Program	B. Pharmacy
Name of Unit	Cosmetic & Packing material
Subject /Course name	INDUSTRIAL PHARMACY -1
Subject/Course ID	BP 502T
Class: B.Pharm. Semester	V
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Learning Outcome of Module 05

LO	Learning Outcome (LO)	Course Outcome Code
LO1	Students will learn about the cosmaceutical products.	BP502.1 BP502.2
LO2	Students also studied about consideration of cosmetic product.	BP502.1
LO3	Students will learn about the art of packing material for different pharmaceutical products .	BP 502.1
LO4	Students will understand quality control parameters of packing.	BP502.1

Content of Module

Topic
• Introduction, Skin physiology, Classification of cosmetics • Formulation and Evaluation of Lipstick, Shampoos, Cold and vanishing cream, Tooth paste, Hair dyes and Sunscrens • Function of packaging, Types of packaging systems • Packaging materials with respect to different dosage forms • Stability testing and Quality control

INTRODUCTION OF COSMETICS

Cosmetic is a Greek word which means to 'adorn' (addition of something decorative to a person or a thing). It may be defined as a substance which comes in contact with various parts of the human body like hair, skin, nail, lips, teeth, and mucous membranes etc. Cosmetic substances help in improving or changing the outward show of the body and also mask the odour of the body. It protects the skin and keeps it in good condition. In general, cosmetics are external preparations which are applied on the external parts of the body.

Even in earlier days, men and women used to decorate their bodies for improvement of appearance. Men used leaves of vegetables and parts of animals whereas women use to wear colored stones and flowers round their neck and wrist. Gradually, they start using colored earth and ointments on their face and body. Even bangles and necklace made of baked earth materials became very common among the people. Eye shadow were made of copper (coloured earth) and lamp black (coloured earth) while red colour was used for dyeing of hair.

Currently, cosmetics are considered as essential components in life. They not only, attract the people towards it but also impart psychological effects. It has gained popularity in the last 3-4 decades and its use has been increased exponentially both-in males and females. The most popular cosmetics are powders, hair dyes and creams. Most countries have now laws to control, manufacture, labeling, sale etc. of cosmetics in such a way that use of cosmetics harmful to health is prevented. In India Drug Act has been renamed as Drug and Cosmetic Act and contains some section to exercise control over cosmetics.

The cosmetic in gerenal 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 nail for the purpose of covering, colouring, softening, cleansing, nourishing, setting, mollification, preservation, removal and protection.

SKIN PHYSIOLOGY

The skin is a complex, multipurpose organ, one that attracts much attention and scientific study. Science is constantly unraveling the intricacies of skin physiology, of the chemical substances present in the skin, and of their interaction. This knowledge, in turn, increases the understanding of the process of skin disease and skin aging. Scientists are identifying the skin’s individual chemical compounds and physiological reactions that accelerate aging. With the aging process better understood, laboratories are developing and incorporating new ingredients into cosmetic products that can reduce or decelerate aging and other skin problems, as well as counteract and/or correct

them. A large number of new cosmetic ingredients have been incorporated into cosmetic products in the last 9 years and this is expected to continue at a fast pace. Many of these ingredients are intended to delay the aging process, rejuvenate the skin, improve skin problems, and even reduce the risk of skin cancer. An increased understanding of skin physiology allows for more targeted and effective skin care cosmetic formulations.

Functions

- As the body's largest organ, the skin performs a series of key functions resulting from multiple chemical and physical reactions that take place within it.
- The skin is a barrier, protecting the body from the elements, injury and oxidation.
- It helps to maintain a constant body temperature by helping the body adaption to different ambient temperatures and atmospheric conditions through the regulation of moisture loss.
- It gathers sensory information and plays an active role in the immune system, protecting from disease.
- In order to play all of these functions protective, metabolic, sensory, and immunological the skin must maintain its own auto-repairing capacities and functional integrity.
- Cosmetic products are very important to the skin's protective function. Sunscreens protect against UV radiation and, therefore, against premature skin aging and skin cancer.
- The skin also protects internal organs from exposure to oxygen. Without the skin, the body's organs would rapidly oxidize; much like a peeled banana or apple does when its interior is left exposed to air. Through the secretion of sweat and sebum, the skin performs an excretory function, eliminating a number of harmful substances resulting from the metabolic activities of the intestine and the liver.
- Creams and lotions with a bactericidal effect reduce and/or control excessive proliferation of bacteria on the skin, a problem particularly associated with oily skin, and one of the main causes of acne development. And, by forming an invisible barrier on the skin's surface, specific moisturizing ingredients can help reduce the skin's moisture loss that results in dehydration.
- The skin also secretes hormones and enzymes. When the skin's chemistry and chemical composition are not compatible with a particular product's ingredient(s), the result is overall product sensitivity and even allergic reactions.
- The large number of nerve endings in the skin makes it sensitive to touch. As a result, the skin is a sensory organ and the point of receptivity for cold, heat, and pain.

- The skin plays an immunological role, primarily through the Langerhans cells, which carry antigens from the skin to the lymphatic system. Excessive UV radiation either destroys or inhibits the performance of Langerhans cells, increasing the risk of skin cancer.
- The skin tends to be discussed and treated as an entity unto itself, so this close relationship between the skin and the body is often overlooked or forgotten. Although it protects the body in a variety of ways, the skin and its condition are governed by a number of internal body functions. For example, skin oiliness arises from oil gland hyperactivity.
- Pigmentation problems are due to the tyrosinase enzyme, and are regulated by hormonal functions. Given this relationship between the skin and the body, for the skin to look its best, there is a need for overall health through proper nutrition, exercise, and rest. This connection also highlights the potential problems that ingredients penetrating deep into the dermis may cause if they are systemically absorbed by the capillary system. When the skin performs in perfect harmony, the result is a beautiful, glowing, healthy complexion. If the skin is not in harmony because of deterioration due to age, sun damage, bacterial infection, hyperkeratinization, or simply loss of natural moisture, cosmetic products are meant to assist in restoring its balance and beauty. They must do so, however, by working in conjunction with the skin's very complex structure.

Structure

The key to a better understanding of the skin's functions is to take a closer look at its structure. A vertical section of the skin reveals three distinct layers, namely the outermost epidermis, the dermis and finally the hypodermis or subcutaneous layer.

(a) Epidermis

The epidermis is an a vascular structure, made up of many layers of cells. The special structure of the epidermis is classified as stratified squamous epithelium and is typical of vertebrate animals. It is responsible for producing the main barrier known as the **horny layer** or **stratum corneum,** which forms the outermost part of the epidermis. The horny layer is made up of water-resistant dead cells, called corneocytes, which are segmented together with a complex lipid material. The epidermis varies in thickness from 75 to 150 micrometres in most areas to 4 mm on the palms of the hands and the soles of the feet. In terms of cells the epidermis consists of about 35 cell layers of which 15-20 layers make up the horny layer. It rests on the connective tissue component of the skin known as the dermis, which contains blood vessels and lymphatic vessels. The epidermis itself is avascular. The area of contact between the epidermis and the dermis is an undulating surface, which

helps to secure attachment, increasing the surface area for the supply of nutrients to the epidermis via the blood vessels, known as dermal papillae.

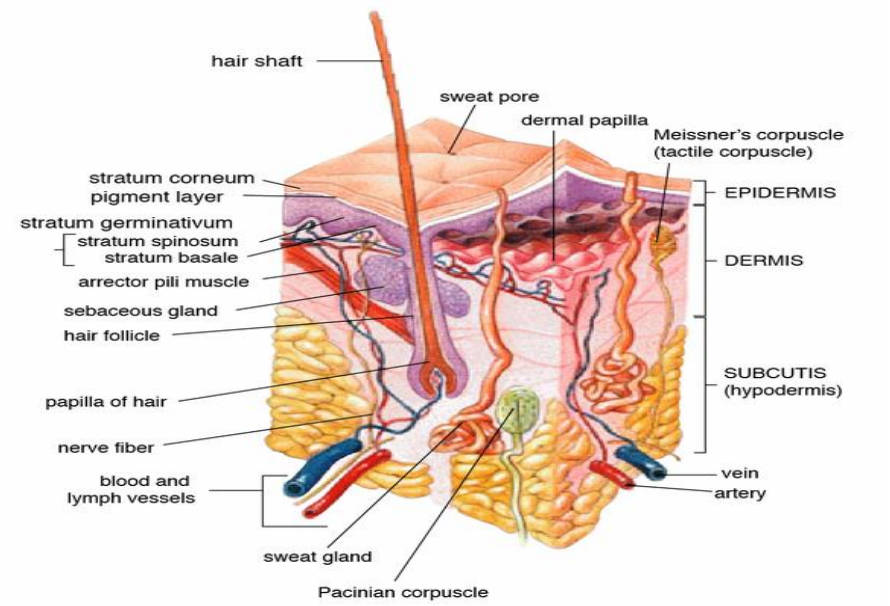

Figure 1: Structure of Skin

The lower living layers of the epidermis can also be subdivided as follows:

- The germinative or basal layer.
- The stratum spinosum or prickle cell layer.
- The stratum granulosum or granular layer, which is characterized by the presence of distinctive keratohyalin granules.

Keratinization

The dynamic process of epidermal renewal is known as keratinization. It begins in the basal layer where the cells, known as keratinocytes, multiply by mitotic cell division and are continually pushed upwards producing the protein, keratin. By the time these keratinocytes reach the outer layer they are dead, water resistant flakes which are segmented together with a complex lipid material. Due to wear and tear, these cells in the horny layer are lost to the environment in a process called desquamation.

Prickle cell layer. The dividing keratinocytes move outwards into the prickle cell layer and assume a more flattened or polyhedral shape. They are described as prickle cells because when they are isolated they have numerous tiny projections. These cells synthesize a network of keratin filaments within the cytoplasm, called tonofibrils.

Granular layer:

As the keratinocytes move into the granular layer they become more flattened and synthesize a compact amorphous material called keratohyalin. The latter bunches up to enclose the tonofibrils.

Degradation of cell organelles:

The next stage involves the degradation of the cell organelles, namely the mitochondria, ribosomes and ultimately the nucleus. The cells are markedly flattened and are filled with keratohyalin masses and filaments. At the same time an insoluble keratinized envelope surrounds the cells. The degraded cell organelles contribute to the formation of a hygroscopic amino acid pool commonly referred to as the **natural moisturizing factor** (NMF). The NMF acts as a water resevoir in the horny layer, which keeps the latter pliable and feeling soft.

Formation of stratum corneum:

The keratinized cells, now known as corneocytes, pump out lamellar granules, which are thought to be arranged into lipid bilayers between the cells of the lower stratum corneum. These intercellular lipids contribute to the maintenance of healthy skin in several ways; namely, hydration, corneocyte adhesion and reduction in transepidermal water loss.

Desquamation:

In the upper stratum corneum this series of lipid bilayers becomes progressively more haphazard. This process, together with the degradation of the desmosomes, is involved in the poorly understood mechanism that is associated with the desquamation of the superficial cells into the environment. The human epidermis is able to maintain its functions by virtue of the structure plus its ability to renew itself constantly. It has been reported that the whole epidermis renews itself once every 2 months.

(b) Dermis

The dermis functions as a supporting frame to the epidermis, supplying it with nutrients via the blood capillaries. It also supports the sensory nervous system, secretory glands and hair follicles.

Unlike the epidermis, which is a cellular structure, the underlying dermis consists of connective tissue. Other examples of connective tissue in the body include bone, cartilage and loose areolar tissue. In skin, the connective tissue consists of a fairly dense network of protein fibres embedded in a hydrophilic viscoelastic gel called the ground substance. Cells known as fibroblasts carry out synthesis, maintenance and replacement of this connective tissue.

Collagen forms the major constituent of the fibrous protein which gives the skin its tensile strength. These collagen fibres make up 30% of the wet weight of the dermis and are arranged largely as

interwoven strands or bundles that lie in a plane which is parallel to the skin's surface. The second type of protein fibre is called elastin; this makes up a smaller percentage and tends to be interwoven among the collagen bundles. These elastic fibres allow the skin to deform and return to its original state once the pressure or tension is removed.

Ground substance:

The dermal ground substance consists of salt, water and glycosaminoglycans. The latter form complexes with protein molecules known as proteoglycans. The best-known examples of 'glycosaminoglycans' are hyaluronic acid and chondroitin sulfate. Hyaluronic acid is known to play a vital role in the hydration of tissues since it carries with it a large volume of water.

Mast cells:

The mast cells, which are the second major cell type in the dermis, can be found close to the small blood vessels. They are responsible for synthesis and secretion of (a) heparin, which is an anticoagulant, and (b) histamine (c) prostaglandins, both of which have vasoactive properties.

Sweat glands:

Sweat glands are found only in mammals. There are two distinct types of sweat glands: the eccrine and apocrine glands. The apocrine glands are associated with the hair follicles in the dermis and are found in the axillae, breasts, ear canal and anogenital region. Their function is not well understood. They are under the control of the sex hormones and, like the sebaceous glands, become active around puberty; in particular, they respond to emotional stress. Apocrine sweat is produced in minute quantities, about 1 µl/day, and expelled by contraction of the smooth muscle around the apocrine duct, as a milky viscous fluid. The latter is sterile and odourless but is then quickly broken down by the skin bacteria (diphtheroids) to produce more than one hundred volatile substances. The result is the production of socially unacceptable odours, particularly in the axillae. This presents a challenge to formulators of deodorant and antiperspirant products

Sensory skin receptors:

Human skin is the largest sensory organ of the body, and within this function it serves to maintain an open communication channel between the body and the external environment. The cosmetic scientist knows that the perceived texture of, say, a moisturizing lotion before, during and after use is a very important factor which helps the consumer to decide which to pick from a dozen others on the shelf. For instance, a person with dry skin may prefer to use the heavier texture of a cream because he/she perceives it to be more efficacious than a light milk. This may not be true technically but it is necessary also to appeal to the consumer's perception. External stimuli usually

result in sensations which can be classified into two groups: thermal and/or tactile; pleasurable or unpleasant. Sensory receptors in the skin pass incoming information to the brain via nerve fibres which travel through the spinal cord to the cortex of the brain. The latter then relay a series of responsive motor impulses in a system described as a feedback mechanism. In general, the sensory nerves all arise from the spinal nerve branches. These branches are arranged in such a way that one branch serves an area called a dermatome.

(c) Hypodermis

Below the epidermis there is a layer of fatty or adipose tissue called the hypodermis. The cells in this layer synthesize and store fat as an energy reserve. This is to help insulate the body from low external temperatures and to act as a buffer against trauma. On a more familiar note, the hypodermis provides the body with its contours, whether they are attractive curves or unwelcome bulges.

LIPSTICKS

Lipstick may be basically defined as dispersion of the colouring matter in a base consisting of a suitable blend of oils, fats and waxes with suitable perfumes and flavours moulded in the form of sticks to impart attractive gloss and colour, when applied on lips. Lipsticks provide moist appearance to the lips accentuating them and disguising their defects.

Lipsticks are made from hydrophobic materials. When the solid formula is applied to lip surface, friction melts it briefly and allow for transfer. The materials cool and reform creating a film that sticks to surface due to hydrophobic interactions. Color is a key ingredient of lipsticks. It gives an impression on lip surface. Silicones and oily materials are also added to reflect light and provide shine. In general, wax and oil make up about 60 % of the lipstick (by weight), with alcohol and pigment accounting for another 25 % (by weight). Fragrance is always added to lipstick, but accounts for one percent or less of the mixture. In addition to using lipstick to color the lips, there are also lip liners and **pencils.** The manufacturing methods described here will just focus on lipstick and lip balms.

Ideal Characteristics of Lipsticks

The ideal requirements for the formation of a good lipstick may be as follows:

- It should be able to maintain the intensity of colour without any alteration in the degree of its shade.
- It should efficiently cover lips with colour and impart a gloss which would last long.
- It should be able to adhere firmly to the lips and should not provide any greasy appearance.

- It should possess good thixotropic property so as to deposit the colour with minimum pressure.
- It should show a smear proof coloring effect.
- It should possess required plasticity and be able to maintain all the properties throughout the storage period.
- It should not be gritty.
- It should be easily dried.
- The stick should possess even firmness and should maintain its strength at varying temperatures up to 55 °C.
- The stick should not dry or crumble easily.
- The lipstick should possess a pleasant fragrance and a good flavour.
- Should be safe and non-irritating to the lips.

Formulation of lipsticks

The lipstick base is made by mixing the oils and waxes in varying proportions in order to obtain a desirable viscosity and melting point.

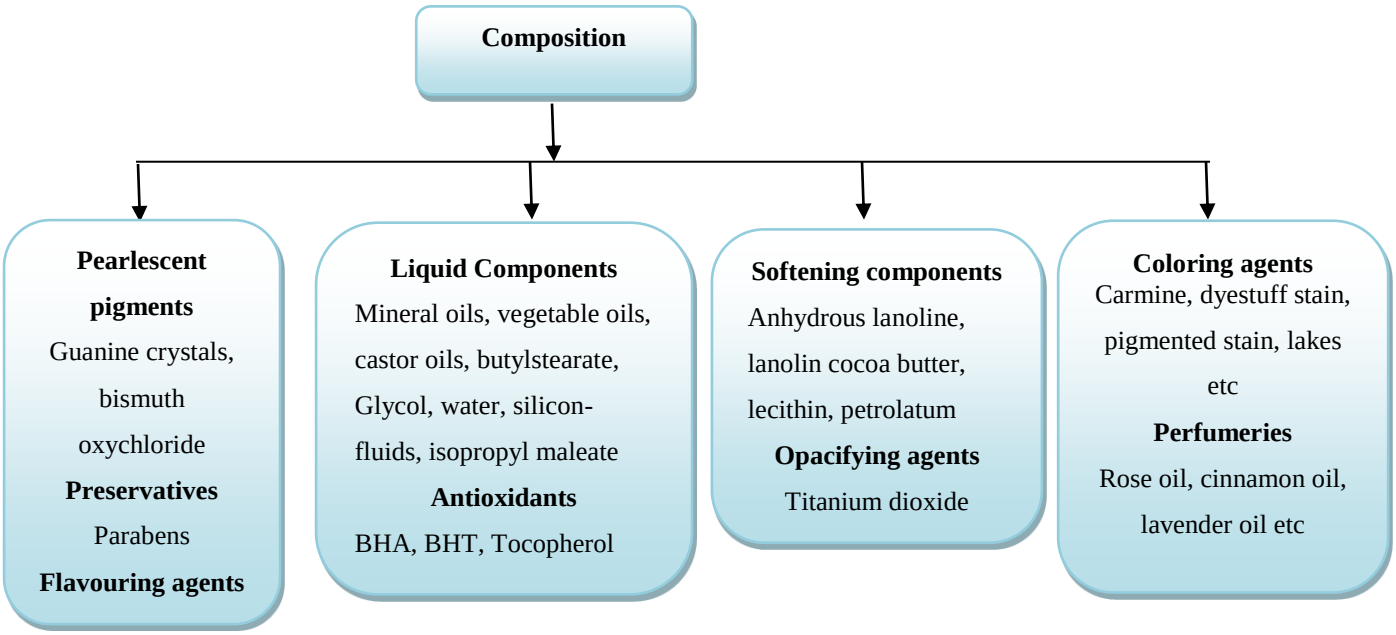

Figure 3: Raw materials used in the Formulation of the Lipsticks

1. **The Solid Components/waxes:** The solid components are responsible for the final structure of the product by solidifying the liquid matrix. The materials required for attaining a reasonable body, hardness, melting point and shrinkage necessary for the easy release of the mould are together referred to as natural waxes. The solid components of the formulation are mostly natural waxes which may be classified as follows:

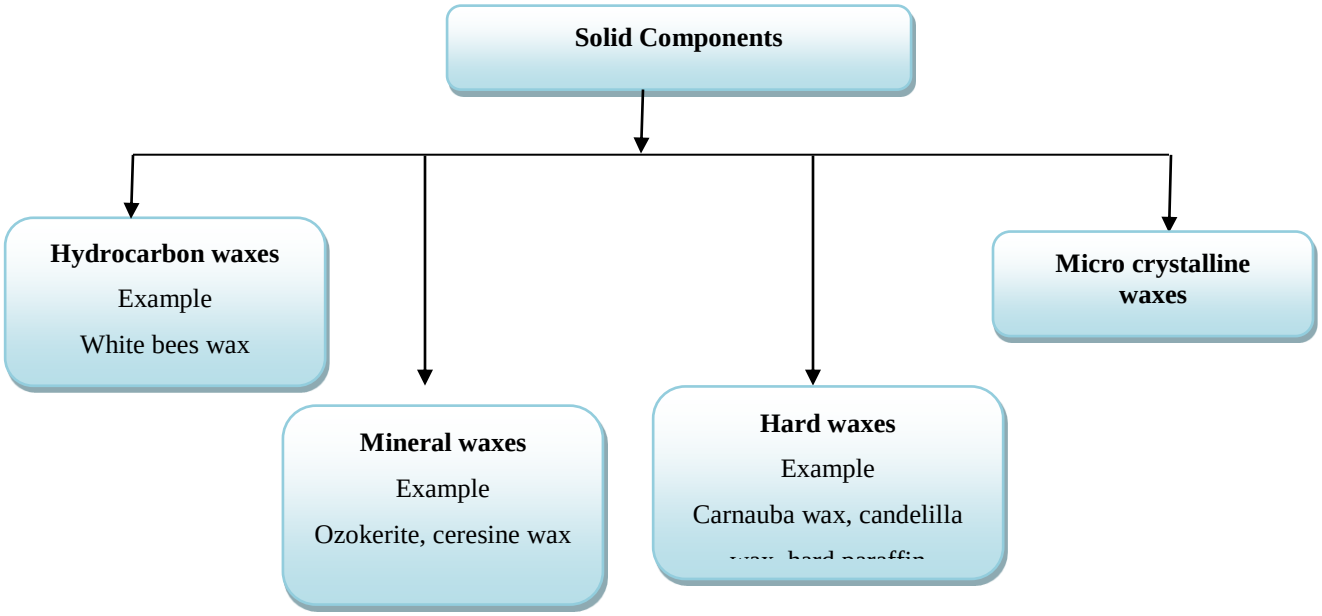

Figure 4: Solid Components used in Lipsticks

(a) Hydrocarbon Waxes :

White Bees wax:

It is also known as the common wax and forms the oily base in the formulation of lipsticks.

