gm
Ninol AB21 (thickening agent)	q.s.
Oleyl alcohol (conditioning agent)	q.s.
Perfume	q.s

Formula 8

Monoethanolamine lauryl sulphate (27% active)	40.0 gm
Ethylene glycol monostearate	5.0 gm
Water	55.0 gm
Perfume	q.s.
Preservative	q.s

Heat and mix the ethylene glycol monostearate with a small quantity of the detergent to form a homogeneous mixture. Add more detergent slowly and then water, mixing thoroughly before addition of next. Perfume is added last after cooling to 35°C.

Formula 9

Fatty alcohol sulphate	27.50 gm
Lauric isopropanolamide	1.00 gm
Ethylene glycol monostearate	3.00 gm
Egg powder	0.25 gm
Water	68.25 gm
Perfume	q.s.
Preservative	q.s.
Colour	q.s.

Add whole egg powder or dried egg yolk with small quantity of water to make a paste. Dilute it with some amount of detergent. Mix other ingredients with water separately. Add the first mixture to it with stirring. Add perfume.

SOLID CREAM/GEL SHAMPOOS

These are made from sodium lauryl sulphate paste with suitable gelling agent such as sodium stearate. Since they have to be stored in collapsible tubes or jars, they should have thick consistency.

Formula 10

Sodium lauryl sulphate	20.00 gm
Coconut monoethanolamide	1.00 gm
Propylene glycol monostearate	2.00 gm
Stearic acid	5.00 gm
Sodium hydroxide	0.75 gm
Water	71.25 gm
Perfume	q.s.

Formula 11

Sodium lauryl sulphate paste	47.0 gm
Oleic acid	20.0 gm
Triethanolamine	10.5 gm
Water	22.5 gm
Perfume	q.s.
Preservative	q.s.
Colour	q.s.

Mix water, oleic acid and sodium lauryl sulphate paste and heat to 60°C. Slowly add triethanolamine with continuous stirring. Add perfume after cooing to 35°C.

Formula 12

Miranol	15.0 gm
Triethanolamine lauryl sulphate (40%)	25.0 gm
Coconut diethanolamide	10.0 gm
Methocel (Methyl cellulose)	1.0 gm
Water	49.0 gm
Perfume	q.s.
Preservative	q.s.
Colour	q.s.

Mix miranol, triethanolamine lauryl sulphate and coconut diethanolamide with heat. Add methocel and colour with water to make a viscous preparation. Mix this with the previous mixture with continuous stirring. Add perfume after cooling to 35°C.

OIL SHAMPOOS

Oil shampoos basically consist of detergents made of sulphonated oils. They have good cleansing ability to remove dirt and oil from the hair but they do not form foam. Sulphonated vegetable oils are made by treating vegetable oils with sulphuric acid or other sulphonating agents, and are good detergents.

Formula 13

Sulphonated olive oil	16.0 gm
Sulphonated castor oil	16.0 gm
Water	68.0 gm
Perfume	q.s.
Preservative	q.s.
Colour	q.s.

Mix all the ingredients together. Colour and preservatives should be dissolved in a small quantity of water. Perfume can be added last.

MISCELLANEOUS SHAMPOOS

These are encompassing shampoos containing ingredients incorporated to achieve specific function along with cleansing action. Shampoos can contain anti-dandruff agents, other medicinal agents like vitamins, amino acids, protein hydrolysate, plant extract, antibacterial agents, etc. and are expected to give additional effects apart from cleansing action.

ANTISEPTIC/ANTI-DANDRUFF SHAMPOOS

Formula 14

Sodium lauryl sulphate (paste)	25.0 gm
Stearic acid	7.0 gm
Sodium hydroxide	1.0 gm
Biosulphur powder	2.0 gm
Water	65.0 gm
Perfume	q.s.
Preservative	q.s.

Dissolve the sodium hydroxide in a small quality of water with heating at 75°C. Add biosulphur to the sodium hydroxide solution. Take sodium lauryl sulphate and stearic acid together and mix with heating at about 60°C and then add to the aqueous solution. Stir and cool and add perfume and preservative.

Formula 15

Triethanolamine lauryl sulphate	14.0 gm
Lauric monoethanolamide	1.5 gm
Hexachlorophane	0.5 gm
Water	84.0 gm
Perfume	q.s.
Colour	q.s.

Prepare by simple mixing process.

Formula 16

Selenium disulphide	2.5 gm
Bentonite	5.0 gm
Sodium lauryl sulphate (paste)	40.0 gm
Water	52.5 gm
Perfume	q.s.

First disperse selenium disulphide evenly in bentonite. Mix sodium lauryl sulphate with water with heating and stirring to a temperature of about 90°C. Add part of this detergent mix to the selenium disulphide-bentonite dispersion with stirring to get a homogeneous mixture. Add

this to rest of the detergent mix with continuous stirring. Cool to 40°C and add perfume. Addition of perfume is optional.

Formula 17

Thymol	0.05 gm
Menthol	0.10 gm
Camphor	0.10 gm
Triethanolamine lauryl sulphate	50.00 gm
Water	49.75 gm
Perfume	q.s

Mix thymol, menthol and camphor together. Add perfume and mix a small amount of detergent with stirring. Continue the addition of detergent with gentle stirring. Add water to volume.

Evaluation of Shampoos

Shampoos, before releasing to the market, must be tested for their safety on application, to the skin and eyes. General tests for identification of ingredients and quantity of each ingredient should be carried out by proper chemical analysis. Some other specific tests are done.

(1) Various physical properties and performance characteristics should be studied. These are foam formation and foam stability, rheology, of the products, nature of foam, effect of the shampoo on the hair and its characters etc.

Performance and character of the foam can be studied by stirring the foam in a specially designed device, and by adding selected soil such as lanolin, mineral oil, vegetable oil or dirt to foam and studying their effect.

Effect on the hair can be studied by half-head technique, where half of the hair is shampooed, the other half is used as control, and comparing the two parts by observation and by combing and other process.

(2) *Effect on skin and eyes* : This can be done by applying it on animals. Irritation on skin can be studied by applying it on skin and observing the effects on skin.

CHAPTER-9

Hair Tonics

Hair tonics, whether their therapeutic action is real or not, occupy a large market today. They claim action against a variety of disorders such as dandruff, alopecia or baldness, seborrhoea and the like. Dandruff can be controlled by using a 0.25% solution of a cationic surfactant or selenium sulphide or other selected substances dissolved in water. Seborrhoea can be lessened by removing oily secretions by rubbing hair daily with an alcoholic lotion. Baldness, according to science, cannot be cured by any external application on the head. But massaging on the scalp can enhance the blood supply to the scalp and the hair growth. But several tonics claim to grow hair on bald heads. People have suspicion about these products but still demands are there.

Loss of hair is a natural phenomena of the cyclic activity of the hair follicle. Germinal matrix becomes inactive during the resting phase appearing after the growing phase. Eventually hair becomes detached and moves up the follicle and falls out. This normal loss, if little higher, makes the people use hair tonics or hair lotions. When this loss is not replaced by new hair, baldness starts. Baldness can occur due to any of the three reasons hereditary, presence or increase of male sex hormone, and disease of the scalp. Some dubious products are marketed to cure baldness.

Another new type of products have got the attention of the people. They are termed as hair conditioners mainly used by women, to repair the damage done to the hair by excessive use of other hair treatment preparations or shampoos.

An ideal hair tonic should have the following ingredients:

(1) A counter irritant to improve supply of blood to the dermal papillae.

(2) Vitamins and sulphur-containing amino acids for biosynthesis of keratin.

(3) Antiseptics for control of dandruff and seborrhoea.

(4) Optionally it can also contain conditioners.

(5) Should not damage scalp or hair.

Hair tonics have been made for dry scalps or for oily scalps. Those for oily scalps are designed to correct the oily condition and are alkaline. For dry scalps the preparations contain substances to supplement oily character of the scalp.

Materials

Various raw materials have been suggested and are being used in hair tonics. Some of these ingredients help to maintain the scalp in good condition. Some other ingredients are used to enhance the appearance of the hair.

Except in case of oily preparations as tonic, normal vehicle for the hair tonics is industrial methylated spirit diluted with water. Alcohol can be used in concentration range from 10-95% as required. It acts as a solvent for removal of a fatty acid-protein complex from the hair. Alcohol is not recommended in high concentration as it can cause breakdown of the protein.

Isopropyl alcohol can replace alcohol as vehicle but it has a strong pungent odour. Glycerine in 2-5% is also incorporated to get emollient and lubricating effects. It also helps as cosolvent.

Several rubefacient drugs are recommended to incorporate in hair tonics to stimulate hair growth. Vasodilators are also incorporated nowadays. But the massaging done to apply such tonics also helps in stimulating hair growth as it increases temperature and localized circulation. Some of the active constituents used are cantharides, pilocarpine, quinine, ammonia, rosemary oil, acetic acid, capsicum, resorcinol, salicylic acid, sulphur, cholesterol, mercuric chloride.

Cholesterol has been reported to have an effect on the activity of the sebaceous glands and hair formation. As it is water-insoluble and has some solubility in alcohol, cholesterol can easily be dissolved in alcohol of high concentration. However, if alcohol concentration is low, a solubilizing agent like cetomacrogol, emulsifying wax, needs to be incorporated. Polyoxyethylene condensation product of wool wax alcohols can also be used as solubilizers.

Castor oil, lanolin condensation products or wool wax alcohol condensation products are used as oily material for hair dressing.

Other important substances used in hair tonics are vitamin F, vitamin E, pantothenic acid, biotin (vitamin H), protein hydrolysation products and nucleic acids.

The idea of using these substances is that either growth or structure and rigidity of the hair will benefit by using them on scalp and in contact with keratogenous zone or the tissue surrounding the hair papilla or germinal matrix. Vitamin F is the mixture of unsaturated fatty acids including linoleic, linolenic and arachidonic acids and they help in treatment of skin irregularities and in hair preparations. For protein hydrolysate proteins of leather, skin, gelatin, hair are treated with acids, alkalis or enzymes and the products are used.

Several anti-dandruff materials like sulphur, cationic surfactants, selenium sulphide, cadmium sulphides are also used in hair tonics or lotions.

(1) Resorcinol : Resorcinol and its monoacetate have powerful antiseptic properties and are therefore used in anti-dandruff preparations. They are less toxic than phenols. Large doses of resorcinol are however toxic, due to the formation of methaemoglobin. It is absorbed through skin, especially injured surfaces. Due to these reasons, it is not much used in tonics.

(2) Beta naphthol (beta hydroxynaphthalene) : It is a powerful antiseptic, slightly soluble in water (0.1%). Boric acid increases its solubility.

(3) Natural extracts quinine : Being a poison to all forms of living matter, it helps in keeping the scalp sterile and stimulates it by friction.

(4) Capsicum : Capsicum consists of the dried ripe fruits of capsicum and contains a crystalline colourless pungent substance called capsaicin. Its tincture is used in tonics.

(5) Cantharides : Dried "Cantharis vesicatoria" contains a crystalline lactone cantharidin. It is used for its irritating, stimulant properties on the scalp.

(6) Vitamins and unsaturated acids are also used in conjugation for their hair growing properties.

Preparations

Formula 1

Fowler's solution	16.00 gm
Sulphonated castor oil	10.00 gm
Resorcinol monoacetate	1.50 gm
Perfume	0.25 gm
Alcohol	72.25 gm

Formula 2

Betanaphthol	2.0 gm
Alcohol (90%)	50.0 gm
Water	48.0 gm
Glycerine	10.0 gm
Perfume	q.s.

Formula 3

Borax	2.0 gm
Quinine arsenite	0.1 gm
Glycerine	3.0 gm
Formaldehyde	0.3 gm
Alcohol	4.0 gm
Chloroform	7.0 gm
Water	83.35 gm
Perfume	0.25 gm

Formula 4

Chlorothymol	0.1 gm
Tincture of capsicum	3.0 gm
Quinine arsenite	0.1 gm
Benzoic acid	0.3 gm
Alcohol	40.0 gm
Water	56.3 gm
Perfume	0.2 gm

Formula 5

Pilocarpine nitrate	0.05 gm
Quinine hydrochloride	2.00 gm
Glycerine	5.00 gm
Alcohol	5.00 gm
Water	89.75 gm
Perfume	q.s
Preservative	q.s.

The preparation can be made by simple solution technique.

Formula 6

Cholesterol	0.5 gm
Alcohol	25.0 gm
Cetomacrogol	1.0 gm
Water	73.5 gm
Perfume	q.s.
Preservative	q.s.

Formula 7

Calcium pantothenate	0.5 gm
Glycerine	3.0 gm
Alcohol	27.5 gm
Water	69.0 gm
Perfume	q.s.
Preservative	q.s.
Lactic acid (to adjust pH 5.0-6.0)	q.s.

Formula 8

Protein hydrolysate	1.0 gm
Glycerine	2.0 gm
Calcium pantothenate	0.2 gm
Alcohol	25.0 gm
Water	71.7 gm
Perfume	q.s.
Preservative	q.s.
Lactic acid (to adjust pH 5.0-6.0)	q.s

Formula 9

Salicylic acid	0.2 gm
Resorcinol	0.2 gm
Oleyl alcohol	20.0 gm
Alcohol	79.6 gm
Perfume	q.s.

Formula 10

Salicylic acid	0.2 gm
Precipitated sulphur	3.0 gm
Glycerine	0.3 gm
Alcohol	10.0 gm
Water	86.5 gm
Perfume	q.s.
Preservative	q.s.

Conditioners

Conditioners are used after shampooing the hair, to render the hair more lustrous, easy to comb, and free from static electricity when dry. They are also used to improve damaged hair. Hair may be damaged by excessive use of bleaches and permanent waves. Conditioners are usually based on cationic detergents and fatty materials like lanolin or mineral oil.

Formula 11

Stearyl alcohol	0.6 gm
Glyceryl monostearate	0.2 gm
Sodium chloride	0.2 gm
Benzalkonium chloride	1.5 gm
Water	97.5 gm
Colour	q.s.
Perfume	q.s.

Formula 12

Stearyl dimethyl benzyl ammonium chloride	5.0 gm
Ethylene glycol monostearate	2.0 gm
Cetyl alcohol	3.0 gm
Water	90.0 gm
Perfume	q.s.
Preservative	q.s.

Hair oil : This is widely used by the people for nourishment and care of hair. Variety of hair oils are available in the market. Some are pure oil like coconut oil etc. Others normally contain some important ingredients dissolved in oil.

Evaluation

As in any other cosmetic products, these products should also be evaluated for the contents estimation and their identification. Also some other tests are required to be done according to purpose.

(1) *Antiseptic property* : This can be done by *in vitro* antimicrobiological tests against some specific organisms using liquid or solid medium.

(2) *Stability test* : Stability of the products and of the ingredients must be studied particularly effects of heat, light etc. It is well known that most of the phenolic materials will discolour on exposure to light and thus may make fair hair dark, particularly in the presence of traces of alkali or soap. For stability study accelerated stability study may be done.

(3) *Sesitivity test* : Some of the ingredients, like antiseptics, may cause irritation, sensitization or photosensitization of the skin. So, these should be tested and can be done by patch test, either open or occlusive.

CHAPTRER-10

Hair Colorants

Hair colorants, or hair dyes as they are popularly known, occupy a large market today. They are used either to hide gray hair or to change the colour of the hair by individuals, either at home or at hairdressing saloon. Colouring of hairs, eyebrows and eyelashes is not new and practised from earliest antiquity but in crude form. A naturally occurring colouring agent kohl, containing lead sulphide, was used by Egyptian women to give a black colour to the hair, eyebrows and eyelashes. Further, several other plants were also identified and used for colouring of hair, eyebrows and eyelashes. Henna to obtain auburn tints, lysimachia for imparting blond tint, corisson to dye the hair black, are notable examples. Extract obtained by boiling ophouys, the eyebrow plant, in oil was used to impart blackness to the hair. Over the time lot of changes occurred and presently various types of dyes are available to impart intended colour and shades.

An ideal hair dye should have the following characteristics:

(1) It should not be toxic to the skin or hair and should not impair the natural gloss and texture of the hair.

(2) It should not be dermatitic sensitizer.

(3) The colour that it imparts to the hair must be stable to air, light, water and shampoo.

(4) Should be easy to apply.

The important factors to be considered while selecting a dye are its molecular size and its pH. The keratin lattice structure of hair does not permit the penetration of molecules much larger than ethylene glycol. At high pH, hair may swell and absorption may be enhanced. But it may cause irreversible damage to hair. Most dyes are small molecules and thus penetrate hair easily.

These days hair colorants may be classified into following categories:

(1) Temporary colorants
(2) Semi-permanent colorants

(3) Permanent colorants
(4) Lighteners or bleaches

(1) TEMPORARY COLORANTS

These dyes or colorants impart colour to the hair for a short time. They are washed off during the first shampoo. They offer the advantage that the user is allowed to experiment. Early examples of temporary colorants can be the practice of rinsing hair with either vinegar or lemon juice after shampooing with soap. These were used before the development of shampoo based on synthetic detergents. Soap which remains on the hair has a dulling effect and rinse was considered to give effect as a result of neutralizing the alkali. Same effect was obtained when rinsed with a solution of citric or tartaric acid. Present-day temporary colorants are based on this principle and consist of a mixture of a suitable dyestuff with an acid either in powders or in liquid forms.

Powder products are simple mixture of dyestuff with citric acid or tartaric acid in a sachet or capsule. To use, the contents of the package is dissolved in about half a pint of warm water and the solution poured repeatedly over the wet hair immediately after shampooing. Absorption of dyestuff takes place from the solution on to the hair cuticle but no penetration to the cortex or medulla. The dye can easily be removed by shampooing. Various shades can be created by this process like blue, pink, light golden or auburn shades.

These preparations may also be applied in a transparent polymeric material as sprays. They may also be formulated with soaps, shampoos and waxes and used as crayons for temporary colouring. pH of the solution preparation is adjusted at about 5.0.

POWDER

Formula 1

Certified colour	5.0 gm
Tartaric acid	95.0 gm

RINSE SOLUTION

Formula 2

Acid dyestuff	6.0 gm
Alcohol	10.0 gm
Acetic acid (30%)	10.0 gm
Water	74.0 gm

Formula 3

Acid dyestuff	6.0 gm
Alcohol	10.0 gm
Acetic acid	40.0 gm
Water	44.0 gm

CRAYON

Formula 4

Colour	6.0 gm
Stearic acid	14.0 gm
Triethanolamine	7.0 gm
Glyceryl monostearate	4.0 gm
Beeswax	42.0 gm
Paraffin wax	9.0 gm
Microcrystalline wax	9.0 gm
Coconut diethanolamine	7.0 gm
Perfume	q.s.

In shampoo type preparations 0.5 to 2.0% of the dyestuff can be incorporated depending on the colour effect required.

(2) SEMI-PERMANENT COLORANTS

These colorants give a stronger coloration to the hairs and can withstand six to eight subsequent shampoos although some of the colour is removed during each shampoo. These are made of dyes having smaller molecules which penetrate the hair easily. These are more preferred by the professional hairdresser and the home user as they are easy to apply and have less risk of damage to hair and skin in comparison to permanent dyeing process.

These colorants are mainly based on basic dyestuffs of nitro-amino dyes. The most important nitro dyes are picramic acid (2,4-dinitro-6-aminophenol) and 4-nitro-1-2-phenylene diamine. These dyes are usually red or yellow. Brown dyes are normally larger in size and do not penetrate easily. Therefore, in order to get a brown shade, blue is mixed with red and yellow. Anthraquinones, e.g. 1,4-diamino anthraquinone, give blue colour and are sufficiently small in size. To achieve the optimum dyeing effect of a particular dyestuff the following factors must be considered—

(a) Water solubility
(b) The composition of the vehicle or base
(c) Effect of pH of the medium
(d) Effects of diluting solvents on the dye and basic composition

A low-water soluble dyestuff, like nitro-amino type, does not produce satisfactory colouring when applied in an ionic surface-active agent. In such a case incorporation of 2-5% of an alkylolamide will increase the effect of dyestuff. Basic dyestuff can also colour the hair by absorption effect when they are applied in a cation effective vehicle. In several cases a mixture of anionic and/or non-ionic surface active agents with a cation active dye is used to get a semi-permanent colouring by forming anion-cation colour complexes.

Colour complexes can be formed by any of the following processes:

(a) Mixing an anionic surfactant with a solution of basic dyestuff.
(b) Mixing a cationic surfactant with a solution of a anionic dyestuff.
(c) Mixing an anionic surfactant with a solution of a dyestuff containing a cationic surface-active agent.

Normally these preparations are applied to dry hair after cleaning with shampoo and kept for about 30 minutes to allow maximum absorption of colour. The hair is finally rinsed with warm water, or with shampoo, if necessary, to remove excess colour. Some illustrative formulae are mentioned below.

Formula 5

Quaternary ammonium compound	12.0 gm
Anionic surfactant	9.6 gm
Lactic acid	4.8 gm
Alkylolamide	12.0 gm
Dyestuff	1.2 gm
Water	60.4 gm

Dissolve the dyestuff in a mixture of the alkylolamide and anionic surface-active material. Separately dissolve acid and quaternary ammonium compound in the water and add gradually to the colour solution while stirring.

Formula 6

Quaternary ammonium compound	12.0 gm
Nonyl phenol ethyleneoxide condensate	9.6 gm
Lactic acid	4.8 gm
Coconut diethanolamine	12.0 gm
Dyestuff	1.2 gm
Water	60.4 gm

Dissolve the dye in noryl phenol ethleneoxide condensate and coconut diethanolamine. Dissolve lactic acid and quaternary ammonium compound separately in water and add this slowly to the dye solution with stirring.

(3) PERMANENT COLORANT

Permanent colorants are colouring preparations which are generally accompanied by a chemical process. Permanent colorants can be used to intensify the natural colour or completely change the hair colour. They can also be successfully used to give a shade near to the natural colour of the hair. These are also used to give a dramatic effect. Permanent colorants are either of vegetable origin or salts of heavy metals. But most preferred or of commercial importance are the oxidation dyes based on synthetic organic chemicals.

Oxidation dyes such as p-phenylene diamine, p-tolulenediamine are used as permanent dyes. They are first converted to quinine-diamine which is colourless and small in size. These penetrate the hair and form molecules of increasing size and colour. These polymers are very difficult to remove and the dyes remain permanent.

These dyes also cause some toxicity to hair and skin. Toxicity of such dyes is due to the p-phenylenediamine and not due to any intermediates. Patch test should be done on small area of skin before every application.

Phenols such as resorcinol, pyrogallol may be used to modify the shades. The main ingredients of a formulation will be of—

(a) *Base* : Solution, emulsion, gel, powder, shampoo.

(b) *Dye* : Oxidation base

(c) *Alkali* : Ammonia

(d) *Antioxidants* : Ammonium thioglycolate

(1) Vegetable Dyes

The most important vegetable dye is 'Henna'. It contains dried powdered leaves of Lawsonia alba, Lawsonia spinosa and Lawsonia inemis.

Lawsone (2-hydroxy-1,4-naphthaquinone, the main ingredient) is soluble in hot water and in a pH of 5.5 acts as an effective dye. The powdered henna is made into a paste with hot water, suitably acidified and applied on the head. It is kept for the required amount of time.

Henna has no local or systemic toxicity and shows no sensitization. Its colour is deposited in the hair shaft unlike metallic dyes which coat the hair shaft. Its main disadvantages are that it is messy, produces reddish shades and dyes the finger nails also. Apart from its use as dye, henna may be used in rinses.

HENNA RINSE

Formula 7

Henna leaves (coarsely ground)	10.00 gm
Alcohol	44.00 gm
Water	45.75 gm
Perfume	0.25 gm

The leaves are boiled in water and then the mixture is allowed to stand for a few hours. It is strained to remove the leaves and alcohol and perfume are added.

Addition of pyrogallol and metallic salts may be used to produce a range of colours with henna. But this may prove toxic if applied on broken skin.

LIGHT BROWN

Formula 8

Henna powder	90.0 gm
Pyrogallol	5.0 gm
Copper sulphate	5.0 gm

DARK BROWN

Formula 9

Henna powder	83.0 gm
Pyrogallol	10.0 gm
Copper sulphate	7.0 gm

BLACK

Formula 10

Henna powder	73.0 gm
Pyrogallol	15.0 gm
Copper sulphate	12.0 gm

CAMOMILE

This consists of the flowers of Anthemis nobilis and Matricania chamomillae. The active ingredient is 1,3,4-trihydroxyflavone or apigenin. The flower heads are applied in the form of a paste in hot

water along with kaolin. It may also be used as hair brightening rinses. A typical formula is—

Formula 11

Camomile flowers	10.00 gm
Alcohol	44.00 gm
Water	45.75 gm
Perfume	0.25 gm

Formula 12

Powdered henna leaves	18.200 gm
Powdered camomile flowers	5.820 gm
Pyrogallic acid	0.150 gm
Citric acid	0.073 gm
Alcohol	2.200 gm
Glycerine	0.730 gm
Water	78.827 gm

(2) Metallic Hair Dyes

Colours caused by metallic compounds such as lead acetate are either due to sulphides formed by sulphur in the keratin or due to metallic oxide formed by reduction. The hair shaft is coated with a dull, metallic sheen, leaving the hair brittle. The main compounds used for this purpose are lead acetate, bismuth citrate, silver nitrate.

(a) Lead dyes : Lead dyes are generally based on solutions of lead acetate and it is considered that the reducing action of keratin forms the insoluble lead salts. The coloration process is slow and gives an illusion of restoring of natural colour. The rate of colouring is dependent on concentration of lead and influenced by air and light.

Lead acetate is normally used in combination with precipitated sulphur or sodium thiosulphate.

Formula 13

Precipitated sulphur	1.3 gm
Lead acetate	1.6 gm
Glycerine	9.6 gm
Water	87.5 gm

The shades produced depend on the concentration of lead used. It is relatively non-toxic.

(b) Bismuth dyes : They also produce a range of colours from blond to dark chestnut.