Source: It is naturally obtained from honey combs of the honey bee Apis mellifera.

Melting Point: the ranges between 62 – 65 °C.

Concentration: It is used in concentrations of about 3-10 % of the total formulation. Available Forms: It is available in the form of blocks, pills, slabs and cakes. The commercially available bleached form is widely used.

Uses:

1. It forms an important base and is extensively used for entrapping castor oil.
2. It has good plastic property and can be readily deformed when it is warmed.
3. It is used as a traditional stiffening agent for lipsticks.
4. It forms a good base in the formulation of moulded products.

Advantages:

1. It is compatible with vegetable minerals and animal waxes.
2. It can be moulded into required form.

Disadvantage: When it is used at a concentration of more than 20 %, it forms a dull film on the surface of the lips. It is usually mixed along with other waxes such as Ozokerite wax, carnauba wax and candelilla wax.

(b) Mineral Waxes: They are not popular and have been replaced by the microcrystalline waxes but still used with the same names. They are:

(i) Ozokerite Wax:

Source: It is a type of amorphous hydrocarbon obtained naturally, from bituminous products.
Melting Points: It is available in various grades with melting point ranging between 56-82°C.
Concentration: It is used in a concentration range of between 5 to 10%.

Uses:

1. It is used in order to increase the Melting point of the base.
2. It is also efficient in promoting the formulation of a fine crystalline wax gel and thus ensures the maximum retention of the oil matrix.
3. It can be easily transformed into required shapes.

Advantage: It is easily available in various grades.

Disadvantage: It may be subjected to adulteration.

(ii) Ceresine Wax:

Source: It is also obtained naturally from the bituminous products like the Ozokerite wax**.**
Melting Point: The melting point range is between 60–75 °C.

Uses:

1. It is used as stiffening agents to provide firmness to the finished product.
2. It is used to increase melting point of the base.

(c) Hard Waxes: These waxes are mainly responsible for the shape and the hardness of the lipsticks. They include the following waxes,

(i) Carnauba Wax:

Source: It is obtained as exudates from the pores of the leaves of the Brazilian wax palm tree Copernicia prunifera. The extraction involves cutting, drying and heating of the leaves.
Melting Point: Its melting point ranges between 81–90 °C.
Available Forms: It is available in three colors yellow, gray and brown. It is available in hard forms and soft forms.

Uses:

1. It is used in modest proportion in order to ensure high melting points.
2. It is used to provide rigidity to the stick.
3. It helps in moulding by shrinking the stick away from the surface of the mould in order to aid easy removal.

Disadvantage: It is not miscible with the other waxes and remains as a separate solid phase due to its high melting point.

(ii) Candelilla Wax:

Source: It is obtained from Euphorbiaceae plants such as Euphorbia cerifera and Euphorbia antisyphilitica. The extraction involves the immersing of the plant in boiling water containing sulfuric acid and later skimming off the wax that rises to the surface.

Melting Point: Its melting point ranges between 65 – 75 °C.

Uses: It is used to increase the hardness and melting point of the product either alone or in combination with carnauba wax.

(iii) Hard Paraffin:

Source: It may be present as a purified blend of several solid Hydrocarbon bases that are obtained from petroleum.

Melting Point: Its melting point ranges between 55 – 65 °C.

Uses: It is occasionally used in minor quantities to improve the gloss of the finished products.

2. Imparts rigidity to the product.

Disadvantage: It has limited solubility in the castor oil and hence doesn't dissolve and may provide a greasy look.

(d) Microcrystalline Waxes: They are the hydrocarbons containing a long carbon chain.

Melting Point: They have wide melting points ranging between 60- 120°C.

Uses: They help in maintaining the crystal structure of the lipstick and hence may prevent the sweating.

Disadvantage: They possess low solubility in the castor oil.

Liquid Components: The liquid components are mostly constituted by the oils such as mineral oil, vegetable oil, castor oil, alcohol etc.

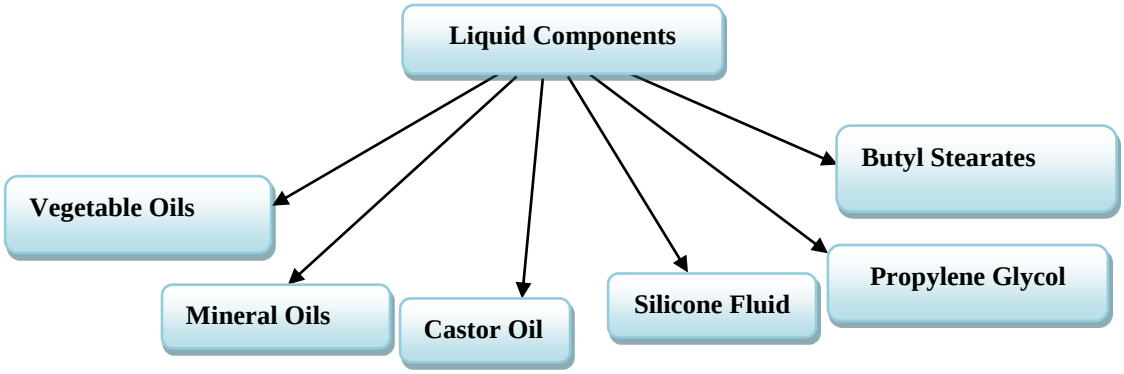

Figure 5: Liquid components used in lipsticks

The properties of the oils should be as follows:

(i) It should possess good dissolution properties in order to dissolve all the bromo acids.

(ii) It should possess an optimum viscosity range.

(iii) It should be colourless, odourless and tasteless.

(iv) It should be non-toxic and non-irritating.

(v) It should be easily compatible and stable.

The most commonly used liquid components may be as follows:

(a) Vegetable Oils: The vegetable oils used may be sesame oil and olive oil. The vegetable oils provides low solubility towards staining dyes and hence less commonly used.

(b) Mineral Oils:

(i) They consist of a blend of hydrocarbons obtained from petroleum source.

(ii) They may be availale as either light mineral oils or heavy mineral oils.

(iii) They are mostly used in order to impart gloss to the product rather than their solvent property.

(iv) They are used in concentrations of less than 5% and are not rancid.

(c) Castor Oil: It is obtained from the seeds of the castor plant, Ricinus communis. It forms a most valuable lipstick base. It may be used in concentration of 40 - 50% of the total formulation. It has high viscosity and good dissolving power. It possesses stability towards oxidation. It is widely compatible with other ingredients.

(d) Silicone Fluid: It is mostly used to aid in mould release and prevent the rub-out of the wax. It is used in minor quantities.

(e) Propylene Glycol: It is non-toxic and possesses a sweet taste. It has good wetting property towards high colouring stains. It is always used in combination with other monoesters of propylene glycol.

(f) Butyl Stearates: They are useful for the dispersion of colour though they possess less solubility. They can readily wet the colouring pigments. They are odourless and free from rancidity.

(g) Isopropyl Maleate (IPM): It is used in concentration of 2.3% to increase lip gloss. It acts as a co-solvent along with mineral oil and helps in increasing lip gloss.

(h) Water: It is not used as a solvent but may be used in minor quantities in order to dissolve the colour.

3. Softening Agents: They are used to increase the spreadability by softening the lipstick. The most commonly used softening agents include.

(a) Lanolin: It is also referred to as hydrous wool fat. It is used in minor quantities in order to

improve the covering properties of the film. It contains 25-30 % of water and may result in sticky and greasy products. It aids in the dispersion of colored pigments.

(b) Anhydrous Lanolin: It is also known as wool fat or woolwax. It is used at low concentration of about 0.25 % in order to impart gloss, softness, emolliency and protection to the lips. The melting point ranges between 36 – 42 °C.

(c) Cocoa Butter: It was used in the past due to its good emollient property. The usage has been stopped due to rancidity and surface crystallization. It provides oily look on the lips and hence imparts good gloss.

(d) Lecithin: It is used in minor quantities to impart smoothness and emollient effect. It increases the ease of application.

(e) Petrolatum: It is a hydrocarbon obtained from petroleum. It is odourless and tasteless. It is added mainly to enhance the gloss.

(f) Lanolin Derivatives: They include ethers, esters and lanolin oils. They are almost none drying and thus provide a non-greasy look to the film. They are also used as blending agents or plasticizers.

4. Colouring Agents: Colour may be imparted to the lips either by staining the lip with a dye stuff colour or by covering the lips with coloring layers. The colours used in the formulation of lipsticks are of two types:

(a) Soluble Colours: They are dye stuff agents which are easily soluble in oil, water and alcohol.

(b) Insoluble Colours: They are organic or inorganic pigments which are insoluble.

Properties of Colouring Agents:

- They should impart good opacity to the lips by imparting good colour.
- They should be easily and uniformly miscible with the oils used.
- The colours must be certified with the F, D and C grade.
- They should possess very low content of impurities such as arsenic, lead etc

The commonly used colourants for lipsticks:

(i) Pigmented Stains: They form dispersion in the solvent base. They may be either organic or inorganic. They are used in combination with metallic lakes in order to improve the intensity of the colour.

(ii) Carmine: It was extensively used in the past and is obtained as carminic acid from the cochineal insects by extracting the insects with ammonia. The carminic acid obtained is precipitated with alum and is dried.

(iii) Dye Stuff Stains: They include eosin dyes and provide a long lasting effect on the lips by retaining the color on the lip cells. They are:

(a) Acid Eosin Dye: It has orange colour and may change to intense red colour at acidic pH of 4. But they may to toxic effects such as allergic reactions or cheilitis and hence used alone with bromo acids.

(b) Eosin Dye: It is used to impart orange red colour to the lips.

(iv) Lakes: They are potential pigments of many of the D and C colours. They may be adsorbed on the aluminium hydroxides, barium oxides, and calcium oxides etc, Example: Aluminium lakes, barium or calcium lakes, strontium lakes. They are used at concentrations of about 8-10%.

5. Opacifying Agent: It is used for opacifying or whitening of lipsticks. It can also alter the basic shade of the pigment. Various shades can he obtained by, varying the proportions.

Example: Titanium Dioxide.

6. Pearlescent Pigments: They are used to impart nacreous or a pearl like appearance to the product when applied on the lips. The natural pearlescent pigments may be guanine crystals obtained from fish scales. Bismuth oxychloride in 70 % castor oil may also provide a lustrous look.

7. Perfumes: Light floral fragrances can be used in lipsticks. They include rose oil, cinnamon oil, lavender oil etc. The fruity flavours that cover fatty odour of the oily waxes may also be used. They should be tasteless, non-irritating and compatible.

8. Miscellaneous Agents: They include the following:

(a) Flavouring Agents: They are included in order to impart good flavor to the product. They may include the spearmint oil, cinnamon oil etc. Along with the flavouring agents, sodium saccharin and the ammonium glycyrrhizate may also be used in order to improve the taste.

(b) Antioxidants: The ingredients used in the formulation may be susceptible to oxidation. This may result in the degradation of the product. Thus, antioxidants are added in order to prevent oxidation of the ingredients. The commonly used antioxidants are butylated hydroxyl anisole (BHA), butylated hydroxyl toluene (BHT), tocopherol, propyl gallate, butylated hydroxyl quinines etc.

(c) Preservatives: They are used to increase life period of the product by reducing the microbial growth. Though they are anhydrous preparations, preservatives such as methyl paraben and propyl paraben may be commonly used. The concentration of the preservative should not exceed 0.1 % w/v.

Preparation of lipsticks

Successful preparation of lipstick shades depend upon the adequate dispersion of the lake colours in the lipstick mass. It is advisable to prepare the dispersion of lake colours in castor oil. Dispersions are generally prepared by milling about 25 % concentrations of lakes in castor oil. The various formulae for the preparation of lipsticks are as follows:

Formula 1	**Quantity for 100 g**
Castor oil (dissolving liquid)	54 g
Anhydrous lanoline (Emollient)	11 g
Candelilla wax (hardening agent)	9 g
Isopropyl myristate (blending agent)	8 g
White bees wax (stiffening agent)	5 g
Carnauba wax (provides rigidity)	3 g
Ozokerite wax (increase melting point)	3 g
Eosin (dye)	2 g
Lakes (color)	5 g
Rose flavour (perfume)	q. s
Tocopherol (antioxidant)	q. s
Paraben (preservative)	q. s

Method of Preparation

If a solvent is used for the dissolution of bromo acid, the solution is first prepared and set aside until required. If commercial colour pastes are not being used, then lake colours are first dispersed by mixing with suitable quantity of castor oil. The colour paste obtained is passed through a triple roller mill until it becomes smooth and free from agglomerates and gritty particles. The colour mixture is then mixed with the bromo acid mixture. All the ingredients of the base are identified and arranged in the increasing order of their melting points. This mixture is remilled until it is perfectly smooth. Preservatives and anti-oxidant are dissolved in remaining oil and are added to the mixture.

Finally, the perfume is added and the mass is stirred thoroughly, but gently to avoid entrapment of air. Automatic ejection mould is preferred for the large scale production. The mould is lubricated with liquid paraffin or isopropyl myristate before pouring the mass into the mould. It is important to

prevent settling down of the coloring mass when the moulds are chilled. Lubrication facilitates easy removal of sticks.

Evaluation of Lipsticks

The evaluation studies are important in order to determine the efficiency, stability and the consistency of the finished product. The evaluation tests for the lipsticks are as follows:

1. Breaking Load Point Test: Breaking point is done to determine the strength of lipstick. The lipstick is held horizontally in a socket ½ inch away from the edge of support. The weight is gradually increased by a specific value (10 gm) at specific interval of 30 seconds and weight at which breaks is considered as the breaking point.

2. Melting Point Determination Test: The determination of melting point is done in order to determine the storage characteristics of the product. The inciting point of lipstick base should be between 60 to 65 °C in order to avoid the sensation of friction or dryness during application. The method of determination is known as capillary tube method:

- In this method, about 50 mg of lipstick is taken and is inserted into a glass capillary tube open at both ends.
- The capillary tube is ice cooled for about hrs and then placed in a beaker containing hot water and a magnetic stirrer.
- The temperature at which material starts moving through the capillary is said to be the melting point temperature.
- The melting point should be higher than the droop point which determines the safe handling and storage of finished product.

3. Microbiological tests: The test is carried out in order to determine the extent of contamination either from the raw materials or mould. The test involves the plating of known mass of sample on two different culture media for the growth of microorganisms and incubating them for a specific period of time. The extent of contamination can be estimated by counting the number of colonies.

4. Thixotrophy character - It is 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 ºC. The depth of penetration was a measurement of the thixotropic structure of lipstick.

5. Test for the Application Force: This is a test to determine the force to be applied during application. In this method, two lipsticks are cut to obtain flat surfaces which are placed one above other. A smooth paper is placed between them which is attached to a dynamometer to determine

force required to pull the paper indicates the force application.

6. Test for Rancidity: The oxidation of oil such as castor oil and many other ingredients may result in bad odour and taste and also result in a sticky product. The test for rancidity can be done by using hydrogen peroxide and determining its peroxide number.

7. Solubility test -The formulation herbal lipstick is dissolved in various solvents to observe the solubility.

8. Stability to Oxidation: The oxidation characteristics of the finished product are determined in order to check the stability of the product to oxidation. The extent of oxidation can be determined by peroxide number of product after exposure or substance to oxygen for a specific period of time.

9. Storage Stability: This test is done in order to determine the stability of product during storage.

10.Perfume stability -The formulation herbal lipstick was tested after 30 days, to record the fragrance.

11. Determination of Colour dispersion: The test is done in order to determine the uniform dispersion of color particle. The size of the particle is determined by the microscopic studies and it should not be more than 50 μ.

12. Determination of Surface Characteristics: The study of surface property of the product is carried out in order to check the formation crystal on the surface or the contamination by microorganisms or formation of wrinkles and the exudation of liquid.

SHAMPOOS

Shampoos assumed importance as a product category with the advent of synthetic detergents. These were developed in the 1930s, became widely used in laundry markets by the mid-1940s and appeared in a shampoo format during the 1950s. Shampoos are probably the most widely used hair products today; based on synthetic detergents they are relatively insensitive to water hardness, thus allowing for efficient rinsing since there are no scum residues. In the early days a shampoo could be defined as an effective cleansing agent for hair and scalp, but today the shampoo must do much more. It must leave the hair easy to comb, lustrous and controllable whilst being convenient and easy to use.

Requirements of a shampoo

1. To remove sebum (the secretion of the sebaceous glands) and atmospheric pollutants from the hair and scalp.
2. To remove the residues of previously applied hair treatments, e.g. polymeric constituents from styling lotions and hair sprays.

3. To deliver an optimum level of foam to satisfy the expectation of the user.
4. To leave the hair in a satisfactory condition after rinsing so that it can be combed easily both in the wet and dry state.
5. To perform as a vehicle for the deposition of beneficial materials onto the hair and scalp.
6. To be non-toxic and non-irritating to the hair and the scalp.

Types of shampoo

Various types of shampoos are available and they are classified based on their consistency. They are as follows:

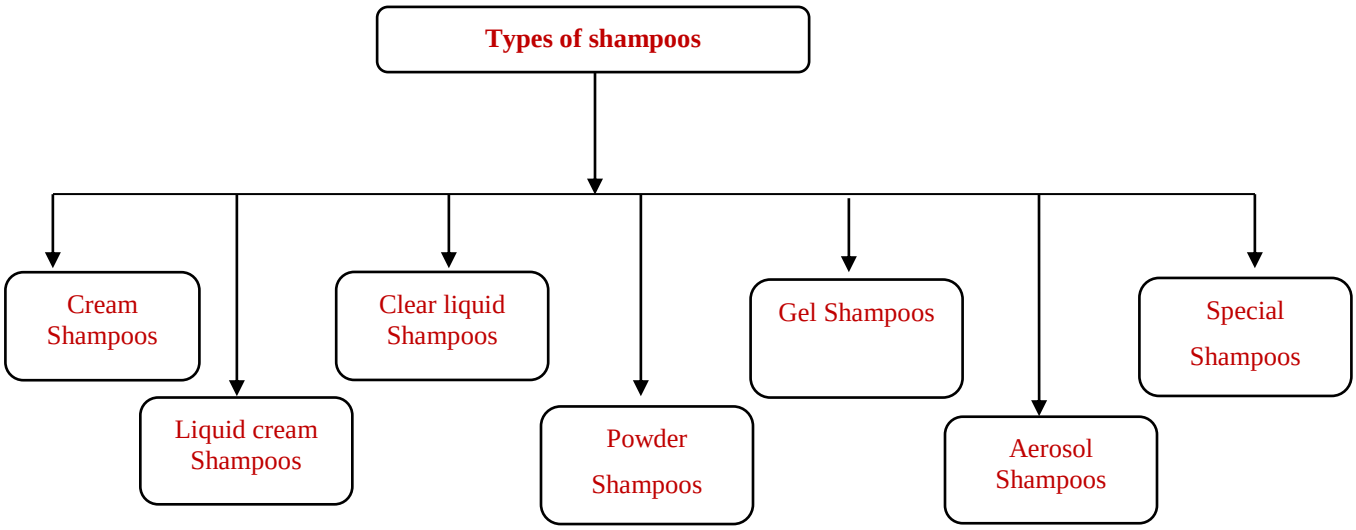

Figure 6: Types of shampoos

1. Cream Shampoos: These shampoos have a paste like consistency and are packed in collapsible tube. They find great use in hair salons. They are also available in jars with wide mouth. The paste consistency is developed by addition of alkyl sulphates Cetyl alcohol is added, which serves as a builder.