Formula 14

A.	Bismuth citrate	50.0 gm
	Water	50.0 gm
B.	Sodium thiosulphate	6.0 gm
	Water	94.0 gm
	Ammonium hydroxide	q.s.

(c) Silver dyes : The hair is first treated with an aqueous ammoniacal solution of silver nitrate. After a short while, a solution of pyrogallol is applied. The proportion of silver may be reduced for lighter shades. A greenish black colour is produced, which stains skin too.

Formula 15

Solution 1	
Silver nitrate	5.0 gm
Ammonium nitrate	3.0 gm
Water	To 100.0 gm
Ammonium hydroxide	q.s.
Solution 2	
Pyrogallol	4.0 gm
Alcohol	46.0 gm
Water	50.0 gm

Salts of copper, nickel and cobalt may be added to modify the colour.

Formula 16

Lead acetate	0.5 gm
Sodium thiosulphate	1.5 gm
Glycerine	8.0 gm
Alcohol	10.0 gm
Water	80.0 gm
Perfume	q.s.

Formula 17

Lead acetate	0.6 gm
Sodium thiosulphate	1.2 gm
Propylene glycol	10.0 gm
Water	88.2 gm

Formula 18

Precipitated sulphur	2.0 gm
Lead sulphate	1.0 gm
Propylene glycol	10.0 gm

Alcohol	10.0 gm
Water	77.0 gm

Oxidation Hair Colorants

These are the most important group of permanent dyes but slowly have been replaced by semi-permanent dyes. The oxidation dyes are based on synthetic organic chemicals like paraphenylenediamine and paratolulenediamine. The principle of dyeing is to add necessary oxidation end product, an azine dye, which reacts with keratin to form insoluble azine derivatives and consequently gives a permanent coloration. To improve the stability of the dye to the effect of light and wear and to obtain certain specific colours some other materials are used as modifiers along with the main dyestuff. They are resorcinol, pyrocatechol, chlorohydroquinone, pyrogallic acid, diamino-anisidine, etc.

(4) LIGHTENERS OR BLEACHES

Lighteners or bleaches are also discussed here as they alter the colour of the hair. These preparations can also be termed as decolouring preparations because they lighten or remove the natural colour.

The colour of the hair is due to the melanin which is produced in the living cells of matrix of the follicle and then distributed in the dead keratinized cortex and cuticle. So, the bleaching process is modification or lightening by destruction of the melanin by some chemical reactions.

Though metallic and oxidation dyes or camomile extract may lighten dark hair, but strong bleaching effect is not possible by using these substances. This can be done by treating with oxidizing agents like alkaline hydrogen peroxide, permanganate solutions etc. After bleaching normally the hair is rinsed with blue solution to give it a better appearance.

The bleaching effect is produced by the oxidation effect of the oxygen released by the action of alkali on the oxidizing agent hydrogen peroxide. During this oxidation sulphur linkages of the hair get damaged. Extent of damage is dependent on the time of exposure of the hair to the bleaching agent.

As temporary colouring of hair is also in demand, this is done preferably after bleaching the hair and making the colour light, so that any shades of colour can be imparted easily. Dyes, particularly lighter shade, can be applied better on bleached hair than darker hair. Care should be taken not to damage the hair shaft while treating with alkali

solution. As some substances of hair are soluble in alkali, treatment with alkali for longer time makes the hair soft and gelatinous when wet and makes the combing difficult. To prevent damage to the hair several workers suggested addition of additives, like proteins, which can be incorporated into the bleaching preparations or pretreated before bleaching.

Materials

Though permanganate solution is recommended for bleaching purpose but application of it can cause serious damage to the hair if any mistake is made in application. Alkaline hydrogen peroxide solution is more preferred. For domestic use 3-4% peroxide solution is suggested but for professional application 5-6% solution can be used for faster bleaching. Further higher concentrations can damage the hair. Normally suitable stabilizing agents, such as acetanilide, diluted acids, ammonium bisulphate are incorporated in hydrogen peroxide solution to stabilize it. As presence of various metals causes damage to the hair, sequestering agent EDTA may also be added to the preparation. Cholesterol, lanolin derivatives, fatty alcohols or other hair conditioning substances are incorporated in the hydrogen peroxide solution to have a better appearance of the hair.

Before application, ammonia is added for faster degradation of peroxide and better bleaching effect. This also softens the hair. As bleached hair never regains colour, so in subsequent bleaching only freshly grown hair is required to be bleached.

The products are marketed in powder, paste, and solution forms. Powder preparations contain inert materials such as kaolin, magnesium carbonate mixed with peroxide and ammonia to achieve better control in the application to the hair. Also there are substances which when mixed provide ammonia and active oxygen. Mixture of magnesium peroxide and sodium perborate is such an example. Sodium perborate, sodium peroxide when mixed with water produce alkaline hydrogen peroxide.

Formula 19

Ammonium bicarbonate	20.0 gm
Ammonium bisulphate	10.0 gm
Light magnesium carbonate	50.0 gm
Light calcium carbonate	20.0 gm

This powder mixture is to be mixed with hydrogen peroxide solution before use.

Formula 20

Ammonium persulphate	20.0 gm
Ammonium bicarbonate	3.0 gm
Ammonium bisulphate	3.0 gm
Sodium perborate monohydrate	2.5 gm
Calcium carbonate (light)	20.0 gm
Magnesium silicate	51.5 gm

Formula 21

Ammonium persulphate	20.0 gm
Sodium percarbonate	20.0 gm
Ammonium bicarbonate	3.0 gm
Sodium perborate monohydrate	2.5 gm
Magnesium carbonate (light)	54.5 gm

The preparations are prepared by mixing all the ingredients except oxidizing agent, sodium perborate monohydrate, which is mixed slowly with base afterward. The products are to be mixed with water before use.

Liquids and Paste Bleaches

Normally these preparations are marketed in two containers one containing stabilized hydrogen peroxide solution and the other the activator. Before use they are mixed in one part of activator and 4 parts of hydrogen peroxide solution and applied.

Formula 22(i)

Oleic acid	45.4 gm
Alcohol	18.3 gm
Ammonium hydroxide solution	22.7 gm
Triethanolamine	13.6 gm
Perfume	q.s.

Formula 22(ii)

In hydrogen peroxide solution for preparation (i) dissolve the perfume in alcohol and add oleic acid. Mix thoroughly. Add ammonium hydroxide solution slowly with continuous stirring. Finally add triethanolamine.

Formula 23

A. Carbopol 934	2.0 gm
Hydrogen peroxide solution (acid stabilized)	88.0 gm
B. Triethanolsamine solution (10% in water)	10.0 gm

Disperse the carbopol in the peroxide with vigorous stirring. Allow to stand for 20 minutes. Then add solution of triethanol amine and adjust pH to 5.5.

Formula 24

Hydrogen peroxide solution	80.0 gm
Stearyl dimethyl benzyl ammonium chloride	1.0 gm
Water	19.0 gm
pH to be adjusted to	5.5

Dissolve the second component in water. Then add hydrogen peroxide solution slowly. Adjust pH to 5.5.

Hair Dye Removers

Though permanent hair dye is applied to have a stable colour which will be difficult to remove, but sometimes users may want really to remove it for various reasons or to have a lighter shade. One method of removal can be using hot vegetable oil. First vegetable oil is applied to cover the hair properly. Then the strands of hair are passed through a heated iron marcel or comb and then rubbed with towel. Vegetable extract dyes and lead dyes can be easily removed by this technique. Silver colour and copper colour are very difficult to remove by this method. Oxidation dyes cannot be removed by this.

Turkey red oil can be used to remove dyes and is also advantageous as some other additives can also be incorporated to help in removal of colour.

Chemical reagents can also be used as artificial dyes. Metallic dyes are not removed by chemical reagents as it may cause a violent production of heat which may damage hair and scalp. Oxidation dyes can be removed by treating with reducing agents such as sodium hydrosulphite, sodium formaldehyde sulphoxylate, sodium thiosulphate, sodium dithionate solutions. These are used at 5% concentration. Hydrogen peroxide solutions in 5-6% strength can be useful for lighter shades of oxidation dyes but not for dark shades. Most of these substances are used in acidic solution but sodium formaldehyde sulphoxylate is used as weakly ammoniacal solution.

The following formula is a representative preparation and can be used to remove silver colours.

Sodium thiosulphate	5.0 gm
Sulphuric acid	2.0 gm
Water	93.0 gm

Evaluation

As hair colorants can cause sensitization of skin or can produce toxic effects, it is imperative to do tests for this apart from normal quality test for ingredients and their quantity.

(1) Sensitization test : This can be done on the animal skin by applying dyestuff or the preparation and observing the effect on the skin. If necessary, histopathological study can be done of the related tissues or cells when applied.

(2) Long-term toxic effect : This is also necessary to evaluate the long-term effect. This can also be done on animal.

CHAPTER-11

Hair Grooming Aids

Hair is an important component of overall appearance of a person whether a man or woman. However clean or well-dressed the person may be, untidy hair will give a messy overall impression. So, hair grooming aids are important group of cosmetics and are used by both men and women to keep the hair in order for good looking and also to enhance overall appearance. Setting or control of hair is more important to many men than the glossy hair. Men's products are mainly based on use of oils, fatty materials or resins. Women's emphasis is on both requirements.

Various products are marketed as hair grooming aids. They include brilliantines, hair oils, hair creams, hair dressings, hair lacquers or sprays, hair lotions. Their compositions vary but basically they are used for setting of hair and improve the appearance. They can be all called as decorative preparations.

Some hair grooming aids are very similar to emollient preparations and produce natural appearance and gloss by compensating the loss of water and fat in the hair shaft. Other preparations additionally contain fixer, biological substances that affect the hair papillae, antiseptic agents. Preparations such as setting lotions soften the hair and fix it in position as it is dressed. Many of the commercial products have multiple functions.

Various hair grooming aids which are discussed in this chapter are categorized according to their compositions.

(1) Brilliantines and hair oil
(2) Hair setting lotions
(3) Hair creams
(4) Hair lacquers or sprays

(1) BRILLIANTINES AND HAIR OILS

These products are mainly based on wax and oils. Depending on the consistency they may be classified into the following products—

(a) *Hard* : Stick brilliantine
(b) *Soft* : Brilliantine
(c) *Liquid* : Hair oils, liquid brilliantine

These preparations completely adhere to the hair surface and hold the hair in position and make them lustrous. The oily or waxy materials, which are used, make the hairs tacky and surroundings of one hair adhere with that of other hairs and keep the hair down by increased weight of adhering materials. They can also act by covering the hair by thin layer and thus neutralizing the electrostatic charges generated on hair by shampooing and/or combing which makes a repulsion among hairs and makes them look ruffled. More viscous the preparation, the fixative effect will be more. However, too tacky preparations will also attract dirt and dust. Thus the preparations should be just tacky enough to hold the hairs.

Substances which are used to get tackiness are petrolatum, beeswax, animal fats, castor oil, coconut oil, high viscosity mineral oils. Incorporation of paraffin waxes, spermaceti, low-viscosity mineral oils, isopropyl myristate lowers the tackiness.

Originally preparations containing mineral oils and waxes were termed brilliantine and those with animal and vegetable fats were called as pomeds. This differentiation is no more used presently.

Application of the oily material should be in thin layer and of even nature to get the glossiness. Suitable oil soluble perfume should be added. Preservatives and antioxidants are also required to incorporate, particularly in preparations containing vegetable or animal oils. Colour can also be added optionally.

SOLID BRILLIANTINE

Formula 1

Petroleum jelly	90.0 gm
Paraffin wax	10.0 gm
Perfume	q.s.
Preservative	q.s.

Melt the wax. Add jelly and mix it at about 70°C. Add perfume and preservative after cooling.

Formula 2

Carnauba wax	5.0 gm
Wheat germ oil	20.0 gm
Petroleum jelly	70.0 gm
Paraffin wax	5.0 gm
Perfume	q.s.
Colour	q.s.
Preservative	q.s.

Melt the waxes at about 70°C and add oil and jelly. Mix thoroughly. Add colour, perfume and preservative after cooling.

BRILLIANTINE

Formula 3

Isopropyl myristate	24.0 gm
Lanolin	1.0 gm
Mineral oil	55.0 gm
Sunflower oil	20.0 gm
Perfume	q.s.
Colour	q.s.
Antioxidant	q.s.
Preservative	q.s.

Melt all oils and waxes together at 70°C and mix well. Add perfume, colour, preservative, antioxidant after cooling.

HAIR OILS

Formula 4

Mineral oil	85.0 gm
Isopropyl myristate	15.0 gm
Perfume	q.s.
Preservative	q.s.

Take isopropyl myristate and mineral oil together and mix perfume. Add preservative and filter.

Formula 5

Mineral oil	75.0 gm
Acetoglyceride	10.0 gm
Isopropyl myristate	15.0 gm
Perfume	q.s.
Preservative	q.s.

Mix all the ingredients together. Add perfume and preservative and filter.

SPIRIT BRILLIANTINE

Formula 6

Isopropyl myristate	20.0 gm
Cetyl alcohol	2.0 gm
Toilet spirit	78.0 gm
Perfume	q.s.
Preservative	q.s.
Colour	q.s.

Mix isopropyl myristate, cetyl alcohol and toilet spirit together. Add perfume, colour and preservative.

(2) HAIR SETTING LOTIONS

For a long time hair setting lotions are in use. These products can be gum based, resin based or can be purely alcohol based lotions.

Gum mucilage-based lotions partly have been replaced by resin lotions. These products, after application, dry to form invisible continuous elastic film that keeps the hair firmly positioned. They do not contain, normally, hair conditioners, nor do they impart gloss, but they are excellent fixers of hairs.

Products of early stages mainly contained gum mucilage, alcohol and alkali. The alkali rendered the hair shaft soft to help in setting. Alcohol is used to help in quick drying. There are several gums in use. Tragacanth, karaya, alginate, pectin are most popular ones. Acacia is comparatively less popular.

Presently synthetic polymers or resins are also used and polyvinyl pyrrolidone, polyvinyl alcohol, polyethylene glycols, dimethyl hydantoin-formaldehyde, resin are good as hair fixers. Castor oil and mineral oils are incorporated as plasticizers to make the film elastic. Also water-soluble or water-dispersible lanolin derivatives are useful for this purpose. Humectants, like glycerol, sorbitol, help the film not to become too dry and brittle. The products are normally coloured and perfumed and also need preservatives as mucilage or resins are favourable for microbial growth.

Some products are purely alcohol-based and basically alcoholic solution of perfume oil and can be coloured. But they are not very good to hold or fix the hair. Sometimes some other additives are incorporated in these preparations. They are tincture of capsicum and tincture of arnica to enhance stimulating effect and antiseptic substances like hexachlorophene, o-phenylphenol, quaternary ammonium compounds etc.

Polyethylene glycol or its monofatty acid esters are also incorporated to impart lustre and hold the hair in place.

HAIR SETTING LOTIONS

Formula 7

Tragacanth	1.2 gm
Alcohol	10.0 gm
Glycerine	5.0 gm
Water	83.8 gm
Perfume	q.s.
Colour	q.s.
Preservative	q.s.

Dissolve preservative in glycerine. Mix tragacanth in the glycerine and then add water. Add glycerine and mix it properly. Add colour and perfume.

Formula 8

Tragacanth	1.5 gm
Glycerine	5.0 gm
Water soluble lanolin	2.0 gm
Cholesterol	0.1 gm
Water	91.4 gm
Perfume	q.s.
Preservative	q.s.
Colour	q.s.

Dissolve the preservative in glycerine. Add cholesterol and tragacanth to prepare a smooth paste. Mix water, water-soluble lanolin and perfume separately. Add this mixture to the tragacanth mixture with vigorous stirring.

Formula 9

Polyvinyl pyrrolidone	2.00 gm
Carboxy vinyl polymer	0.60 gm
Triethanolamine	0.75 gm
Alcohol	10.00 gm
Water	86.65 gm
Perfume	q.s.
Preservative	q.s.

Dissolve polyvinyl pyrrolidone and preservative in alcohol. Disperse the polymer in triethanolamine and then add water gradually with stirring. Add the alcohol solution and perfume, mix properly.

Formula 10

Polyvinyl pyrrolidone : Vinyl acetate copolymer (60:40)	1.00 gm
Isopropyl myristate	0.15 gm
Alcohol	70.00 gm
Water	28.35 gm
Perfume	q.s.

Dissolve the copolymer in the alcohol with stirring. Add the isopropyl myristate and perfume. Then slowly add the water with constant stirring.

Formula 11

Dimethyl hydantoin-formaldehyde resin	2.0 gm
Alcohol	70.0 gm
Isopropyl alcohol	5.0 gm
Diethyl phthalate	1.0 gm
Glycerine	0.5 gm
Water	21.5 gm
Perfume	q.s.
Dye	q.s

Dissolve the resin in alcohol with stirring. Add the isopropyl alcohol and diethyl phthalate. Add the perfume. Then add glycerine and water with stirring.

Formula 12

Isopropyl palmitate	6.0 gm
Tween 20	3.0 gm
O-phenylphenol	0.1 gm
Alcohol (95%)	49.9 gm
Water	41.0 gm
Perfume	q.s.
Colour	q.s.

(3) HAIR CREAMS

Hair creams can be either water-in-oil or oil-in-water type. Water-in-oil type creams have more holding capacity than the latter and provide better gloss to the hair.

Water-in-oil type creams impart nearly similar effect as anhydrous products like brilliantine. Presence of w/o emulsifying agents helps in stabilizing emulsion as well as proper distribution of oil phase to the

hair. Appearance of hair is better than in case of brilliantine. These creams are prepared by using calcium salts of fatty acids which produces w/o type emulsion. Also non-ionic surfactants like spans can also be used to make w/o type creams. Other emulsifying agents can be used are wool alcohols, lanolin derivatives. These preparations are not much stable. They can get separated easily, particularly with increased temperature. But stability of creams made by using non-ionic surfactants is better. As, normally, the oil content is high in these creams they soil clothes and are greasy in use. But when some specific non-ionic surfactants are used the washing may become easier as washing with water converts the cream from w/o to o/w and is easily removed. The stability of the products is influenced by—

(a) Specific gravity of oil
(b) Proportion of oil and water
(c) Method of manufacturing

Normally 0.14% concentration of calcium hydroxide can be used. However, when higher concentration is required the solubility of calcium hydroxide can be increased by incorporating saccharine and forming calcium saccharate. Beeswax-borax combination can also be used for making these creams. These creams can be stabilized by incorporating zinc stearate. Viscosity can be increased by incorporating cetyl alcohol.

Oil-in-water type creams are less greasy and when applied make the hair wetty as water is continuous phase. When water gets evaporated the oil comes in contact with hair. They can be easily diluted with water and can be well distributed on hair by wet comb. These preparations can be made with very less amount of oil. Stearic acid and beeswax are used as emulsifying agent. But these creams make the hair dull as water is continuous phase and oil is a dispersed phase. But fixative property is good. These creams also contain humectant to prevent fast drying of water. Glossy effect appears only after evaporation of water. Oil-in-water creams can also be made by triethanolamine stearate, glyceryl monostearate, etc. In all these creams perfumes, colours and preservatives are also incorporated.

WATER-IN-OIL TYPE CREAMS

Formula 13

Beeswax	3.5 gm
Mineral oil	37.5 gm
Paraffin wax	1.0 gm
Lime water (fresh)	58.0 gm

Perfume	q.s.
Preservative	q.s.

Melt beeswax, mineral oil and paraffin wax together, but adding gradually in increasing melting point, at about 70°C. Warm the lime water and add slowly to the oil phase with continuous stirring. Cool while stirring and add perfume when temperature is about 35°C.

Formula 14

Beeswax	4.0 gm
Mineral oil	37.5 gm
Petroleum jelly	5.0 gm
Zinc stearate	2.0 gm
Lime water (fresh)	51.5 gm
Perfume	q.s.
Preservative	q.s

Formula 15

Beeswax	4.0 gm
Mineral oil	32.5 gm
Petroleum jelly	2.5 gm
Sorbitan sesquioleate	2.0 gm
Borax	0.5 gm
Water	58.5 gm
Perfume	q.s
Preservative	q.s.

Melt first three components at about 70°C and add borax and sorbitan sesquioleate and mix properly. Mix borax with water, heat it and add slowly with continuous stirring. Cool while stirring and add perfume when cooled to 40°C.

OIL-IN-WATER CREAM

Formula 16

Mineral oil	45.0 gm
Stearic acid	3.5 gm
Triethanolamine	1.5 gm
Water	50.0 gm
Perfume	q.s.
Preservative	q.s.

Heat mineral oil, stearic acid at about 70°C and add triethanolamine. Add water while stirring. Cool and add perfume.

Formula 17

Mineral oil	35.5 gm
Stearic acid	2.5 gm
Glyceryl monostearate	2.0 gm
Propylene glycol	4.5 gm
Triethanolamine	1.0 gm
Water	54.5 gm
Perfume	q.s.
Preservative	q.s.

Heat stearic acid and mineral oil together at about 70°C. Mix glyceryl monostearate, propylene glycol (with dissolved preservative), triethanolamine and water and heat it to same 70°C and mix with first one with continuous stirring. Cool slowly and add perfume when the temperature is at about 40°C.

Formula 18

Lanolin	25.0 gm
Cetyl alcohol	1.0 gm
Glyceryl monostearate	9.0 gm
Water	62.0 gm
Glycerine	3.0 gm
Perfume	q.s.
Preservative	q.s.

Heat lanolin and cetyl alcohol at 70°C. Take glyceryl monostearate and water and also heat to 70°C. Add the aqueous mixture with lanolin with continuous stirring. Cool and add perfume. Preservative can be dissolved in glycerine and mix to the prepared cream.

(4) HAIR LACQUERS OR SPRAYS

Hair lacquers or sprays are used to hold the hair setting firmly, specially in women, in shape and control the loose ends without disturbing the good appearance. These products make the hair dry very quickly. As lotions have water and leave the hair damp, lacquers or sprays have advantage over them due to their quick drying. Initial products were not much good and over the years a good amount of change has occurred. Some lacquers are nearly same as gum-based preparations as film forming substances are also present. The appearance, use characteristics, and choice of perfumes make them a different product. They mainly contain a film former in a suitable vehicle and along with a plasticizer or modifier.

The basic composition is:—

(a) Film former
(b) Plasticizer or modifier
(c) Vehicle or solvent
(d) Perfume

In very early period shellac was used as film former which contains 95% of resinous substances like alevritic, shellolic, kerrolic and butolic acids. Shellac is insoluble in water but soluble in alcohol, isopropyl alcohol and in alkali media. Though better film formers are available, still some professional hairdressers use shellac-based sprays. Other early film formers were benzoin, styrax. Afterward polyvinyl pyrrolidone has been found very good. But as it is hygroscopic, slowly water droplets precipitate on hair and make it dull and unattractive. To overcome this problem shellac, lanolin, natural rosin lanopals can be incorporated along with polyvinyl pyrrolidone. Incorporation of silicones also gives better feeling, longer duration of holding and better appearance.

Polyvinyl pyrrolidone can be replaced by other polymers like ethyl cellulose, dimethyl hydantoin-formaldehyde polymer, copolymer of polyvinyl pyrrolidone and vinyl acetate.

As most of these polymers are soluble in alcohol, it is mainly used as solvent or vehicle. When the polymer has some solubility in water, partially water can be used as solvent along with alcohol. Alcohol has added advantage of quick evaporation and drying. Drying rate is an important factor for sprays.

Plasticizer or modifier is required to have elastic film covering the hair. For this castor oil, lanolin derivatives, diethyl phthalate, propylene glycol monolaurate, etc. are used.

Selection of suitable perfume is very important. Perfume should be stable and long acting. Preservative is not normally required as alcohol concentration is very high. The products are marketed in container with spray system or as aerosols.

Formula 19

Polyvinyl pyrrolidone	2.50 gm
Dimethyl phthalate	2.00 gm
Silicon	0.05 gm
Alcohol	95.45 gm
Perfume	q.s.

Preparation can be made by simple solution techniques.

Formula 20

Dimethyl hydantoin formaldehyde resin	5.0 gm
Shellac (25% solution in isopropyl alcohol)	0.5 gm
Silicone fluid	0.1 gm
Isopropyl myristate	0.4 gm
Alcohol	94.0 gm
Perfume	q.s.

Prepare by simple solution techniques.

Formula 21

Polyvinyl pyrrolidone/Vinylacetate (60:40)	2.50 gm
Dimethyl phthalate	0.25 gm
Alcohol	50.00 gm
Water	47.25 gm
Perfume	q.s.

Formula 22

Shellac	4.0 gm
Castor oil	0.2 gm
Diethyl phthalate	0.2 gm
Alcohol	95.6 gm
Perfume	q.s.

By simple solution process.

Evaluation

Apart from identification of the ingredients and their quantity a few other tests are to be carried out:

(1) **Stability of the ingredients :** This is done by normal stability study of the active ingredients at room temperature or by accelerated stability study.

(2) **Physical stability :** This is particularly important for emulsion type preparations to evaluate the stability of the emulsion creams. This can be done by accelerated test by exposing the preparations alternatively to heat and cold.

(3) **Rheology :** This can be studied by using suitable equipment (viscometer) to measure the viscosity and effect of storage on it.

CHAPTER-12

Hair Wavers, Curlers and Straighteners

It is a natural desire for all, specially women, to have a beautiful and attractive curly or wavy hair. It is well known that a method of permanent hair waving was practised by early Egyptian women. The method was used to be winding a mesh on a cane stick, covering it with liquid mud and allowing it to bake dry in the sun. Over the years the method has been modified to make the curling long-lasting, better and faster. As, always, the curling hair is more attractive than straight hair and also can be arranged in further attractive styles. There is a demand for techniques or methods for making hair curling or waving. To make wigs of permanent curly hair, wig-makers used to wound hair on a curling rod and immersed it in boiling water or steam for a few hours. If borax or mild alkali was added to the hot water the time of immersion could be less. Early workers who pioneered in this area are Charles Nessler, E. Fredric and Eugene Suter who suggested chemicals to add in boiling water to achieve curly hair.

Principle of Action

The structure of cortex gives the hair the definite form and it, mainly, consists of long parallel polypeptide chains connected by cross linkages. The chains are, normally, folded and in dry condition it cannot be stretched much. But, in wet condition they can be stretched up to 100% or even more. Permanent waving consists of the following stages.