Formula	Quantity for 100 g
Sodium lauryl sulphate (surfactant)	38 g
Cetyl alcohol (builder)	7 g
Perfume, color, preservative	q. s
Water	55 g

2. **Liquid Cream Shampoos:** These are called as lotion shampoos which are modification of clear liquid shampoos. Addition of opacifier such as glycerylmonostearate, glycol stearate etc., to the clear liquid shampoo yields liquid cream shampoo. Solubilising agents such as

magnesium stearate is used to dissolve the added opacifier.

Formula	Quantity for 100 g
Triethanolamine lauryl sulphate (surfactant)	35 g
Glycerylmonostearate (opacifier)	2 g
Magnesium stearate (stabilizer)	1 g
Perfume, color, preservative	q. s
Water	62 g

3. Clear Liquid shampoo: These are clear liquid preparations that are most widely used. They are usually made by using detergent of low cloud point. Alkanolamides can also be used in these preparations. Some of these shampoos may be transparent.

Formula	Quantity for 100 g
Triethanolamine lauryl sulphate (surfactant)	50 g
Lauricisopropanolamine (foam booster)	2 g
Perfume, color, preservative	q. s
Water	48 g

4. Powder Shampoos: As name suggests, it is available in the form of dry powder, initially it was prepared from dry soaps, but nowadays dry synthetic detergents are used for their preparation. Powder shampoo is prepared where addition of water or other solvent reduces the activity of the components, especially in case of medicated shampoo. Nowadays, these shampoos are not used due to the difficulty experienced in their application.

Formula	Quantity for 100 g
Sodium lauryl sulphate (surfactant)	20 g
Sarcoside	5 g
Sodium bicarbonate	10 g
Sodium sulphate	65 g
Perfume	q. s

Another formulation called dry shampoo is also a type of powder shampoo. Initially they are applied on to the head and then removed by the brush. It doesn't involve the use of water. They are usually preferred, when the hair are greasy. This formulation usually includes adsorbents.

Formula	Quantity for 100 g
Starch (adsorbent)	15 g
Talc (adsorbent)	45 g
Kieselgur (adsorbent)	40 g
Perfume	q. s

5. Gel Shampoo: These are transparent and thick usually made by incorporating a gelling agent, (e.g., cellulose). There is great use in hair salons and beauty parlors. The principle ingredient is detergent which can be used either alone or in combination with soap. By altering the proportion of detergent, gel of required consistency can be obtained. Addition of methyl cellulose to clear liquid shampoo and its subsequent thickening also gives rise to gel shampoo.

Formula	Quantity for 100 g
Alkyl dimethyl benzyl ammonium chloride	15 g
Triethanolamine lauryl sulphate (surfactant)	28 g
Coconut diethanolamide	7 g
Hydroxyl propyl methyl cellulose	1 g
Perfume, color, preservative	q. s
Water	49 g

6. Aerosol Shampoos (Foam Type): They are called aerosol shampoos because they are packed in aerosol containers .Their formulation, preparation and packing is complicated as an additional propellant is included. The propellant added must be compatible and should not reduce the activity of shampooing ingredients. The container opening is provided with a valve. Shampoo comes out as foam when the valve is pressed. Hence also called as foam type shampoo.

Formula	Quantity for 100 g
Triethanolamine lauryl sulphate (surfactant)	60 g
Coconut diethanolamide	2 g
Propellant	10 g
Perfume, color, preservative	q. s
Water	28 g

7. Special Shampoos: These are the shampoos which are meant for special purpose. They are:

(a) Medicated Shampoo: These shampoos contain medicinal agents. These agents treat the disorders of the scalp or hair. Examples of medicated shampoos are: Anti-lice shampoo, Antidandruff shampoo, Anti-baldness shampoo etc,. The medicinal agent added should not irritate the sebaceous glands. It should not sensitize the scalp. The degree of itching and scaling should also be reduced. Among all, anti dandruff type of medicated shampoo is most widely used. Formula for which is given below:

Formula	Quantity for 100 g
Triethanolamine lauryl sulphate (surfactant)	60 g
Thymol (anti dandruff)	0.1 g
Camphor (counter irritant)	0.1 g
Water	38.8 g
Perfume, color, preservative	q. s

(b) Conditioner Shampoos: These shampoos serve for hair conditioning. Initially they clean the hair (and scalp) and keep them in smooth and lustrous condition. They also prevent sticking of hairs. Conditioner shampoo nowadays is widely used by both men and women. Most of the conditioners are made from Quaternary ammonium compounds. These compounds have the property of reducing electric charges between the hair, as a result hair become lustrous easily manageable. These compounds can also exhibit a bactericidal effect.

Formula	Quantity for 100 g
Stearyl dimethyl benzyl ammonium chloride	5.5 g
Ethylene glycol monostearate	2 g
Cetyl alcohol	2.5 g
Water	90 g
Perfume, preservative	q. s

Formulation of shampoo

1. Surfactants: The main use of surfactant is to cleanse and to produce foam. They are generally categorized into four types. They are: (a) Anionic Surfactants (b) Non-ionic Surfactants (c) Cationic Surfactants (d) Amphoteric Surfactants

(a) Anionic Surfactants: These surfactants have good foaming property; hence they are used as principle surfactant. They are considered as main ingredient of shampoo formulation. Examples of Anionic Surfactants:

(i) Alkyl polyethylene Glycol Sulphates: These anionic surfactants exhibit good cleaning as well good foaming property. They are alkyl ether sulphate which forms water soluble sodium salt. Solubility of this salt is greater than sodium lauryl sulphate, hence also serves as a solvent for non-polar ingredients. Because of low cost, they are widely used by small manufacturers.

(ii) Alkyl Sulphates: When fatty acids are subjected to catalytic reduction, it results in formation of long chain sulphated derivatives called as Alkyl sulphates. (Example: Lauryl sulphate, Myristyl sulphate). A combination of above two compounds is most widely used because they give foam. Sulphates with lauryl chain are widely used when compared to octyl or decyl chain. Previously, sodium lauryl sulphate was used

(iii) α- olefin Sulphate: It is an alkyl sulphonate obtained by sulfonation of linear olefin. It produces an excellent foam and the property of foaming is unaffected by sebum and hard water. It produces mild detergent effect without harming the scalp. It is stable at both acid and basic pH and widely used to prepare low pH shampoo. It has low cloud point hence also used to prepare clear liquid shampoo. Apart from the above, other anionic surfactants such as sulphosuccinates, Acyl lactylases etc, are also used.

(iv) Alkyl Benzene Sulphonates: These surfactants are most widely used in the preparation of washing powder but not in cosmetics (i.e. shampoo). Because they cause excessive cleaning, this may lead to damage of scalp and hair. They may also lead to hair fall and skin irritation. Although they have deleterious effects, they are used for cleaning of greasy hair.

(b) Non-ionic Surfactant: These are considered as secondary surfactants. They are not used to produce foam but used as foam boosters, viscosity inducers, emulsion stabilizers and opacifiers. This is because they have less foaming power. Even though they have good cleaning property, they are not used as principle surfactant. Examples of Non-ionic Surfactants:

(i) Poly Alkoxylated Derivatives: These are ethoxylated alcohols and phenols, block polymers, sorbitol ester (polyethoxylated) and polyglyceryl ethers. These derivatives are obtained when

hydrogen (labile) containing hydrophobic compound is subjected to polyaddition reaction with either ethylene or propylene oxide. They are stable at wide range of pH. They have stabilizing, emulsifying, pearlescent and foaming properties. They are available at low cost and cause irritation to eye mucosa. However, they are used as mild detergents and impart a good rinsing property. They can also be used in high concentration.

(ii) Amine Oxides: Amine oxides are obtained by the oxidation of tertiary aliphatic amine with hydrogen peroxide. These compounds possess strong polar linkage between nitrogen and oxygen hence they are also called as polar non-ionic surfactants. They constitute major group of synthetic surfactants. They are water soluble and compatible with various surfactants. They are added as secondary surfactants because of their conditioning, dam boosting and anti-static property. Coconut and dodecyl dimethylamine oxides are most commonly used for this purpose.

(iii) Fatty Acid alkanolamides: These include monoalkanolamides and diethanolamides etc. Monoalkanolamides are made from long chain fatty acids (i.e., C14- C16). They are insoluble in water due to their waxy nature. Hence, they are added directly to detergent solution and dissolved by gentle warming. The detergent solution is made by using principle surfactant to which various ethanolamides are added to serve as:

- Viscosity Inducing Agent: Example: Lauric Monoethanolamide
- Solubilising Agent: Example: Lauric Monoethanolamide.
- Softening and Hair Conditioning Agent: Example: Oleic Ethanolamide.
- Pearlescent and Thickening Agent: Example: Stearic Ethanolamide
- Foam Boosters.

(c) Cationic Surfactants: Surfactants that contain positive charge are called as cationic surfactants. They are used as both principle and secondary surfactants. These surfactants are used in low concentrations because they are toxic to eye. Hence, they are considered as secondary surfactants. Apart from the above toxic effect, they also have good foaming and partly cleaning properties. Hence, they are also used as principle surfactants in conditioner shampoos. Examples Cationic Surfactants:

(i) Ethoxylated amines: These are nitrogen containing surfactants which are obtained by ethoxylation of long, chain alkylamine. They are waxy in nature with low melting point. Because of their waxy nature; they are also used as viscosity inducer. However their main function is emulsification and hair conditioning. Sometimes, they are also used as foam boosters. Due to their emulsifying property, complete dispersion of various ingredients is achieved.

(ii) Alkyl-Betains: These classes of cationic surfactants are obtained from N dimethylglycine. They are readily compatible with majority of surfactants and have following properties.

- Enhance the efficiency of Foam. Example: Foam Booster.
- Contain Conditioning and Anti-static Property.
- Have viscosity inducing property.
- Possess good stability.
- Non-irritant to skin and eye.

Based on the above properties, Alkyl Betains are considered as secondary surfactant. They are also used as principle surfactant in baby shampoo and are often used in combination with ionic surfactants. Various other cationic surfactants like imidazolines and morphollrx derivatives, tetra alkyl ammonium salts are also used.

(iii) Alkylamines: They are used in combination with hydrophilic surfactants in order to provide conditioning and antistatic property to the shampoo. However they precipitate when combined with anionic surfactants. Usually they are used in the form of water soluble salts.

(d) Amphoteric Surfactants: The surfactants which possess both cationic and anionic charges with respect to acidic and basic media are called as amphoteric solvents. They form zwitterions when the pH of media is neutral. These agents produce a mild action and show compatibility with surfactants. They possess excellent hair conditioning property and hence used as secondary surfactants.

(i) N-alkyl Amino Acids: The important compounds of this class are derived from amino acids and asparagine. A compound called N- alkyl-b iminoproperonate is derived from amino acid and it exhibits good foaming property, possesses slightly alkaline pH by changing the pH to acidic range the manageability of hair is improved. Whereas, the derivatives of asparagine are well compatible with both anionic and cationic surfactants. It also possesses the properties like foaming, cleaning and conditioning. Depending upon the pH, these compounds change their nature i.e., they become zwitterions at pH 6 and at neutral pH, they become amine. Solubility of N-alkyl amino acids is greater than they are in the form of sodium salts, whereas the solubility decreases with zwitter ionic form. The foaming property of these agents decreases with decrease in pH. This is because at low pH they become cationated (i.e., cationic form). These agents are highly stable and sometimes also employed as emulsifiers.

(ii) Dialkyl Ethylene Diamines: These surfactants are soluble in water and compatible with surfactants. They are used as detergents and to a lesser extent as emulsifier. They are usually

prepared as aqueous solution or paste into which remaining shampoo ingredients are added. These agents are combined with anionic surfactants in order to minimize the irritation caused by them. These agents neither enhance nor inhibit the foaming property of the principle surfactant. They are most widely used an anti-irritating agent when anionic compounds are used as principle surfactant. These agents also possess conditioner and anti-static property as a result of which the hair becomes smooth and soft .However the pH of the shampoo prepared by using these surfactants must be neutral.

2. Foam Boosters: The surfactants used in the preparation also serves as foaming agents. They, form rich lather i.e., foam which is stabilized or strengthened by using a substance called foam boosters. The substances like amine oxides, fatty acid alkanolamides are used. They make the foam dense and it to remain for long duration. Usually they are added in quantity of about 2 to 5%. Fatty acids and fatty alcohols when added in a range of 0.25 to 0.50% concentrations, they also act as foam boosters.

3. Germicide and Anti-dandruff Agents: Germicides are the agents which prevent the growth of micro-organism on the scalp whereas anti-dandruff agents are used to eliminate dandruff from the scalp. Examples of Germicides are: Quaternary ammonium compounds: such as Cetrimide, Benzalkonium Chloride etc.

4. Pearlescent Agent: these agents are usually added as adjuvants to the conditioning agents. They improve the conditioning property. Addition of these agents also imparts brightness to hair. They make the preparation transparent or opaque; hence they are also called as opacifying agents. The commonly used pearlescent agents are alkanolamides and coumarins like 4-methyl-7-diethyl amino coumarin, 4-methyl-5, 7-dihydrocoumarin etc. Also phosphates and alcohols improve transparent solubilization.

5. Conditioning Agents: These agents improve the condition of hair. These agents also exhibit a bactericidal effect. They make the hair silky and shiny. Most commonly used conditioning agents are lanolin, oils, herbal extracts, egg, amino acids etc. Among the above; amino acid gives an efficient conditioning effect.

6. Thickening Agents: These agents are usually added to make the preparation thick i.e. viscous. Such viscous preparation facilitates ease of handling. Also, they prevent wastage during application. Already the addition of various agents, such as surfactants, foam boosters etc make the preparation viscous even though thickening agent is added. Substances like methyl cellulose, alginates polyvinyl alcohol, polyethylene glycol etc are commonly used to adjust the viscosity of a

shampoo.

7. Sequestrants: These are complex forming agents. They form complex with metal ions like calcium and magnesium. Surfactant are liable to form complex with the metals present in water i.e., calcium and magnesium. Hence addition of Sequestrants prevent complex formation between metal and surfactant. The Sequestrant itself forms complex with the metal ions. Thus, it prevents the formation of film on the scalp i.e., the film formed by surfactant and metal ions. The commonly used Sequestrants are EDTA, citric acid etc.

8. Colour: Addition of colour gives pleasant appearance to the preparation. Various FD & C dyes are used for colouring the preparation. The added colour must be water soluble and it should not impart any colour to hair or scalp.

9. Perfumes: Addition of these agents imparts good fragrance to the shampoo. It also neutralizes the undesirable odour of other ingredients of formulation especially surfactants. Nowadays it has become an important factor for consumer satisfaction. The selected perfumes must be such that they should retain good smell for fixed period of time even after shampooing. The added perfumes should not affect the solubility and stability of the preparation. They are usually obtained from natural sources such as flowers, fruits, herbs etc.

10. Preservatives: These agents have the ability to prevent the growth of micro-organisms. They are usually added to maintain the stability of the preparation for a desired period of time. Shampoo is a wet preparation that provides a media for various micro organisms hence addition of preservative is essential. Preservative used should not cause any irritation to the scalp. Para-hydroxybenzoic acid and phenyl mercuric nitrate are commonly used preservatives.

11. pH modifiers: The isoionoic point for the hair fibre lies between pH 5.6 and 6.2. It is advisable to balance the pH of the formulation to within this range.

PREPARATION OF SHAMPOO

Simple procedure is involved in the preparation of shampoo. Initially only one method available for the preparation of shampoo, but later the basic method was modified in order to obtain different type of shampoo like cream, gel, aerosol etc.

General Method for preparation of shampoo

Liquid shampoo is usually prepared by this method which involves the following steps: Initially the detergent is converted into a solution form or a detergent solution may be directly obtained from the manufacturer. Take about half of the detergent solution into a separate container. To it, add the total

amount of secondary surfactant i.e., alkanolamide. Dissolve the alkanolamide along with stirring. Sometimes, gentle heat is also applied. To the remaining half of the detergent solution add suitable amount of perfuming agent and dissolve it. The perfume solution is then added to the alkanolamide solution. Colour and preservatives are dissolved separately in sufficient volume of water and then added to the main solution. The whole, solution is mixed well by gentle stirring. Excessive stirring may lead to bubble formation. Final volume of the preparation is usually adjusted by the addition of clear sterile waste. This gives clear liquid shampoo. However, when the preparation contains lauryl alcohol ether sulphate. It is required to adjust the viscosity of the shampoo. Viscosity adjustment is done by using an electrolyte solution. Usually, a solution of sodium chloride is added subsequently with constant stirring. Care must be taken to it event the excess addition of sodium chloride.

Methods of Preparation: The methods of preparation of various types of shampoos are modification of the above mentioned general method of preparation of shampoos.

(a) Preparation of Gel Shampoo: The method involved in the preparation of gel shampoo is similar to that of clear liquid shampoo. After preparation, the liquid shampoo is usually treated with a suitable thickening or gelling agent such as hydroxy propyl methyl cellulose, this gives a gel like consistency. Addition of appropriate amount of anionic and amphoteric surfactants also leads to the formation of gels.

(b) Preparation of Cream Shampoo: Certain formula of cream shampoo may include glycol stearate or waxes. Usually, glycol stearate is used as an opacifier and preparation method for such formulae is similar as discussed above. But when wax is included in the formula, the process involves the following steps. Initially, a solution of detergent and water are heated to about 80°C. The wax is heated separately in a container at 80°C which facilitates the melting of wax. Both the solutions are kept at 80°C and mixed uniform mixing by constant and gentle stirring. The solution is allowed to cool to about 40- 45°C. After which the remaining ingredients, such as additives, colours, perfume and preservatives are added. The stirring is continued. Finally, under warm conditions, the mixture is transferred into a suitable container and packed.

(c) Preparation of Powder Shampoo: Powder shampoo is prepared by simple blending. Here, all the ingredients are taken in a state. They are powdered to suitable degree of fineness. The powdered ingredients are blended by using a suitable blender. Two separate solutions of perfume and colour are prepared by using alcohol or water as solvents. The prepared solutions are then sprayed onto the blended mixture. The wet mixture is dried and packed. Otherwise, the ingredients are internally soaked into the solutions of colour and perfume. Wet mass is dried and then subjected to blending.

(d) Preparation of Aerosol Shampoo: This type of shampoo is initially prepared by using (earlier discussed) general method. The prepared shampoo is then incorporated with a suitable propellant. The whole mixture is packed in an aerosol container. The propellant creates a pressure within the container due to which spraying action is achieved and the product (shampoo) is sprayed in the form of foam. Here packing plays an important role and the propellant used should not react with the shampoo.

Evaluation of shampoo

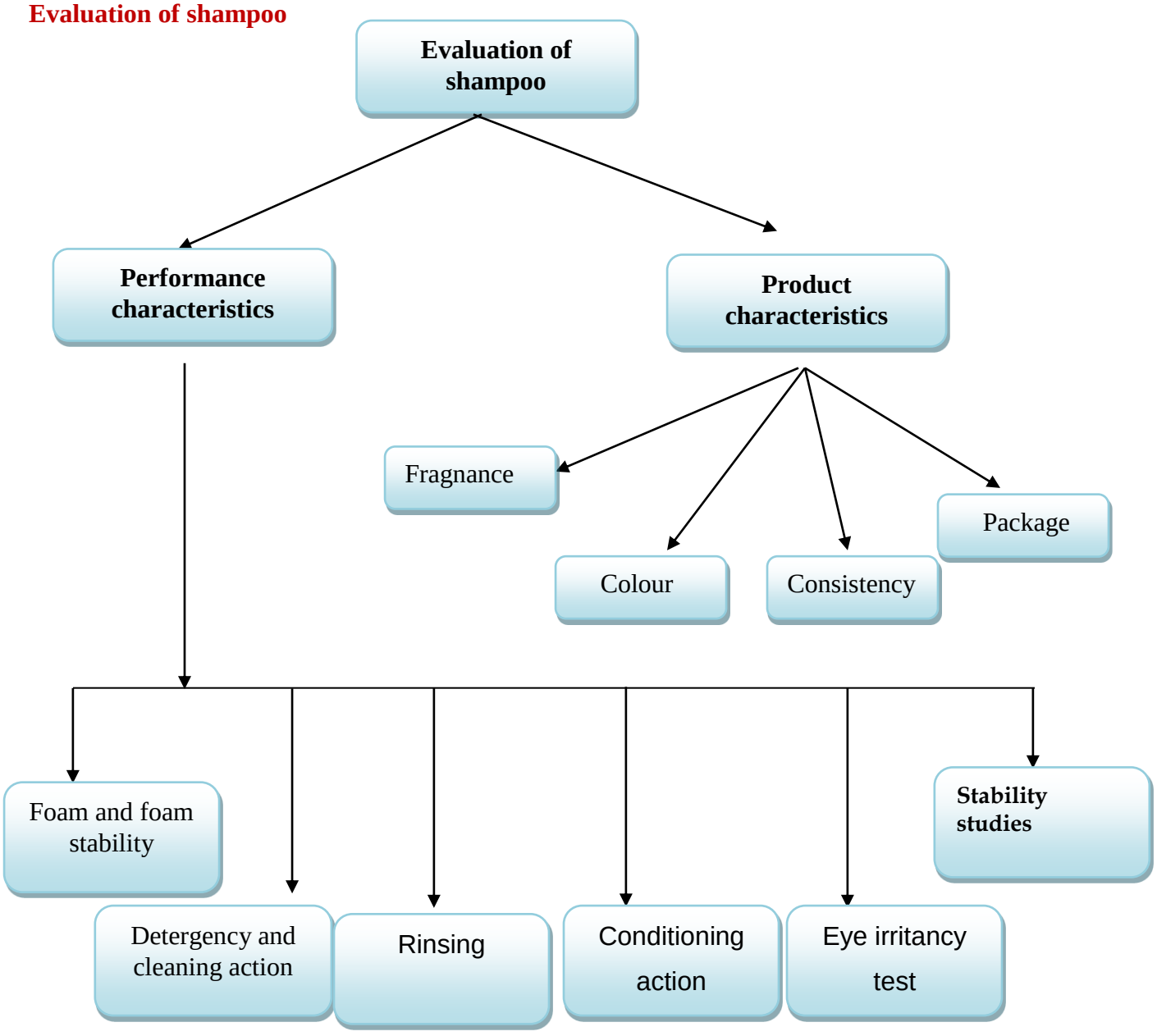

Figure 8: Evaluation of Shampoo

Performance Characteristics

(a) Foam and foam stability:

The Ross-Miles foam column test is accepted. 200 ml of surfactant solution is dropped in to a glass column containing 50 ml of the same solution. The height of the foam generated is measured immediately and again after a specified time interval, and is considered proportional to the volume.

Barnett and Powers developed a latherometer to measure the effect of variables such as water hardness, type of soil and quantity of soil on foams peed, volume and stability.

Fredell and read titrated actual standard oiled heads of hair with additive increments of shampoo until a persistent lather end point appeared.

(b) Detergency and cleaning action:

Cleansing power is evaluated by the method of Barnet. 5 gm sample of soiled human hair is placed at 35°C in 200 cc of water containing of 1 gm of shampoo. The flask is shaken 50 times a minute for 4 minutes. Then washed once again with sufficient amount of water, then after filter the hair dried and weighed. The amount of soil removed under these condition is calculated.

(c) Wetting action

Canvas disk sinking test: A mount veron cotton duck #6 can vasdisk 1 inch in diameter, is floated on the surface of a solution, and the time required for it to sink is measured accurately.

(d) Rinsing:

Skilled beauticians are employed to make comparisons on the performance of several shampoos.

(e) Conditioning action

Conditioning action is a difficult property to assess. This is because it is basically dependent on subjective appraisal. No method has been published for measuring conditioning action.

The degree of conditioning given to hair is ultimately judged by shampoo user who is making the evaluation on the basis of past experience and present experience.

(f) Eye irritation test: Animals (albino rats) are collected from animal house. About 1% shampoo solutions is dripped into the eyes of six albino rabbits with their eyes held open with clips at the lid. The progressive damage to the rabbit's eyes is recorded at specific intervals over an average period of 4 seconds. Reactions to the irritants can include swelling of the eyelid, inflammation of the iris, ulceration, hemorrhaging (bleeding) and blindness.

(g) Stability studies: The thermal stability of formulations was studied by placing in glass tubes and they are placed in a humidity chamber at 45°Cand 75% relative humidity. Their appearance and

physical stability were inspected for a period of 6 months at interval of one month

CREAMS

Creams are semi-solid emulsions which contain mixtures of oil and water. Their consistency varies between liquids and solids. With the availability of wide spectrum additives, like emulsifying agents, etc, and development of newer techniques, the preparation of creams has become very easy. Mostly the creams are emusion type and consistency can vary from a liquid to a spreadable solid. All the skin care creams can be classified on different basis-

a) According to function, e.g. cleansing, foundation, massage, etc.
b) According to characteristic properties, e.g. cold and vanishing cream, etc.
c) According to the nature or type of emulsion.

The most widely accepted classification is based on function. According to function the cream can classified as follows-

CLASSIFICATION OF CREAMS

Creams are classified according to their functions. They are:

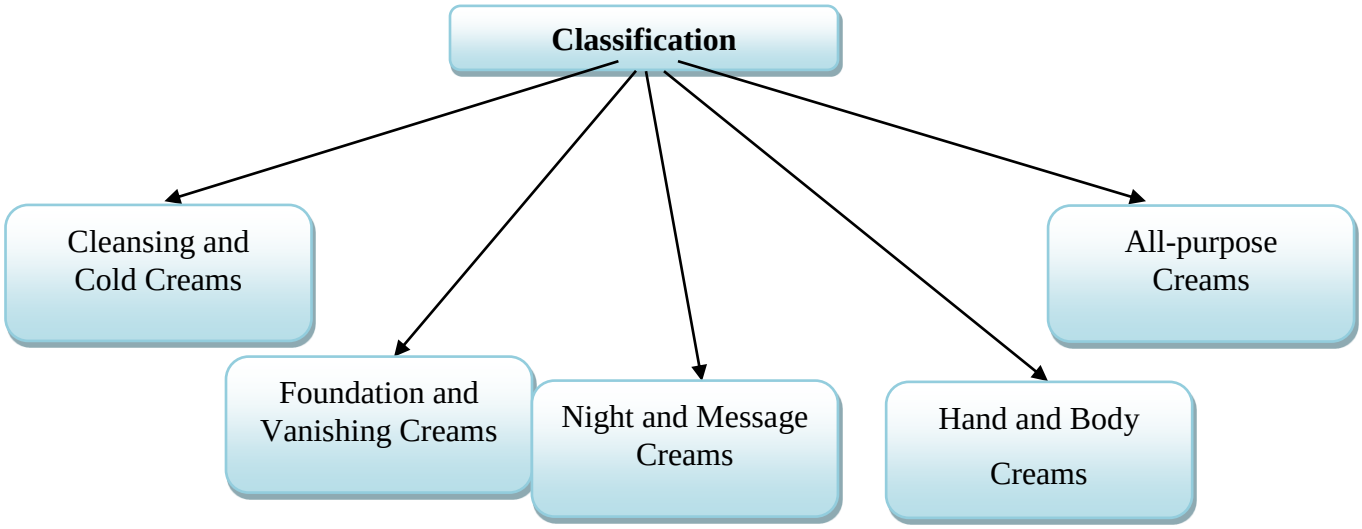

Figure 9: Classification of Creams

Cleansing and Cold Creams:

Cleansing Creams: They are used for the purpose of removing makeup, surface grime (layer of dirt on skin) and secretions of skin from the face and throat respectively.

Properties:

- They spread easily on the skin.
- They are pleasant in appearance.
- They cause less irritation to the skin. They are easy to apply.

- They should produce flushing action on skin and its pore openings.
- They should not make skin dry which happens in case, when the skin is washed with water and soap.
- They should melt or liquefy when applied on to the skin.
- They should form an emollient film on the skin after application.
- They should remove chemicals of facial makeup effectively. They dissolve the greasy binding materials which hold the pigment and finally remove them.
- They should remove solidified oil, sebum, sebum plaques and surface oil layer from the skin.
- They also help in softening, lubricating and protecting skin apart from cleansing purposes.

They are applied on face and throat with the help of finger tips. Then the fingers are rotated upwards on the skin for spreading purpose. Tissue paper or cotton wool used to remove the residue of the cream. The layer which is left on the skin should be non-occlusive and emollient in order to prevent drying. Cleansing creams are of two types. They are:

(i) Liquefying type **(ii)** Bees wax-borax type/Emulsified type.

(i) Liquefying Type: This type of creams consist of a mixture of oil and water which are translucent in nature. They are anhydrous creams with thixotropic character i.e., they liquefy when applied on skin.

(ii) Bees Wax-borax Type / Emulsified Type: It is considered as an important formulation in cleansing creams. This type of preparation liquefies when applied to the skin, which helps in easy spreading. It is white, lustrous and good consistency.

It is an oil-in water type of emulsion, in which high percentage of mineral oil is present. This mineral oil helps in imparting cleansing property. Phase inversion takes place due to evaporation of water after the creams are rubbed on the skin. The phase inversion (i.e., water in-oil type) helps in imparting the cleansing action.

Ingredients used in Skin Cream

A discussion of basic raw material in the manufacture of skin creams is made here. This includes water, petroleum oil, vegetable oils, fats as well as their derivatives, humectants and emulsifying agent.

Water: One of the most widely used raw materials in the manufacture of cream is water. In cosmetics water is used as solvent for many ingredients of cosmetics. Water should be either deionised or distilled, if it has to be incorporated in cream formulations. Water is cheapest ingredient in creams, so it is good judgement to use purest water.

Oil, fats and waxes: Oil, fats and waxes and derivatives comprise an essential portion of creams. Oil may be two types' mineral and glyceride

Mineral oil: Mineral oil consists of hydrocarbons derived from petroleum oil. A number of mineral oils are used in cream formulation.

Examples: Light liquid paraffin, Heavy liquid paraffin

Glyceride oil: Glyceride oil is mostly vegetable oils. Examples of glyceride oils are **almond** oil, arachis oil, castor oil, coconut oil, olive oil etc.

Fats: A variety of fatty materials are used in cream preparations. These materials may be from vegetable, animal or mineral origin. Glyceride oils and fats may be of animals or vegetable origin. They consist of combinations of higher fatty acids and glycerin. When saponified they form soap, or fatty acid and glycerin, depending upon process used. The most common of this fatty acid are lauric, margaric, palmitic, stearic, saturated group. Oleic acid is liquid and most popular unsaturated fatty acid. More specially the oil most commonly used in other cosmetics are olive oil, almond oil, seasame oil, peanut oil, coca butter fat, mutton tallow, lard and beef stearine.

Waxes: Waxes used in creams and other cosmetics include beeswax, carnauba wax, ceresin, ozokerite japan wax and spermaceti. Of these beeswax and spermaceti are of animal origin, while carnauba, candelila and japan wax are from vegetable kingdom. Montan a vegetable wax and ozokerite a mineral wax are both derived from lignite of these waxes. Beeswax, cerecin and spermaceti are most important for cosmetics.

Lanolin: Lanolin is derived from wool fat. The anhydrous grade is free from water. The hydrous lanoline contain between 25% and 30% water. Anhydrous lanolin has melting point of 38- 42°C and a slight odour.

Glycol: Those used in cosmetics consist mainly of ethylene glycol, diethylene glycol and propylene glycol. Glycols are dihydric alcohols lying half way between ethanol and glycerol. There are number of glycol available.

Colours: Colouring agents is infact, a generic term for any colour imparting substances. Most of natural colours have been replaced by coaltar colours so for as cosmetics is concerned. A few of the natural colours might still to be used. Examples of natural colours used in cosmetics are saffron, chlorophyll, cochineal.

Emollients: Emollients, also commonly referred to as moisturizers, are products that help to soften skin or to treat skin that has become dry. Most emollients are forms of oil or grease, such as mineral oil, squalene, and lanolin. They work by increasing the ability of the skin to hold water, providing

the skin with a layer of oil to prevent water loss, and lubricating the skin

Emulsifying agent

Inorganic solid: Inorganic solid which forms emulsion include bentonite, colloidal, kaolin, hydrated lime or magnesia and other clay, when dispersed with water, their colloidal properties permit the formation of emulsion in water.

Gums and proteins*:* Gums and proteins are used as emulsifying agent include gum tragacanth, karaya gum, gum Arabic, agar- agar, irish moss, alginate pectins, saponins, gelatin, casine, methyl cellulose and egg albumin.

Humectants: Humectants (or moisturizers) are important cosmetic ingredients allowing preventing loss of moisture thereby retaining the skin's natural moisture. Some compounds also have the ability to actively attract moisture. Humectants are key ingredients in most skin care products but are also often used in hair care products to volumize the hair by attracting moisture which expands the hair shaft. There is a large variety of very different compounds providing moisturzing effects including proteins, acids, polysaccharides, and various small molecules (e.g. sorbitol, glycerine, urea, *olive oil*, *aloe vera*, honey, grap seed oil, babassu oil, avocado oil etc).

Wetting Agent: Wetting agents are basically a type of surface active agents. Among them are include soap, sulfonated oils, fatty alcohols sulfates, sulfated fatty esters and amides, Secondary alcohol sulfates and aryl alkyl sulfates. Quaternary ammonium compound is series of wetting agents which also exhibit high germicidal and fungicidal properties. Wetting agent have two common properties of lowering surface tension, being un-influenced by hard water forming considerable foam with water and other solvents, possessing considerable solvent action and aiding in formation of emulsions.

Perfumes: Examples of natural perfumes used in creams are-

- White Blossoms
- Rosy Dreams
- Orange Blossom

Some functional raw materials: There are some materials which are incorporated in semisolid preparations for their specified functions and are used in variety of semisolid preparation. These materials are given below.

Amino acids: Amino acids are effective in helping recovery of dry and rough skin by moisturizing the epidermis system. There are several amino acids, but there are certain amino acids with which the body must be supplied such amino acids are called essential amino acids. Essential amino acids

include histidine, arginine, tryptophan**,** methionine, etc.

Anti –inflammatory agents: The term anti-inflammatory refers to something that reduces, or is against, inflammation. Examples of natural Vitamins used in creams are turmeric, green tea, white willow, boswellia, cade oil etc.

Vitamins: Vitamins play an important role in maintaining the physiologoical function of whole body. They also help us maintaining physiological function of skin. Vitamin A, vitamin B, vitamin C, vitamin E, biotin, nicotinamide etc. are generally used in formulations of creams.

Methods for preparation of cold cream

Cold cream is an emulsion of water and certain fats, usually including beeswax and various scent agents, designed to smooth skin and remove makeup. The name derives from the cooling feeling that the cream leaves on the skin. Variations of the product have been used for nearly two-thousand years. Cold cream is an emulsion of fats and water which can be used to clean and soften the skin. Traditionally, cold cream has been used to remove makeup gently at the end of the day, and it can also be used to soften tough skin on the knees and elbows, or to keep skin protected from harsh winter weather.

The cream was designed to moisturize and condition the face, and to help remove the harsh makeup of the period. In some regions, cold cream is called “cream of Galen” or “Galen's cream” in a reference to this; the “cold” in cold cream comes from the cool, refreshing feeling that it leaves behind. There are several ways to use cold cream. To remove makeup, a thin layer is spread on the face, allowed to sit for a moment, and then wiped off. Tissues or washcloths can be used to remove the cold cream. The moisturizing agents in the cream will condition the face and help it recover from harsh beauty products.

General procedure of manufacturing:

As this preparation is 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 agent is 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.

Formula for cold cream

General formula used for preparation of 100 gm base cream is given below in Table:-

Name of ingredients	Quantity for 100 gm
Part A	
Beeswax	8.0 gm
Mineral oil	49.0gm
Paraffin wax	7.0 gm
Cetyl alcohol	1.0 gm
Part B	
Borax	0.4 gm
Water	34.6 gm
Preservative	q.s.
Perfume	q.s

Procedure

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

Vanishing and Foundation Creams:

These creams are also referred to as 'Day Creams' as they are applied during day times. These creams provide emollient as well as protective action to the skin against environmental conditions by forming a semi occlusive residual film. This film is neither greasy nor oily.

(a) Vanishing Creams: They are oil in water type of emulsion. When applied on the surface of skin, they spread as thin oil less film which is not visible to the naked eye. Hence, they are called as vanishing creams. They are used to hold powder on the skin as well as to improve adhesion.

Properties:

- should It have high melting point.
- It should be pure white in colour.
- It should possess very little odour.
- It should have less number of iodine.

Ingrients used in Vanishing Creams

Ingredients	Uses
1. Main ingredient Example: stearic acid	It governs the consistency of the cream and imparts pearlescent property to the cream by forming crystals.
2. Humectants Example : glycerin, sorbitol, Propylene glycol	
3. Alkalies Example : (a) Potassium hydroxide (b) Sodium hydroxide (c) Carbonates i.e., potassium and sodium carbonate (d) Ammonia (e) Borax	It imparts fine texture and consistency without providing harshness It is used in combination with potassium hydroxide because it forms hard cream, when used alone They are widely used, because they liberate carbon dioxide due to this, creams become spongy. It is effective, but difficult to handle because of odour and volatility. It is also making cream yellow in color with age. It is used in combination with potassium hydroxide to produce a white emulsion
4. Emulsifying agent. Example : Triethanolamine soap, Amino glycol soap or Glyceryl Monostearate	
5. Purified water (i.e., distilled and deionized)	It provides stability to the cream. If hard water is used, it leads to the formation of soaps of lime and magnesium, which causes inversion of emulsion and hence stability is reduced.
6. Preservatives Example : Methyl paraben and propyl paraben	They prevent deterioration caused by bacteria or fungi.

7. Perfume i.e., perfume solvent or perfume is dissolved in alcohol. They should be added when the cream attains a temperature of about 40°C. Example: geranium, sandal wood, lavender oil, terpineol etc.	It provides odour to the cream and also has aesthetic value.

(b) Foundation Creams: They provide emollient base or foundation to the skin. They are applied before applying face powder or other preparations of make-up.

Properties:

- Adhesion of powder to the skin is improved by these creams, as they possess good holding capacity.
- They should be easily spread on the skin.
- They should be non-greasy in nature.
- They should be capable of leaving a non-occlusive film on the skin after application.

Ingredients: Ingredients are similar to that of vanishing creams. Except some of the ingredients which are as follows:

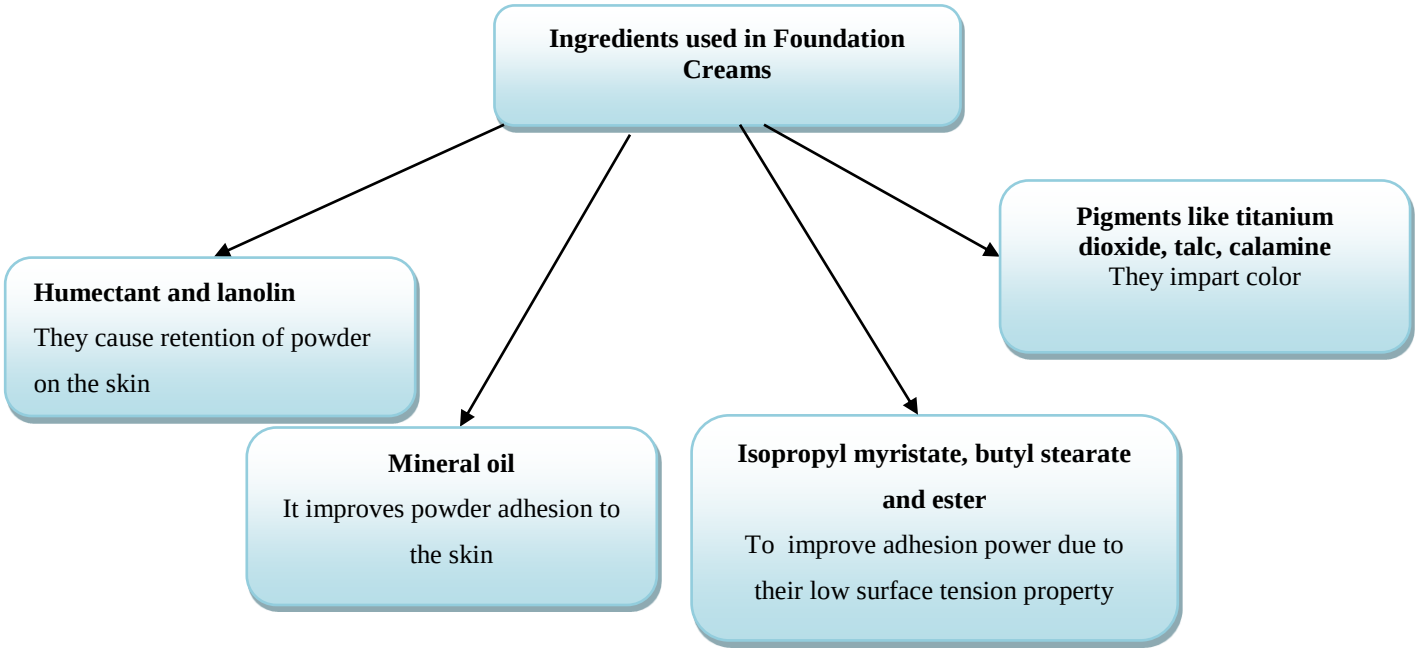

Figure 10: Ingredients used in Foundation Creams

They are of two types:

(i) Pigmented Foundation Creams: They are colored creams.