(1) Differential stretching of the hair : Hair is thoroughly wetted, then rolled and the polypeptide chains are extended with variable force and thus a tension is created on linkages.

(2) Disruption of the cross-linkages : Most of the cross-linkages are broken chemically and the tension is thus relaxed.

(3) Re-establishment of cross-linkage : Then the cross-linkages are restored in such a way that the hair is no longer trained in its new rolled form by drying or cooling of the hair or by removing all chemicals.

Methods and Preparations for Waving

Various methods and preparations are used to achieve waving of hairs. They are discussed below:

(1) Wave set preparations : At room temperature or with moderate heating, water can break hydrogen bond and salt linkages but not disulphide bridges. This can produce limited swelling and softening of the hairs. This helps to arrange the hair-setting as desired and the setting is achieved by quick evaporation of water by some means. The waves prepared by this technique are not long-lasting as amide and disulphide linkages are undisrupted and the new hydrogen bond and salt bridges are soon loosened by moisture from atmosphere and perspiration and the setting is disrupted. The setting life can be enhanced by incorporating mucins in setting lotions, such as pectin, carrageen, alginate, tragacanth, karaya gum or synthetic film former which form a thin film surrounding the hair after the preparation is applied and dried. The mechanical resistance of the film keeps the hair for some time in the new arrangement. Formulae of a few such preparations are mentioned below:

Formula 1

Apple pectin	1.0 gm
Citric acid	0.5 Gm
Rose water	98.5 gm
Perfume	q.s.
Preservative	q.s.

Dissolve preservative and citric acid in water at high temperature. Add the pectin and stir vigorously to dissolve the pectin completely. Add perfume finally.

Formula 2

Sodium carbonate, anhydrous	3.0 gm
Alginic acid	6.0 gm
Rose water	91.0 Gm
Perfume	q.s.
Preservative	q.s.

First dissolve preservative and sodium carbonate in rose water. Add alginic acid with continuous stirring to dissolve it completely.

(2) Hot wave preparations : As it is mentioned earlier, primitive hot waving method was utilized by Egyptian women by winding a mesh of hair over a stick and covering it with liquid mud and drying it in sun.

Over the years the method has been changed and chemical agents are being utilized in place of mud. But the basic principle remains the same. Wet hair can be stretched to 100% or more and soft hair, made by chemical treatment, can be waved permanently. In these preparations, the main ingredient is water which vaporizes when the hair is heated.

As mentioned in the earlier preparations water can disrupt the hydrogen bond and salt linkages but is unable to disrupt disulphide or amide linkages, some chemical agents are incorporated in hot-wave preparations to achieve the disruption of the latter. Bases such as sodium and potassium hydroxides and carbonates as well as borax were preferred earlier. But they have the problem that they fuse with hair and form a hard and brittle cuticle with keratin. So, they were replaced by ammonia which evaporates while drying and leaves no residue. But ammonia imparts an unpleasant odour and mostly evaporates before complete swelling and gives the hair a reddish tint. Then ammonia was combined or completely replaced with less volatile bases like mono/or triethanolamine, or morpholine.

Sodium or potassium sulphites or bisulphites are being incorporated in permanent waving preparations to disrupt disulphide linkages. Also successful use of cyclic organic sulphonates, such as glycol sulphite or butadiene sulphonate, has been reported. Incorporation of surfactants in the preparations promotes rapid wetting of the hair and helps in solubilizing the perfume oil. Some patent preparations reportedly use sequestering agent, EDTA etc., to prevent the oxidation of the solution by inactivating the catalytic metal ions. Also addition of conditioning agents has been suggested by some workers.

The stepwise general procedure for hot waving is as follows. It needs to be modified according to need and preparations.

(a) Hair is cleaned to remove greasy or dusty materials using shampoo.

(b) Hair is divided in several parts and wound around a suitable roller with little tension.

(c) A wet strip soaked with suitable solution is wound over the hair.

(d) The whole set is heated and dried by encasing in a suitable electrical heater or by other means.

PERMANENT WAVING SOLUTIONS

Formula 3

Ammonium hydroxide	20.0 gm
Sodium carbonate	4.0 gm
Potassium sulphite	2.0 gm
Water	74.0 gm
Perfume	q.s.

Prepare by simple gradual mixing and making solution.

Formula 4

Ammonium carbonate	0.25 gm
Sodium carbonate	0.45 gm
Borax	2.65 gm
Water	90.65 gm
Perfume	q.s.

Prepare by gradual mixing and solution.

Formula 5

Monoethanolamine	3.0 gm
Tri-isopropylamine	3.0 gm
Sodium hydroxide	0.6 gm
Sodium sulphite	3.0 gm
Turkey red oil	1.5 gm
Water	88.9 gm
Perfume	q.s.

Mix first four components with part of water. Take turkey red oil and perfume and mix with some amount of water and mix with first solution. Make volume.

Apart from using electrical heating or preheated rods, chemical heating can be also used in permanent waving. In this method the heat is generated by reacting exothermic materials after application of chemicals along with a moistening medium.

The heat is normally generated by any of the following processes.

(1) Oxidation reduction
(2) Hydration
(3) Neutralization

The chemically heating method was developed long back in England in 1923. At early stage of the development of this method quicklime was used with a moistening agent such as ammonium sulphate, agar or ammonia. Afterwards several other agents have been developed and

they include active agents like aluminium and its chloride and sulphate, barium salts, ammonium salts of organic acids, copper carbonate, copper nitrate, iron fillings, etc.

(3) Cold waving procedures : In cold waving procedure, a permanent waving can be achieved by making new permanent cross-linkages in hair without applying heat. This method has partly replaced hot waving method in several places.

Cold waving can be achieved by different methods as mentioned below:

(a) Chemical neutralization
(b) Atmospheric oxidation
(c) Special methods like using pin perms, roller perms, etc.

It has been observed that alkali solution of substituted mercaptan, thioglycollic acid, reduces the disulphide linkages in the keratin. The pH should be above 7.0 and below 10.0, preferably between 9.2 to 9.5. The substituted group of mercaptan may be ionized or non-ionized. The concentration of mercaptan is expected to be between 1 to 1.5%. The alkali vehicle should be a volatile base.

Thioglycollic acid is widely used for cold waving and used in 4 to 8% depending on the need. In addition to thioglycollic acid, coldwave solutions always contain an alkali, preferably ammonia, monoethanolamine, isopropanolamine. Strong bases like sodium or potassium hydroxide may be used in very low concentrations, but not much preferred. Triethanolamine is also not preferred.

After processing the hair with reducing agents for required period, the hair, then, is to be neutralized using an oxidizing solution for 5-10 minutes. Normally after unwinding the hair one more treatment with oxidizing solution is done and the hair is made to intended style. Cold waving preparations can be in solution, powders or creams.

The total process can be divided into the following steps:—

(1) Cleaning the hair to remove grease and dust.
(2) Whole hair is divided into parts and waving lotion is applied thoroughly and wound on curlers.
(3) Kept for about 20-40 minutes.
(4) Then the hair is rinsed with neutralizer and kept for 10 minutes.
(5) Hair is removed from the hair curlers and once again washed with neutralizing solution.
(6) Finally the hair is rinsed off.

WAVING SOLUTIONS

Formula 6

Thioglycollic acid	6.62 gm
Ammonia (35% w/w)	2.11 gm
Water	91.27 gm
Perfume	q.s.

Prepare by simple solution.

Formula 7

Thioglycollic acid	7.0 gm
Monoethanolamine	8.0 gm
Ammonia (35% w/w)	2.0 gm
Water	83.0 gm
Perfume	q.s.

Prepare by simple solution.

COLD WAVE POWDERS

Formula 8

Thioglycollic acid	20.0 gm
Ammonium carbonate	20.0 gm
Sodium carbonate	24.0 gm

Mix thioglycollic acid and ammonium bicarbonate until no more carbon dioxide is liberated. Now add sodium carbonate and mix till no lumps are present and pack it properly to avoid moisture. Before use 15 gm of this powder is to be dissolved in 100 ml water.

Neutralizer

Various substances are used as neutralizer for cold waving. Mostly hydrogen peroxide, bromates, perborates are used. Neutralizing agents play an important role in cold-wave at last stage by restoring cross linkages. The alkaline thioglycollate makes the swollen and disulphide linkages reduced to sulphhydryl groups. The neutralizing lotions are used to decrease the swelling and oxidize the sulphhydryl groups back to disulphide linkages.

The neutralizing lotion consists of—

(1) A weak acid such as acetic, citric, tartaric acid.
(2) An oxidizing agent such as hydrogen peroxide, sodium or potassium bromate, sodium perborate, ammonium persulphate, sodium chlorate, etc.

The neutralizing agents are marketed as aqueous solutions or in powder form. Hydrogen peroxide is marketed as solid or as urea-hydrogen peroxide complex.

NEUTRALIZING LOTIONS

Formula 9

Hydrogen peroxide	26.4 gm
Citric acid	1.2 gm
Polyoxyethylene lauryl ether	2.8 gm
Rosin opacifier	0.4 gm
Water	69.2 gm

Formula 10

Sodium bromate	20.0 gm
Polyglycol 400 laurate	5.0 gm
Diglycol stearate	1.0 gm
Glyceryl monostearate	1.0 gm
Sodium cetyl sulphate	2.5 gm
Polyglycol 400	0.5 gm
Water	60.0 gm

Atmospheric Oxidation

In this method the hair is reduced by the same way as mentioned in earlier topic by using alkaline thioglycollic acid but the hair is kept for several hours in curlers and allowed for atmospheric oxidation. Then the hair is released from the curlers and washed and set as desired. As it is kept for 6 hours, it can only be used at home, but the hair is treated with less reagents.

Special Methods

Different and special techniques and accessories are used to achieve cold-waving and are mentioned below:—

(1) Tepid warm air wave : In this method the thioglycollate treatment is done at slightly elevated temperature for faster and better result. Using elevated temperature will also reduce the required concentration of thioglycollate. The heating can be done by electrical process or by hood dryer.

(2) Roller and pin perms : When the curling is intended for a short time, say few weeks, this modified method can be very useful. The hair can be wound over large diameter (1½") roller curlers or over ordinary hairpins to make curls of 1" in diameter. Then the application of

reducing lotion, processing of hair and neutralization process are done as usual.

As for normal permanent waving the hair is tightly wound over curlers, it takes a plenty of time to set the hair. In the above-mentioned method resetting does not take time. After the treatment the hair can be directly dried and can be reset easily or need not require to set at all.

(3) Instant perms : These are more or less same as chemically neutralized perms. But here the processing time after winding is nil. The contact of the reducing agent and the hair is done before winding. Normally the processing time is made less by using more of free ammonia.

Thioglycollate is toxic to eye and irritant to skin, if remains in contact for a long time. So, care should be taken while applying to same eye and skin.

Hair Straighteners

Though the hair straighteners are actionwise opposite to waving or curling process but it is discussed here as this is also achieved by modifying the hair structure by breaking cross linkages.

Hair straighteners are also, to some extent, related to cold-wave preparations. In this the thioglycollate treatment is done for reverse purpose. They are used to straighten the curly or kinky hair by breaking the disulphide linkages of curly hair and reforming them in uncurled shape.

There are different methods or techniques for straightening of hairs.

(1) Hot comb-pressing oil methods : In this method, first petroleum jelly is applied to straighten the hair and then combed using a hot metal. A mixture of petrolatum and paraffin can also be used. Petrolatum acts as a heat transfer agent between hot metal and hair. After doing the hot comb, the hair is washed and dried. The method is not a permanent one.

(2) Caustic preparation : In this method caustic alkali preparations in cream form are applied for straightening purpose. The alkali is used in between 4 to 9% and higher concentration makes the process faster. To prepare the cream, selection of oil phase and surfactants has to be done carefully. They should not form salt with alkali. As alkali causes damage to scalp or eye, care should be taken.

(3) Chemical hair reducing agents : Thioglycollate reducing agents can be used here also, as they break disulphide linkages of curly hair and

straighten them. The curlers are removed after thioglycollate treatment, when the hair is in soft condition. Then the hair is rinsed with neutralizing lotions. After this a suitable cream is applied to hold the hair firmly in position.

Evaluation

It is necessary to measure the quantity of the chemical agents present in the preparations as use of higher concentration is toxic and not permitted by several countries. Also identification tests for other ingredients are to be done.

(1) Toxic or side effects : Several tests are required to evaluate the toxic effects; the effects can be scalp irritation, damage to the general health, incompatibility due to cross-sensitization leading to dermatitis. This can be done on animal or by patch test on human volunteers.

(2) Stability test : It is necessary to test the stability and usefulness of the product during shelf life, as several ingredients are present. This can be done by normal stability test or accelerated stability test.

CHAPTER-13

Hair Removers

Removal of superfluous hair has been in practice from the ancient period. Egyptian dancers and courtiers, thousands of years ago, knew how to remove hair growth on arms and legs. Shaving by men, probably, started much before that. One of the earliest substances reported to be used by the Egyptian dancers for removal of unwanted hair is rhusma, a mixture of quicklime and arsenical pyrites in a ratio of 1:2. In powder form this was mixed with aqueous alkali before use. Another substance reported to be used for the same purpose was orpiment which is arsenic trisulphide. Another technique which was used, in early stages, for removal of unwanted hair was rubbing the skin surface with pumice stone.

Practice of hair removal by men is mainly removal of facial hair, partly or totally. This is termed as shaving and preparations for this will be discussed in the subsequent chapter (Shaving Preparations).

Women use various techniques and substances to remove hair from armpits, arms, legs, and, if necessary, the face. Hair can be removed by purely mechanical means of cutting it at skin surface or pulling it out by the root. Also hair can be decomposed by chemical or physical means by attacking the hair shaft, hair root or even hair papilla. Utilizing biological measures by affecting the physiological process locally in hair papilla for loss of hair can be a futuristic idea.

Among various methods used nowadays for shaving, plucking with tweezers, tearing out with a wax preparation, or by threading can be considered as mechanical and termed as epilatory methods. Removal by destroying the hair using chemical means is termed as depilatory methods. Other methods for hair removal presently used, mainly in beauty salon, are electrolysis and diathermy.

Depilatories

Depilatories are the preparations used for degradation of the superfluous hair chemically without affecting the skin. Depilatory removes the

hair at the neck of the hair follicle and thus has advantage over razor shaver which removes hair on a level with the surface of the epidermis. Razor shaven hair growth is thus noticeable sooner than depilatory removal.

As mentioned in the introduction, the first depilatory is reported to be rhusma used by the Egyptian dancers. The depilatories act by degrading the hair keratin. As it is known that keratin is sensitive to the action of strongly alkaline aqueous solutions and reducing agents, most of the depilatories consist of such agents. The alkaline reducing agents cause the swelling of the hair fibres and break the cystine bridges between adjacent polypeptide chains as a first step to the complete degradation of the hair.

As stratum corneum also contains keratin, depilatories may cause local damage of the skin by also affecting skin keratin when applied for hair removal. This effect can be avoided or minimized by properly formulating with correct choice of agents in proper concentration and applying it for a short period of time. So, the preparation should be such that it can preferentially and rapidly reacts with hair for selective degradation of hair keratin without damaging the skin.

So, the desirable characters of an ideal depilatory preparation are—

(1) Selective in action
(2) Efficient and rapid action in few minutes
(3) Non-toxic and non-allergic to the skin
(4) Odourless
(5) Easy to apply
(6) Stable
(7) Non-staining to clothing

Ingredients

Different substances are used for removal of hair in depilatory preparations. Apart from the active component of depilatory agent and water as vehicle, the preparations also contain humectants such as glycerine, propylene glycol; thickening agents to enhance the viscosity; surfactants to emulsify incorporated fat, if any. Also polyethylene glycols are used to form a film on the skin. Optionally, sometimes, astringents, local anaesthetics or mucins and inert powders are also incorporated.

(1) Inorganic sulphides : First depilatory reported, rhusma, contained arsenic trisulphide (As_2S_3). It is no more used as it can be dangerous to skin, particularly the skin not in good condition. The sulphides of sodium, calcium, strontium and barium are there for use as

depilatory. Sodium sulphide, 2% aqueous solution at pH 12, is a strong depilatory and can degrade hair in 6-7 minutes. But it has a strong action on the skin, so not preferred nowadays. Barium sulphide is highly toxic and calcium sulphide is less toxic but also less effective as depilatory. Depilatory activity of the magnesium sulphide is also very low but zinc sulphide is poorly water soluble. Strontium sulphide is a better choice as depilatory. Though it is not as active as sodium sulphide but when used at high concentration of about 25-50% it can degrade hair in 3-4 minutes. At 15% concentration the same can be achieved by 5-7 minutes. For optimum activity pH should be about 12. The short period of action almost does not cause any skin irritation or damage. One disadvantage of inorganic sulphides is unpleasant odour produced by formation of hydrogen sulphide on hydrolysis. Sometimes it remains even after washings.

(2) Thioglycollates : Most widely used active ingredients in depilatories, present day, are substituted mercaptans, especially thioglycollates. These are also used in conjunction with an alkali. Calcium thioglycollate at 2.5 to 4% is a good depilatory agent when used in conjunction with calcium or strontium hydroxide and at pH between 11-12. At concentrations below 2% it is very slow and above 4% there is not much enhancement in activity. Depending on concentration of calcium thioglycollate it takes 5-15 minutes for removal of hair. This substance is less toxic and odour is much less than sulphides.

Lithium thioglycollate has also been reportedly used as a depilatory agent. Apart from calcium and strontium hydroxides alkali hydroxides, sodium or potassium, can also be used as bases. Cetyl alcohol is also incorporated to obtain a cream like product.

(3) Stannites : In the period of 1930–1945 several patents have reported use of stannites. Particularly sodium stannite (NaH_3SnO_3) is a much reported active ingredient in depilatory preparations. In presence of water these salts impart a strong reducing and alkaline effect. It is odourless, in comparison to sulphides. But these substances were not found in much use later.

(4) Enzymes : Keratinase enzymes have also been found in use as depilatory. They are non-irritant and odourless. Enzymes digest the keratin of hair at a buffered optimum pH of 7-8. Enzyme is used at a concentration between 3-4%.

(5) Other additives : Humectants are incorporated to prevent quick drying on the skin. Substances that can be used are glycerine, sorbitol, propylene glycol.

Thickening agents, like methyl cellulose, starch, mucins, are also incorporated to achieve a proper consistency for applying on skin and to help in dispersing any solids used.

Sometimes inert powders like talc, calcium carbonate, zinc oxide, osmo-kaolin, titanium oxide are incorporated to get consistency, preventing quick drying on the skin and to make a visible film.

Polyethylene glycols are used to form a film which is easy to wash off.

Fats are incorporated to have skin-protecting or conditioning effect.

Surfactants are used to emulsify any fats incorporated or to promote wetting of the hair. They also help in washing off the preparations after use.

Sometimes astringents, local anaesthetics or disinfectants are used. Water-soluble perfumes and preservatives are also incorporated.

Formula 1

Strontium sulphide	20.0 gm
Talc	20.0 gm
Methyl cellulose	3.0 gm
Glycerine	15.0 gm
Water	42.0 gm
Perfume	q.s.
Preservative	q.s.

Formula 2

Strontium sulphide	30.0 gm
Titanium dioxide	3.0 gm
Zinc oxide	7.0 gm
Calcium carbonate	5.0 gm
Glycerine	8.0 gm
Gum tragacanth	5.0 gm
Lime water	42.0 gm
Perfume	q.s.
Preservative	q.s

Dissolve the preservative in the glycerine. Then to a portion of the glycerine mix the gum tragacanth and add sufficient water to make a mucilage. Triturate titanium dioxide with zinc oxide and mix with remaining portion of the glycerine. Add the mucilage slowly to this with trituration. Add the strontium sulphide, calcium carbonate and perfume with trituration. Dilute it with remainder of the lime water.

Mix until homogeneous and then mill to smooth the product.

Formula 3

Thioglycollic acid (90%)	4.0 gm
Hydrated lime	10.0 gm
Calcium carbonate (precipitated)	20.0 gm
Stearyl alcohol	6.0 gm
Sulphonated stearyl alcohol	0.6 gm
Water	59.4 gm
Perfume	q.s.
Preservative	q.s

Prepare the cream base by mixing and triturating stearyl alcohol, sulphonated stearyl alcohol and water and preservative. Add the substances gradually to the base with trituration. Mill to the smooth.

Formula 4

Calcium thioglycollate trihydrate	6.0 gm
Calcium carbonate	20.0 gm
Titanium dioxide	2.0 gm
Cetyl alcohol	5.0 gm
Sodium lauryl sulphate (powder or needless)	0.5 gm
Glycerine	5.0 gm
Water	61.5 gm
Perfume	q.s.
Calcium hydroxide to adjust pH to 12	q.s

Mix and triturate titanium dioxide with glycerine. Melt cetyl alcohol and add the glycerine mixture and add a little water to form a paste. Prepare a mixture of sodium lauryl sulphate, calcium hydroxide and calcium thioglycollate separately. Add this to a mixture of calcium carbonate in water. Now add this mixture to the cetyl alcohol paste with continuous stirring to form a cream. Adjust the pH value and total weight with calcium hydroxide and water and then finally mill.

Formula 5

Calcium thioglycollate trihydrate	6.0 gm
Calcium carbonate	17.5 gm
Mineral oil	5.0 gm
Cetyl alcohol	5.0 gm
Sodium lauryl sulphate (powder or needless)	0.5 gm
Glycerine	3.5 gm

the quantity. It can be done by any instrumental chemical analysis.

(2) Toxicity test : The test can be done on animal. For this purpose rabbit can be used. Preparations can be applied for hair removal and the effect on the skin can be studied by observation or by microscopic study.

(3) Stability : Stability of the product is very important. This is done by any normal stability study or accelerated stability study at higher temperature.

(4) Rheology : Rheology of the preparation can be studied by using any suitable viscometer.

CHAPTER-14

Shaving Preparations

In the preceding chapter preparations and methods adopted for removal of unwanted hair have been discussed. As shaving creams are different in use and in nature, it is discussed separately in this chapter.

These are widely used men's cosmetic products. Shaving preparations may be divided, basically, into two groups—

(1) Preparations used before shaving
(2) Preparations used after shaving

(1) PREPARATIONS USED BEFORE SHAVING

These preparations are used for softening the beard for wet shaving and also to produce rich foam to facilitate shaving by razor, safety blade or electric shaving. These preparations can further be classified into two—

(A) Preparations used for shaving with razor blade
(B) Preparations used for electric shaving

Historically probably men started removal of hair from the face after agricultural revolution. Earlier to that it is to be assumed that males also kept hair like animals. At very early stage the shaving must have been very rudimentary. Probably it was effected by cutting hair with some sharp metallic edge.

Of course water might have been used for softening of the hair. The use of cosmetics came at a very late stage. Most of the shaving preparations make the hair soft and assist the movement of razor on the skin surface. Even now in many rural parts the shaving is done only by moistening hair with water. As this chapter will unfold, shaving preparations are a class by themselves.

(A) Preparations Used for Shaving with Razor Blade

Though it is possible to shave by razor or blade without any assistance from cosmetic preparations, but because of hardness of the dry

keratin, movement of the razors or blades becomes difficult. The shaving causes irritation. Also, the hard keratin spoils the blades or razor edge. As the shaving remains incomplete, several shavings are required. Multiple shavings may possibly cause the cutting of the skin.

As discussed earlier in hair and hair removal chapters, water can soften the hair. But, normally, water gets evaporated before sufficient wetting of the hair as it takes some time to soften hair. These drawbacks can be overcome by use of shaving preparations like shaving soaps, and creams and others, though water is main component for such softening.

Shaving preparations support the action of water by multiple mechanisms of the constituents of such preparations—

(1) Wetting agents promote the wetting of the hair.

(2) Alkali reaction of some agents causes faster swelling of the keratin.

(3) Humectants and water-impermeable substances prevent rapid evaporation of the water.

Additionally these preparations, particularly rich lather, helps to keep the hair erect, so as not to escape the razor or blade and lubricating effect permits the smooth gliding of the razor or blade over the skin.

Also, some hair softening agents, particularly rich agents, may be incorporated but as the shaving takes short time, such agents should act very fast, should not damage the skin and should not have unpleasant odour.

These preparations can be classified into three groups—

(1) Shaving soaps : Solid and creams

(2) Brushless shaving creams

(3) Aerosol preparations

(1) Shaving soaps : Once, solid soaps or cakes or sticks were used widely. But over the years shaving creams have largely replaced the solid soaps. The creams have replaced the solid products because of ease of application.

In all these preparations, a concentrated aqueous solution of soap, supported by the mechanical action of the brush, is used to produce lather and acts on beard. Before application a normal washing is done to remove fat film over the beard. The products are expected to produce a rich, soft and fine lather and the lather should be long-lasting, at least for 5-10 minutes for complete shaving.

Soaps are marketed in three forms: cake, solid stick and creams.

Shaving soaps mainly consist of potassium soap with a little amount of sodium soap. Potassium soaps are preferred because of the higher solubility, quicker effect and denser lather. For this purpose mainly potassium soaps of myristic acid with small additional soaps of lauric acid and lower fatty acids are preferably used. Soaps of lauric acid and lower fatty acids produce a good but coarse and unstable lather. Soaps of fatty acids of 8-10 carbon atoms are irritating and thus not incorporated in shaving preparations. As some amount (5-15%) of glycerine is required to be incorporated in shaving preparations, it can automatically be available in saponification of neutral fats. But if soap is prepared from fatty acids, glycerol is to be incorporated additionally.

Superfatting agents such as mineral oil, petrolatum, free fatty acids, fatty alcohols, polyoxyethylene glycols and lanolin are normally incorporated in the preparations to make the lather softer and creamier and also to have an emollient effect on the skin. In creams total fatty substances should be minimum 30%. Additionally some other additives are also incorporated to have additional effects. They are chlorhexidine or other disinfectants, menthol etc. for cooling effect, silicones for lubrication and ease of dragging razor or blade, perfumes for appealing flavour and preservatives, if required.

SOAP BAR

Formula 1

Stearic acid	49.00 gm
Coconut oil	13.00 gm
Caustic potash	22.00 gm
Caustic soda	12.00 gm
Water	1.25 gm
Sodium dioxystearate (50%)	0.75 gm
Sorbital liquid	1.25 gm
Glycerol	0.75 gm
Perfume	q.s.
Preservative	q.s.