(ii) Unpigmented Foundation creams: These creams do not contain pigments in the formulation.

Formula	Quantity for 100 g
Lanolin (emollient)	2 g
Cetyl alcohol	0.50 g
Stearic acid (lubricant)	10 g
Potassium hydroxide (softening agent)	0.40 g
Propylene glycol (humectants)	8 g
Water (vehicle)	79.10 g
Perfume (odour)	q. s
Preservatives	q. s

Method for preparation of Foundation Cream:

Lanolin, cetyl alcohol, stearic acid and potassium hydroxide are heated to a temperature of about 75 °C in one container. This is oily phase. In another container, water and propylene glycol are heated to same temperature i.e., 75 °C. Preservatives should be dissolved in water before heating is carried out. This is aqueous phase.

Then slowly aqueous phase is added to oily phase along with continuous stirring until the preparation becomes cold. 4 °C. Perfume is added to the preparation when the above mixture reaches a temperature of 35 °C. Finally the preparation is passed through a triple roller mill for milling purpose, (milling is carried out to obtain a good product).

Foundation Make-up: Foundation make-up cream helps in overcoming the trouble associated with foundation creams i.e., application of foundation cream is a two-step process where it acts as a base to hold the powder makeup. These two steps can be avoided by using foundation make-up. These are available in various forms especially the liquid foundation make-up- is popular because it is easy to apply as compared to loose powders and it also provide smooth appearance to the skin. Surfactants present in the foundation make-up may allow the pigments or colours to penetrate into hair follicles and fissures present in the epidermis of the skin. Hence, should be completely removed after application.

Formula	Quantity for 100 g
Lanette wax	8 g
Stearic acid (lubricant)	8 g
Water (vehicle)	64 g
Glycerin (humectants)	10 g
Powder (base)	1 0g
Perfume (odour)	q. s
Color	q. s
Preservatives	q.s

Method:

Lanette wax, stearic acid and water are heated to a temperature of about 85-90 °C in a separate container. Preservative should be dissolved in water before heating of mixture. This is mixture A. Colour and perfume are added to powder base and mixed. Then this mixture is dispersed in glycerin. This is mixture B. Mixture B is added to mixture A and then it is mixed thoroughly.

Night and Massage Creams:

(a) Night Creams: The preparations which are applied during night time and removed in the morning are called night creams.

(b) Massage Creams: The preparations which are gently applied and rubbed on the skin through massage technique are called massage creams. Skin becomes dry due to the following reasons:

- When stratum corneum is exposed to low humidity, excessive loss of water takes place which attributes to dryness of skin.
- When the lower layer of epidermis does not hydrate properly.
- When the skin is in contact with soap or solutions of detergent for long time.

Properties:

- These creams are formulated with fatty substances which help in easy spreading on the skin.
- These creams help in providing occlusive layer to the skin, which reduce the rate of water loss from the transepidermal layer. The occlusive layer is also responsible for providing moisturizing effect on the skin.

Ingredients: Ingredients are either fat soluble or water soluble.

Ingredients	Uses
Fat soluble ingredients Example: Mineral oil, Petroleum jelly, Paraffin, Ceresin, Dimethyl polysiloxanes, Methyl phenyl polysiloxanes etc.	They help in reducing evaporation of water from the surface of the skin by forming a thin film.
Water soluble ingredients Example: Propylene glycol, Glycerol, sorbitol.	They reduce evaporation of water in case of oil-in-water type of emulsion. The activity of retaining water in external phase is known as emollient activity, which in turn provides water to stratum corneum.

Method:

Mineral oil, petroleum jelly, white beeswax, paraffin wax and lanolin are heated to a temperature of about 75°C in a one container. This is mixture A.

Borax, water and antioxidant are heated in another separate container to same temperature i.e. 75 °C. Preservative is dissolved in water before heating the mixture. This is mixture B.

Slowly mixture B is added to mixture A along with continuous stirring. Perfume is added after the preparation has attained a temperature of about 35°C.

Formula	Quantity for 100 g
Petroleum jelly (lubricant)	8 g
Mineral oil (lubricant)	38 g
Lanolin (emollient)	2 g
Paraffin wax (base and lubricant)	1 g
White beeswax (emollient)	15 g
Borax (buffer)	1 g
Water (vehicle)	35 g
Perfume (odour)	q. s
Preservatives	q. s
Antioxidant (to prevent oxidation)	q. s

Hand and Body Creams: Due to exposure of skin to water, soaps and detergents many times a day, removal of lipids and other secretions from the skin occurs. Cold and dry winds are

responsible for chapping of the skin. Chapping occurs due to loss of moisture from the skin, which is also associated with cracking. Water is sufficient enough to treat the dryness of the skin, but evaporation of water takes place rapidly, which again, makes the skin dry and no emollient effect is produced.

In case, if hands are immersed in water for longer time then abnormal hydration takes place. This hydration will lead to swelling of cells in stratum corneum, which ultimately results in rupturing of cells. Hence, hand and body creams are formulated with suitable emollient, which not only make water available but also regulates the water take-up by the cells of stratum corneum.

Properties:

They are easy to apply.

- They help in softening or imparting emollient effect to hands.
- They should not leave behind sticky film after their application.
- Perfume and colour should be added in the cream preparation for pleasant smell and appearance.

Ingredients used in hand and body creams

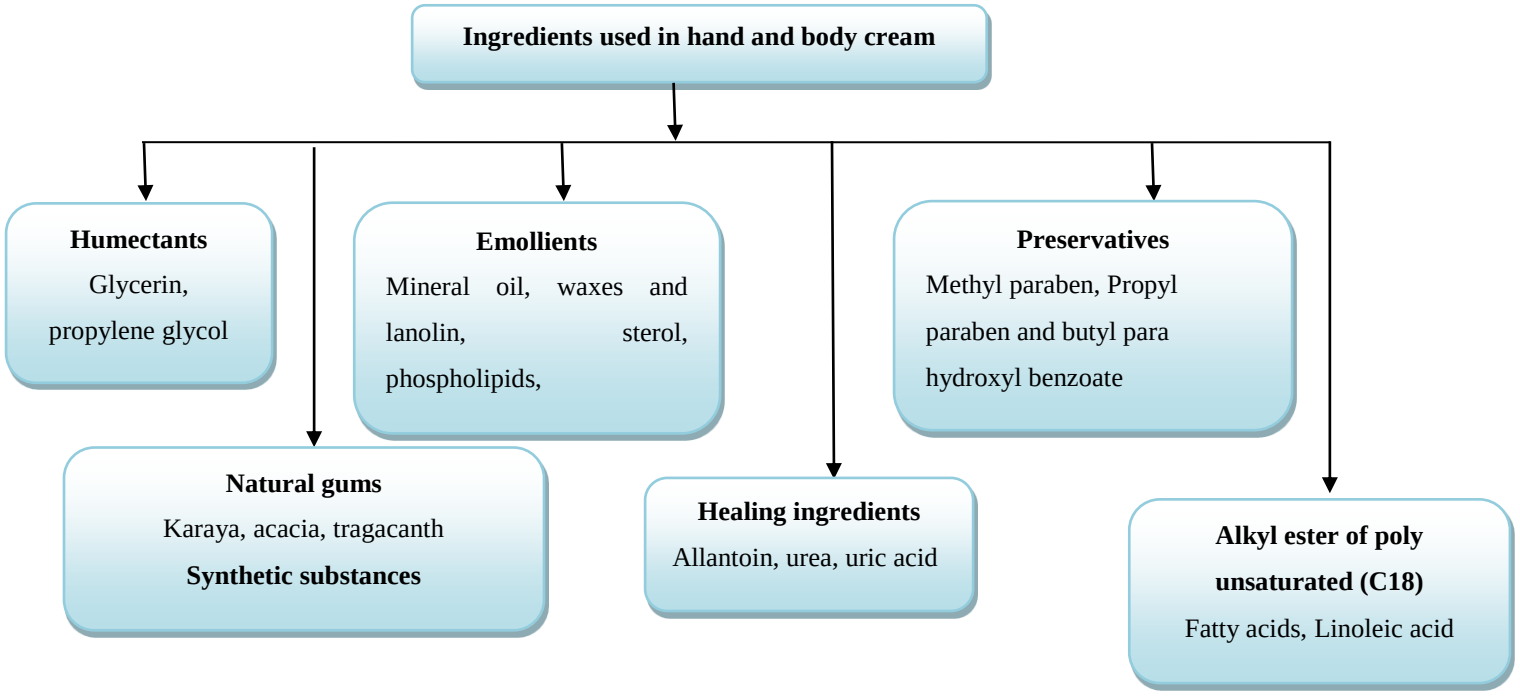

Figure 11: Ingredients used in Hand and Body Cream

Method:

Isopropyl myristate, mineral oil, emulsifying wax and lanolin are heated in a container. This is a

mixture A.

Glycerin, triethanolamine and water are heated in a separate container. Preservative is dissolved in water before heating the mixture. This is a mixture B.

Mixture B is added to mixture A along with continuous stirring until cream is formed. Perfume is added to the preparation when it reaches a temperature of 35°C. Finally, the preparation is passed through a triple roller mill for milling, which provides good texture.

Formula	**Quantity for 100 g**
Isopropyl myristate (lubricant and emollient)	4 g
Stearic acid (lubricant)	3 g
Mineral oil (lubricant)	2g
Emulsifying wax (emulsifier)	0.275 g
Glycerin (humectants)	3 g
Lanolin (emollient)	2.5 g
Triethanolamine (emulsifying agent)	1 g
Water (vehicle)	84.2 g
Perfume (odour)	q. s
Preservatives	q. s

All-purpose creams/sports creams: These creams are used by sport persons and also by people who do outdoor activities. Hence, they are called as sport creams.

Properties:

- They are oily in nature but non-greasy type.
- They provide protective film to the skin.
- They make the rough surfaces of the skin smooth.
- When it is applied in more quantity, it act as

- Nourishing agent
- Protective cream in order to protect the skin from sunburn.
- Night cream
- Cleansing cream
    - When it is applied in less quantity, it act as
- Hand creams

- Foundation creams

Ingredients: The various ingredients used in the formulation are as follows:

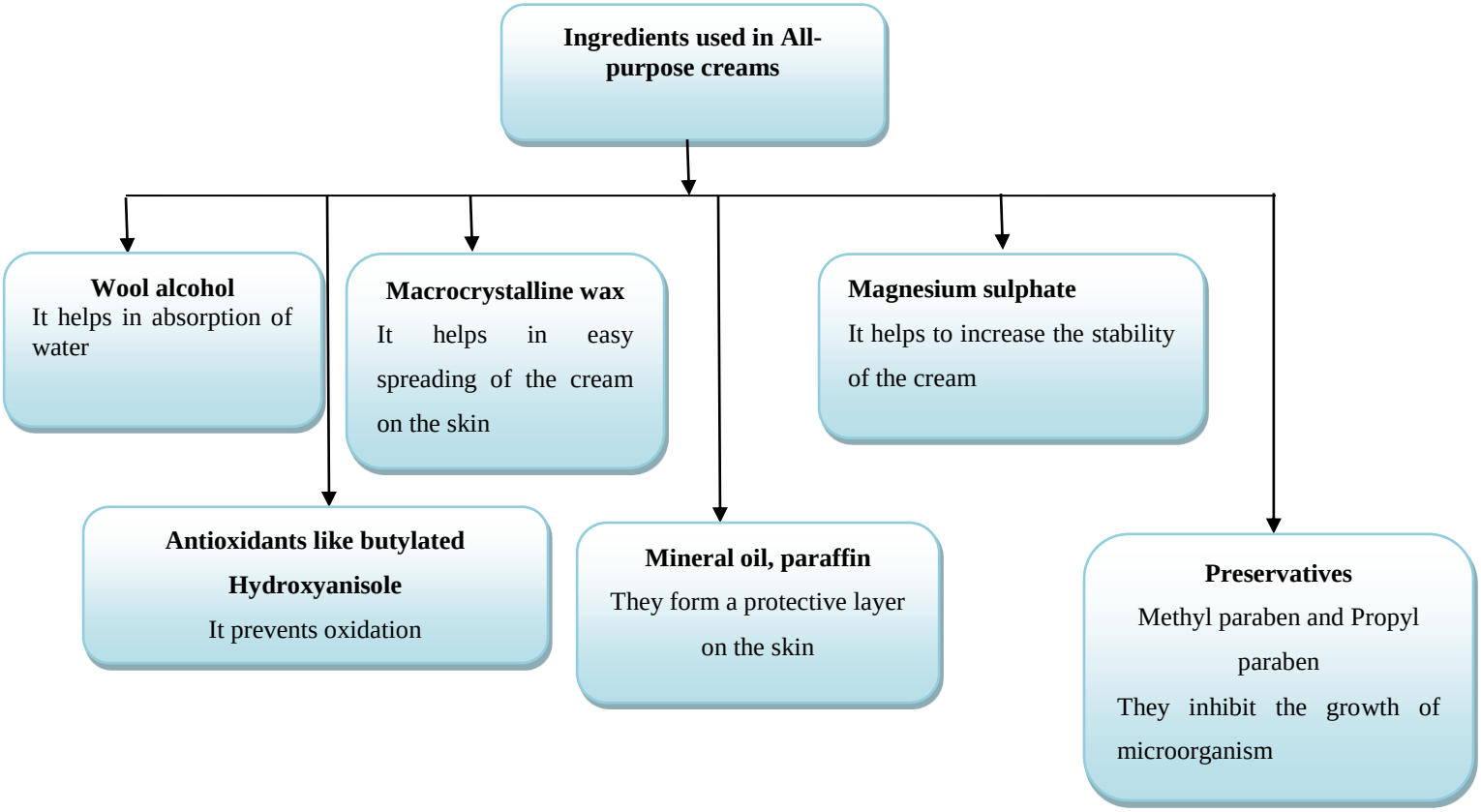

Figure 12: Ingredients used in All-purpose creams/sports cream

Method:

Wool alcohol, soft paraffin, hard paraffin, liquid paraffin and antioxidant are melted. Stirring is carried out until the preparation is cooled. Perfume is added to the preparation, when it reaches a temperature of 35°C. Hydrous ointment can be prepared by using the same base ingredients but with the incorporation of equal amount of water.

Formula	Quantity for 100 g
Wool alcohol (emollient)	6 g
Hard paraffin(soothing agent)	24 g
Liquid paraffin (emollient)	60 g
White soft paraffin (emollient)	10 g
Antioxidant	q. s
Perfume (odour)	q. s

Evaluation of creams

The creams are evaluated for pH, drug content, viscosity, spreadability, tube extrudability, stability studies and primary skin irritation tests are conducted on experimental animals (Rabbits).

Viscosity: Rheological measurements can be regarded as sensitive tools for detecting structural changes in pharmaceutical creams and should be regarded as an integral part of the quality evaluation of pharmaceutical creams. The viscosities of formulated creams are measured by Brook field Viscometer (DV-II) using spindle no 64 at 20 rpm at a temperature of 25 ºC and the determinations are carried out in triplicate and the average of three readings is recorded.

Determination of pH: The pH of various formulations is determined by using digital pH meter. About 1 g of the cream is weighed and dissolves in 100 ml of distilled water and store for two hours. The measurement of pH of each formulation is done in triplicate and average values are calculated.

Determination of type of emulsion

Dye solubility test

In this test an emulsion is mixed with a water soluble dye (amaranth) and observed under the microscope. If the continuous phase appears red, it means that the emulsion is o/w type as the water is in the external phase and the dye will dissolve in it to give color. If the scattered globules appear red and continuous phase colorless, then it is w/o type. Similarly, if an oil soluble dye (Scarlet red C or Sudan III) is added to an emulsion and the continuous phase appears red, then it is w/o emulsion.

Dilution test

In this test the emulsion is diluted either with oil or water. If the emulsion is o/w type and it is diluted with water, it will remain stable as water is the dispersion medium but if it is diluted with oil, the emulsion will break as oil and water are not miscible with each other. Oil in water emulsion can easily be diluted with an aqueous solvent, whereas water in oil emulsion can be diluted with an oily liquid.

Rheological behaviour of the cream

The rheological property is determined to know the flow behavior of formulation. The viscosity at different rpms is measured using Brookfield viscometer. The rheological behavior of the formulation is studied by taking 100 g of the cream in the beaker. The rate of shear is increased gradually from minimum to maximum and corresponding dial reading is noted; then, the rate of

shear is decreased gradually to the lowest value and the dial reading is recorded. The graph is plotted between percent torque and viscosity to determine type of flow.

Spreadability

Spreadability denotes the extent of area to which the formulation readily spreads on application to skin or hair. The bioavailability efficiency of a formulation also depends on its spreading value. The spreadability is expressed in terms of time in seconds taken by two slides to slip off from the cream, placed in between the slides, under certain load. Lesser the time taken for separation of the two slides, better the spreadability. Two glass slides of standard dimensions are taken. For this purpose, cream is applied in between two glass slides and they are pressed together to obtain a film of uniform thickness by placing 1000 gm weight for 5 minutes. There after a weight (10 gm) is added to the pan and the top plate is subjected to pull with the help of string attached to the hook. The time in which the upper glass slide moves over the lower plate to cover a distance of 10 cm is noted. The spreadability (S) can be calculated using the formula.

$S = M. L / T$

Where,

M = Weight tied to upper slide

L = Length of glass slide

T = Time taken to separate the slides

Primary Skin Irritation test: The study is conducted upon the approval of University Animal Ethics Committee. The animals selected are albino rabbits. These animals are kept in different cages and supplied with fresh food and water during the test period of 24 hours prior to test, and the hair from the neck and thigh region is shaved to expose sufficiently large test area.

The test site is cleaned with surgical spirit briefly. Then cream is applied to the test area. The test site is observed for erythema and edema for 24 h; 48 h; and 72 h after application. This test is conducted to evaluate the irritation caused by the prepared cream on the intact skin of animals. The prepared cream does not show any erythema or edema, indicating that the prepared formulation is non-irritant on the skin of animals.

Tube extrudability: The method adopted for evaluating cream formulation for extrudability is based upon the quantity in percentage of cream extruded from tube on application of certain load. More the quantity extruded better is its extrudability. The formulations are filled into a clean, lacquered aluminium collapsible one- ounce tube with a 5 mm opening. It is then placed in between two glass slides and was clamped. Extrudability is determined by weighing the

amount of creams extruded through the tip when a constant load is placed on the slides and cream extruded is collected and weighed. The percentage of cream extruded is calculated and grades are allotted (++ good; + fair). The comparative extrudability of the formulations is noted.

TOOTHPASTES

Dentifrices such as toothpastes, tooth powders and tooth gels are meant for cleaning the surface of the teeth by removing the food debris and plaque adhered to surface of the teeth which is the main cause for tooth problems. The general requirements for a dentifrice are as follows:

- It should leave a pleasant, cool and refreshing sensation in the mouth.
- It should be capable of cleaning the teeth adequately by removing food debris, plaque and stains efficiently.
- It should be able to maintain its flow properties all through its commercial period of storage. It should be easy to pack and easy to use. The abrasive character of the dentifrice should be under the limits of the standards and should not be harsh on the enamel and the dentine.
- It should be harmless, non-toxic and should not cause irritation in the mouth or any ulcers in the buccal cavity.
- It should confirm to the standards of the EC cosmetic directive which states that it is not liable to cause damage to human health when used under normal conditions.
- The assessment of any claims shall be certified based on properly conducted clinical trials.
- Most of all it should be economical to purchase in order to encourage regular and frequent use by common people.

Formulation

Tooth pastes are the most popular form of dentifrices. They include the following ingredients which determine the quality and efficiency of tooth pastes.

1. Abrasive Agents/Polishing Agents: The abrasives or the polishing agents are used to polish the teeth and remove food debris adhered to the surface of the teeth. They are used in concentration of about 20 - 50% of the total formulation. They should possess the following characteristics:

- They should possess good abrasive properties.
- They should not produce any gritty sensation in the mouth.
- They should not lead to any incompatibilities and should be compatible with the other ingredients.