SOAP CREAM

Formula 2

A.	Stearic acid	30.0 gm
	Coconut oil	10.0 gm
	Palm kernel oil	5.0 gm
B	Potassium hydroxide	7.0 gm
	Sodium hydroxide	1.5 gm

Glycerine	0.0 gm
Water	36.5 gm
Perfume	q.s.
Preservative	q.s.

Heat with compositions of 'A' and 'B' separately at about 75°C. Preservative should be incorporated with glycerine or water. Mix 'B' to 'A' with stirring until cream is formed. Cool it to 45°C and add perfume. Mill it.

Formula 3

Stearic acid	38.0 gm
Olive oil	2.0 gm
Coconut oil	6.0 gm
Glycerine	4.0 gm
Lecithin	2.0 gm
Potassium hydroxide (80%)	1.6 gm
Sodium hydroxide (90%)	0.3 gm
Water	46.0 gm
Perfume	q.s.
Preservative	q.s.

(2) Brushless shaving creams : In these preparations, lathering with brush is omitted. After washing off the face with soap and warm water, these shaving creams are applied to keep the beard soft till the shaving is completed. Initial washing helps in defatting and makes the hair soften. The creams function is to prevent the keratin from drying and hardening. As these creams are applied on wet face, they should be miscible with water for even spreading. They mainly consist of stearate soap and additionally contain oils, humectant, viscosity enhancing agent. The fatty substances should be at least 20%. Incorporation of some waxes can enhance the viscosity and it is required as consistency is important for proper application. Perfumes and preservatives are also incorporated.

Formula 4

Stearic acid	16.0 gm
Mineral oil	14.0 gm
Spermaceti	2.0 gm
Glycerine	6.0 gm
Dilute solution of ammonia (10% of NH_3)	2.0 gm
Water	60.0 gm
Perfume	q.s.
Preservative	q.s.

Formula 5

Glycerol monostearate	14.0 gm
Stearic acid	8.0 gm
Glycerine	5.0 gm
Mineral oil	3.0 gm
Water	70.0 gm
Perfume	q.s.
Preservative	q.s.

(3) Aerosol preparations : These preparations have become very popular in the last decade, particularly in advanced countries, even to some extent in India. They are shaken before use to form a good lather and under pressure the foam is discharged out and applied on skin. The face should be wetted with water before application. The product design requires prior work to decide preparation of ingredients to get products of proper lather, texture, stability of foam. Also warm effect can be obtained by using exothermic reaction agents and keeping them separately in two parts of the container. Fat, water and propellant and their proportion should be decided properly to avoid problem. Proper, stable and non-corrosive perfume is to be selected and used.

(B) Preparations Used for Electric Shaving

These preparations have become very popular after increase in popularity of electric shaving systems. They are designed to dry the skin during summer or in hot climates when skin is covered with perspiration. They can be either powders or alcoholic lotions.

Powders are normally applied just before shaving to dry and lubricate the skin. They mainly consist of talc with little amount of metallic stearate to get lubricating action and promote adhesion. Absorbent substances are also incorporated to absorb perspiration and kaolin, magnesium carbonate are used for this purpose. Perfume is also incorporated.

Lotions contain large amount of alcohol which on evaporation helps in drying of the skin and contracts erector pillion muscles. They also contain astringents, antiseptics, oils. Astringents tighten the skin and help in hair standing. Antiseptics are used to prevent infection to damaged epidermis, if caused. Oils help in lubrication on the skin.

POWDERS

Formula 6

Magnesium stearate	7.0 gm
Kaolin	5.0 gm
Talc	88.0 gm
Perfume	q.s.

Formula 7

Zinc stearate	7.0 gm
Kaolin	6.0 gm
Talc	87.0 gm
Perfume	q.s.

LOTIONS

Formula 8

Isopropyl myristate	12.0 gm
Alcohol	88.0 gm
Perfume	q.s

Formula 9

Isopropyl myristate	12.00 gm
Menthol	0.05 gm
Zinc phenosulphonate	0.10 gm
Alcohol	87.85 gm
Perfume	q.s.

(2) PREPARATIONS USED AFTERSHAVING

These are another group of shaving preparations widely used. Whatever may be the method of shaving there may be some irritation, minor damage to skin or cuts. The extent depends on method, instrument and preparations used for shaving. To overcome or treat these problems various preparations are used and they are termed as after-shave preparations.

The after-shave preparations are basically applied to cool and refresh the skin, to overcome irritation on the skin, to neutralize the soreness, to disinfect or heal the skin damage or cut. They are used in the form of lotions, creams or powders.

The lotions are clear solutions containing 25 to 50% alcohol. Additionally they may also contain antiseptic, emollient, haemostyptic substances. Also they may contain extract of witchhazel, menthol, glycerine, boric acid, alum, potassium oxyquinoline sulphate and chloroform. If alcohol content is less, the perfume should be water soluble or soluble in less concentrations of alcohol. Alternatively solubilizing agents may be used.

Most of the lotions are used as after-shave preparations. Powders are also used to some extent but use of creams is comparatively less.

The useful antibacterial or antiseptic substances are quaternary ammonium compounds, chlorhexidine diacetate.

Creams are preferred for skins sensitive to alcoholic lotions. Creams can also give extra benefit to the skin like any other emollient or protective creams.

Formula 10

Toilet spirit	50.0 gm
Glycerine	3.0 gm
Cetrimide	0.1 gm
Water	46.9 gm
Perfume	q.s.

Formula 11

Alum	2.0 gm
Glycerine	3.0 gm
Menthol	0.1 gm
Witchhazel extract	25.0 gm
Alcohol	25.0 gm
Water	44.9 gm
Perfume	q.s.

Formula 12

Glycerine	2.0 gm
Chlorhexidine diacetate	0.2 gm
Menthol	0.1 gm
Alcohol	40.0 gm
Water	57.7 gm
Perfume	q.s.

Formula 13

Carbopol-934	1.0 gm
Menthol	0.1 gm
Alcohol	45.0 gm
Di-isopropanolamine	0.8 gm
Water	53.1 gm
Perfume	q.s.

Formula 14

Glyceryl monostearate	12.0 gm
Stearic acid	5.0 gm

Isopropyl myristate	2.0 gm
Glycerine	5.0 gm
Water	76.0 gm
Perfume	q.s.

POWDERS

Formula 15

Boric acid	3.0 gm
Magnesium stearate	4.0 gm
Talc	93.0 gm
Perfume	q.s.

Formula 16

Calcium carbonate	5.0 gm
Zinc stearate	10.0 gm
Kaolin	5.0 gm
Boric acid	2.0 gm
Chlorhexidine diacetate	0.5 gm
Talc	77.5 gm
Perfume	q.s.

Evaluation

As in any other products, shaving preparations and after-shave preparations should also be evaluated for quality and performance.

Identification of various ingredients and their quantitative estimation should be done by suitable methods. Apart from these some other tests also are to be carried out for these products.

(A) For Shaving Preparations—

(1) Determination of free caustic alkali : As free alkali can damage the skin, it is necessary to determine it. It can be done by any suitable method.

(2) Determination of potash soap : As it is necessary that 50% of the alkali used for saponification be potash, it is also required to estimate it.

(3) Determination of total free acids : It is also necessary to determine the free fatty acids present in the soaps or creams. The titre of total fatty acids is required to be determined by suitable means.

(4) Determination of total fatty materials : As a minimum amount of total fatty materials must be present in different shaving preparations

for supplementing oils to the skin, this is also to be checked and determined.

(5) Foam formation : For foam producing preparations formation of foam, the nature and stability of foam should be studied and compared with the standard.

(6) Skin sensitization test : This is also important as these preparations, due to presence of some agents, can cause skin sensitization.

(7) Stability of the creams : This is to study physical stability of the products by various means or accelerated stability study.

(B) For Aftershave Lotions—

(1) Antiseptic property : As these preparations contain antiseptics, it is necessary to evaluate antiseptic property by *in-vitro* test.

(2) Determination of alcohol content : This can be determined by any suitable method. As these preparations contain alcohol it is necessary to estimate the alcohol content.

(3) Dermatological safety : The products should not have effect on skin. So, suitable test should be carried out to study the effect on skin. This can be done on animal skin.

CHAPTER-15

Nail

Nail is another part of body which, also, is used to enhance the beauty and overall appeal, specially by women. It can be assessed by the number and variety of cosmetic products available in the market for nail care or nail beautification. The nails should receive regular care as an essential part of grooming and to maintain them in good condition. They should be shaped and trimmed regularly. Most of the modern manicure preparations are meant to promote nail hygiene and offer protection against effects of detergents, solvents, or other interfering materials of daily use. The general health of nails, particularly finger nails, has been found to be dependent on certain general physical conditions such as nervous strain, alterations in glandular function or dietary deficiencies of amino acids, vitamins and essential fatty acids which are essential components of nail composition and nail growth.

To design the nail cares of effectiveness, the knowledge of anatomy and histology of nails is very much essential.

(1) Anatomy and History

Nails (Fig 15.1) form on the dorsal surfaces as a protective, translucent covering of the tips of the fingers and toes. The function of nails is protecting the exposed tips of the fingers and toes and to help limit their distortion when they are subjected to various mechanical stresses, such as while running or grasping objects. The nail bed is covered by the nail body. An epithelial fold, invisible from the surface, is called nail root from which nail production occurs. The inner end of the nail root lies very close to the periosteum of the bone of the finger tip. Cuticle or eponychium is formed by the extension of a portion of the stratum corneum of the nail root. The pink colour of the nail is due to the presence of underlying blood vessels. The vessels near the root are obscured and thus produce a pale crescent which is called the lunula. The nail body is recessed beneath the level of the surrounding epithelium and it is bounded by nail grooves and nail folds. The free edge of the nail extends over the hyponochium, a thickened stratum corneum.

The body of the nail basically consists of tightly compressed dead cells packed with keratin. As the cells producing the nails can be affected by conditions controlled by body metabolism, changes in the shape, colour, structure of the nails can help in diagnosis of diseases. In patients of chronic respiratory disorders, thyroid gland disorders, or AIDS the nails become yellow. In psoriasis the nails may become pitted and distorted. They become concave in some blood disorders.

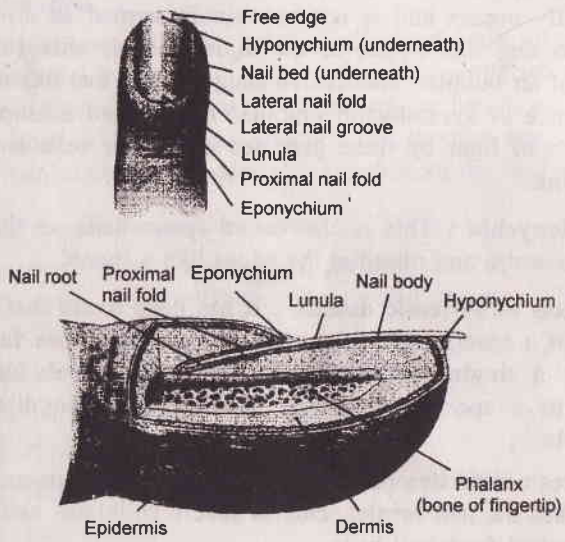

Fig 15.1 Schematic structure of nail

(2) Composition

The nails are also made of hard keratin like hair. The protein structure contains a high proportion of sulphur-rich amino acid cystine with small proportion of methionone, tyrosine, lysine, and histidine. The nail is composed of three layers, a soft lower layer called central nail, with hard keratin forming the intermediate layer, and the outer layer called dorsal nail. The nail also contains 12 to 14% water and fatty materials mainly of cholesterol.

The knowledge of composition suggests that the manicure preparations should possibly avoid use of materials that remove natural fat or water-soluble substances as these could damage the lattice-like structure of nail and may hasten the splitting or breaking. Sometimes fatty materials are incorporated in manicure preparations to supplement them.

(3) Nail Disorders

As mentioned earlier the nail disorders may be attributed to disorder of general condition of body, nervous strain or body metabolism or dietary deficiency of vitamins, amino acids etc. Occasionally minor disorder also may occur.

There can be several disorders of nails.

(a) Leukonychia : Complete whiteness of the nails or spots on the nail frequently occurs and is not necessarily termed as disease. One suggestion is that this is due to the injury to nail with simultaneous production of air bubble. Alternative suggestion is that this may be due to the presence of keratohyalin granules or enlarged acidophilic cells. The diffusion of light by these granules makes the cells appear white instead of pink.

(b) Koilonychia : This is also called spoon nails, as the nails are depressed in centre and raised at the edges like a spoon.

(c) Effects of systemic disease : It has been found that sometimes occurrence of a specific mark on nails, such as transverse furrowing of the nails or a single furrow running across each nail, indicates the occurrence of a specific disease. Different systemic diseases have specific mark.

Sometimes a defective blood supply may cause a damage to the nail bed and makes the nail brittle. Due to severe chilblains nails may also become detached from nail beds.

(d) Brittleness : Brittleness of nails may be caused by congenital defects, systemic disorders or due to some other factors. The brittle nails may split easily. Systemic disorders which can make nails brittle are anaemia, avitaminosis, gout, hypo- and hyper-thyroidism.

Sometimes continuous use of nail varnishes or varnish removers, without supplementing, in between, with nail creams, may also cause brittleness.

It has, also, been observed that continuous supply of gelatin, orally, makes the nails hard and brings back normalcy in appearance and recovery from brittleness.

This probably suggests that lack of gelatin supply may cause brittleness.

(e) Disorders of fungal or bacterial origin : The fungal and bacterial infection of nails causes diseases like paronychia, nail ringworm, and lesions produced by syphilis. Paronychia is caused by yeast-like

fungi in which the nail folds become red and swollen and mostly occurs in women whose hands are constantly in contact with water, soaps and detergents.

Infection of fungus under free edge of nail and attacking the nail bed and nail subsequently leads to ringworm of the nails. The affected nails become rough, opaque and brittle.

(4) Nail Nutrition

Though there is no definite proof of effects of deficiency of vitamins or other essential substances, but some workers reported that supplementing with vitamins A, D and B improves the health and appearance of nails. Other substances like amino acids, proteins are also probably required. Fats or oily substances also supplement the health of nails.

(5) Nail Cares and Preparations

Various products are marketed and are available for enhancing attractiveness of nails and contributing to overall beauty. They can be classified as follows—

(a) Nail lacquers and removers.

(b) Auxiliary products

(i) Cuticle removers

(ii) Nail bleaches and nail whites

(iii) Nail creams

CHAPTER-16

Nail Lacquers and Removers

Regular care and treatment is very much important for nail grooming and to maintain them in good condition. A set of manicure preparations consists of a number of different cosmetic products which are concerned with cleansing and preparations of the nail and its decoration. Nail is considered, particularly by females, as an important part for grooming and decoration to enhance beauty and overall appeal.

Nail Lacquers

The nail lacquers are the largest and most important group of manicure preparations. The products can vary from transparent uncoloured to once highly favoured pale pink to present day vivid shades. Present day nail lacquers, which are also known as nail enamel or nail varnish, are as important, to women, as lipstick. It has come to a stage where women use shades according to the dresses or other make-ups used to have a complete match.

The application of nail lacquers covers the nail with a water-and air-impermeable membrane which remains for days and normally can be removed only by suitable solvent. So there is demand for removers as much as that of lacquers, as users change the colour or shade frequently to suit their choice and necessity.

From consumers' necessity point of view few factors are to be considered sincerely while designing nail lacquers and are discussed below—

(1) Quality requirements for the lacquers
(2) Its behaviour during application
(3) Character of the lacquer film
(4) Non-harmful or non-toxic

Quality of the product is very important and should remain constant during the storage life. The product should remain homogeneous during storage and the pigments should not settle at the bottom. The consistency also should be constant. Colour should not change during shelf-life.

To produce a smooth film the product should remain liquid enough for a smooth application. But it should not take much time to dry to avoid damage to the applied film while drying. The lacquer should be thin enough to apply easily but not so much thin that it moves quickly on nail surface. During application, preferably, it should not have any obtrusive odour.

Film should be continuous and must adhere to the nail surface, and it should not peel off. The film should be glossy and must retain the gloss under the influence of external interfering factors such as humidity, air, light, warm or cold, soap and detergent solutions. The colour should be firm and must not spoil the clothing.

The preparation should not be harmful or toxic to the nail or to the adjacent skin surface.

The characters of the film are expected to be as follows—

(1) It should be of even thickness for which viscosity should be proper and satisfactory.
(2) Uniform colour production by using finely ground pigments and wetted by the medium.
(3) Should have good gloss.
(4) Good adhesion to the nail.
(5) Satisfactory flexibility to avoid brittleness and cracking.
(6) It should form a non-tacky surface.
(7) Quick drying character.
(8) Long maintenance of the film character.

A good nail lacquer should, in overall, fulfil the following characters—

(1) It must be innocuous to the nails and skin.
(2) It must be easy and convenient to apply.
(3) Product should be stable on storage.
(4) The product should produce a good and satisfactory film.

Composition

Modern nail lacquers contain the following important ingredients—

(1) Film formers
(2) Resins
(3) Solvents
(4) Diluents
(5) Plasticizers

(6) Colours
(7) Pearlescent pigments
(8) Others

(1) Film forming substances : The common film former for nail lacquers is nitrocellulose or cellulose nitrate. Though, over the years, several other substances are being used, but still nitrocellulose remains as the most preferred film former. The other film formers used are cellulose acetate, cellulose acetobutyrate, ethyl cellulose, methacrylate and vinyl resins. But none of these materials has been found to be as good as cellulose nitrate.

Nitrocellulose film is better in terms of hardness, toughness, resistance to abrasion and low solvent retention capacity. Films of nitrocellulose are waterproof and stable to atmospheric conditions.

Nitrocellulose is available in various grades and only low viscosity grades are used for lacquers. Use of special grade nitrocellulose prevents discoloration of nails. When used alone, it produces film of poor gloss, brittle due to shrinking and poor adherence to most surfaces. To overcome these problems normally modifying resin is incorporated. Nitrocellulose is marketed dampened with ethyl or butyl alcohol to reduce high inflammability.

(2) Resins : Resins are incorporated in nail lacquers to give the film more body, gloss, depth and adhesion. It also helps in dispersing insoluble pigments and lakes. Though initially natural resins such as gum damar, benzoic resin, gum copal, gum elemi, shellac etc. were widely used but they have now been replaced by synthetic resins. Amongst synthetic resins, sulphonamide-formaldehyde resins are presently used most. The polymer made by mixing equimolecular proportions of formaldehyde and p-toluene sulphonamide brings excellent gloss, depth, adhesion, and resistance to water. Two such commercial products of the aryl sulphonamide-formaldehyde type are santolite MHP and santollite MS 80%. The first one gives an harder film and the latter imparts greater flexibility and gives high gloss and good flow properties. But, they also cause allergic reactions more frequently than others. Other synthetic resins which are also used occasionally include alkyl resins, polystyrene, polyvinyl acetate, polyacrylic ester, epoxy ester, coumarone indene polymers, and copolymer of vinyl acetate and vinyl chloride.

(3) Solvents : Solvents are, normally, volatile organic liquids that combine all the ingredients of lacquer and make a homogeneous viscous preparation. Normally mixture of solvents is preferred over single

solvent. Solvent(s) should evaporate leaving behind a continuous, impermeable, hard film. The selection of solvent to be used in lacquer is important and the mixture is to be so balanced that the rate of evaporation prevents changes which cause precipitation of nitrocellulose. Though quick evaporation is needed but too rapid evaporation may make distribution on the nail impossible or troublesome. Knowledge of boiling point of the various solvents is important. By mixing middle boiling point solvents such as alcohols, acetates and aromatic solvents the rate of evaporation can be retarded. Judicious selection of mixture of medium, high, and low boiling solvents is an important criteria for making a good lacquer. Liquids with boiling points up to 100°C are termed as low and with boiling points between 100-150°C as medium and with boiling points over 150°C as high boiling point liquids.

TABLE 16.1
Nail Enamel Solvents and their Boiling Point

Solvent	*Boiling Point*	*Solvent*	*Boiling Point*
Ether	35°C	Diethyl carbonate	126°C
Carbon disulphide	46°C	Ethylene glycol monomethyl ether	134°C
Methyl acetone	50°C	Ethylene glycol monoethyl ether	135°C
Acetone	55°C	Ethyl lactate	135°C
Methyl acetate	56°C	Xylene	138°C
Ethyl acetate	68°C	Amyl propionate	140°C
Methyl ethyl ketone	70°C	Isoamyl acetate	140°C
Carbon Tetrachloride	77°C	Butyl propionate	145°C
Ethyl alcohol	78°C	Cyclohexanone	154°C
Isopropyl alcohol	80°C	Ethylene glycol Isopropyl ether	159°C
Benzene	80°C	Hexalin	160°C
Isopropyl acetate	92°C	Methyl cyclohexanone	160°C
Butyl formate	96°C	Furfural	162°C
Ethyl propionate	99°C	Diacetone alcohol	164°C
n-butyl acetate	110°C	Methyl hexalin	165°C
Toluene	110°C	Hexalin acetate	183°C
Amyl formate	110°C	Ethyl oxalate	185°C
Butyl alcohol	113°C	Butyl lactate	185°C
Amyl alcohol	120°C	Glycol diacetate	186°C
Amyl acetate	125°C	Cyclohexanone phthalate	190°C

The solvent system should be selected such that it should

(a) Dissolve or disperse all the ingredients.

(b) Produce a proper viscosity.

(c) Maintain the quality during storage life.

(d) Evaporate in such a way that leaves a good film and also makes application easy.

(4) Diluents : They are not exactly solvents but are organic solvents miscible with nitrocellulose solvents. Diluents are incorporated for multiple purposes.

(a) To build and stabilize the viscosity of the lacquer.

(b) To help in solubilization of incorporated resins.

(c) To lessen the effect of freshly applied enamel on a previously applied lacquer film.

(d) To lower the overall cost of the product.

The various groups of solvents used are alcohols, aromatic hydrocarbons, and aliphatic hydrocarbons.

The alcohols which are preferably used are ethyl alcohol, butyl alcohol and selectively used along with their esters as main solvents like butyl alcohol with butyl acetate. This group of solvents are also called as 'latent solvents' and they increase the effectiveness of principal or active solvent in combination with them.

To keep all the ingredients in solution, there is a limit of the amount of diluent solvent which can be accommodated by the active solvent. This limit is expressed by tolerance ratio or dilution ratio. This is defined as the maximum diluent/solvent ratio which can be tolerated by the nitrocellulose solution without precipitating the nitrocellulose. As the viscosity of the product is increased by the increase in diluent volume, closer the diluent/solvent ratio to the tolerance value higher the viscosity.

While selecting the proper combination of diluent with solvent, the diluent should evaporate at faster rate than the solvent or solvent mixture. This will prevent the precipitation of nitrocellulose as diluent/solvent ratio will decrease. This will avoid a harsh, rough and cloudy film and produce a smooth, clear and continuous film. A high boiling point diluent will make a brighter film. For matt films highly volatile solvents and diluents are used.

Apart from alcohols other diluents used are benzene, xylene, toluene. Solvents with strong and unpleasant odour are avoided. Also they should not be irritating.

(5) Plasticizers : A suitable plasticizer is most important component of nail lacquers. Nitrocellulose or other film formers alone, normally, make a dull and brittle film which can easily flake off the nail. Incorporation of a plasticizer imparts the required flexibility, gloss, adhesion to the nail and reduces its tendency to shrink. It also has effect on viscosity and the volatility or rate of drying. Palsticizers should be non-volatile and miscible with film former, solvent and the other constituents.

It should be colourless, odourless and non-toxic. Functionwise they can be placed into two categories:

(a) Solvent plasticizers, which also act as solvent for film formers.

(b) Non-solvent plasticizers, which only act as softener.

The latter alone may not give a good film, so a combination is taken, preferably. A good plasticizer should have the following characters—

(1) Miscible with other ingredients

(2) Non-irritating and non-toxic

(3) Low volatility

(4) Improve the flexibility, gloss and adhesion

(5) Should not destabilize the preparation

(6) Should not discolour the product

(7) Colourless, odourless and stable

(8) Improve the viscosity of the preparation

The plasticizers are, normally, used in 5% of the total mixture or 25 to 30% of the film formers. The plasticizers used successfully are dibutyl phthalate, *n*-butyl stearate, resorcinol diacetate, castor oil, triethyl citrate, camphor or urea derivatives, chlorinated diphenylenes etc. Incorporation of acetylated monoglycerides along with other plasticizers improves the flexibility and lasting power.

(6) Colours : Soluble dyes alone cannot, normally, impart sufficient depth of colour or intensity. Also it may colour adjacent area. Thus insoluble pigments or lakes are incorporated. Staining of the nail is not desirable. The lakes should be resistant to light or to action of organic solvents and be non-toxic, non-irritating. The lakes should not be separated by the solvents.

About 5% of titanium dioxide or lithopone is incorporated along with the lakes to achieve opacity, creaminess and to produce pastel shades. However, to obtain brown or tan shades iron oxides are normally used. But, to obtain a brilliant brown colours, pigments derived from dinitrobenzene are preferred.

Though the pigments can be available in the form of dispersion, but for better products, they are further milled after incorporating in lacquer base. Usual concentration of pigments is normally between 3 to 5%.

(7) Pearlescent pigments : Another special additive which is used to obtain the pearly or iridescent appearance is nacreous pigments. These can be of natural origin or synthetic origin. Materials of natural origin are guanine crystals (2-amino, 6-oxypurine) separated from fish skin and fish scales, and are marketed as suspension or paste. As their refractive index is high (1.8) it reflects light.

Synthetic nacreous pigments are either obtained from mica flakes or platelets coated with bismuth oxychloride or titanium dioxide. Synthetic nacreous pigments are cheaper than natural products.

(8) Perfume (others) : This is added basically to mark the odour of the other ingredients. The perfume need not be strong. Normally synthetic perfumes are preferred. But it should not destabilize the colour or product.

Application

Application technique of nail lacquers is very important to get good effect. The nail lacquers can be applied differently. Present day products are mainly applied directly, several times, to get a good, even and firm coat.

But to get more attractive appearance, sometimes, the whole application is done stepwise. First a base coat is applied prior to the application of coloured nail enamel. This is a clear concentrated lacquer base and forms an even surface and helps the distribution of subsequent application properly. Then the coloured lacquer is applied. Finally a top coat or hardener is used over the coloured lacquer. This is basically a clear lacquer base with less plasticizer but more resin.

Sometimes for quick drying an aerosol spray is applied, which evaporates the solvent faster.

General Preparation

The base is prepared separately or diluted from the mother lacquer available in the market. Nitrocellulose or film former is dissolved in the solvent. Resin, plasticizer can be dissolved directly or may be dissolved in a small amount of solvent and then may be mixed with nitrocellulose solution. Dispersed pigments are also available readily in the market. The pigments are first dispersed by milling in a suitable vehicle and then incorporated in the base. Alternatively, the milled dispersion is converted into coloured chips. The coloured chips are dissolved in the lacquer base and blended to prepare suitable shades. Also concentrated colours are available, which can be suitably diluted and blended with base.

Formula 1

Nitrocellulose	16.0 gm
Resin	9.0 gm
Plasticizer	4.8 gm
Solvent	60.5 gm
Colour	0.5 gm
Perfume	q.s.

Dissolve all the ingredients in the solvent gradually.

Formula 2

Nitrocellulose	7.0 gm
Dibutyl phthalate	5.0 gm
Polyvinyl acetate	8.0 gm
Methylene chloride	29.4 gm
Ethylene glycol monomethyl ether	28.0 gm
Diethyl glycol monomethyl ether	2.0 gm
Ethyl alcohol	14.0 gm
Perfume oil	6.0 gm
Colour	0.6 gm

Formula 3

Nitrocellulose	13.0 gm
Dioctyl adipate	13.5 gm
Triethyl phosphate	6.5 gm
Camphor	3.0 gm
Acetone	3.0 gm
Ethylene glycol monomethyl ether	35.0 gm
Colour	0.4 gm

Formula 4

Nitrocellulose	4.0 gm
Plasticizer	4.0 gm
Polypropyl methacrylate	18.6 gm
Butyl acetate	23.9 gm
Ethyl alcohol	25.6 gm
Toluene	23.4 gm
Colour	0.5 gm

Lacquer Removers

These products are also called nail cleansers. They are totally different from other cleansers, such as hair, skin and teeth cleansers, as nail cleansers are required to remove only nail lacquers whereas others are used to remove greasy materials, dirt, dust, etc. As nail cleansers are required to be applied on a smooth and highly resistant surface, composition can be different. These preparations rarely come in contact with the surrounding skin, which is not so in the case of other cleansers. So, the chance of damage is much less than shampoos or other cleansers.

Basically all lacquer removers should contain solvent or mixture of solvents which can dissolve the nail lacquer. An ideal lacquer remover should have the following characteristics—

(1) It should not be too volatile to evaporate during application.

(2) It should not be non-irritating to surrounding skin.

(3) It should not leave nails fatty or sticky.

(4) It should not have strong degreasing effect to leave nails brittle.

(5) It should not have unpleasant and obtrusive odour.

Normally the products contain suitable solvent like acetone, ethyl acetate, amyl acetate, ethyl butyrate or mixture of them or toluene along with some fatting agents to compensate the degreasing effect and not to leave the nail brittle. The products are made more attractive by incorporating perfume.

Though acetone has an unpleasant odour and strong degreasing effect, still it is widely used due to its good solvent characters. Other solvents, mentioned above, also have some unpleasant odour. Esters of dibasic acids such as dibutyl phthalate, dioctyl adipate are frequently used as they are odourless or have very faint odour. Liquid esters of higher acids like butyl stearate, isopropyl myristate are also preferred as they are less volatile and odourless. Other substances used as solvent or

co-solvent are butyl, propyl, amyl alcohols, monoalkyl ethers of dihydric alcohols like methyl and ethyl ethers of ethylene glycol and monoethyl ethers of diethylene glycol. They are odourless and less volatile. Another good solvent which is suggested by several workers is gamma-valerolactone.

Fatting agents used to prevent too much drying effect are vegetable oils like castor oil, lanolin and its derivatives, fatty alcohols etc.

To overcome the unpleasant odour of solvents 3-10% of inexpensive floral volatile fragrance can be incorporated. Examples are orange oil, terpenes, terpineol etc. which also act as solvents.

Formula 5

Butyl acetate	15.0 gm
Ethylene glycol monoethyl ether	80.0 gm
Propylene glycol ricinoleate	5.0 gm
Perfume	q.s.

Prepare by simple solution.

Formula 6

Castor oil	3.0 gm
Diehtylene glycol monoethyl ether	15.0 gm
Acetone	82.0 gm
Perfume	q.s

Prepare by simple solution.

Formula 7

Butyl stearate	3.0 gm
Ethyl acetate	20.0 gm
Butyl acetate	20.0 gm
Acetone	25.0 gm
Toluene	32.0 gm
Perfume	q.s.

Prepare by simple solution.

Evaluation

Like any other products, the tests for identity of the ingredients and their individual quantity, checking of colour shade are part of the quality tests. Apart from these, several other tests are required to be done on the performance and nature of the products and film produced. Sometimes the product is evaluated against a standard or established product.

(1) Non-volatile content : This can be done by taking a definite amount of lacquers and applying on a plate of flat surface. Weight of the residual film after evaporation of solvent will indicate the non-volatile content.

(2) Drying rate : This can be done by taking the product on a flat surface and touching the product with tip of finger at short intervals of time to feel the tackiness. Time taken for disappearance of tackiness is noted.

(3) Smoothness : This is the character of the film. The film is applied on a surface and the surface characteristics of the film are studied microscopically.

(4) Hardness : This is the measure of the hardness of film. After application of the film on a flat surface the hardness in measured by applying pressure mechanically.

(5) Adhesion : This is the measurement of adhesion character of the film with adhering surface. This is done by applying the film and then measuring the adhesion character by trying to remove the film mechanically and the force required for that.

(6) Abrasion resistance : This quality is studied by applying the film on a surface and then a mechanical abrasive effect is applied. The surface characteristics of the film are studied before and after abrasive effect.

(7) Water resistance : This is the measurement of the resistance towards water permeability of the film. This is done applying a continuous film on a surface and immersing it in water. The weights before and after immersion are noted and increase in weight, is calculated. Higher the increase in weight lower the water resistance.

(8) Viscosity : This is also an important character and can be measured by any viscometer. It can simply be measured by the flow of lacquers from the applicator brush and comparing it with a standard or good commercial product.

(9) Stability : Stability study of the product as well as colour is also very important and essential. This can be done by accelerated stability test.

CHAPTER 17

Auxiliary Products for Nails

As mentioned in the chapter on nails, various products are available in the market for the care and beautification of nails. Nail lacquers and removers are having the largest share of them. But there are other products which are used for various other purposes and care of the nails. All these products have been put under auxiliary products and are discussed separately here. They are—

(1) Nail creams
(2) Cuticle softeners and cuticle removers
(3) Nail bleaches
(4) Nail whiteners and nail strengtheners

All these products are used for specific purposes and to maintain the health and appearance of the nails.

(1) Nail Creams

Continuous and frequent application of nail lacquers and ordinary removers may make the nail brittle. This can occur due to strong degreasing effect of the solvents of the lacquers and removers. Due to excessive removal of fatty substances from nail surface the appearance of the nail becomes dull.

So, to overcome this brittleness and to maintain the normal health of the nail and its appearance good and shiny, some preparations are used. One suggestion was to apply olive oil after washing the nails by warm water. This normally takes a few weeks' time to achieve the intended effect.

Alternatively, an emollient cream can be used to supplement the oil and to retain the moisture content. These preparations mainly contain lanolin and its derivatives or other oily substances along with a humectant. The preparations can be lanolin based, absorption base or beeswax-borax based emulsion creams. Cholesterol also has been reported to assist natural elasticity of the nails.

These creams are recommended to apply once a day or three times a week after washing the nails with warm soapy solution and then drying

before going to bed. Suitable perfumes and preservatives are also being incorporated.

Formula 1

Beeswax	15.0 gm
Ozokerite	2.5 gm
Montan wax	2.5 gm
Mineral oil	40.0 gm
Cetyl alcohol	2.0 gm
Borax	1.5 gm
Aluminium stearate	10.0 gm
Water	26.5 gm
Perfume	q.s.
Preservative	q.s.

Melt all waxes and oils in a container at 75°C. Dissolve the preservative in water and warm to same temperature. Mix the water solution to first mixture with continuous stirring. Add perfume at final stage after cooling the mixture to about 45°C.

(2) Cuticle Softeners and Cuticle Removers

The cuticle is the thin fold of skin that extends over the lunula at the base of the nail. Cuticle is formed by the extension of a portion of the stratum coreum of the nail root by cornification of the skin at the place where skin adjoins the nail. It becomes unpleasant looking due to its irregular growth. Therefore preparations are used to improve its appearance. However, this can be removed by cutting but that process is not satisfactory.

Some preparations are available to take care of cuticle. They can soften or remove the cuticles. The most important product is cuticle removers.

Cuticle softeners can soften the cuticle along with preventing nail to become brittle and ribbed. The preparations can be cream type or lotion type. They contain lanolin or its derivatives or quaternary ammonium compounds which soften the cuticle to help in mechanical removal.

Quaternary ammonium compounds such as cetyl pyridinium chloride, stearyl dimethyl benzyl ammonium chloride, soften the cuticle by their affinity for protein and are used in 3-5%. These substances also act as a bactericidal. Urea can promote the swelling of keratin and softening of cuticle whereas lanolin or isopropyl myristate gives emollient action. To make it viscous and to market it in tubes, methyl cellulose or hydroxypropyl ethyl cellulose is incorporated in suitable proportion.

There is another product called cuticle oils which is used, also, for softening the cuticle. They are normally made by using oil soluble liquid lanolin or its derivatives diluted with any vegetable oil or fatty acid esters.

Cuticle creams or oils, on regular use, loosen cuticle and keep it in a healthy condition. These preparations are applied using an orange stick tipped with cotton wool, on the cuticle and pressing them backward, gently, and away from the nail. This improves the appearance of the cuticle.

Cuticle removers are used for removal of cuticles by hydrolysis and swelling of the softened cuticles. This is done by using potassium hydroxide and sodium hydroxide, monoethanolamine, triethanolamine or sodium carbonate either in liquid or cream form. They are used as 2-5% in either aqueous or hydroalcoholic vehicles. To counteract the irritation caused by alkali normally humectants such as glycerine or propylene glycol are incorporated. They also prevent the evaporation of water and increase the viscosity of the preparations.

Water-soluble gums and hydrocolloids are also used to increase the viscosity. Alkaline polybasic salts like trisodium phosphate or tetrasodium pyrophosphate in 8-10% can also be used in combination with 2-3% sodium lauryl sulphate or triethanolamine lauryl sulphate. They have milder action but are less effective. Perfume and preservatives are to be incorporated according to the need and choice. Care must be taken while applying such preparations to prevent damage to the skin, nail bed or dermatitis.

CUTICLE SOFTENER CREAMS

Formula 2

Lanolin (anhydrous)	4.0 gm
Beeswax (white)	1.0 gm
Petroleum jelly	95.0 gm
Perfume	q.s.

LOTIONS

Formula 3

Stearyl dimethyl benzyl ammonium chloride	1.5 gm
Alcohol	5.0 gm
Diethyl phthalate	1.5 gm
Water	92.0 gm
Perfume	q.s.
Preservative	q.s.

CUTICLE OILS

Formula 4

Liquid lanolin	75.0 gm
Castor oil	25.0 gm
Perfume	q.s.

Formula 5

Liquid lanolin	75.0 gm
Isopropyl myristate	25.0 gm
Perfume	q.s.

CUTICLE REMOVERS

Formula 6

Potassium hydroxide	2.0 gm
Glycerine	20.0 gm
Water	78.0 gm
Perfume	q.s.
Preservative	q.s.

Formula 7

Potassium hydroxide	3.5 gm
Glycerine	15.0 gm
Propylene	5.0 gm
Alcohol	25.0 gm
Water	51.5 gm
Perfume	q.s.

Formula 8

Trisodium phosphate	10.0 gm
Glycerine	20.0 gm
Sodium lauryl ether sulphate	3.0 gm
Ethoxylate lanolin derivatives	0.5 gm
Rose water	66.5 gm

(3) Nail Bleaches

These preparations are used to remove different types of stains and discolorations on the nails and to whiten them. The stains can be of ink, tobacco, vegetables, etc. The stains can be removed by either oxidation or reduction process depending on the nature of stair. Oxidizing agents normally used are hydrogen peroxide, sodium perborate, zinc peroxide. Other agents which are used for removal of stain or bleaching are citric acid, tartaric acid, hydrochloric acid. Sulphites with dilute acid are also used for achieving reduction.

The products are marketed either in solution or in cream forms. Cream makes the application easier. The product can be marketed in two pack systems. One containing bleaching agent and the other containing acid or alkali to attain intended pH of reaction.

Formula 9

Hydrochloric acid (concentrated)	0.4 gm
Glycerine	10.0 gm
Water	89.6 gm

Formula 10

Hydrogen peroxide (3% 10 vol.)	73.5 gm
Ammonia	0.5 gm
Rose water	26.0 gm
Preservative	q.s.

Formula 11

Beeswax	10.0 gm
Paraffin wax	5.0 gm
Mineral oil	46.0 gm
Pumice powder	8.0 gm
Borax	0.5 gm
Water	30.0 gm
Perfume	q.s.

(4) Nail Whiteners and Strengtheners

These products are not much in use nowadays. They are presently used rarely, as use of nail lacquers has increased.

Nail whiteners are used on the outer edge of the nail to produce a white edging. They are used as a thick paste containing either zinc oxide or titanium dioxide in a base of either glycerine-tragacanth jelly or petroleum jelly and beeswax mixture. Other substances occasionally used, as whiteners, are kaolin, talc, colloidal silica, etc.

Nowadays pencils are also available which can be applied easily without messing problem of creams. The pencils are normally made of waxy materials containing titanium dioxide.

Nail strengtheners are basically used for hardening of nails, particularly to treat dry brittle nails. They normally contain astringent salts and are aqueous solutions of chlorides, sulphates, acetate, salts of aluminium, zirconium and strontium. Also potassium, sodium or ammonium alums are used. The astringent salts are used in 1-5% along with glycerine or propylene glycol for even application and improved penetration. Use of

dimethyl or diethylolthiourea solution also has been reported for nail strengthening purpose.

After washing and drying off the nails the lotion is applied with a brush. The hands are kept downward for few minutes to allow drying. Further application may be made after drying, if required.

NAIL WHITENERS

Formula 12

Titanium dioxide	25.0 gm
Petroleum jelly	70.0 gm
Beeswax	5.0 gm

Melt last two together and add titanium dioxide with trituration and mill it.

Formula 13

Titanium dioxide	38.0 gm
Petroleum jelly	62.0 gm

Melt jelly and mix titanium dioxide properly and mill it.

NAIL STRENGTHENERS

Formula 14

Potash alum	3.000 gm
Glycerine	10.000 gm
Formaldehyde	0.010 gm
Menthol	0.001 gm
Water	86.989 gm
Perfume	q.s.
Preservative	q.s.

Formula 15

Aluminium chloride	5.0 gm
Glycerine	10.0 gm
Solution of formaldehyde (40%)	0.1 gm
Soft soap	1.0 gm
Alcohol	5.0 gm
Water	78.9 gm

Evaluation

Tests for identification of individual ingredients and their weight are essentially to be done. Also stability of the products, rheology, film characters etc. are some tests which are required to be done depending on the type of products. Some of these tests are similar to nail lacquers.

CHAPTER-18

Tooth and Oral Cavity

Maintenance of health of the teeth and gums well is very important for having good general health. More often than not, health of teeth and gums of a person is an indication of his general health. So, it is necessary to take care of health of teeth and gums. Various preparations are used for cleansing and maintenance of good health of teeth, gum and oral cavity. The products, termed as dentifrices, are used to keep the teeth clean, shiny and to inhibit the formation of unpleasant odour in mouth and freshen the breath. But before studying such preparations, it is important to study the anatomy of the teeth and physiology of the oral cavity and also diseases of teeth, gum and oral cavity.

Structure of Teeth and Physiology of Oral Cavity

Macroscopically, the tooth can be distinguished into three distinct parts of free-standing crown, the slender neck which is covered by gums termed as gingiva, and the root which is embedded in the jaw. The root of each tooth sits within a bony socket called an alveolus.

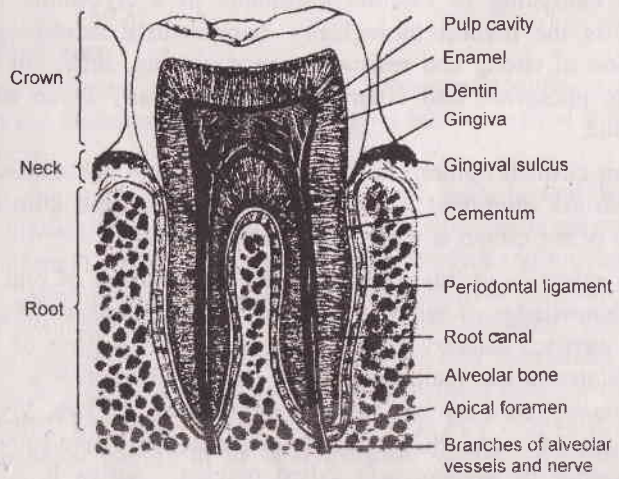

Fig. 18-1 Schematic sectional view of tooth

A sectional view through an adult tooth is presented in Fig. 18.1. The bulk of each tooth consists of a mineralized matrix material called dentin. This material is similar to that of bone but the only difference is that it does not contain living cells. Instead, the cytoplasmic processes extend from cells in the central pulp cavity into the dentin. From the root canal, a narrow tunnel located at the root, blood vessels and nerves are supplied to the pulp cavity. The blood vessels and nerves enter into the root canal through the apical foramen to supply the pulp cavity.

The periodontal ligament, which is made of collagen fibres, extends from the dentin of the root to the alveolar bone, creating a strong articulation called gomphosis. Dentin of the root is covered by a layer of a substance called cementum, providing protection and firmly anchoring the periodontal ligament. Histologically, the structure of cementum is very similar to bone. It is less resistant to erosion than dentin. The exposed portion of the tooth is called crown. The boundary between the root and the crown of the tooth is marked by the neck. The neck of each tooth is surrounded by a shallow gingiva sulcus. The mucosa of the gingiva sulcus is loosely bound to the tooth. This epithelial attachment of the tooth is important for preventing bacterial access to the lamina propina of the gingiva and the relatively soft cementum of the root. Brushing and massaging of gums stimulate the epithelial cells and make the attachment stronger. Breaking down of the epithelial attachment causes bacterial infection of the gingiva and is called gingivitis.

The dentin of the crown is covered by a layer of a material called enamel consisting of calcium phosphate in a crystalline form. The enamel is the hardest biologically manufactured substance. For the formation of strong and resistant enamel coating, sufficient quantity of calcium, phosphate and vitamin D are essentially to be taken during childhood.

From cosmetic point of view only the visible and exposed parts of the teeth are important. These are crown, neck and gum or gingiva. Enamel of the crown is most important for that.

The saliva is an integral part of the environment of oral cavity and teeth. Knowledge of saliva is important for maintenance of good health of oral cavity. Salivary glands produce 1.0 to 1.5 litres of saliva each day. Water is the main constituent and is about 99.4%. Remaining 0.6% mainly consists of several electrolytes, buffers, glycoproteins, mainly Na^+, Cl^- and HCO_3^-. Lubricating action of the saliva is due to the presence of glycoprotein called mueins. Saliva is a mixture of

glandular secretions and is secreted 70% from submandibular salivary glands, 25% from parotids, and 5% from sublingual salivary glands. Continuous secretion of saliva flushes the oral surfaces helping to keep them clean and wet. Buffers present in the saliva maintain the pH slightly acidic, close to 7.0, and thus prevent the build up of acids produced through bacterial growth. Saliva also additionally contains immunoglobulins (Ig A) and lysozymes that help in control of oral bacterial population. Any reduction or elimination of salivary secretions caused by either radiation exposure, emotional distress, or other factors, triggers a bacterial population explosion in the oral cavity. This leads to recurring infections and progressive erosion of teeth and gums. The saliva serves several functions during eating.

(1) Lubrication of the mouth.

(2) Moistening and lubricating materials in the mouth.

(3) Dissolution of chemicals which stimulate the taste buds and provide sensory information about the material.

(4) Initiating the digestion process of complex carbohydrates, before swallowing, by the amylase enzyme present in the saliva.

The surface of the normal sound tooth is smooth. The gingival tissue strongly encloses the neck of the tooth. Continuously circulating saliva removes the remaining food materials adhered to or between the teeth. Any hard ingredients present in the food materials also polish the dental surfaces.

Dental Problems

Dental problems can be of various types and require care. Some problems can be taken care of by cosmetics but some need medical care and medicine.

Tooth decay is caused by the action of bacteria that inhabit the mouth. A sticky matrix material is produced by bacteria adhering to the surfaces of teeth. This material traps food particles and creates deposits which is called plaque. This organic material, over the time, becomes calcified forming a hard layer of tartar or dental calculus. Calcification occurs by enzymatic degradation of calcium rich substances in saliva and resultant formation and deposition of insoluble calcium compounds on the teeth. Removal of these hard layers is very difficult. Normally tartar formation occurs at or near gingival sulcus. Brushing cannot remove this deposition, even in the early stage.

The deposited plaque protects the oral bacteria from the effect of salivary secretion, thus salivary secretion cannot control their growth. Bacterial growth over the food remnants produces acids that slowly erode the surface and structure of the teeth. This results in dental caries or dental cavities. The most commonly occurring bacteria S. mutans, when reaches and infects the pulp, causes pulpitis. In such condition, normal treatment is the complete removal of the pulp tissue, particularly the sensory innervation and all areas of decay. The pulp cavity is then packed with alternative and appropriate materials. This process is called root canal.

Normal brushing of the teeth can only cover the exposed surfaces of the teeth. So, this can only prevent the settling of the bacteria and the entrapment of food. But the bacterial and the food remnants in inter-proximal space or between the teeth or within the gingival sulcus cannot be removed by the brush. Daily use of dental floss to keep clean these spaces as well as regular stimulation of gingival epithelium by massaging are recommended for maintenance of good oral health. Acids generated by bacteria and plaque remaining within the gingival sulcus for extended period of time will lead to erosion of the connections between the neck of the tooth and the gingiva. As a result the gum appears to recede from the tooth and leads to periodontal disease. In addition to these, the bacteria attack the cementum, finally leading to destruction of the periodontal ligament and erosion of alveolar bone. These further lead to loosening of the tooth and thus the tooth falls out or is required to be removed. Periodontal disease is the most common cause for the loss of teeth.

Dental Preparations

To take care of various dental problems and maintain dental health and oral cavity various preparations are available and marketed. The following chapters will deal with such preparations. These preparations are classified as follows—

(1) Dental Care Preparations
   (a) Tooth pastes
   (b) Tooth powders
   (c) Solid and liquid dental preparations
(2) Mouthwashes

CHAPTER 19

Dental Care Preparations

Maintenance of teeth clean and in good health is essential and also important for everyone. This can be achieved by using various dental care preparations or dentifrices. Dentifrices are the preparations used for cleaning the surfaces of teeth and keep them shiny and to preserve the health of the teeth and gums. These preparations may also expected to help inhibit the formation of unpleasant odours and freshen the breath. Regular use of dentifrices helps to prevent occurrence of tooth decay. A good dental health increases the possibility of a good general health.

Importance of cleaning the teeth was probably realized along with the need for maintenance of body cleanliness. Several old Greek, Roman, Buddhist and Hebrew literary works mention the use of tooth-picks, chew sticks and sponges for teeth cleaning purpose. Materials used as ingredients of dentifrices at that time were dried animal parts, herbs and plant parts, honey and minerals. Several items of the early ingredients were found to be harmful, destroying teeth, irritating oral mucosa. Some of these harmful substances were sulphuric acid, acetic acid, lead ores, and abrasive minerals. Over the period of time, various studies on these substances have helped to identify safe and useful dentifrice ingredients.

Dentifrices can be either simple cleansing dentifrices or also be therapeutic dentifrices. Therapeutic dentifrices are basically cleansing preparations containing, additionally, some drugs or chemicals which decrease the occurrence of dental caries or help in control of periodontal disease. These are achieved by the bactericidal, bacteriostatic, enzyme-inhibiting or acid-neutralizing qualities of the drugs or chemicals used. Therapeutic dentifrices containing stannous fluoride are widely used products.

Dentifrices are prepared in paste, powder and to a lesser extent in liquid and block forms.

Functions of Dentifrices

Though the primary function of a dentifrice is the cleaning of the accessible surfaces of the teeth, but it can have some other functions also. The expected functions of a dentifrice are as follows—

(1) Cleansing of tooth
(2) Prevention of formation or removal of dental plaque
(3) Prevention of formation of calculus
(4) Polishing of tooth
(5) Reduction of the occurrence of tooth decay
(6) Reduction of periodontal disease
(7) Prevention or reduction of mouth odours and freshening of breath

Some commercial dentifrices may be performing all of the above functions and some may be fulfilling partial functions.

(1) TOOTH PASTES

Tooth pastes are most popular, valuable and widely used preparations for cleansing the teeth. It has largest share of dental cleansing and care preparations. Though they are expensive than tooth powders but still they are more preferred.

Tooth pastes are preferred because of the following reasons—

(1) Easy to take measured quantity and spread on the tooth brush.
(2) No spillage or wastage.
(3) Attractive consistency.
(4) Proper distribution in mouth.

A good tooth paste should have following characters—

(1) It must clean the dental surface properly without any scratches.
(2) Softness should be such that it can be easily squeezed out of the tube to spread on the brush, but should not sink into the brush.
(3) The consistency should remain constant in wide range of temperature during shelf-life.
(4) It should not dry, at least not quickly.
(5) It should not be toxic and should not sensitize buccal membrane.
(6) It should not interact with the container material.