- They should provide a good shine to the enamel.
- They should be harmless to the enamel and the abrasive property should be under limits.

The most commonly used Abrasive agents are as follow:

(a) Precipitated Calcium Carbonate: It is also known as precipitated chalk and is available in a number of grades. The crystalline form of the precipitated chalk may be available as:

(i) Aragonite: Contains orthorhombic crystals.

(ii) Calcite: Contains rhombohedral crystals.

Advantages:

- It is very low cost.
- It is available in different grades in white or off-white colours.
- The lighter grades are very stable and do not get hardened on storage.

Disadvantages:

- The abrasivity is not consistent within the lots of same grade of powder due to the presence of impurities.
- It is incompatible with sodium fluoride which is used as anticaries agent.

(b) Phosphates of Calcium: A large variety of insoluble calcium phosphates are used as abrasive agents. They may be as follows:

Dicalcium Phosphate (DCP) Dihydrate: It is a commonly used abrasive agent among the phosphate of calcium.

Advantages:

- It provides good flavour stability.
- Toothpastes made with Dicalcium phosphate are better than toothpastes made with chalk.
- They do not make use of additional whitening agents.
- The hardening of the paste during preparation is accelerated in the presence of fluoride ions.
- It has less abrasive effect on dentine.

Disadvantages:

- It is incompatible with sodium fluoride.
- The only source of fluoride is sodium monoiluoro phosphate since it consists of free calcium ions that react with other fluoride sources leading to incompatibility.

- The DCP Dihydrate is unstable in its natural form and may convert into anhydrous form which may result in hardening of the paste.

The other commonly used phosphates of calcium are tricalcium phosphate, calcium pyrophosphate etc., The insoluble sodium metaphosphate, dibasic ammonium phosphate are also used as abrasive agents.

(c) Dental grade silica / Polymers of Silica : They are polymer of silica that are commonly used as abrasive agents in the formulation of toothpaste `gels in large quantities. They are available in two forms as:

- Thickening Form of Silica
- Abrasive Form of Silica

Thickening silica: They are referred to as aerogels. The particles are small in size and possess a greater surface area. They have the ability to swell and provide a thickening effect to the pastes.

Abrasive Silica: They are also referred to as xerolgels. They possess good abrasive property and are used in low concentration. They have least effect on the consistency of the finished product.

Advantages:

- The silicas are mostly used as abrasives in gels.
- They can be used in low concentration.
- They are inert and easily compatible with other ingredients.
- They provide good gloss to the dentine due to their high refractive index.

Disadvantage: The abrasive property is not consistent within the different grades.

(d)Trihydrated Alumina: It may be available in two forms: As suspension or as crystalline powder.

Advantages:

- It possesses stability with fluorides.
- It is less costly.
- It is compatible with other ingredients.
- It possesses a good abrasive characteristic.
- It is easily available and is stable during storage.

Disadvantage: It has poor thickening property.

2. Foaming Agents / Surfactants: They are also known as wetting agents. The mechanism of cleansing action is by reducing the surface tension at the interface of the adhered material and

enamel of the teeth. They aid in abrasive action by wetting the surface of the teeth. They help in the diffusion of into narrow spaces, thus enhancing the cleansing action. The properties of the surfactants are as follows:

- It should be compatible with other ingredients of the formulation.
- It should be tasteless.
- It should possess good surface active property.
- It should be non-toxic and non-irritant to the oral mucosa of the buccal cavity.

The most commonly used surfactants are:

(a) Sodium Lauryl Sulphate: It is used in concentrations of 0.5 to 2% in order to provide necessary foaming action.

Advantages:

- They have a neutral pH range.
- The recrystallized grades have good surfactant property.
- They are more compatible with other ingredients of the formulation.
- It is available in a large variety of graded forms.

Disadvantages:

- The different grades are very expensive.
- The nature of the foaming agent may be altered by the presence of any free alcohol content.

(b) Sodium Lauryl Sarcosinate: It is one of the most preferred detergents for oral products.

Advantages:

- It is consistently stable with a neutral pH range.
- It shows anti-enzymatic activity besides acting as a surface active agent.
- It is easily soluble in aqueous solvents and hence most preferred for the formulation of oral products.

Disadvantage: It may alter the taste of the final formulation when used in high concentrations.

3. Humectants: Humectants are used in order to prevent the rapid drying of dentifrices. They prevent excessive moisture loss from the product. They may additionally impart plasticity to the final product. The concentration of the humectant used in the formulation may vary from 20% to 40%. The most commonly used humectants in the formulation of dentifrices are as follows:

(a) Sorbitol 70: It consists of 70 % w/v concentration of the sorbitol solution. It comprises the largest pan in the humectant phase.

Advantages:

- It imparts cool sensation in the mouth and may also enhance the sweetening property.
- It possesses good compatibility with other ingredients; it is less expensive than glycerin.
- It has high viscosity and can produce firm toothpastes with good plasticity.

(b) Glycerine: It can be used at concentrations ranging between 5 to 10%.

Advantages:

- It is easily available both from natural and synthetic sources.
- It provides a good gloss and good shine to the product.
- It is safe, stable and compatible with other ingredients.

Disadvantages:

- It provides a warm sensation in the mouth.
- It is very expensive.

(c) Propylene Glycol: It is less commonly used and has been replaced by sorbitol.

Advantage: It has good solvent property and can also be used as a co-solvent.

Disadvantage: It has very low viscosity and may also impart a bitter taste to the product.

4. Ceiling/ Binding Agents: The binding agents are used in order to hold the solid and the liquid components together to form a smooth paste and maintain its property, particularly during storage. They prevent bleeding from the paste and also add up to the body and viscosity of the final formulation.

The commonly used binding agents are cellulose derivatives such as Carboxy Methyl Cellulose (CMC), Hydroxyethyl cellulose, Sodium Carboxy Methyl Cellulose (SCMC), Cellulose ethers etc.

(a) Sodium CMC: It is a commonly used cellulose derivative and used in concentrations between 0.9 to 2.0%. It is sensitive to pH value outside 5.5 to 9.5. The properties with its advantages and disadvantages are as follows:

Advantages:

- It provides stability to the gels.
- It resists change in the efficiency of the formulation even in the presence of divalent calcium ions and other electrolytes.

Disadvantage: It may react with cationic substitutes of antibacterial agents due to its anionic nature. Hence it cannot be used in such formulations.

(b) Ethers of Cellulose: Methyl cellulose and hydroxyethylcellulose are the most commonly

used cellulose ethers.

Advantages:

- They are stable over a wide range of pH changes.
- They are not affected by the metallic ions.
- They can be used in the toothpastes containing cationic antibacterials.
- The properties can be adjusted as required by varying the degree of substitution of the components.

Disadvantages:

- The tooth pastes made with cellulose ethers are more viscous and disperse slower than those made with SCMC.
- They cannot be used with glycerine as they are incompatible with it.
- The other naturally available gelling agents may be Gum karaya, Gum tragacanth, Iris moss (Chondrus), Gum Arabica etc,

(c) Water: Water is used in the deionized form in the formulation of toothpastes. It can be used either as a solvent for the soluble ingredient of the formulation or as a supporting media for the binding agents. Binding agents swell after imbibing water. It is used in concentrations of more than 10% in the formulation of clear gels.

5. Sweetening Agents: These are added to improve the sweetening properties and cover the bitter taste of the other ingredients like surfactants, binders etc. They help in promoting the acceptance of the product when administered orally. The most commonly used sweetening agents are Saccharin sodium, Chloroform, Aspartame, Cyclamates and Potassium acesulfame.

(a) Saccharin Sodium: It is the most widely used sweetening agent. It is used at concentrations of about 0.05- 0.31 %. The concentration may vary depending upon the amount of humectant (glycerine) used.

Advantages:

- It is of low cost.
- It is widely distributed and easily available.
- It is compatible with all other ingredients.
- It provides good sweetening property.

(b) Chloroform:

Advantages:

- It masks the taste of precipitated chalk and prevents dry feeling in the mouth.

- It provides a fresh and sharp sweetness.
- It also has antibacterial property besides the sweetening property.

Disadvantages:

- It is expensive.
- It is incompatible with certain ingredients.

6. Colouring Agents: They are used in concentration of less than 0.01% as permitted by the EEC Cosmetics Directive. They can be used generally in combination with a portion of a white creamy base. They are mainly in order to influence consumer preferences and increase the purchase intent.

7. Flavouring Agents: Flavouring agents may comprise the most proprietary and most crucial part of the formulation essential to meet the consumer preferences. They are generally a mixture of edible volatile oils consisting of spearmint and peppermint oil as major components. The other components included may be thymol, anethol, eucalyptol, aniseed oil, oil of winter green etc. Flavouring agents are used in the concentration range of about 0.5 to 1.5% and constitute the most costly part of the formula; they may interact with other components of the formulation which may result in incompatible.

8. Whitening Agents: Whitening agents such as Titanium dioxide shall be preferentially added in order to provide additional whiteness and brilliance to the paste.

9. Preservatives: Preservatives are used in the formulation in order to maintain the properties of the product throughout the storage period and to improve the shelf-life of the product. Generally, a mixture of 5% methyl paraben and 0.02% propyl paraben is the most effective and commonly used combination preservatives. Sodium benzoate is not preferred due to its incompatibility with some of the therapeutic agents.

10. Therapeutic Vehicles: Therapeutic vehicles are included in toothpastes in order to provide additional beneficial effects besides normal cleansing properties.

Examples:

(a) Antiplaque Agents: Triclosan, Chlorohexidine etc.

(b) Anticaries Agents: Fluoride derivatives

(c) Antitartar Agents that prevent the Colouring of Teeth. Zn salts, Pyrophosphate ions, Tetra sodium pyrophosphate, Disodium dihydrophosphate.

(d) Sensitive Dentine Agents: Strontium chloride, Strontium acetate, Formaldehyde etc.

(e) Optical Brightness: Substituted coumarins in long chain alkylamines.

(f) Bleaching Agents: H_2O_2, Sodium peroxides.

(g) pH Regulators: Zirconium silicate.

Preparation of toothpaste

The preparation of toothpastes may be carried out by using two methods which are as follows:

1. Dry Gum Method:

In this method, all the solid components of the formulation like abrasive agent, binding agent etc., except the surfactants are mixed together in a dry mixer. The mixer may be an agitation mixer which consists of slow rotating blades. The liquid components such as the humectants and water are gradually added to the dry mixture. The mixing process is carried out till a smooth paste is formed. The remaining ingredients like the surfactants and the flavouring agents are added to the homogenous paste under vacuum.

2. Wet Gum Method:

In this method, all the liquid components are mixed together to form a liquid phase. The binding agent is then mixed with the liquid phase with uniform stirring in order to form mucilage. The solid ingredients excluding the surfactants are then gradually added to the mucilage with uniform mixing in an agitation mixer, in order to form a homogenous paste. The remaining ingredients i.e., the surfactants, coloring agents, the flavoring agents are added under vacuum to the homogenous paste. Based on the principle involved in the above methods, some acceptable techniques have been proposed for the manufacture of toothpaste which is as follow:

1. Cold compression technique: The preparation of toothpaste using this technique can be carried out as follows. Initially, the humectants such as sorbitol (70% w/v) or glycerine are taken in the bowl of the mixer. The binding agent is then sprinkled over the humectant under agitation for uniform dispersion. The liquid components such as water, sweetener and the preservatives are mixed to form a separate liquid phase and any therapeutic additives if necessary are also added to the liquid phase. This liquid phase is then added to the humectant-binder mixture in the bowl and mixing is carried out for 5 minutes in order to remove the air from the thick gelatinous liquid phase. The vacuum is stopped and the abrasive agents are added with constant mixing until they are completely dissolved. The vacuum is reapplied and mixing is continued for at least 30 minutes. The surfactants and the flavouring agents are dispersed separately in 5% humectant. This mixture is added to the vacuum at the end and 5 minutes of additional mixing is carried out.

Finally, it leads to the formation of an air free smooth paste.

2. Hot Liquid Phase Technique: The method of preparation using this technique is as follows: In this method, the abrasive agent, binding agent and preservatives are mixed separately in a dry mixer. The humectant, sweeteners and water are mixed separately and this liquid phase is heated. The hot solution is then slowly added to dry powder with constant mixing. The resultant mass is then mixed under vacuum for 30 minutes. Finally, the solutions of the flavouring agent and the surfactant are added and vacuum, mixing is carried out for 5 more minutes. A clear and homogeneous paste is formed by this method.

3. Multiple Liquid Phase technique: This method is suitable for formulations that make use of carboxy methyl cellulose (CMC) and magnesium aluminium silicate hinder combination. The preparation can be carried out as follows: Initially, hot water is taken in a mixer bowl and magnesium aluminium silicate is added to it. The humectants, the flavouring agent, the binding agent and the preservatives are mixed separately to form a separate liquid phase.

This solution is then added to the mixer and the final volume is made using the humectants. Vacuum is introduced into bowl in order to remove the air from the liquid mixture. The vacuum is removed and the abrasive agents are added and the vacuum is again introduced in the mixer for 30 minutes. Finally, the surfactants are added with constant stirring for 5 minutes. The method is also suitable for the preparation of clear-gel dentifrices.

Evaluation of Toothpaste

Colour: The prepared toothpaste is evaluated for its colour. The colour is checked visually.

Taste: Taste is checked manually by tasting the product.

Odour: Odour is found by smelling the product**.**

Stability Stability of toothpaste is checked by exposing the product at 45±2 °C for a period of 6 months. Also expose to refrigerator conditions at 2-8 °C for 6 months. The product is observed for phase separation, fermentation and gassing.

Determination of spreadability: Take one gram of toothpaste, placed on a glass slide (10 x 10 cm) and cover with another glass slide. Then carefully placed 2 kg weight on covered glass slide. Measured the spreading (in cm) of the toothpaste after 3 minutes. Repeat the experiment and take the average value of three readings.

Determination of sharp and edge abrasive particles: Take the contents on to the finger and scratch on the butter paper for 15-20 cm long to check for the presence of any sharp or abrasive particles. Repeat the same process for atleast ten times. No sharp or abrasive particles are found.

Determination of fineness: Weigh accurately about 10 g of toothpaste and place in a 100 ml

beaker. Add 50 ml of water, and allow for standing 30 mins with stirring until the paste is completely dispersed. Transfer the solution to 150µ & 75µ IS sieves and wash with a slow stream of tap water. Allow the running tap water to drain of completely and dry the sieve at 105±2 °C by placing it in an oven. Transfer the residue particles present on the sieve on to a watch glass and weigh it.

Material on the sieve % by (Retained mass / Material taken) x 100.

Determination of lead: The color produced with sample solution containing hydrogen sulfide is compared with standard lead solution.

pH determination: Weigh 10 g of toothpaste, place in 150 ml beaker. Add 10 ml of boiled and then cool water. Stirr vigorously to make a suspension. Measure the pH of the suspension using pH meter.

Foaming power: Take a suspension of the material in measuring cylinder; shake the suspension for 12 times and measure the volume of the foam produced after shaking for 5 minutes. **Procedure:** Weigh 5g of toothpaste in to a 100 ml glass beaker. Add 10 ml of water cover the glass beaker with a watch glass and kept aside for 30 minutes. Heat the suspension gently to dissolve the detergent if present in it. Stirr the suspension with glass rods and transfer it to 250 ml measuring cylinder. Examine if no foam is produced (more than 2 ml). Transfer the residue retained in the beaker to measuring cylinder by adding of 5-6 ml of water. Then make up the cylinder with 50 ml of water. Stir the contents with up-down movements to get uniform suspension at 30 °C. After shaking, keep the cylinder aside for 5 minutes.

Determination of moisture and volatile matter

Weigh 5 g of sample placed in a porcelain dish of 6-8 cm in diameter and 2- 4 cm depth. Dry the sample in an oven at 105 °C.

% by mass =100 M1 / M

M1 - loss of mass (in grams) on drying

M - Mass (in grams) of the material taken for the test.

Determination of fluoride ion

Fluoride ions are determined using potentiometer containing fluoride ion sensitive electrodes. Calculation: A graph is plotted on a log scale, taking the concentration of fluoride (x-axis) Vs potential in mV (y-axis).

From the calibration curve, the fluoride ion concentration (in mg) of test solution is measured. Fluoride ion concentration (ppm) M = 2 a × 10000

a = mg of fluoride ion calculated from graph

M= Mass of sample taken in gram

HAIR DYES

Hair colourants are the cosmetic preparations which are used by men and women either to change the natural hair colour or to mask grey hair. The properties of typical hair colourants are

- Must possess properties like non-irritant and non-sensitizing.
- The formulation of the hair colourant should be stable.
- They should not lead to loss of the natural shine of hair.
- The shaft of the hair must not be damaged.
- They should colour the hair evenly.
- The natural moisture of the hair must not be lost.
- Must be non-toxic in nature. Must impart stable color to the hair.
- The colored hair must be unaffected by sunlight, air, water, gels, sweat, friction, lotions, oils, shampoos etc.

Classification of hair colourants

The major classification is listed as follows:

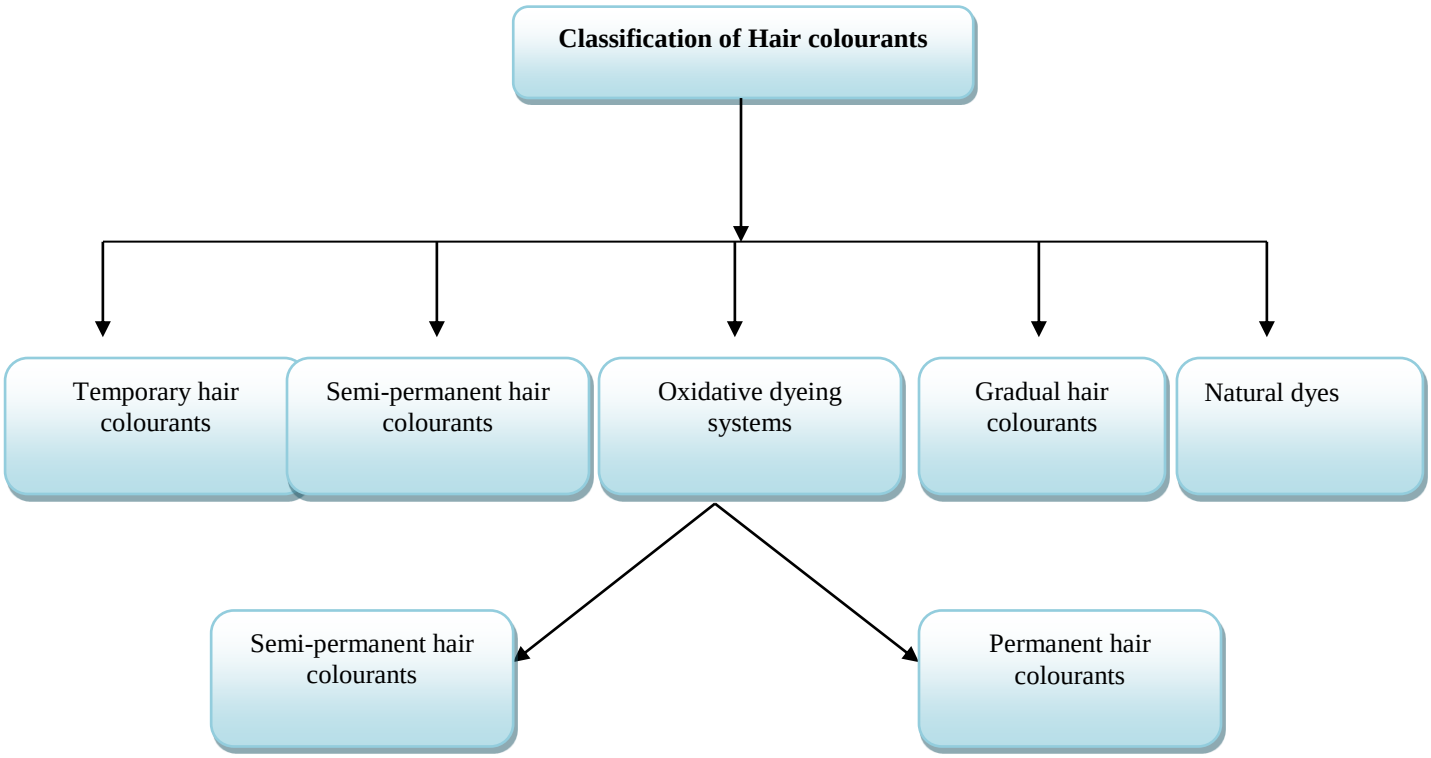

Figure 13: Classification of Hair colourants

Temporary Hair Colorants: They are leave-in preparations. The hair is not rinsed after the application of the colorant. The colorant is easily removed with one wash using a shampoo because they are absorbed into the cuticle and cannot enter into the cortex of the hair. They are rarely called as water rinses. Basically temporary hair colorants consist of dye stuffs and acid. The different dye stuffs are acid dyes, basic dyes, metalized dyes and disperse dyes. Chemically the dye stuffs are anthraquinone dyes, azo dyes, benzoquinoneimine dyes, triphenyl methane dyes, xanthenic dyes and phenazanic dyes. The hair colourants are available in different formulations like crayons, powders, liquids and shampoos.

(a) Powder Formulations: They are mostly used in theoretical make up and masquerades. The powder consists of dye stuff and acid like tartaric acid or citric acid. They are available in sachets.

Formula	Quantity for 100 g
Certified color	5 g
Tartaric acid (buffer)	95 g

Application Technique: The powder is dissolved in 250 ml of water and this solution is applied on wet hair after shampooing.

(b) Crayon Formulations: These temporary hair colorants are applied between the applications of permanent hair colorants. They color the new growing hair. They are available in many shades of colors. The composition of crayon is waxes, soap, pigments or dyes.

Formula	Quantity for 100 g
Stearic acid (anionic surfactant)	15 g
Ozokerite (wax)	7 g
Beeswax (wax)	50 g
Carnauba wax(wax)	13 g
Triethanolamine (surfactant)	7 g
Glyceryl mono stearate (surfactant)	6 g
Tragacanth (gum)	2 g
Color	q. s

Method:

Tragacanth, triethanolamine and glyceryl monostearate are heated to 70°C. Stearic acid is incorporated in the above mixture and the mixture is heated to 75°C. Carnauba wax and Beeswax

are melted separately at 70-80°C. The molten waxes are added to the above mixture and stirred well. Color is added and the mixture is stirred well. This mixture is then poured into the moulds.

2 Semi-permanent Hair Colourants / Direct Dyes: These colourants have a long lasting colour retaining ability when compared to colour shampoos. The colour produced is stronger as well. Dark colours are obtained with the colourants though they do not contain H_2O_2. This offers an advantage that the melanin of the hair doesn't get bleached but is only masked with the colourant. The colour obtained on the grey hair is different than the black (pigmented) hair because of which the hairs are highlighted. The colourants are easily applied. This colour is not lost with one wash, but is gradually lost in 5 - 8 washes with shampoo. Fragrance may be added in the composition of the colourant.

Ingredients: The semi-permanent hair colourants consist of the following constituents.

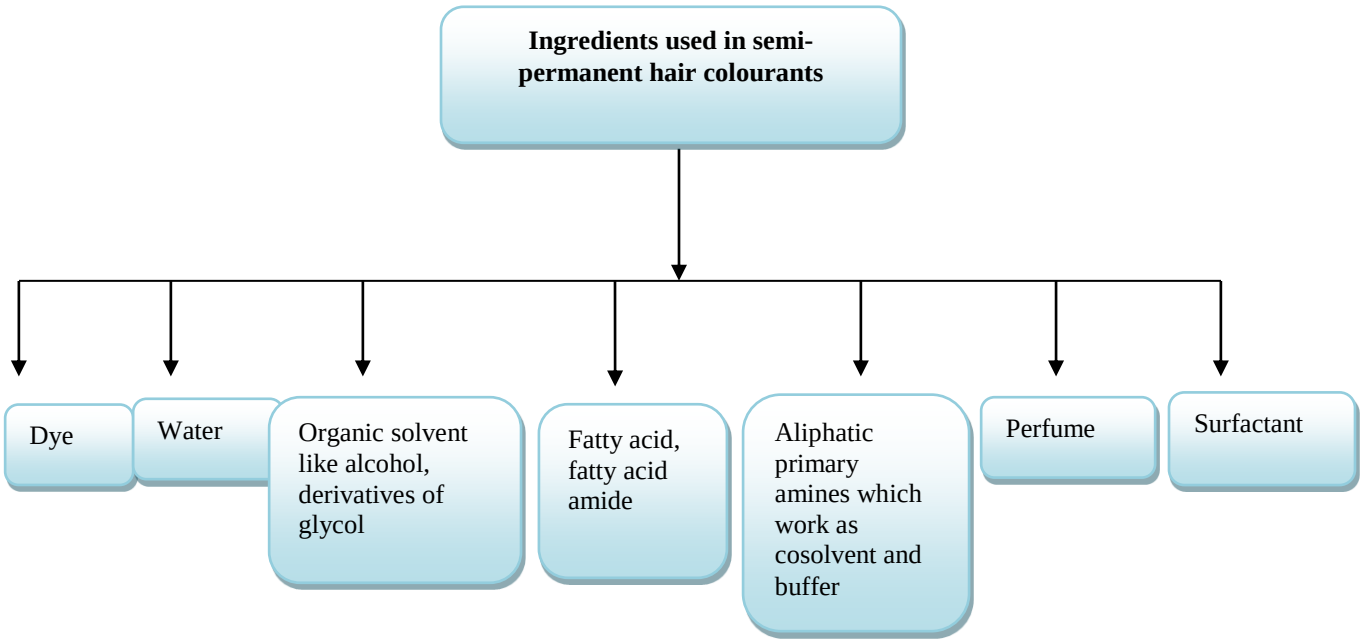

Figure 14: Ingredients used in Semi-Permanent Hair Colourants

3 Oxidative Dyeing Systems: These dyes are also called as 'para dyes'. At the time of application, these dyes are colourless but turn to a particular colour after undergoing chemical reactions on the hair. The chemical reactions include the following reactions in alkaline pH, which are oxidation and coupling and condensation.

Ingredients:

The ingredients of these dyes which render the above reactions are bases, couplers and oxidizing agent.

Bases: Chemically they are aromatic compounds. They are primary intermediates.

Couplers: They are aromatic in nature, and are referred as modifiers. They are the derivatives of benzene which show – NH_2 and - OH substitutions at meta position. Oxidation of couplers with hydrogen peroxide is difficult to achieve. Example: 2, 4-diaminoanisole, Resorcinol, m-phenylene-diamine, m-chloro resorcinol.

Oxidizing Agents: Commonly used oxidizing agent is hydrogen peroxide. Formulation of Oxidative Dyeing Systems: The following factors are of great concern during the preparation of oxidation dyes

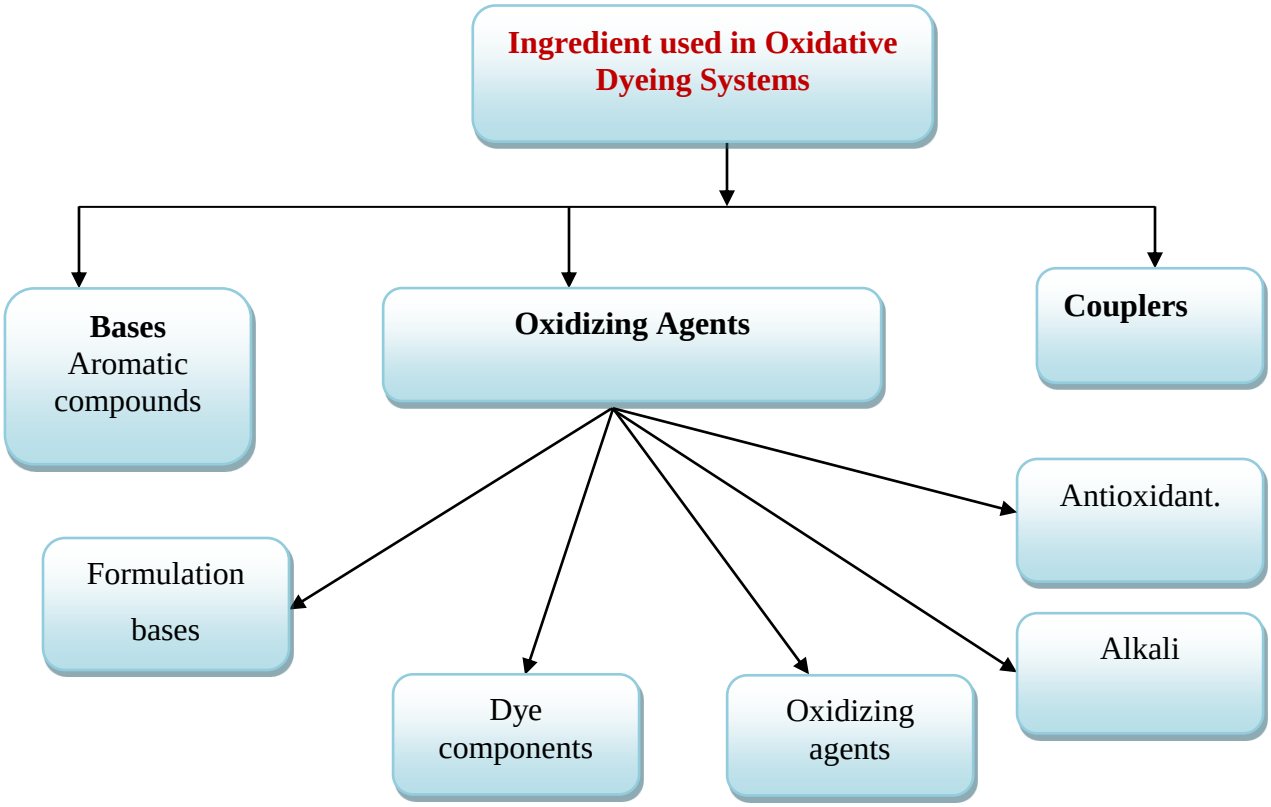

Figure 15: Ingredients used in Oxidative Dyeing Systems

1. Formulation Bases: They are used as vehicles for dyes (amino dyes) and modifiers. The vehicle is one which uniformly distributes the colourant mixture on the hair. Example: In amino dyes, a mixture of water, glycerine (0.5 - 2%), ethyl alcohol (20-50%) is used because the amino dye has low aqueous solubility. If the preparation is an emulsion i.e., lotion or cream (rather than a solution) the distribution of the preparation on hair is more even. The formulation bases may be of the following kinds such as bleach-dye combination products, emulsion type and powder preparations. The emulsion type preparations are of two types. They are non-foaming and foaming types.

(a) Non-Foaming-type Creams: They are emulsified by using cetyl alcohol, mineral oil and non-

ionic emulsifier.

Formula	Quantity for 100 g
Mineral oil (emulsifying agent +emollient)	1.5 g
Cetyl alcohol (emulsifying agent +emollient)	5 g
Non-ionic emulsifier (emulsifying agent)	3-5 g
Preservative	q. s
Water (solvent)	To make 100 g

(b) Foaming-type Creams: They are emulsified using surfactants like monoethanolamine lauryl sulfate and ethylene glycol monostearate.

Formula	Quantity for 100 g
Monoethanolamine lauryl sulphate (surfactant)	10 g
Ethylene glycol monostearate (surfactant)	1 g
Preservative	q. s
Water (solvent)	To make 100 g

(c) Bleach-dye Combination Products: They are used to bleach as well as colour the hair. Increased levels of ammonium hydroxide are used along with proportionate amounts of hydrogen peroxide. Powder Preparation: It contains oxidizing agent such as sodium peroxide and alkali ammonium hydroxide. This powder preparation is made into a paste using water and is then applied.

2. Dye Components:

(a) Oxidation bases: By using varying concentrations of p-phenylene diamine or p-toluene diamine, a number of shades can be achieved.

(b) Coupling Agents: Instead of coupling agents, direct colouring agent can also be used, coupling agents modify the shade and stabilize it. The time required to develop color with different modifiers.

3. Oxidizing Agent: On exposure to air, dyes such as amino dyes turn black. However oxidizing agent is added in its composition to achieve the desired colour. Examples are potassium permanganate, ferric chloride, hydrogen peroxide, potassium dichromate etc. Hydrogen peroxide is popularly used. It is used in a concentration of 5 - 6% solution which generates 20 volumes of

oxygen. H_2O_2 is responsible to develop colour on the hair. It is sold in a package containing two containers. One container contains dye and the other contains the developer.

4. Alkali: The oxidation dyes work best in alkaline medium. Therefore, alkali is incorporated in their composition. The best alkali is ammonium hydroxide. It leaves no evidence of its presence on the hair. It is used in a concentration of 1 - 2% in the final preparation. Because of its odour, it is completely or partially replaced with ammonium carbonate, monoethanolamine, guanidine or arginine derivatives, triethanolamine, alkanolamide, diethanolamine etc.

5. Antioxidant: During the manufacturing of dyes, especially amino dyes, an atmosphere of nitrogen is maintained to prevent the darkening of the dye. Since dyes (amino dye) are darkened on exposure to air. Instead of maintaining nitrogen atmosphere, chemical antioxidant like sodium sulfite is included in the preparation. The total amount of base and the coupling agent used gives the amount of sodium sulfite to be used in the preparation. If darker shades are desired, then the amount of sodium sulfite is increased.

Types of Oxidative Dyeing System

(a) Semi-permanent Hair Colourants: The permanent and semi-permanent hair colourants are the two classes of oxidation dyes or oxidative dyeing systems. They differ in the extent of giving light colour shades to the hair. The common constituents of both the classes are alkalizing agents, dyes, oxidants, solvents and surfactants.

Alkalizing Agents: The alkalizing agents are added.

- To generate active oxidizers from hydrogen peroxide.
- To increase the pH of the formulation to an optimal level.
- To swell the hair fibres for absorption of dye.

Examples of alkalizing agents include Monoethanolamine, ammonia.

The rate of bleaching of hair is based on the following factors and the rate of bleaching is directly proportional to the following factors.

- Concentration of hydrogen peroxide.
- Amine added.
- pH.

The rate of bleaching of different amines and ammonia is shown.

Tertiary amine < secondary amine < primary amine < ammonia.

It means ammonia is a strong alkalizing agent, which is used-widely. Instead of ammonia, high

level of monoethanolamine is used alone or monoethanolamine and ammonia are used in combination. The semi permanent products employ monoethanolamine alone, where a little bleaching is required, whereas hindered primary, secondary or tertiary amines are employed, when no bleaching is required.

Oxidant: Oxidant is added in the composition of the colourants to generate active species (likebenzoquinone monoamine, p- phenylene diamine) for coupling. Oxidants are used to bleach melanin present in the hair. Light colour shades are obtained when the grey and pigmented hair are coloured evenly by using semi permanent colourants.

Dye: Dyes are used to impart the desired colour shade to the hair.

Surfactant: It reduces the surface tension between the different ingredients, to make a homogeneous preparation.

Solvents: The constituents of the colourants which are not soluble in water are dissolved by using solvents, so that a homogenous system is obtained.

(b) Permanent Hair Colourants: The colour produced by these colourants last longer when compared to semi-permanent colourants. Actually it is the precursor of dye which when applied undergoes chemical changes to form the colour rather than the dye itself. They are available in light colour shades to dark colour shades. It is the growth of hair more than fading of colour, which arises the need to re-dye. This results in stripped appearance of the hair. The oxidation dyes may cause allergic reactions in some individuals. According to the rules of drugs and cosmetics, the preparation must contain the caution in English, local and other regional languages on both the inner and outer labels.

4 Gradual colourant: It includes heavy metals in its composition. The hair is gradually coloured with several application of the colourant. The heavy metals used are lead or bismuth in their salt forms. The salts of the heavy metals are made into solutions and are used in the preparations. The preparation is applied many times because the colour develops gradually.

Demerit: The preparation includes heavy metals, it offer negative effects on the health. Therefore the use of these colourants is declined.

5 Natural dyes: Since, antiquity, plant materials are looked upon as beneficial sources for various ailments and other purposes. The leaves are used as colourants:

(a) Henna: The leaves of henna are powdered and sold. The paste is formed by mixing the henna powder in hot water. The paste is directly applied on hair and a warm towel is wrapped around the head to enhance the colouring effect. lt gives reddish colour to the hair. Henna is non-toxic and non-sensitizing.

The active constituent of henna is lawsone, which is chemically 2-hydroxy-l4 - napthaquinone. It is responsible for imparting the color. Indigo leaves or synthetic indigo is added to henna to alter the colour. Apart from this, pyrogallic acid and metallic salts like copper sulphate are added. An increased level of pyrogallic acid added to henna, gives darker shades.

Formula	Quantity for 100 g
Powdered henna (color)	89 g
Copper sulphate (color)	3g
Pyrogallic acid (color)	6 g

Evaluation of hair colourant:

The following tests are carried out to evaluate hair colourants.

1. The toxic effect test

2. The sensitization test

Long term toxic effect: This is also necessary to evaluate the long term effect. This can also be done on animals.

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 cell when applied.

SUNSCRENS

Extraterrestrial sunlight includes ultraviolet, visible, x-ray, ionizing and infrared radiation and radiowaves. The solar spectrum at the earth's surface (sea level) consists of wavelengths of electromagnetic energy only between 290 and 3000 nm, while the spectrum implicated in human skin reactions involves wavelengths up to 1800 nm.

Ultraviolet (UV) radiation is arbitrarily subdivided into three bands,

UVA (320-400 nm)

UVB (290-320 nm)

UVC (200-290 nm)

Formulation and preparation of a sunscreen

Sunscreens traditionally have been divided into organic (chemical) absorbers and inorganic

(physical) blockers on the basis of their mechanism of action. The organic compounds absorb high-intensity UV rays with excitation to a higher energy state. Excess energy is dissipated by emission of higher wavelengths or relaxation by photochemical process such as heat release and isomerization. They include salicylates, PABA and PABA esters, benzophenones, cinnamates, butylmethoxydibenzoylmethane, drometrizole trisulphonic, anisotriazine, terephthalydene dicamphor sulphonic acid, methylene bisbenzotriazol tetramethylbutylphenol.

A. Organic Sunscreens

Organic UV filters are active ingredients that absorb UV radiation within a particular range of wavelengths, depending on their chemical structure. Once the UV filter absorbs energy, it moves from a low-energy ground state to a high-energy excited state. From this excited state, any of the following three processes may occur, depending on the ability of the filter to process the energy it has absorbed:

- **Photounstable filter:** The filter undergoes a change in its chemical structure, or is degraded after absorbing UV energy. It is not capable of absorbing UV energy again.
- **Photostable filter:** This type of filter dissipates its absorbed energy to the environment as heat energy, and returns to the ground state. It is subsequently fully capable of absorbing UV energy again.
- Photoreactive filter: In its excited state, the filter interacts with surrounding molecules, including other ingredients of the sunscreen, oxygen, and skin proteins and lipids. This leads to the production of reactive species, which may have unwanted biological effects.

Types of Organic sunscreens

Organic sunscreens are further divided into UVB and UVA filters:

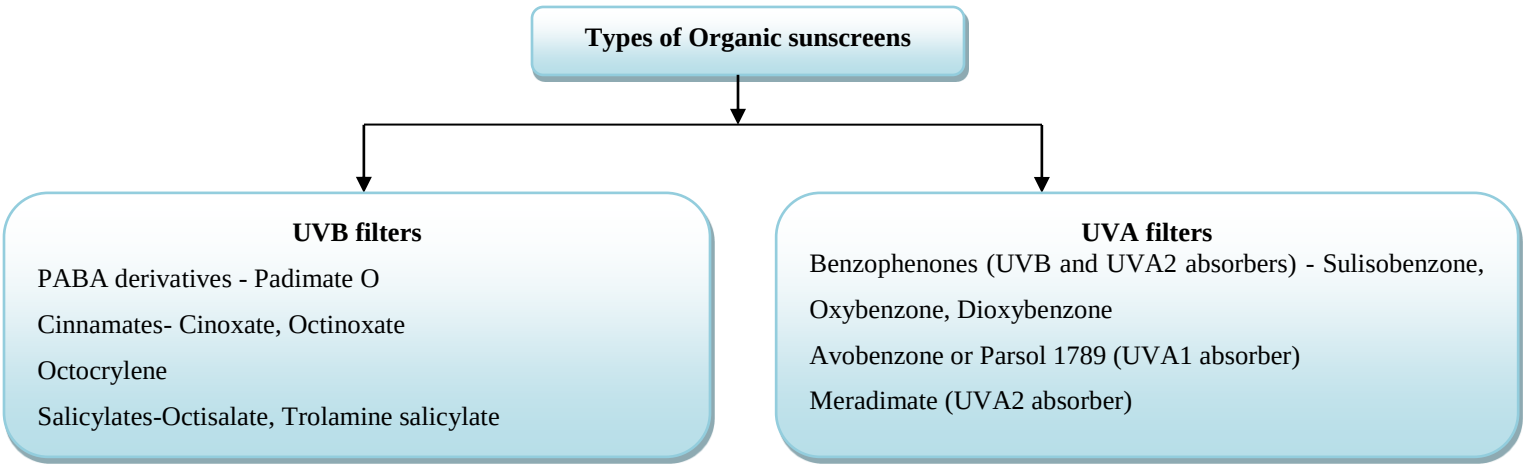

Figure 16: Types of Organic sunscreens

B. Inorganic Sunscreens

1. Titanium dioxide
2. Zinc oxide
3. Others - iron oxide, red veterinary petrolatum, kaolin, calamine, ichthammol, talc

Inorganic agents function by scattering, reflecting or absorbing UV radiation. Their opaque nature and "whitening effect" are an inherent disadvantage, which may reduced by the use of micronized or ultrafine particles.