Ingredients

Tooth pastes contain several ingredients to fulfil various functions. Ingredients of a tooth paste can be classified as follows and are discussed below—

(1) Abrasives and polishing materials
(2) Detergents and foaming materials
(3) Humectants
(4) Binding agents
(5) Sweetening materials
(6) Flavours
(7) Preservatives
(8) Miscellaneous or special ingredients such as therapeutic agents, whitening agents, etc.

(1) Abrasives and polishing materials : These materials are also called as cleansing materials. Abrasive is the main constituent of tooth pastes or tooth powders. An abrasive should have to be powder and hard but not such that it makes scratches on the enamel or gum. They are preferably water-insoluble but water-soluble abrasives have also been suggested in recent times. Abrasives should not have any unpleasant taste, smell and also should not be toxic. Though hardness is the inherent character of each substance, however it can, to some extent, also depend on particle size and impurities. Abrasives are responsible for removing food particles lodged in the teeth. They also help to remove some stains from the teeth. Normally the amount of abrasive is about half of total weight of a tooth paste.

The materials most widely used are calcium carbonate, tricalcium phosphate, dicalcium phosphate, aluminium sulphate, magnesium trisilicate and others.

Calcium carbonate (precipitated chalk) is the most commonly used abrasive. This substance is available in different grades. They vary in density, crystal form, specific surface, particle size. Normally the very light grade calcium carbonate is used in tooth paste preparations. Pastes prepared using lighter grade do not harden. Calcium carbonate imparts alkalinity to the preparation. Chalk is the native form of raw calcium carbonate.

Dihydrate and anhydrous dicalcium phosphate, tricalcium phosphate and calcium pyrophosphate are important calcium salts used as abrasives in tooth pastes. Dicalcium phosphate dihydrate ($Ca_3HPO_4.2H_2O$) is mostly used amongst them. These substances are mild abrasives. Both

the dicalcium phosphates are odourless, tasteless and white. They are slightly soluble in water. They are used, both, as abrasive and polishing agent. Tricalcium phosphate [$Ca_3(PO_4)_2$] is also a tasteless, odourless white amorphous powder and insoluble in water. It also imparts mild abrasive and polishing effect. Dicalcium phosphate imparts neutral pH to the paste whereas calcium carbonate imparts alkaline pH. Thus preparations containing calcium phosphates have better taste and enhance the stability of the flavour.

Sodium metaphosphate, a water insoluble substance, has a good abrasive effect and used along with tricalcium phosphate. It promotes the lustre of teeth.

Magnesium trisilicate is a hydrated magnesium silicate ($2MgO.3SiO_2$) and is used along with other abrasives and polishing agents. It is a fine, white, tasteless and odourless powder and insoluble in water. It acts as a mild antacid.

Aluminium hydroxide [$Al_2O_3.3H_2O$ or $Al(OH)_3$] is also used in combination of other abrasives and polishing agents. This substance is available as a microcrystalline powder as well as a gel suspension. The powder has abrasive and cleansing properties.

Calcium sulphate is occasionally used and is a mild abrasive. It considerably influences the consistency.

Other substances occasionally used are talc, kaolin, zirconium silicate, etc.

(2) Detergents and foaming materials : The cleansing action of the detergents is due to their lowering of surface tension. They help in wetting and dispersion of powdered materials in the paste. They also help penetration of paste and abrasives into the fine cracks and other places and thus assisting in removal of food particles and debris. By their emulsification capability they help in removal of mucus. They also help in producing foam. Soaps and various synthetic detergents are mostly preferred.

Though soaps are alkaline in nature but still they are used. Specially prepared dental soaps are available for use in tooth pastes. As soaps may have odour or taste, tasteless and odourless soaps are to be used.

Synthetic detergents are widely used in tooth pastes. Sodium lauryl sulphate is one of them most widely used. Others are magnesium lauryl sulphate, sodium lauryl sarcosinate, diethyl sodium lauryl sulphosuccinate. Surfactants also lower the abrasive effect of tooth brush and abrasives.

(3) Humectants : Humectants, in tooth pastes, prevent drying out of the product and impart some plasticity character to the paste. The amount of humectants used normally can vary from 5 to 10%. However, sometimes higher amount of 30% or more is used. Actual amount is decided on the specific gravity of the powder mass. Substances with lower specific gravity needs less humectant. Only glycerine, sorbitol and propylene glycol are widely used as humectants in tooth pastes. Glycerine imparts glossy character to the product and is the most widely used humectant. Glycerine also imparts sweetness. Sometimes sorbitol is preferred over glycerine and imparts more viscosity and plasticity than glycerine. Sorbitol is also less sticky than glycerine and prevents separation of water.

(4) Binding agents : Various hydrocolloids are used in tooth pastes to improve and maintain the consistency. They also prevent separation of pastes. Aqueous dispersions of the hydrocolloids are viscous. These hydrocolloids are used in 1-2.5%. Though, once, starch, liquid glucose and simple syrup were used but slowly they were replaced by mucilages of karaya gum, gum arabic and tragacanth. Gum tragacanth is still a widely used binding agent. The exact amount of binding agent will depend on the consistency wanted. Normally the gum is first mixed with sufficient quantity of glycerine, alcohol before adding water. This is done to prevent formation of lumps.

Other substances used are mucilages of chondrus or irish moss, carboxymethyl cellulose, sodium alginate, carbopols, bentonite, veegum, etc.

(5) Sweetening materials : Sweetening agent is very important for tooth paste. Saccharine sodium is a widely used sweetening agent. Sodium saccharine is used in 0.05 to 0.31%. The exact amount will depend on the amount of other materials and sweetness of the other ingredients, like glycerine present. Apart from glycerine, chloroform is also used as a sweetening agent. Alternative sweetening agent is sodium cyclamate but due to its toxicity it is banned in several countries.

(6) Flavours : Flavours are essentially to be incorporated in tooth pastes for a long term effect in the mouth. The flavours normally used are blending of suitable oils which in combination with sweetening agent produce a smooth but distinct taste in the product and also leave a pleasant and refreshing smell in the mouth after use. The flavours most widely used in tooth pastes are a blending of peppermint oil and spearmint oil or only peppermint oil. Only the finest quality flavouring

oils are used. Some other flavouring agents are also used, either along with peppermint oil or in combination with spearmint oil or alone. Other such flavours used are clove oil, cinnamon oil, cassia oil etc., in small quantities. Menthol is also used to modify the flavour of peppermint or its combinations. The proportion of flavouring agents normally used can vary from 1.0 to 3.0% depending on the selection of combination of flavours.

(7) Preservatives : Preservatives are essentially required in tooth pastes as the product is prone to microbial growth due to presence of gums and water. Though high quantity of glycerine may prevent microbial growth, but still a suitable preservative, single or in combination, is used in tooth pastes. Flavouring agents or chloroform present in tooth pastes impart some preservative action but a separate water-soluble preservative is incorporated to have better effect. Preservatives normally preferred are methyl parahydroxybenzoate (0.15%) along with propyl parahydroxy benzoate (0.02%). Sodium benzoate, formalin though used once but are not recommended nowadays. Preservatives are normally dissolved in the humectant and then mixed in other components.

(8) Miscellaneous or special ingredients : These are various substances additionally incorporated in the tooth paste preparations to achieve special functions. They are listed below—

(a) Colours : They are not preferred much as most of the tooth pastes are white. But, nowadays, several coloured tooth pastes are available to attract the consumers attention or to mask the colour of some special ingredient(s) of the tooth paste formulations. Even multicolour is also used in some products. The colour to be used should be from the certified colours from the list approved under Drugs and Cosmetics Rules. Pink, red, green are some important colours used normally. Striped pastes are also in use and made by using pastes of different colours and using a special nozzle system.

(b) Bleaches : For the removal of stains from the teeth and to impart the whitening effect of the tooth pastes or powders bleaches are incorporated. They are basically oxidizing agents such as sodium perborate, stabilized hydrogen peroxide, magnesium peroxide etc. and are used as stain removers and whiteners of teeth.

(c) Lubricants : Lubricants, are sometimes, incorporated in tooth pastes to facilitate the paste to come out or for filling purpose. Even if the paste stiffens, presence of 1.0 to 2.0% liquid paraffin helps to allow the paste come out without any extra pressure.

Occasionally several other chemical substances are incorporated in tooth pastes for some specific purpose or function. Pancreatin has been used in about 2.0% for the removal of tartar without any damage to the tooth enamel. Liquid silicones are occasionally incorporated in non-foaming tooth pastes to form thin water repellent film, after easy spreading over teeth and to prevent adhesion of food particles. It has to be incorporated along with an emulsifying agent. Silicones are used in variable proportions and can be used from 0.5-45%. Suggestion has been made to incorporate chlorophyll in tooth pastes for deodorizing effect in halitosis, though there is doubt about its effectiveness at the concentration of 0.1-0.5% at which it is used in tooth paste.

Sodium lauryl sarcosinate, used as foaming agent in tooth paste, also acts as anti-enzyme and bacteriostat and also has anti-cariogenic activities. At low concentration (0.03%) it only acts as hexokinase inhibitors but at 0.25% it can prevent growth of bacterial flora in saliva. Alkalis and urea are incorporated to neutralize acid in saliva and to prevent decomposition of carbohydrates and formation of acid. Strontium chloride, is incorporated in tooth pastes for the treatment of hypersensitivity. It is well known that fluorides help in preventing tooth decay. It has been observed that in certain conditions stannous fluoride combines with tooth enamel and forms an insoluble tin oxide, tin phosphates and calcium fluoride which inhibit acid penetration and thus tooth decay. In normal formulation condition, stannous fluoride or other fluorides degrade and thus an acidic pH is maintained for the formulation for stabilizing such substances.

Formulations

Several combinations of tooth paste preparations are mentioned below for a comprehensive idea.

General Method of Preparation

These preparations are preferably made in stainless steel mixer container, for large scale manufacture, filled with slowly rotating blades. It can be done in a planetary mixer or similar mixer used for semisolid preparations. Small scale batch can be made in a glass container.

The gum is mixed with a suitable quantity of humectant, without any water, for proper dispersion. Chloroform or alcohol can also be used for dispersion of binding agents. Other colloids may be dispersed in water. Preservative can be dissolved in glycerine or water. Methyl cellulose should be mixed with cold water, but ethyl cellulose should be dispersed in warm water. Other powder ingredients are sifted together and added

gradually to mucilaginous mixture with continuous gentle stirring. Then aqueous media is mixed and stirred further to get the product. Favour and detergent should be added at the last.

In an alternative method the binder is premixed with solid abrasives and other powders and then poured in a suitable mixer (dough-type mixer) along with aqueous solution of the humectant, preservative, sweetening agent and mixing is done. After obtaining a homogeneous paste, flavour and detergent are added.

TOOTH PASTE

Formula 1

Calcium carbonate	56.0 gm
Sodium lauryl sulphate	1.0 gm
Glycerine	22.0 gm
Gum tragacanth	1.5 gm
Water	19.4 gm
Saccharine	0.1 gm
Flavour	q.s.
Preservative	q.s.

Formula 2

Calcium carbonate	44.5 gm
Magnesium carbonate	1.0 gm
Magnesium hydroxide	3.0 gm
Sodium lauryl sulphate	1.0 gm
Gum tragacanth	1.0 gm
Glycerine	31.0 gm
Oil of peppermint	1.0 gm
Saccharine	0.1 gm
Water	18.4 gm
Preservative	q.s.

Formula 3

Dicalcium phosphate	60.0 gm
Sorbitol 70	16.0 gm
Gum tragacanth	1.0 gm
Sodium lauryl sulphate	1.0 gm
Saccharine sodium	0.1 gm
Water	21.9 gm
Preservative	q.s.
Flavour	q.s.

Formula 4

Tricalcium phosphate	50.0 gm
Glycerine	8.0 gm
Propylene glycol	14.5 gm
Sodium alginate	0.5 gm
Saccharine	0.05 gm
Mineral oil	1.0 gm
Sodium lauryl sulphate	1.5 gm
Water	24.0 gm
Preservative	q.s.
Flavour	q.s.

Formula 5

Stannous fluoride	0.4 gm
Calcium pyrophosphate	40.0 gm
Glycerine	29.0 gm
Gum tragacanth	1.0 gm
Stannous pyrophosphate	1.0 gm
Sodium lauryl sulphate	1.5 gm
Flavour oil	0.1 gm
Water	26.9 gm
Saccharine	0.1 gm
Preservative	q.s.

Formula 6

Dicalcium phosphate	36.0 gm
Calcium carbonate	13.0 gm
Glycerine	20.0 gm
Gum tragacanth	1.2 gm
Saccharine	0.1 gm
Sodium lauryl sulphate	10.0 gm
Water	19.75 gm
Flavour	q.s.
Preservative	q.s.

(2) TOOTH POWDERS

Tooth powders are, structurally, the oldest and simplest preparations and they are also the cheapest. Over the years their market share has been reduced by popularity and advantages of pastes, but still they have a considerable share of the market and population. The main problems

encountered with tooth powders are floating of powders in air during manufacturing, formation of cake on storage, and uneven distribution in mouth. The oldest tooth powder is reported to be camphorated chalk. More or less every dental care manufacturer also markets tooth powders alongwith toothpaste products.

Composition

Basically, tooth powders contain the following four ingredients:

(1) An abrasive
(2) A surfactant or detergent
(3) A sweetening agent
(4) Flavour
(5) Colour (if required)

Abrasives used in manufacturing tooth powders are the same as used in tooth pastes, such as calcium carbonate, dicalcium phosphate, tricalcium phosphate, calcium pyrophosphate, calcium sulphonate, aluminium sulphate etc. Though lighter calcium carbonate is used in tooth paste but in tooth powders heavier grade calcium carbonate is used. Other ingredients are also selected as in tooth pastes.

The following are some of the formulae of tooth powders which are prepared by simple mixing.

General Procedure for Manufacture

This is done by simple mixing. First ingredients of small quantity are premixed and then mixed with other ingredients in ribbon-type or agitator type of mixer. Flavour can be sprayed on to the bulk or can be premixed with part of some abrasive and polishing agent and then mixed with the bulk.

TOOTH POWDERS

Formula 7

Phenol	2.5 gm
Kieselguhr	57.5 gm
Calcium carbonate (heavy)	40.0 gm
Flavour	q.s.
Colour	q.s.

First prepare a triturate of the phenol and a small quantity of kieselguhr. This is then sieved and mixed with rest. Add colour and flavor, mix and finally sieve once more.

Formula 8

Calcium carbonate	92.8 gm
Dental soap powder	6.0 gm
Flavouring oil	1.0 gm
Saccharine sodium	0.2 gm

Formula 9

Calcium carbonate	76.0 gm
Kaolin	11.9 gm
Sodium lauryl sulphate	2.0 gm
Powdered pumice	10.0 gm
Saccharine sodium	0.1 gm
Flavour	q.s.
Colour	q.s.

Formula 10

Calcium carbonate	84.0 gm
Tricalcium phosphate	10.0 gm
Sodium lauryl sulphate	3.0 gm
Sodium perborate	2.0 gm
Saccharine sodium	1.0 gm
Flavour	q.s.
Colour	q.s.

(3) SOLID AND LIQUID DENTAL PREPARATIONS

Though these preparations are not much popular, but still they exist in the market and have limited use for tooth cleaning purpose.

Solid dental preparations are basically a tooth powder suspended in a soap base and converted to solid shapes. The abrasive materials vary from 50-80% and the soap is about 20-50%. They also contain flavours, sweeteners and occasionally colours.

Formula 11

Dental soap	16.9 gm
Calcium carbonate	80.0 gm
Glycerine	3.0 gm
Saccharine sodium	0.1 gm
Colour	q.s.
Flavour	q.s.

The soap and calcium carbonate are mixed along with glycerine, and other additives and then milled and mixed with some water, if necessary,

to form a soft mass. Then they are made into bars, stick by mechanical process.

Use of liquid dentifrices is comparatively less than the solid ones. They are basically aqueous or hydroalcoholic solutions of surfactants with additional components of thickening agent, sweetener, flavour, etc. They do not contain any abrasive as they will sediment. So the action of these preparations on dental surface is less but the cleansing effect is a little more.

Formula 12

Sodium myristate sulphate	4.0 gm
Methyl cellulose	4.0 gm
Saccharine sodium	0.1 gm
Flavouring oil	0.3 gm
Glycerine	5.0 gm
Alcohol	10.0 gm
Water	85.4 gm

The manufacturing process is basically making simple solution of all ingredients. The hydrocolloids are first dispersed in part of the solvent prior to mixing with other ingredients. Flavour is dissolved in alcohol and then added to glycerine and mixed to the bulk.

Evaluation

Identification of ingredients and estimation of their contents are essential components of overall quality control and evaluation of dental care products. The products, tooth pastes and tooth powders, can be basically classified into foam forming and non-foam forming.

Some other special evaluation tests are as follows:

(1) Abrasiveness : Various tests have been designed and reported over the year, mostly on the set of extracted teeth. The teeth were mechanically brushed with pastes or powders and then the effects were studied by observation, mechanical or other means. Abrasive character normally depended on the particle size. So, study of particle size can also give such idea.

(2) Particle size : This can be determined by microscopic study of the particles or by sieving or other means.

(3) Cleansing property : This is studied by measuring the change in the reflectance character of a lacquer coating on a polyester film caused by brushing with a tooth cleanser (paste or powder). Also an

in vivo test has been suggested in which teeth were brushed for 2 weeks and condition of teeth was assessed before and after use with the help of photographs.

(4) Consistency : It is important that the product, paste, should maintain the consistency to enable the product press out from the container. Study of viscosity is essential for this. Rheology of powders is also important for proper flow of the powders from the container.

(5) pH of the product : pH of the dispersion of 10% of the product in water is determined by pH meter.

(6) Foaming character : This test is specially required for foam-forming tooth pastes or tooth powders. Specific amount of product can be mixed with specific amount of water and to be shaken. The foam thus formed is studied for its nature, stability, washability.

(7) Limit test for arsenic and lead : This is very important as these are highly toxic metals. Specific tests are there to estimate these two metals. However, if the raw materials are tested for the limit of these two metals, products may not have excess of such metals.

(8) Volatile matters and moisture : A specific amount of the product required to be taken in a dish and drying is to be done till constant weight. Loss of weight will indicate percentage of moisture and volatile matters.

(9) Effect of special ingredients : Special tests should be done for the special ingredients if any, like antiseptic, enzymes, etc. For each one special and specific test are to be done.

CHAPTER-20

Mouthwashes

These products are not discussed along with tooth pastes or tooth powders, as there are definite differences between the two categories of products, both functionwise and compositionwise. The main function of tooth pastes and tooth powders is cleansing whereas mouthwashes are basically deodorants and antiseptics. But, it should be mentioned here that all tooth pastes and tooth powders also act as deodorants as they help in the removal of food debris which causes mouth odours on decomposition in mouth by oral bacteria. If any bacterioside is also present in tooth pastes they help in inhibiting bacterial activity. As most of the tooth pastes contain fragrance, they also help in masking the unpleasant odour of the mouth. Similarly mouthwashes, apart from their main function of deodorants and antiseptics, can also help in cleansing by removing water-soluble substances or loose debris from the surfaces or between the teeth or from oral cavity.

A good mouthwash should have the following characters—

(1) Good and quick antiseptic action at the dilution it is used
(2) Attractive flavor to impart a odour to the mouth
(3) Sweet taste
(4) Not much expensive
(5) Non-irritant to mouth and mucous membrane
(6) Non-toxic

Composition

Mouthwashes are mainly alcoholic or hydroalcoholic solutions, as they are used in oral cavity, which may be suitably diluted, if necessary. However, there can be mouthwashes as solid, powder or concentrated products which are to be dissolved or diluted with water before using as mouthwash. These types of products are, presently, only few in the market, though they are economic in manufacture, packing, transportation and storage. In the recent past several lozenges or chewing gum type mouth fresheners have also been introduced. They may also contain antiseptics. Also few aerosol products as mouthwashes have

been launched in recent past particularly in advanced countries. The important components of mouthwash preparations are—

(1) Antiseptic or antibacterial substances
(2) Astringents
(3) Deodorizing agents
(4) Drug extracts
(5) Flavours
(6) Surfactants
(7) Sweeteners
(8) Colours
(9) Vehicle

Some of the above components are essential but a few of them are optional and may be incorporated according to the specific requirements and target population.

(1) Antiseptic Substances

These are the active constituents of most of the mouthwashes. Various substances are available to select a suitable antiseptic for incorporating in a mouthwash. The choice of specific antiseptic is made according to the need and matching with other ingredients. Substances normally used are phenol and its derivatives, hexachlorophene, quaternary ammonium compounds, thymol, salicylic acid, formalin, boric acid, tannic acid, hydroxy benzoates etc.

Phenol and its derivatives : Though there are a large number of phenol derivatives having antiseptic properties, only a limited number of them are actually used in mouthwashes. The non-suitability of others may be due to objectionable taste, poor solubility, degradation and discoloration, toxicity, sensitization property and cost. The phenol and its derivatives and their concentration used in mouthwashes are phenol (0.1-1%), beta-naphthol (0.3-0.5%), thymol (0.1%), chlorothymol (0.05-0.1%), hexachlorophene (0.02-0.2%), hexylresorcinol (0.05-0.1%), amyl-, hexyl-, heptyl- and octyl-phenols (0.05-0.3%). Normally, phenolic compounds are more active in hydroxyl form than the phenolate form. Para substituted to hydroxyl group are more active than other phenol derivatives. Aqueous solution, normally, is more active than solutions in other solvents. If water solubility of any phenolic compound is poor it can be solubilized by using a suitable surfactant or solubilizing agent, such as tweens.

Quaternary ammonium compounds : These compounds have been found useful as antiseptics in mouthwashes. Some quaternary ammo-

nium compounds are very good oral antibacterial and deodorant agents. Sometimes these compounds are used along with some other antiseptics, such as chlorohexidines. The quaternary ammonium compounds are effective against a wide spectrum of bacteria and normally active at alkaline pH. One important problem with quaternary ammonium compounds is their incompatibility with other compounds, particularly anionic detergents, oil of peppermint, methyl parahydroxy benzoates, citric acid, saccharine, boric acid etc. However, there are some quaternary compounds which are highly effective over a wide range of pH and with higher compatibility. Such stable compounds are cetyl pyridinium chloride, quarternary morpholinium alkyl sulphates etc. Quaternary ammonium compounds should not be used in excess, as at higher concentration they are toxic and irritant to mucosa.

Essential oils : Though they are basically used as favouring agents, but some essential oils also have antiseptic properties. Cinnamon oil, cassia oil, clove oil, eucalyptus oil, thyme oil, peppermint oil, anise oil, oil of wintergreen or main constituents of these oils such as thymol, menthol, eucalyptol, anethole and methyl salicylate have antiseptic properties.

Miscellaneous antibacterial compounds : Other individual antiseptics are clubbed under this category. Variety of substances of different structures are used as oral antiseptics. Formalin, an aqueous solution of formaldehyde (37-41%), is a powerful germicide. Formalin is occasionally incorporated as 1% solution in mouthwashes and further diluted (1:5) before use. Diluted hydrogen peroxide is also a useful germicide and used occasionally. Boric acid (2-4%), benzoic acid (1-2%) are also occasionally incorporated in mouthwashes. Iodine liberating substances are also used as iodine is a good antiseptic. Sodium perborate, urea peroxide or other oxygen-bearing compounds have also been recommended to incorporate in mouthwashes as antiseptic.

(2) Astringents

Astringents are being used in mouthwashes from a long time. Astringents are incorporated in mouthwashes for following various actions:

(a) To shrink and protect inflamed mucous surfaces.

(b) To precipitate proteins of saliva.

(c) To diminish accumulated mucous secretions by precipitation.

Astringents are also known to have mild antiseptic property though not much proof is available.

Substances used for astringent action are zinc chloride, zinc acetate, aluminium sulphate (alum), all in 0.05-0.2%. Zinc phenosulphate is used in 0.1-0.3% concentration. Tannic acid and its derivatives, acetic acid, citric acid, lactic acid are also used in mouthwashes in 0.05-0.5%. 3% alcoholic solution or aqueous solution containing glycerine and borax, or tannic acid haveare also used. Copper iron or manganese salts are not used due to metallic taste or staining character though they are astringent.

(3) Deodorizing Agents

It is not only the bacterial growth on food particles in the mouth, but several other factors, as suggested earlier, contribute to the cause of bad breath. Pathological conditions of oral cavity, teeth, throat, gastrointestinal tract, the lungs and nasal passage may cause bad breath. Severe congestion or cough can also cause bad breath. However, a local measure can be taken to achieve deodorizing effect in mouth. Quaternary ammonium compounds, chlorophyllin have been found to exert deodorizing effect in oral cavity.

(4) Drug Extracts

Several extracts have found use in mouthwashes. They can act as astringents, stimulants or flavouring agents. Extracts which are suggested to use are tincture of myrrh, an oleogum-resin obtained from the stem of commiphora molmol or other species, tincture of cinchona, benzoic tincture, tincture of quillaia, etc.

(5) Flavours

Various flavouring agents are available for incorporating in mouthwashes. Peppermint oil, menthol, thymol, aniseed oil, clove oil, eucalyptus oil, cinnamon oil, anethole, fennel, methyl salicylate are widely used. As mentioned earlier some of them also act as an antiseptic.

(6) Surfactants

Occasionally surfactants are incorporated in mouthwashes to have wetting, or detergent, or solubilizing effects. To keep all the ingredients, particularly when water content is more, in solution sometimes solubilizing agents may be required. Tweens or other compatible surfactants can be used. Particularly to keep flavours in aqueous media surfactants help in solubilization of flavours.

(7) Sweeteners

Sugars are not used as sweetener in mouthwashes. Saccharine, or other synthetic sweetener extracts can be used for this purpose.

(8) Colours

Mouthwashes are often coloured with vegetable dyes. The useful dyes are saffron, carmine, phloxine, erythrosine. They do not have effect on the other ingredients and on their action.

(9) Vehicle

This is a very important ingredient as all the constituents have to be kept in solution in the vehicle. Alcohol alone or in combination with water is the widely used solvent. Thus the preparations are to be diluted with water in definite proportion, as suggested on the label, before use. Dilution with water may have another advantage as dilution with water, just before use, may lead to the precipitation of flavours and disinfectants. This will lead to better adherence of the above substances on the oral cavity and membrane and thus longer action.

Glycerine is also incorporated in mouthwashes. Use of glycerine has an added advantage as it is also a sweetening agent with a flavour. It has also a demulcent and conditioning effect on mucous membrane. Sometimes a small quantity of hydrocolloids is incorporated to increase the viscosity.

Formula 1

Benzoic acid	1.00 gm
Cetyl triethyl ammonium bromide	0.60 gm
Resorcinol	1.00 gm
Thymol	0.15 gm
Methyl salicylate	0.35 gm
Eucalyptol	0.15 gm
Menthol	0.15 gm
Alcohol	22.00 gm
Water	74.60 gm

Formula 2

Tincture of myrrh	2.0 gm
Benzoic tincture	1.5 gm
Tincture of iris	1.5 gm
Peppermint oil	1.5 gm

Thymol	0.2 gm
Anethol	0.5 gm
Eugenol	0.2 gm
Cinnamon oil	0.1 gm
Saccharine sodium	0.5 gm
Alcohol	70.0 gm
Water	22.0 gm

Formula 3

Anethol	0.6 gm
Methyl salicylate	1.0 gm
Menthol	0.2 gm
Propylene glycol	20.0 gm
Glycerine	30.0 gm
Tween 80	20.0 gm
Saccharine sodium	2.0 gm
Ethyl alcohol	26.2 gm
Colour	q.s.

Formula 4

Phenol	1.0 gm
Boric acid	2.2 gm
Tincture of myrrh	2.0 gm
Tincture of quillaia	10.0 gm
Glycerine	5.0 gm
Rose oil	10.0 gm
Peppermint oil	0.4 gm
Aniseed oil	0.4 gm
Cinnamon oil	0.1 gm
Clove oil	0.2 gm
Alcohol	68.7 gm

Formula 5

Phenol	3.6 gm
Solution of sodium hydroxide (3.56% w/v)	9.5 gm
Concentrated orange flower water	2.0 gm
Concentrated rose water	1.0 gm
Glycerine	12.5 gm
Water	71.4 gm
Colour	q.s.

Formula 6

Sodium potassium copper chlorophyllin	0.05 gm
Peppermint oil	0.06 gm
Spearmint oil	0.04 gm
Sodium carboxy methyl cellulose	1.00 gm
Solublizing agent	0.50 gm
Saccharine sodium	0.15 gm
Ethyl alcohol	10.00 gm
Water	88.20 gm

All the above products are required to be diluted with water before use according to the instructions on the label. The dilution is 1:5 for formulae 2, 4 and 5 but formula 3 can be diluted by 1:0. Formulae 1 and 6 are to be diluted by 1:1

Evaluation

As mouthwashes are used for specific purposes, such as antiseptic, deodorizing action etc. in the mouth, it is necessary to perform suitable tests to determine their effectiveness. The following important tests should be carried out apart from common tests for identity, content, clarity.

(1) Antiseptic property : Though the antiseptics normally used are well known and established one, but their activity in pure state is of limited value for the expected antiseptic activity in the formulations. Other ingredients present in the formulation may modify the activity. So it is necessary to carry out separate test for their activity in formulation, both *in vitro* and *in vivo*.

(a) *In vitro* antiseptic activity : This can be carried out against suitable oral microorganisms in a suitable liquid media or agar media against a control and determining their effectiveness against the growth of the organisms.

(b) *In vivo* antiseptic activity : This can be done by collecting representative bacterial samples, before and after the use of mouthwash, and culturing and counting colonies on agar plate. The representative samples can be collected from the mouth by rinsing with saline solution or swabbing with cotton and then inoculated on agar plate. After incubation for a required period of time the number of colonies will be indicative of organisms present in the mouth. By this process, optimum time required to keep the mouthwash in mouth can also be determined.

(2) Deodorizing effect : Local deodorizing effect can be evaluated in mouth by using chemical analysis, surface tension effects. Instruments reported to be used to measure level of odour are gas chromatograph, fair-wells osmoscope etc. Also human olfactory system can be used to evaluate odour intensity and deodorant action. Professional human tasters are there for such evaluation as used in tea industry, flavor industry.

(3) Stability study : Stability of the products and their components also needs to be carried out. Activity of the antiseptics can be decreased over the time. Also stability of the astringents, flavours, colours are important. This can be done by normal stability study or accelerated stability study.

(4) Other special tests : Clinical trials may need to be carried out for mouthwashes as they sometime contain therapeutic agents. Tests which are normally suggested, according to the need, are effect on dental caries, effect on oral soft tissue problems, cleaning and astringent effects, etc.

APPENDIX-I

Provisions of Drugs and Cosmetics Act as Applicable to Cosmetics

A. Definition

Cosmetics, as defined in the Act, mean articles meant to be rubbed, poured, sprinkled or sprayed or introduced into or otherwise applied to the human body or any part thereof for cleansing, beautifying, promoting attractiveness or altering the appearance.

In the last few years the consumption of cosmetics has touched new heights and the curve is shooting upwards and hence the controls sought to be exercised on the drugs have been extended to a certain extent to the cosmetics.

B. Import

For purposes of import, the cosmetics are deemed to be drugs for the import of which no license is necessary and all rules applicable to import of such classes of drugs are applicable to cosmetics as well. However, the import of the following classes of cosmetics is prohibited.

(i) Misbranded cosmetics which contain colors other than those prescribed or are not labeled in the prescribed manner or make any false or misleading claims.

(ii) Spurious cosmetics meaning cosmetics which are imitations or substitutes for other cosmetics or resemble other cosmetics in a manner likely to cause deception or are imported under names of other cosmetics or bear names of manufacturers which are fictitious or who are truly not the manufacturers.

(iii) Cosmetics not of standard quality.

(iv) Cosmetics containing any harmful or unsafe ingredients.

(v) Cosmetics containing prescribed colors which contain more than 2 p.p.m. of arsenic or 20 p.p.m. of lead or 100 p.p.m. of heavy metals other than lead.

(vi) Cosmetics intended for use on the eye brows or eye lashes or around the eyes containing coal tar dyes or intermediates.

(vii) Cosmetic colored with arsenic or lead compounds.

(viii) Cosmetics containing hexachlorophene or mercury compounds.

(ix) Cosmetics whose use is likely to involve any risk to the users.

However, small quantities of cosmetics whose import is otherwise prohibited may be imported if they are meant for personal use and form part of a passengerÆs baggage and are declared to the customs authorities on being directed to do so.

C. Manufacturing

A license obtainable from the Licensing Authority is now essential for undertaking manufacture of cosmetics. The licenses are granted on payment of requisite fees and fulfilment of other prescribed conditions and, in general, rules applicable to the licenses granted for the manufacture of allopathic drugs are applicable to these licenses as well. Manufacture of cosmetics containing hexachlorophene or mercury compounds or misbranded or spurious cosmetics or cosmetics which are not of standard quality is prohibited. A person licensed to manufacture cosmetics should fulfil following conditions:

(i) The factory premises should be maintained in clean condition, should be situated in hygienic surroundings, and should be distinct and separate from premises used for residential purposes.

(ii) Adequate space and staff should be provided and manufacture should be conducted under the direction and personal supervision of competent technical staff at least one of whom should be a whole time employee and should either hold diploma in pharmacy approved by the Pharmacy Act or should have passed intermediate examination with chemistry as one of the subject. However, for small scale manufacturers, employing not more than 5 persons, a person with general training and experience, extending over not less than 4 years in the manufacture of cosmetics, may be deemed to be competent technical staff by Licensing Authority.

(iii) Either adequate facilities should be provided on the premises for the testing of raw materials and manufactured products or suitable arrangements should be made with approved institutions for the purpose. Records relating to such tests should be maintained for at least 3 years from the date of manufacture.

(iv) Cosmetics containing colors other than those specified by Bureau of Standards or colors which contain more than 2 p.p.m. of arsenic or more than 20 p.p.m. of lead or more than 100 p.p.m. of heavy metals other than lead and eyebrows or eye-lashes etc. containing any coal tar color should not be manufactured. The use of arsenic or lead compounds for coloring cosmetics is also prohibited.

(v) The Inspectors should be allowed to inspect premises, records etc., and to take samples of manufactured products. An inspection book should also be maintained wherein the inspectors can enter their remarks.

(vi) Records of manufacture should be kept as per Schedule U(I) for at least 3 years.

As in the case of drugs, licenses for the manufacture of cosmetics remain valid up to 31st December in the year following the year of issue and may be suspended or cancelled if the licensee fails to observe any of the conditions, discussed above. A licensee, aggrieved by this decision can appeal to the State Government within 3 months of suspension or cancellation. Cosmetics can also be manufactured under loan licenses as is the case with drugs.

Anyone manufacturing any spurious cosmetic shall be punishable with imprisonment up to 3years and fine. Persons convicted of manufacture of cosmetics in contravention of any other provision are liable to imprisonment for a term up to 1 year and or fine up to Rs. 1000.

D. Sale

No license is necessary for the sale of cosmetics but the dealers in cosmetics can sell only such products as do not contravene any provisions of the Act and the Rules. In case a dealer is required to disclose the name and other particulars of the person from whom he obtained cosmetics he is legally bound to comply with such directions. Anyone who fails to disclose the name of manufacturer or sells any cosmetic in contravention of the Act and the Rules may be imprisoned for 1 year or fined Rs. 500 on first conviction or imprisoned for 2 years and fined up to Rs. 1000 on any subsequent conviction.

The following classes of cosmetics are expressly prohibited to be stocked, sold or exhibited for the sale:

(i) Misbranded or spurious cosmetics and cosmetics not of a standard quality.

(ii) Cosmetics containing any ingredient which makes them unsafe or harmful for use under the directions indicated or recommended.

(iii) Cosmetics imported or manufactured in contravention of any provision of the Act and the Rules.

The inspectors may require a person not to dispose any stock of cosmetics.

E. Labeling and Packing

Cosmetics sold or distributed in India, whether they are of Indian origin or imported from outside, should be labeled and packed in accordance with the following provisions:

Class of Cosmetics	*Labeling particulars (On both Inner and Outer Labels)*
Cosmetics in general	Name of the cosmetics and name and address of the manufacturer. Manufacturing License Number preceded by the letter B if the cosmetic is packed in containers having more than 10 gm. *On the Outer Labels* Net contents of the package expressed as weight for solids and semi-solids, as volume for liquids or as numerical counts, if the cosmetic is subdivided provided that this statement need not appear if the contained cosmetic is not more than 60 ml/30 gm. *On Inner Label Only* Adequate directions for safe use; warning, caution, or special directions; names and quantities of ingredients that are hazardous.
Hair dyes containing dyes, colors, and pigments.	With the words: *Caution*. This product contains ingredients which may cause skin irritation in certain cases and so a preliminary test according to the accompanying directions should be made. This product should not be used for dyeing the eyelashes or eye brows as such use may cause blindness. (Equivalent labeling in local languages is also mandatory).

Note : If the cosmetic has only one label, all the information required to be disclosed on the inner or outer labels shall be displayed on this label.

The following instructions in English and local language should accompany the package of Hair dyes.

"This preparation may cause serious inflammation of the skin in some cases and hence a preliminary test should always be carried out to determine whether or not special sensitivity exists. To make the test, clean a small area behind the ear or upon the inner surface of the forearm using either soap or water or alcohol. Apply a small quantity of the hair dye as prepared for use to the area gently with soap and water. If no irritation or inflammation is apparent it may be assumed that no hypersensitivity exists. The test should however be carried out before

each and every application. The preparation should on no account be used for dyeing, eyebrows or eyelashes since severe inflammation of the eye or even blindness may result."

Alcoholic fragrance solutions such as eau-de-cologne containing diethyl phthalate	(i) The words: HARMFUL IF TAKEN INTERNALLY (ii) Content of Diethyl phthalate in each ml.
Cosmetic for export	(i) Specific requirements, if any (ii) Name and address of manufacturer and name of cosmetic or a code No. approved by the licensing authority.
Soap containing hexachlorophene	Contains hexachlorophene; not to be used on babies
Tooth pastes containing fluorides	(i) Content of fluoride in p.p.m. (max.1000 p.p.m.) (ii) Date of expiry.

Note : No soap is permitted to contain more than 1% hexachlorophene.

F. Colors

The following colors may be added to medicine and cosmetics provided the common name and the percentage of the color are stated on the label of the container. The medicines or cosmetics to which these colors are added shall not be deemed to be misbranded only because of the fact of addition of colors therein:

1. *Natural colors* : Annatto, carotene, cochineal, curcumin, chlorophyll, red oxide of iron, yellow and black oxide of iron, titanium dioxide.
2. *Artificial colors* : Carmel.
3. *Coal tar colors* :

Common Name of Colors	*Color Index Number*	*Chemical Name*
Green:		
Quinazarine Green SS	61565	1,4-bis(p-Toluino)anthraquinone
Alizarin Cyanine Green F	61570	Disodium salt of 1,4-bis (o-sulfo-tulouino)
Fast Green FCF	42053	anthraquinone
Green S	44090	

Common Name of Colors	*Color Index Number*	*Chemical Name*
Yellow:		
Tartrazine	19140	Trisodium salt of 3-carboxy-5-hydroxy-1-p-sulfophenyl-4-p-sulfo phenyl-azopyraozle
Sunset Yellow FCF	15985	Disodium salt of 1-p sulfo-phenyl-azo-2 naptho 1-6 sulfonic acid
Quinoline Yellow WS	47005	Disodium salt of disulfonic acid of 2(2-Quinolyl)-1,3 indardoine
Red:		
Amaranth	16185	Trisodium salt of 1(4-sulfo-inaphthylazo) 2-naptho 1-3, 6-disulfonic acid
Erythrosine	45430	Disodium salt of 9-0-carboxy- phenyl-6-hydroxy 2,4,5,7-tetrabromo-3-isoxanthone.
Eosin YS Or Eosin G	45380	Disodium salt of 2,4,5,7-tetrabromo-9-p-carboxyphenyl-6-hydroxy-3- isoxanthone.
Toney Red or Sudan III	26100	1-p-phenylazophenylazo-2-naphtho.
Ponceau 4 R	18255	Trisodium salt of 1-(4-sulpho-1-naphthyl-azo) û2naphtho 1-6;8 disulphonic acid
Carmoisine	147720	Disodium salt of 2-(4-sulpho-1-4 sulphonic acid)
Fast Red E	16005	Disodium salt of 2-(4-sulpho-1-naphthyl-azo)-2- naphthol-6-sulphonic acid
Blue:		
Indigo Carmine	73015	Disodium salt of indigotin
Brilliant Blue FCF	42090	-5:5-Disulphonic acid
Violet:		
Alizurol Purple	60725	Disodium salt of 1 phenylazo 2 naptho 1-6, 8-disulphonic acid
Brown:		
Resorcin Brown	20170	Monosodium salt of 4 p-sulfophenylazo 2(2,4-xylylazo) 1,3-resorcinol
Black:		
Naphthol Blue	20470	Disodium salt of 8 amino 7-5-nitro phenylazo-2 phenylazo 2 phenylazo-1-naphthol 3,6 disulfonic acid

APPENDIX-II

Most Often Used Ingredients of Cosmetics

ABSORBENTS

Bentonite
Calcium carbonate
Colloidal kaolin
Corn starch
Magnesium carbonate
Magnesium oxide
Potato starch
Precipitated chalk
Rice starch
Tricalcium phosphate
Wheat starch

ADHESIVES

Calcium myristate
Calcium stearate
Lithium stearate
Magnesium myristate
Magnesium silicate
Magnesium stearate
Talc
Zinc stearate

ANTIOXIDANTS

Ascorbic acid
Ascorbyl palmitate
Beta-Napthol
Butylated hydroxyanisole
Butylated hydroxytoluene
Citric acid
Dilauryl thiodipropionate
Distearyl thiodipropionate
2, 5-di-tert-butylhydroquinone
Ethyl gallate
Gallic acid
Hydroquinone
Isoascorbic acid
Lecithin
Maleic acid
Monoisopropyl citrate
Nor-dihydroguaiaretic acid
Phenyl alphanaphthylamine
Propyl gallate
Pyrogallol
Pyrocatechol
Sodium bisulphite
Sodium metabisulphite
Sodium sulphite
Sodium thiosulphate
Thioglycerol
Thiosorbitol
Thiourea
Thioglycollic acid
Trihydroxybutyrophenone

ANTISEPTICS

Bethional
Benzalkonium chloride
Boric acid
Beta naphthol
Camphor
Chlorhexidine diacetate
Chlorinated bisphenol
Hexyl phenol
Heptyl phenol
Methyl para-hydroxy benzoate
Propyl parahydroxy benzoate
Menthol
Methyl salicylate
Phenol

Chlorothymol
Cinnamon oil
Clove oil
Cresol
Formalin
Hexachlorophene
Hexyl resorcinol
Phenosulphonate
Salicylic acid
Thymol
Tannic acid
Octyl phenol
Zinc phenosulphonate

ANTIDANDRUFF AGENTS

Cadmium sulphide
Camphor
Menthol
Selenium sulphide
Sodium sulphacetamide
Thiol-n-oxide
Thymol
Zinc pyridinium
Zinc undecylinate

BINDERS

Carboxymethyl cellulose
Chondrus
Eithyl cellulose
Glyceryl monostearate
Hydroxypropyl cellulose
Isopropyl myristate
Karya gum
Lanolin derivatives
Magnesium stearate
Methyl cellulose
Mineral oil
Polyvinyl pyrrolidone
Soaps
Sodium alginate
Starch
Tragacanth
Veegum
Zinc stearate

COLORS

Iron oxides
Alizarin
Alminium hydrate
Amaranth
Carmine
Cochineal
Chlorophyll
Chromium oxides
Citrus red
Eosin
Erythrosine
Fluorescein
Indigo
Indigo carmine
Iragalite red
Lake red D
Lake red DBA
Lake red DCA
Napthol blue black
Orange G
Phthalocyanine blue
Resorcin brown
Rhodamine B 500
Saffron
Tartrazine
Tetrabromofluorescein
Tetrachlorofluorescein
Titanium dioxide
Ulramarines
Zinc oxide

COVERING AGENTS

Kaolin
Magnesium stearate
Precipitated chalk
Rice starch
Titanium dioxide
Zinc oxide
Zinc stearate

DETERGENTS

Acyl beta-aminopropionates
Acyl peptides
Acyl sarcocine
Alkyl ether sulphates
Ammonium lauryl sulphate
Coconut diethanolamide
Diethyl sodium lauryl sulpho-succinate
Isopropanol amide
Magnesium lauryl sulphate
Methyl taurides
Monoethanolamide
Monoethanol lauryl sulphate
Monoglyceride sulphate
Sodium alkyl benzene sulphonates
Sodium cetyl sulphate
Sodium decyl sulphate
Sodium lauryl sulphate
Sodium di-(ethyl-hexyl) sulpho-succinate
Sodium di-tert-nonyl sulpho-succinate
Sodium octyl sulphate
Sodium lauryl sarcosinate
Triethanol lauryl sulphate

EMOLLIENTS

Cestostearyl alcohol
Cetyl alcohol
Cocoa butter
Groundnut oil
Isopropyl myristate
Isopropylpalmitate
Isopropyl lanolate
Lanolin
Lanolin alcohol
Lanolin oil
Lanolin wax
Spermaceti
Stearic acid
Wool wax alcohol
Wool wax steroids

FILM FORMERS

Acacia
Agar agar
Beeswax
Carboxy cellulose
Cellulose acetate
Cellulose acetobutyrate
Cellulose nitrate
Cetostearyl alcohol
Ethyl cellulose
Gum copal
Gum damar
Gum elemi
Isopropyl lanolate
Lanolin alcohol
Lanolin oil
Lanolin wax
Liquid paraffin
Methacrylate
Methyl cellulose
Paraffin wax
Phospholipids
Polyvinyl pyrrolidone
Shellac
Stearic acid
Stearyl alcohol
Tragacanth

Karya gum
Lanolin
Vinyl resin

HAIR COLORANTS

Bismuth citrate
Cadmium sulphate
Camomile
Cobalt sulphate
Copper sulphate
Copper chloride
Henna
Lawsone
Lead acetate
Lead sulphate
Nickel sulphate
Ortho amino phenol
4-nitro-1, 2-amino benzene
Paraphenylene diamine
Paraaminophenol
Pyrogallol
Silver nitrate
Reng

HAIR REMOVERS

Arsenic trisulphide
Barium sulphide
Calcium sulphide
Calcium thioglycollate
Keratinase
Lithium thioglycollate
Magnesium sulphide
Rhodamine
Sodium stannite
Sodium sulphide
Stronsilum sulphide
Stronsium thiolactate
Thiglycolic acid
Zinc sulphide

HAIR CONDITIONING AGENTS

Amino acids
Egg
Herbal extracts
Lanolin
Lanolin oil
Lecithin
Oleylalcohol
Protein hydrolysate

HUMECTANTS

Ethylene glycol
Fructose
Glucose
Glucosamine
Glycerine
Mannitol
Polyethylene glycol
Polyoxyethylene glycerin
Polyoxyethylene sorbitol
Propylene glycol
Sodium lactate
Sodium 2-pyrrolidone-5-carboxylate
Sorbitol
Triethylene glycol
Triethanolamine
Urea

OILS

Arachis oil
Acetoglycerides
Butyl stearate
Castor oil
Mustard seed oil
Oleyl alcohol
Olive oil
Paraffin oil

Coconut oil
Hydrogenated vegetable oils
Isopropyl myristate
Isopropyl palmitate
Isopropyl linoleate
Lanolin oil
Diethyl sebacate
Hexadecyl stearate
Peanut oil
Propylene glycol monoricinoleate
Tetrahydrofurfuryl alcohol
Tetrahydrofurfuryl acetate
Tetrahydrofurfuryl benzoate
Tetrahydrofurfuryl stearate
Tetrahydrofurfuryl ricinoleate

OPACIFIERS

Hydrous lanolin
Lithopone
Magnesium stearate
Polyethylene glycol 400
Propyleneglycol stearate
Titanim dioxide
Zinc oxide
Zinc stearate

PEARLSCENT AGENTS

Almond oil
Bismuth oxychloride
Cocoa butter
Castor oil
Guanine
Liquid paraffin
4-methyl-7-diethylamino coumarin
4-methyl-5,7-dihydrocoumarin
Mica
Spermaceti
Starch

PERFUMES

Ambergris
Amyl cinnamicaldehyde
Benzyl acetate
Bergamot
Bois de rose
Castoreum
Cinnamic alcohol
Citral
Civet
Eugenol
Farnesol
Geraniol
Geranium
Hydroxy citronellal
Ionone
Lavender oil
Linalol
Methyl salicylate
Musk
Patchouli
Phenyl ethyl alcohol
Pine oil
Sandalwood oil
Terpineol
Vanillin
Vetivert
Ylang-ylang

PLASTICISERS

Acetylated monoglyceride
n-Butyl stearate
Camphor
Castor oil
Chlorinated diphenylenes
Dibutyl phthalate
Resorcinol diacetate
Triethyl citrate
Urea

PRESERVATIVES

Benzalkonium chloride
Benzethonium chloride
Benzoic acid
Benzyl parahydroxy benzoate
Butyl parahydroxy benzoate
Acetyl pyridinium chloride
Cetyl trimethyl ammonium bromide
Chlorobutanol
Cinnamic aldehyde.
Cresol
Ethyl alcohol
Ethyl parahydroxy benzoate
Formaldehyde
Formic acid
Hexachlorophene
Methyl chlorothymol
Methyl para-hydroxy benzoate
Ortho-phenyl phenol
Para-chlorobenzoic acid
Para-chloro meta-cresol
Propyl para-hydroxy benzoate
Para-hydroxy benzoic acid
Phenyl marcuric acetate
Phenyl marcuric nitrate
Salicylic acid
Thiomersol

SKIN NOURSHING AGENTS

Androgen
Arachidonic acid
Estrogen
Lanoleic acid
Lanolenic acid
Prednesolone
Progestrin
Vitamin A
Vitamin D
Vitamin E

SOLVENTS/VEHICLE

Acetone
Amyl acetate
Amyl alcohol
Arachis oil
Benzene
Butyl acetate
Butyl alcohol
Butyl stearate
Castor oil
Coconut oil
Dibutyl phthalate
Diethyleneglycol monostearate
Dioctyl adipate
Ethyl acette
Ethyl alcohol
Ethyl butyrate
Gamma-valerolactone
Glyceryl monolaurate
Glycerol monostearate
Isopropyl myristate
Mustard seed oil
Olive oil
Peanut oil
Polyethylene glycol
Propylene glycol
Propylene glycol monomyristate
Tetrohydrofurfuryl alcohol
Triethylene glycol
Toluene
Xylene

SUNSCREEN AGENTS

Antiviray
2-Acetyl-3-bromoindazole
Amyl salicylate
Benzyl acetophenone
Kaolin
Linalyl ortho-amino benzoate
Magnesium oxide
Menthyl cinnamate

Benzyl cinnamate
Benzyl orthoamino benzoate
Benzyl salicylate
Calcium carbonate
Cyclohexenyl ortho-amino-benzoate
Daphnin
Diphenyl butadiene
Esculetin
Ethyl para-amino benzoate
Dibenzalacetone
Dihydroxy naphthonic acid
2, 4-dihydroxy benzophenone
Filtrasol A-1000
Filtrasol B
Glyceryl salicylate
Homomenthyl salicylate
Isobytyl para-amino benzoate
Menthyl salicylate
Menthyl ortho-amino benzoate
Methyl umelliferone
Methyl esculetin
Orth hydroxy biphenyl disulphonate
Para amino benzoic acid
Paradimethyl amino benzoic acid
Parahydroxy biphenyl disulphonate
Phenyl ethyl ortho-amino benzoate
Phenyl salicylate
Sodium 2-naphthol-6, 8-disulphonate
Sodium 2-naphthol-3, 6-disulphonate
Stilbene
Talc
Terpenyl ortho-aminobenzoate
Umbelliferone

SUNTAN AGENTS/STAINING AGENTS

8-Methoxy psoralen
8-Ethoxy psoralen
Di-hydroxy acetone
Juglone
Lawsone
Erythrulose
Olive oil extract of cudbear and henna
Walnut juice

SUSPENDING AGENTS

Acacia
Agar
Alginates
Bentonite
Carbopol
Carbomer
Carboxy methyl cellulose
Cellulose powder
Colloidal silicates
Chondorus
Gelatin
Guar gum
Hectorite
Hydroxy ethyl cellulose
Hydroxy propyl cellulose
Methyl cellulose
Micro crystalline cellulose
Polyvinyl alcohol
Polyvinyl pyrrolidone
Pectin
Tragacanth
Veegum

WAXES

White beeswax
Candellia wax
Carnauba wax
Ceresin wax
Ozokerite wax
Cetyl alcohol
Cetosteryl alcohol
Cocoa butter
Lanolin anhydrous
Petroleum jelly
Paraffin wax
Petrolatum

5. What are the advantages of compact powder over free flowing face powders? What are the different types of binders that are used for making compact face powders?
6. While manufacturing powders, why is perfume mixed along with the adsorbent first?
7. Zinc oxide with particle size 0.02 m is used as covering agent. Comment on this statement.
8. Compare titanium dioxide and zinc oxide in terms of covering power and sun screening action.
9. A female with dry skin has a wound on left leg below the knee. She applied talc on wound immediately available in the house. Do you support her action? Justify your answer.
10. Is covering power of a face powder affected by the degree of oiliness of skin? How would you correlate the two?
11. While making a compact face powder, damp process employed generally gives very good product, but require more time for processing as drying of granules/powder becomes a prerequisite before compaction. What procedure would you suggest to decrease the manufacturing time and at the same time ensure good binding of the powder base?
12. A person is suffering from 'prickly heat' (strophulous) mainly distributed on the face, neck and back. Come up with a customized formula of a preparation suitable for this condition. Justify your choice of preparation/formulation, ingredients and the proportions in which you plan to incorporate them.
13. Which of the following formulations would be more appropriate for a woman with oily face or will either of them work equally well? Justify your answer.

Ingredients	*Formulation-1*	*Formulation-2*
Talc	63.0 g	20.0 g
Kaolin	20.0 g	20.0 g
Calcium carbonate (light)	5.0 g	39.0 g
Zinc oxide	5.0 g	15.0 g
Zinc stearate	5.0 g	–
Magnesium carbonate	1.0 g	5.0 g
Colour	0.5 g	0.5 g
Perfume	0.5 g	0.5 g

14. Look at the following formula of 'compact face powder':

Ingredients	*% w/w*
Talc	32.0
Kaolin	20.0
Precipitated chalk	25.0
Zinc oxide	15.0
Soap (binder)	8.0
Iron oxide	q.s.
Perfume	q.s.

(a) Prepare a flow chart clearly indicating the procedure you would adopt to manufacture this preparation by damp compression in an industrial unit.
(b) Change the above formula to make it suitable for a dry and rough skin full of minute scars. Justify.

Baby Powders

15. Why are colouring agents and strong perfumes not incorporated in baby powders?
16. Justify the statement: Only sterilized talc should be used in baby powders.
17. Can the following formula be used for making baby powder? If yes/no, justify.

Ingredients	*% w/w*
Talc	70.0
Calcium carbonate	25.0
Zinc stearate	4.0
Boric acid	0.3
Lavender oil	0.7
Colour	0.5

18. You have been recently appointed as a 'Formulation Development Executive' by Amcos Ltd., which targets at becoming a specialized manufacturing firm for baby products within next 2 years. The company is proposing at using the following formula for making a 'baby powder' preparation:

Ingredients	*% w/w*
Talc	69.8
Starch	20.0
Titanium dioxide	6.0
Olive oil	2.0
Iron oxide	1.0
Perfume	1.0
Propyl paraben	0.1
Methyl paraben	0.1

As a new experienced entrant in the firm, give recommendations/suggestions on the current proposed formula (with respect to chosen ingredients& proportions). If you find the existing formula appropriate, justify. If not, make necessary changes and justify the same.

Ch. 4 Lipstick/Coloured Make-up

1. What is the role of waxy materials in lipsticks?
2. What is the most important criterion to be kept in mind while preparing lipsticks?
3. Can the base ingredients used in lipsticks have melting point in the range of 36-38°C or not? If yes/no, justify.
4. Among different waxes given below, write the order of mixing for preparing lipstick: white beeswax, candeilla wax, carnuaba wax, ceresin wax, cetylalcohol and cetostearyl alcohol.
5. A woman of 45 years age is using a new lipstick from past 3 days. On 4^{th} day it started crumbling. Explain the probable reason .
6. What happens if an antioxidant is not used in formulation of lipstick? List some antioxidants that are used while formulating lipsticks.
7. As a pharmacist seeing the below given formula of lipstick what can be your reasoning? Correct the formula

Lanolin anhydrous	10.0 g
Candelilla wax	9.0 g
Castor oil	45.0 g
White beeswax	9.0 g
Ozokerite wax	10.0 g
Eosin	2.0 g
Lake colours	12.0 g
Halogenated fluoresceins	3.0 g

8. What is the role of lubricant and temperature while pouring lipstick mixture in mould?
9. Why the melting point of lipstick should be higher than drop point?
10. Write the differences between lip salve and liquid lipstick.
11. How will you evaluate a lipstick after manufacturing?
12. (a) How are 'coloured lipstick', 'liquid lipstick', 'transparent lipstick' and 'lip salve' similar to and different from each other with respect to their use/function and type of pigments/colours incorporated.
    (b) Provided to you are:
    Bromo acid, solvents of bromo acid (acetone, ethyl alcohol, citral, terpiniol, castor oil, oleyl alcohol), oil soluble pigment, alcohol-soluble dye, insoluble red pigment, titanium dioxide, carnuba wax, ethyl cellulose, lanolin, PEG (plasticizer), paraffin oil and lanolin

    For making a liquid lipstick, which ingredients will you choose and why?
13. Enumerate the process you would employ while formulating a lipstick
14. Provided to you is the following formula:

Ingredients	*%w/w*
Polyoxyethylene oleyl ether	20.0
Oleyl alcohol	10.0
Castor oil	40.0
Candelilla wax	10.0
Carnuba wax	10.0
Bromoacid dyes	2.0
Insoluble pigments and lakes	q.s.
Perfume	q.s.

    (a) Mention the purpose of each ingredient in the above formula.
    (b) Can this formula be used for making 'lip salve'? If not, then make minimum changes in the formula to convert it into a lip salve preparation. Justify your answer.
15. Which type of rouge you prefer mostly and why?
16. In beeswax – borax type rouges what is the purpose of using hygroscopic substances?

Ch. 5 Skin Creams

1. What is the chemical basis of the bees wax-borax type of cleansing cream?
2. Why is all-purpose cream called as 'all-purpose' cream? Does it fulfil the requirements of all types of creams? If yes/no, justify.

3. Which types of creams are used for nourishing the skin? Discuss different categories (along with examples) of ingredients used while making these types of creams.
4. Differentiate between the following:
   (a) Cold cream and vanishing cream
   (b) Vanishing cream and foundation cream
   (c) Cleansing cream and massage cream
5. What are moisturizing lotions? How will you evaluate a moisturizing lotion with respect to its functions and physical characteristics?
6. Design a cosmetic formulation meant to be used in the daytime for dry and scaly skin, full of minute scars. Justify your formulation. Give the composition and use of individual ingredients that you choose. Also, briefly explain the method of preparation of the same.

Skin allergy/sensitivity

7. Mrs. Kulkarni travels in the sun for at least 1 hour daily. She started using a new hand and body lotion. Nothing happened to her for the first 15 days, but from the 16^{th} day she started developing rashes only on the exposed portions of her body. Give probable reasons for the same.
8. On applying preparations made of each of the below listed compounds, certain specific reactions were observed on the skin as mentioned against each compound:

   Compound A : Severe stinging immediately after application, which intensified till the first five minutes and then subsided after 20 minutes.

   Compound B : Reddening and swelling after application only upon exposure of skin surface to the sunlight for 10 minutes.

   Compound C : Reddening and itching only after 14 days of continuous application.

   Compound D : Reddening and swelling after an hour of application.

   Name the category to which each of these compounds belongs.
9. Compound A has a very good sun-screening capacity, but produced rashes on skin (when incorporated in a skin cream and applied) within 5 minutes of exposure to the sun. Nothing happened on the covered regions.

   Compound B is a dye, which (when incorporated in a lipstick) did not produce any reaction upon repeated application by women staying indoors/outdoors on the first twenty days. But on the twenty-first day, both group of women (staying indoors as well as outdoors) developed chelitis of the lips. Upon discontinuing the use, the lips regained their normal state within 2-3 days. After a gap of one month, when the lipstick was re-applied, chelitis occurred in all the women on that day itself.

Ch. 6 Sunscreen/suntan and Palliative Preparations

1. Why are blacks more resistant towards sunburns than whites?
2. What is E-vitons/cm^2, where it is used?
3. Explain the useful and harmful effects of the ultraviolet radiation from a cosmetic point of view.
4. Explain how zinc oxide may act as a sunscreen. In what other ways can a sunscreen act?
5. What should be the $E^{1\%}_{0.1cm}$ for an effective sunscreen lotion?
6. How will you evaluate the functional effectiveness of a sunscreen lotion?
7. Differentiate between a sunscreen and a suntan lotion.
8. Suntan preparations should contain sunscreen agents. Write whether this statement is true or false with justification.
9. To produce a minimal perceptible erythema on Prabha's skin, exposure of 25.92 E-viton minutes/cm^2 of skin is necessary. The intensity of solar radiation is 3.6 E-viton/cm^2 of skin. How long an exposure will produce perceptible erythema on her skin?
10. A fair illiterate male person who works as a coolie in road construction during the period of 1^{st} may to 7^{th} may in Rajasthan observed skin tanning. He is drinking a preparation, which contains extract of animagus. From may 19^{th} onwards, he started using a sunscreen for 2 weeks, but no effect was found. What could be the reason/s & remedy?
11. A male (35 yrs) living in Mumbai has sunburn. To get relief of irritation due to sunburn, he is using a lotion, which has the following formula. Do you expect a good recovery? Justify your answer.

Ingredients	*%w/w*
Calamine	15.0
Zinc oxide	5.0
Camphor	1.0
Zinc sulphocarbonate	1.0
Mineral oil	5.0
Glycerin	10.0
Rose water	54.0
Methyl paraben	q.s.

12. Look at the following formulation:

Ingredients	*%w/w*
Sunscreen agent	10.0
Nonionic surfactant	2.5
Ethyleneglycol monostearate	2.0
Propyleneglycol	8.0
Dihydroxyacetone	3.0
Water	74.5
Perfume	q.s.
Preservative	q.s.

What will happen if:
(a) there is no sunscreen agent in the above formulation?
(b) the concentration of dihydroxyacetone exceeds 5%?
(c) the concentration of dihydroxyacetone is 10% and pH is 2.5?

13. Mr. Ali (resident of Saudi Arabia) has a very pale and sensitive skin. He prefers to have a tanned complexion, but when he goes out in the sun, he develops painful skin burns instead of a healthy tan. To do away with this problem, he visits a pharmacist who dispenses him the following product:

Ingredients	*%w/w*
p-amino benzoic acid	5.0
Methyl cellulose	0.5
Glycerol	5.0
Ethyl alcohol	40.0
Perfume	q.s.
Purified water	q.s. to 100

He starts using this 'sunscreen preparation' before sun exposure. Though the amount of tan produced is negligible, he does not develop a painful skin burn and he is partially satisfied with the preparation until the 15th day after which he starts developing a swelling and blistering reaction on the sun exposed regions.

(a) What are the probable reason/s for this reaction, which appears from 15th day onwards

(b) Provided to you are: Calamine, Ethyl *p*-aminobenzoate, Ethyl alcohol, Methyl *p*-hydroxy benzoate, Dihydroxyacetone, Ethyl *p*-dimethyl amino-benzoate, Zinc oxide, Methyl salicylate and Titanium dioxide. As a 'dispensing pharmacist', choose one or more ingredients from this list to custom-make a preparation specifically for Mr. Ali. Incorporate any auxiliary ingredients on your own. Give justification of the ingredients chosen and also the proportion in which incorporated.

14. Following preparation was formulated as a 'palliative preparation' for sunburn:

Ingredients	*%w/w*
Petroleum jelly	20.0
Mineral oil	10.0
Methyl salicylate	10.0
Lanolin	5.0
Sodium stearate	5.0
Salicylic acid	2.0
Purified water	q.s. to 100

Would this formula be effective for the purpose? If yes, then justify. If no, then make changes and give reasons for the same.

Ch. 7 Hair

1. A woman of age 50 yrs has white hair on her scalp. A man of same age also has white hair on his scalp but more whitening is seen. Why does it happen so?
2. How hair responds to external stimuli?
3. Why redness of hair occurs.
4. What are the elements in brown hair?
5. (a) How are skin, hair, and nails similar and how are they different
   (b) Upon which two factors does the length of hair depend?
   (c) What are the probable causes of 'alopecia areata' (patchy baldness)
   (d) What effect will cutting, plucking and exposing the hair to ultraviolet radiation for long time respectively, have on hair and its growth cycle?
6. What is greying of hair? What could be the probable reason(s) and remedy(ies) for the same?
7. Write whether the given statement is true or false with justification. Hair should be trimmed regularly because cutting the hair from the tips stimulates a new anagen phase.

Ch. 8-11 Hair Cleansing Preparations

1. How will you test a shampoo for its eye irritation? Mention the steps in brief. What is the significance of carrying out this test?

2. What are principle and secondary surfactants in the shampoo preparations? Explain their role in the formulation of liquid shampoos with examples.
3. Discuss the evaluation of the shampoos.
4. Design a shampoo formulation for red, scaly, irritable scalp skin. Person is also been found to be suffering from seborrheic dermatitis. Give the formula, justify the use each ingredient.
5. Mention the main uses of surfactants in hair cleansers.
6. A manufacturer uses the following formula for making a 'shampoo'.

Ingredients	*%w/w*
Sodium stearate	50.0
Sodium chloride	3.0
Perfume, colour and preservative	q.s.
Purified water	q.s. to 100

Mention the purpose of each ingredient in the formulation. As a product development executive, will you proceed with this formula or would you make some changes? If you decide to make change/s, account for each addition/deletion of ingredients or change in proportion/s. Otherwise, justify the appropriateness of the current formula.

7. Formulate a 'Hair tonic' for alopecia areata. Justify your choice of ingredients and the proportions in which you plan to incorporate them. Also, write the directions for using the same.
8. For sensitivity testing of a hair dye containing coal tar colour, what will you do.

Ch. 12 Hair wavers, Curlers and Straighteners

1 Look at the following formula:

Ingredients	*Quantity*
Triethanolamine	3.0 g
Monoethanolamine	3.0 g
Ammonium carbonate	0.25 g
Borax	3.25 g
Sodium/Potassium sulphate	0.5 g
Glycol sulphate	0.65 g
Water	89.35 g
Perfume	q.s.

A woman using the above hair waving solution found her hair as becoming hard and cuticle becoming brittle. What might be the probable reason? Suggest the modifications in the above formula accordingly

2. Why the pH of alkali solution of substituted mercaptan need to be maintained in between 9.2–9.5?
3. What is the best method to achieve cold waving and why? How the processing time can be prolonged?
4. Discuss the microanatomy of the Hair Follicle. Describe, in short, the various phases involved in hair cycle.

Ch. 13 Hair Removers

1 Given a formulation:

Ingredients	*Quantity*
Barium sulphide	10.0 g
Zinc sulphide	10.0 g
Glycerine	15.0 g
Polyethylene glycol	2.5 g
Sodium CMC	3.0 g
Water	9.5 g
Perfume	q.s.
Preservative	q.s.

What happens:
(a) if barium sulphide alone is replaced by strontium sulphide?
(b) if both barium sulphide and zinc sulphide are replaced by strontium sulphide?

2. A cosmetologist plucked the hair of 40 yrs old lady by tweezers, where the plucked hair is removed along with hair bulbs. To avoid discomfort of pulling hair she applied benzocaine. After two days the female complained of infection at the site of hair removal
(a) What is the name of procedure the cosmetologist used
(b) To prevent such infection what might may be given?
3. Name the functions of the main components present in a Depilatory.
4. Mention the purposes of main ingredients used in hair lacquers.

Ch. 14 Shaving Preparations

1 Why do shaving soaps contain little amount of sodium soap than potassium soap?

2 Mention the role of super fatting agents in shaving preparations at usual concentration (30%), at a concentration beyond (50%) and at too low

concentration (5%).

3 Lotions used as after-shave preparations contain alcohol, emollient, antiseptic etc. If there is skin sensitivity with the lotion what should be the remedy for this?

4 Theoretically 'Lather shaving cream' should corrode the razor blade edge more than the 'brushless shaving cream', but practically, it is the other way around. Justify this statement.

5 Why do some people prefer using 'aerosol shaving cream' even though it is more expensive than normal/conventional shaving cream preparation dispensed in tubes?

6 (a) What is an 'after-shave powder? How is it similar to and different from 'body talcum powder'?
(b) What properties should an after-shave powder possess? Mention one ingredient (per property) that will help in achieving those desired properties.

7. Formulate an after-shave preparation. Justify the formula.

8. What are 'beard softeners'? When are they used? What do they contain as their main component/s?

9. Justify the statement: pre-shave preparations for wet shaving have an opposite action to that of pre-electric shave preparations.

Ch. 15 Nail

1. What is the difference between eponychium and hyponychium?

2. An obese (because of thyroid problem) T.V. actress applies nail varnishes twice daily, for 5 days in a week without any supplementation to nails. Her nails are brittle and hard. What are all the probable reasons for this and give at least two important suggestions.

3. A male dhobi who was always in contact with water, detergents had red and swollen nails, which became rough, opaque and brittle afterwards. Name the infection and its origin. Also name the later stage of infection and state how does it occur.

4. What is cuticle? How nail polish and nail lacquer similar?

Ch. 16 Nail Lacquers and Removers

1. Justify the following:
(a) 100% acetone is not an ideal solvent for removing nail lacquers.
(b) Castor oil is often used as a plasticizer in nail lacquers, but in conjunction with another plasticizer.

2. Acetone alone cannot remove coatings of nail varnish. Some additional ingredients are also incorporated in nail varnish removers. What are they and why do we incorporate them?

3. Following is the formula of a nail varnish:

Ingredients	*% w/w*
Nitrocellulose	18.0
Sulphonamide-formaldehyde resin	6.5
Dibutyl phthalate	3.0
Castor oil	1.5
Ethyl acetate	10.0
Butyl acetate	20.0
Isopropyl alcohol	10.0
Toluene	22.0
Red iron oxide	3.5
Bismuth oxychloride	1.0
Titanium dioxide	0.5
Bentonite 27	1.0
Perfume	3.0

Nitrocellulose is soluble in ethyl acetate and butyl acetate.

Make a flow chart, clearly indicating the procedure you would employ for preparing this nail varnish. Mention the order of addition, temperature or condition wherever applicable.

4. Justify the statement: Formulations of top coat (nail varnish) contain higher proportion of nitrocellulose and plasticizer, and lower proportion of resin.

Ch. 17 Auxiliary Products for Nails

1. The following preparation was made with a view to treat brittle nails:

Ingredients	*%w/w*
Glycerol	15.0
Triethanolamine	11.0
Perfume	q.s.
Purified water	q.s. to 100

Can it be used for treating brittle nails? Why (what effect will it have)? Formulate a preparation on your own to treat brittle nails. Justify.

2. Enumerate the differences between Nail bleach and Nail white.

3. What is a 'fingernail-elongator'?

4. Your nails are dry and brittle and split very easily. Which of the following would you adopt to attain healthy nails? The right option could

be none, one or more than one. Give reason for either choosing an option or rejecting an option.

(a) Massaging your nails with a good brand cuticle remover once in a week
(b) Oral ingestion of 2.0 g of gelatin for one month
(c) Keeping the nails clean by frequent washing with soap and water
(d) Applying a fresh coat of nail varnish everyday after cleaning the previous application with a nail remover.
(e) Soaking the nails in warm water followed by application of a nail cream before going to bed (once in a week)
(f) Soaking the nails in 4% HCl solution (Conc. HCl in water) followed by application of a good quality nail white before going to sleep (once in a week)
(g) Oral ingestion of 2.0 g of PABA for one month

Ch. 18 Tooth and Oral Cavity

1. Teeth tend to develop: calculus, acquired pellicle, plaque and caries. What is the order of occurrence of these on teeth?
2. Enumerate the measures that could be taken to control caries.

Ch. 19-20 Dental Care Preparations

1. Enumerate the physical/functional parameters that you would evaluate in the tooth powder.
2. Enumerate the differences between tooth powder and toothpaste.
3. You own a cosmetic manufacturing unit. One of the products is toothpaste (net weight 50 grams). Make a draft of the label (including all necessary information) for the same.
4. How will you evaluate toothpaste after manufacturing?
5. Name the functions of main ingredients present in a mouthwash.
6. Comment on the statement: It is advisable to prevent the formation of tartar rather than to remove it afterwards.
7. Following represents a formula of toothpaste, with some stability problem/s:

Ingredients	*%w/w*
Precipitated calcium carbonate	50.0
Glycerol	30.0
Sodium lauryl sarcosinate	2.5
Essential oils (peppermint, clove and anise)	7.5
Hydroxyethyl cellulose	1.5
Zinc chloride	0.5
Stannous fluoride	0.4
Chloroform	0.25
Sodium saccharine	0.05
Purified water	q.s. to 100

Make minimum change/s in the above formula to make it stable. What is the function of each ingredient in the preparation?

8. Provided to you is the following formula:

Ingredients	*%w/w*
Potash alum	2.0
Alcohol	10.0
Purified water	q.s. to 100

Would you prefer using this preparation as a 'mouth wash', 'astringent lotion' or both? Justify your choice. If you were given the liberty to make minimum changes in the formula to make it an ideal mouthwash preparation, what would be those changes? Support your answer with reasons.

9. Look at the following formula of a mouth wash:

Ingredients	*%w/w*
Zinc phenolsulphonate	3.0
Glycerol	8.0
Menthol	0.05
Alcohol	15.0
Preservative	q.s.
Purified water	q.s. to 100

(a) To what type of customers will this product be targeted?
(b) Would consumers readily accept the above composition as a mouthwash? If yes, justify. If no, then suggest some improvisations and give reasons for the same.
(c) Give 'directions for use' that you would include on the label of this product.
(d) To which other category/ies of preparations can this formula belong? Justify.

Miscellaneous

1. You are provided with two emulsifying agents: A (HLB value-2.3) and B (HLB value-7.4). In what proportion will you mix the two to obtain a requisite HLB value of 6.7?

2. What are spans and tweens and what type of emulsions they make? Why?
3. What is silicone oil? Where is it employed and why?
4. What are the types of stability testing to which a finished product is subjected?
5. Out of oleic acid, liquid paraffin and coconut oil which one is least likely to undergo oxidation? Give reason/s.
6. Usually tocopherols are naturally present in fats and oils. Give the probable reason/s for the same.
7. What will heating the water to 120°C in a thin film and then instantaneously cooling it do? Will it demineralize the water? Enumerate the processes you would employ for demineralizing water for making cosmetic preparations.
8. What are volatile silicones? Where are they used and why?
9. What is the full form of cetrimide? What are its uses in cosmetic products?
10. What is UHST of water? What is its purpose?
11. Suggest two means by which a red toner is converted into a red lake.
12. Silicones can be present in the form of volatile free flowing liquids, higher boiling point viscous liquids, as well as resinous semi- solids. Justify.
13. Enumerate the methods that can be employed for microbiological purification of water, meant for making cosmetic preparations.
14. What are stearic acid and oleic acid? For what purpose/s are they employed in cosmetic products?
15. Enumerate the functions of ethyl alcohol and soft paraffin.
16. What is ambient condition testing of a product and what is its significance?
17. Enumerate 4 categories of cosmetic products for which you would carry out skin sensitivity testing.
18. Write the applications of zinc oxide in different formulations.
19. How will you build quality into the final product?
20. Your firm has been provided with 100 containers (containing 10 kg each) of purified talc by a supplier. What would be the sampling technique adopted by your 'quality assurance dept.' to minimize variability in results.
21. What is 'repeated insult test'? What are the limitations of 'prophetic patch test' that the 'repeat insult test' overcomes?
22. Give two examples of each of the following category of components. In which all cosmetic preparations are they used and what function do they perform in those specific preparation/s?
    (a) Quaternary ammonium compounds (b) Thioglycollates
    (c) Vegetable oils (d) Mineral hydrocolloids
    (e) Synthetic resins (f) Higher fatty acids

SUBJECT INDEX

APPENDIX-III

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APPENDIX-IV

Model Questions

Ch. 1 The Skin

1. Name the skin surfaces that are exempted from the distribution of hair follicles.
2. How does skin prevent infection?
3. Skin is the largest organ. Justify by emphasizing the functions it performs.
4. Name the substance that is produced by tyrosine (amino acid) in the skin.
5. For an average 5 foot, 58 kg human of surface area 1.58 m^2, what will be the total number of hair follicles and sebaceous glands approximately?
6. Identify the following conditions:
   (a) Scaly red patches on the elbows, which bleed on removing the scales.
   (b) Flaking of stratum corneum on scalp due to microbial infection.
7. Skin continually replaces cells, removed by wear and abrasion with new cells, migrating upwards from below. Then, how is it possible that the colour of an individual's skin remains more or less constant through out the lifetime?
8. What is strophulus/prickly heat? What is the reason for the lesions that develop?
9. What is the difference between melanocytes and keratinocytes with respect to their structure, function and location?
10. What are the changes that occur in the skin due to aging?
11. Mention and briefly explain the various disorders of the oil and sweat glands (present in the skin).

Ch. 3 Powders and Compacts

1. Face powders have optimum particle size. Justify.
2. What are the typical characteristics required in a face powder? Give a few examples of the raw materials that impart these characteristics.
3. Which category of ingredients are added in powders for proper spread and for proper adherence respectively? Give examples.
4. What is the basic difference between a 'loose' and a 'compact' face powder? How are they similar?

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