Evaluation of sunscreen

As in any other preparation 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 compulsory for these types of compounds.

i. **Erythermal dosage**: It is important to estimate the erythermally effective radiation or E-vitons/ cm^2, transmitted by a suntan preparation. The erythermal energy is the product of the solar energy transmitted through the film of suntan preparation and effectiveness factor at that wavelength.

ii. **Spectrophotometric characterization**: 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.

iii. ***In vivo* skin testing**: This is direct test on animal skin, especially 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 radiations source, size of the test field, etc.

iv. **Sunscreen index**: This is evaluation of the relative screening activity of the sunscreen products. This is estimation of extinction coefficient at 308 mμ wavelength and comparison with other.

INTRODUCTION OF PACKING

Packaging is one of the largest industrial sectors in the world, worth $280 billion. Consumer healthcare packaging represents 4% of packaging industry. As a drug manufacturer's approach the 21st century they face a number of challenges that packaging can help them to meet. It is very important in preserving the quality, potency and safety of pharmaceutical products. The pharmaceutical industry must ensure that their products maintain the desired shelf lives during the period of storage and consumptions under specified conditions. It has been often observed that the inappropriate and cheap packaging materials used by many industries do not maintain the desired characteristics in the formulations and therefore they may not be able to provide the clinical efficacy of the product. It is utmost important that depending upon the chemical nature, stability of the solid and liquid formulations, a judicious selection of the packaging material be made which is not only compatible with the product but does not allow any effects which would cause degradation of the chemical in the product. In the development of packaging material for a particular formulation all the desired tests are to be carried out to ensure its preserving capabilities to maintain the essential characteristics of the formulation during storage. The consideration of economy in the selection of packaging material may render it unfit for use for the intended formulation and, therefore, the patient may not derived full benefit from the use of product. In many cases it has been observed that considerable degradation of the drug has occurred resulting in undesirable physical and chemical changes along with some toxic effects which may be highly hazardous to the patient.

Packaging: Packing consists of enclosing an individual item, or several items, in a container, usually for shipment or delivery. This operation is mostly done by hand and machine.

Pharmaceutical Packaging: The combination of components necessary to contain, preserve, protect & deliver a safe, efficacious drug product, such that at any time point before expiration date of the drug product, a safe & efficacious dosage form is available is called as pharmaceutical packaging. He further stated that, it is a complex, dynamic, scientific, artistic and business function, which in its most fundamental form contains, protects, preserves, provides convenience and informs the concerned people within the acceptable environment constraints. The complex nature of packaging is seen in the fact that, there are a number of aspects which have to be kept in consideration so that one side should not be in conflict with the other. For instance, manufacturers should not concern themselves with only the container that is supposed to protect the product since the concern is on getting the product to the final consumer. They need to consider the structural aspects of packaging, grades of packaging,

materials of packaging and the stability of packaging in respect of the intended pharmaceutical products. This is necessary because of the possibility of the chemical interaction between the packaging and the contents and their ultimate harmful effects on the consumer.

The packaging is stated as the technology and art of preparing a commodity for convenient transport, storage, and sales. Packaging is the expression of the brand identity of the product, its intrinsic qualities and stability. Solid dosage form design and process development depend on the physical and chemical properties of the active and excipients components. These properties are closely linked to the final product specification such as purity, strength, stability, hardness, friability, disintegration, dissolution, appearance and mechanical durability. The physico-chemical properties of the product are dependent upon the efficacy of the packaging material.

The selection of the packaging, therefore, begins with the determination of the product's physical and chemical characteristics, its protective needs and its marketing requirements. The material selected must be not reactive with products; protective from environmental conditions not impart to the products tastes or odors; non-toxic; FDA approved; meet applicable tamper-resistance requirement; adaptable to commonly employed high-speed packaging equipment. Some of the definations regarding nature of the pack given in USP 30 are:

a. **Well-closed container**: A packaging system that protects the contents from contamination by extraneous solids and from loss of the article under the ordinary or customary conditions of handling, shipment, storage and distribution.
b. **Tight container**: tight container protects the contents from contamination by extraneous liquids, solids, or vapors; from loss of the article and from efflorescence, deliquescence, or evaporation under the ordinary or customary conditions of handling, shipment, storage, and distribution; and is capable of tight reclosure. Where a tight container is specified, it may be replaced by a hermetic container for a single dose of an article.
c. **Tamper-Evident Packaging** : The container or individual carton of a sterile article intended for ophthalmic or otic use, except where extemporaneously compounded for immediate dispensing on prescription, shall be so sealed that the contents cannot be used without obvious destruction of the seal. Articles intended for sale without prescription are also required to comply with the tamper-evident packaging and labeling requirements of the FDA where applicable.
d. **Light-Resistant Container** : A light-resistant container protects the contents from the effects

of light by virtue of the specific properties of the material of which it is composed, including any coating applied to it. Alternatively,a clear and colorless or a translucent container may be made light-resistant by means of an opaque covering,in which case the label of the container bears a statement that the opaque covering is needed until the contents are to be used or administered. Where it is directed to "protect from light"in an individual monograph, preservation in a light-resistant container is intended. Where an article is required to be packaged in a light-resistant container, and if the container is made light-resistant by means of an opaque covering, a single-use,unit-dose container or mnemonic pack for dispensing may not be removed from the outer opaque covering prior to dispensing.

e. **Hermetic Container**: A hermetic container is impervious to air or any other gas under the ordinary or customary conditions of handling, shipment, storage and distribution.

f. **Unit-Dose Container**: A unit-dose container is a single-unit container for articles intended for administration by other than the parenteral route as a single dose, direct from the container.

Functions of Pharmaceutical Packaging

1. **Containment-** The containment of the product is the most fundamental function of packaging for medicinal products. The design of high-quality packaging must take into account both the needs of the product and of the manufacturing and distribution system. This requires the packaging: not to leak, nor allow diffusion and permeation of the product, to be strong enough to hold the contents when subjected to normal handling and not to be altered by the ingredients of the formulation in its final dosage form.
2. **Protection-** The packaging must protect the product against all adverse external influences that may affect its quality or potency, such as light, moisture, oxygen, biological contamination, mechanical damage and counterfeiting/adulteration.
3. **Presentation and information -** Packaging is also an essential source of information on medicinal products. Such information is provided by labels and package inserts for patients.
4. **Identification-** The printed packs or its ancillary printed components serve the functions of providing both identity and information.
5. **Convenience** - The convenience is associated with product use or administration e.g., a unit dose eye drop which both eliminates the need for preservative and reduces risks associated with cross infection, by administering only a single dose.

Types of Pharmaceutical Packaging

Primary packaging system is the material that first envelops the product and holds it i.e., those

package components and subcomponents that actually come in contact with the product, or those that may have a direct effect on the product shelf life e.g., ampoules, vials, prefilled syringes, IV containers etc.

Secondary packaging system is outside the primary packaging and used to group primary packages together e.g., cartons, boxes, shipping containers, injection trays etc.

Tertiary packaging system is used for bulk handling and shipping e.g., barrel, container, edge protectors etc.

TYPES OF PACKAGING MATERIALS

Glass

Glass is generally the first choice of packaging for all types of pharmaceutical products. Glass is the only packaging material rated 'GRAS' or 'generally regarded as safe' by the U.S. Food & Drug Administration. In the European and the United States pharmacopeias various grades of glass are classified as official based on their chemical characteristics and efficacy within the packaging of pharmaceuticals. Glass containers also are beneficial from the economical point of view as glass is abundantly present in nature and because of its capability to be sterilized and hence be recycled. Its distinction when compared to other packaging materials lies in the unique combination of durability, inertness and transparency. The container chosen for a given preparation shall be such that the glass material does not release substances in quantities sufficient to affect the stability of the preparation or to present a risk of toxicity. In justified cases, it may be necessary to have detailed information on the glass composition, so that the potential hazards can be assessed. The hydrolytic stability of glass containers for pharmaceutical use is expressed by the resistance to the release of soluble mineral substances into water under the prescribed conditions of contact between the inner surface of the container or glass grains and water.

Advantages:

1. Superior protective qualities
2. Economical
3. Readily available in a wide variety of sizes & shapes
4. Essentially chemically inert, impermeable, strong and rigid
5. Does not deteriorate with age
6. Provides an excellent barrier against every element except light with a proper closure system. Colored glass, especially amber, can give protection against light.

Disadvantages:

1. They are brittle and break easily.
2. They may crack when subject to sudden changes of temperatures.
3. They are heavier in comparison to plastic containers.
4. Transparent glasses give passage to UV-light which may damage the photosensitive drugs inside the container.
5. **Flaking:** From simple soda-lime glass the alkali is extracted from the surface of the container and a silicate rich layer is formed which sometimes gets detached from the surface and can be seen in the contents in the form of shining plates known as 'flakes' and in the form of needles they are known as 'spicules'. This is a serious problem in parenteral preparations.
6. **Weathering:** Sometimes moisture is condensed on the surface of glass container which can extract some weakly bound alkali leaving behind a white deposit of alkali carbonate to remain over there, further condensation of moisture will lead to the formation of an alkaline solution which will dissolve some silica resulting in loss of brilliance from the surface of the glass called weathering

Types of glass containers

According to the hydrolytic resistance characteristics, glass containers are classified as follows:

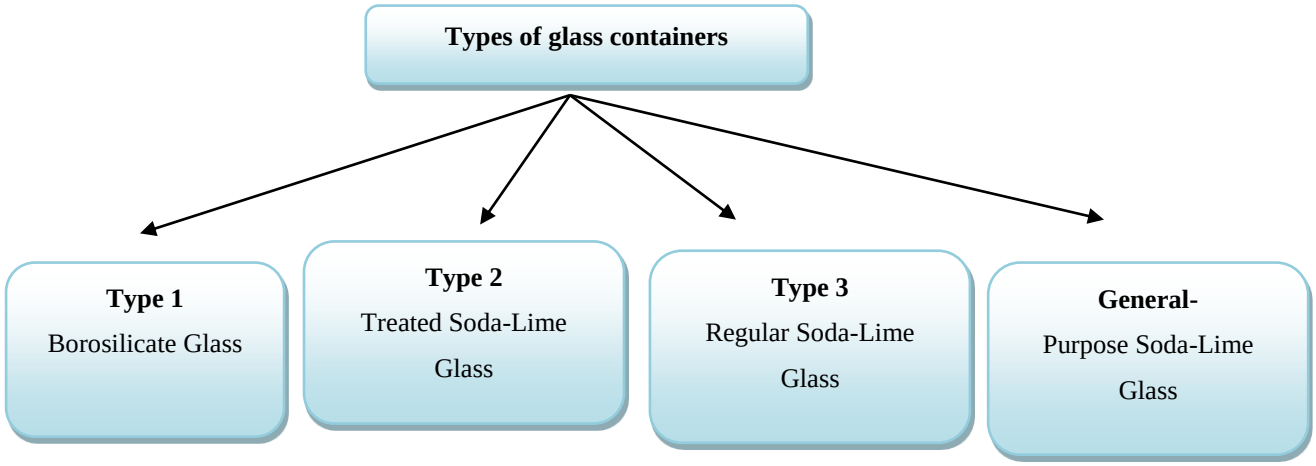

Figure 1: Types of Glass Containers

Type 1 —Borosilicate Glass

Borosilicate Glass is a highly resistant glass. In this type of glass a substantial part of the alkali and earth cations are replaced by boron and/or aluminum and zinc. It is more chemically inert than the soda-lime glass, which contains either none or an insignificant amount of these cations. Although glass is considered to be a virtually inert material and is used to contain strong acids and alkalies as

well as all types of solvents, it has a definite and measurable chemical reaction with some substances, notably water. The sodium is loosely combined with the silicon and is leached from the surface of the glass by water. Distilled water stored for one year type III glass picks up 10 to 15 parts per million (ppm) of sodium hydroxide along with traces of other ingredients of the glass.

Type 2 —Treated Soda-Lime Glass

Type II containers are made of commercial soda-lime glass that has been de-alkalized or treated to remove surface alkali. The de-alkalizing process is known as "sulfur treatment" and virtually prevents "weathering" of empty bottles. The treatment offered by several glass manufacturers exposes the glass to an atmosphere containing water vapor and acidic gases, particularly sulfur dioxide at an elevated temperature. This results in a reaction between the gases and some of the surface alkali, rendering the surface fairly resistant, for a period of time, to attack by water. The alkali removed from the glass appears on the surface as a sulfate bloom, which is removed when the containers are washed before filling. When glassware is stored for several months, especially in a damp atmosphere or with extreme temperature variations, the wetting of the surface by condensed moisture (condensation) results in salts being dissolved out of the glass. This is called "blooming" or "weathering," and in its early stages, it gives the appearance of fine crystals on the glass. At this stage, these salts can be washed off with water or acid.

Type 3—Regular Soda-Lime Glass

Containers are untreated and made of commercial soda-lime glass of average or better than average chemical resistance.

General-Purpose Soda-Lime Glass

Containers made of soda-lime glass are supplied for nonparenteral products, those intended for oral or topical use.

Composition of glass

The only anion of consequence is oxygen. Many useful properties of glass are affected by the kind of elements it contains. Reduction in the proportion of sodium ions makes glass chemically resistant; however, without sodium or other alkalies, glass is difficult to melt and is expensive. Boron oxide is incorporated mainly to aid in the melting process through reduction of the temperature required. Lead in small traces gives clarity and brilliance, but produces a relatively soft grade of glass. Alumina (aluminum oxide), however, is often used to increase the hardness and durability and to increase resistance to chemical action. Glass is composed principally of silica with varying amount of metal oxides, soda-ash, limestone, and cullet. The sand is almost pure silica; the

soda ash is sodium carbonate, and the limestone, calcium carbonate. Cullet is broken glass that is mixed with the batch and acts as a fusion agent for the entire mixture. The composition of glass varies and is usually adjusted for specific purposes. The most common cations found in pharmaceutical glassware are silicon, aluminum, boron, sodium, potassium, calcium, magnesium, zinc and barium.

Plastic

Plastics are long-chain polymers that can be melted, formed into a desired shape, and solidified during cooling. The general advantages of using plastic materials in pharmaceutical packaging include consumer acceptance, preference, excellent safety characteristics (non fragility), less weight than other materials, moisture barrier properties, gas barrier properties, good puncture resistance, low heat conductivity, good sealant properties, and recyclability. Plastics are inexpensive, light weight, strong, durable, corrosion-resistant materials, with high thermal and electrical insulation properties, because of these properties plastics are widely used in the pharmaceutical packaging industry. In addition to this it can be easily molded into the preferred shape and provide protection against contamination and in the storage and transportation.

Types of plastics

Plastics are classified into two groups according to their behaviour when heated.

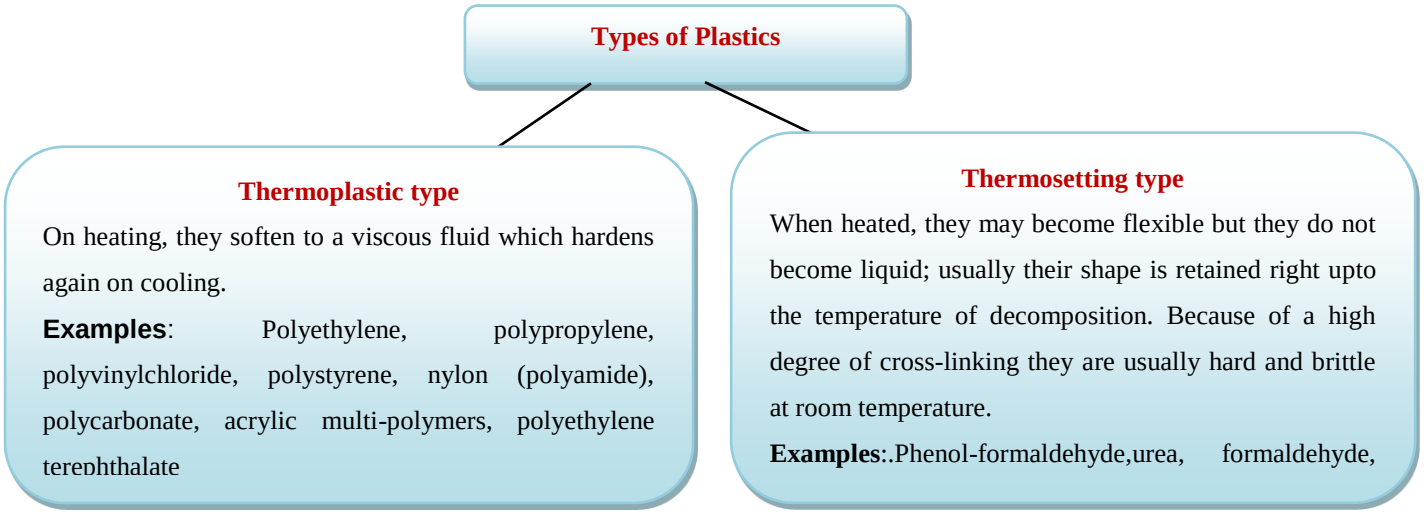

Figure 2: Types of Plastics

Polyethylene (PE)

Polyethylene is available in three different grades including low (LDPE), medium (MDPE) and high (HDPE) density (ranging from 0.91 to 0.96). As the density of PE increases both physical and chemical properties vary. The clarity and translucency depends upon the density of PE. The low,

medium and high density PE has oxygen transmission of 500, 250-535 and 185 respectively. High density polyethylene (HDPE) is the most crystalline material and is most widely used for the containers by the pharmaceutical industry for drug packaging because it offers good barrier against moisture but a relatively poor one against oxygen and other gases. HDPE mostly used for solid oral medication in pharmaceutical industry. Polyethylene is the material of choice with polypropylene (PP) as a polymeric material used for on line blow fill seal technology.

Polystyrene (PS)

The polystyrene is the clear rigid hard material with good tensile strength but is one of the most brittle plastics when dropped. It is resistant to mineral oil, water and alkali but is soluble in organic solvents. It is fairly permeable to moisture and is generally not a suitable packaging material for pharmaceutical products.

Polycarbonate (PC)

The poly carbonate material is having good impact resistance with excellent dimensional stability. It has a low water absorption capacity and is heat resistant. PC is used to make membrane filters, reusable bottles and sterilize-able medical packaging.

Polyvinyl chloride (PVC)

PVC used as a forming film is called rigid PVC because it is almost free of softening agents. Currently it is the most widely used forming film and displays ideal forming characteristics. Its water-vapor permeability is very low.

Advantages of PVC are the low cost and the ease of thermo forming. PVC has a negative environmental due to its chlorine content. In the case of blister packaging the PVC sheet does not contain any plasticizer and is sometimes referred to as rigid PVC or RPVC. In the absence of plasticizers, PVC blisters offer structural rigidity and physical protection for the pharmaceutical dosage form. On the other hand, the blister cavity must remain accessible by the push-through effect and the formed web may not be too hard to collapse when pressed upon; for this reason the PVC sheet thickness is typically chosen between 200-300µ depending on the cavity size and shape. Most PVC sheets for pharmaceutical blisters are 250µ or 0.250 mm in thickness. Multi-layer blister films based on PVC are often used for pharmaceutical blister packaging, whereby the PVC serves as the thermo formable backbone of the structure. Also, the PVC layer can be colored with pigments and/or UV filters. The following factors must be considered when PVC is used for pharmaceutical purpose like stabilizers, plasticizer, monomer, residue, modifiers, lubricants and catalytic residue.

Poly vinylidene chloride (PVDC)

PVDC-coated PVC has characteristics similar to those of uncoated PVC except that the water vapor permeability of films coated in this way is reduced by a factor of 5-10. The coating is applied on one side and usually faces the product and the lidding material. PVDC is copolymer of vinyl chloride or vinyl acetate and vinylidene chloride. It is an excellent resistance to permeation by moisture and gas and mostly widely used as a coating.

PVC and ACLAR (CTFE)

PVC-CTFE films made from PVC and ACLAR (CTFE) have the lowest water-vapor permeability of all the films used for blister packaging. The environmental concerns raised about PVC also apply to PVC-CTFE film. Poly chloro trifluoro ethylene (PCTFE) can be laminated to PVC to obtain very high moisture barrier. Typical constructions used for pharmaceutical products are 250µ PVC film laminated to 15µ-100µ PCTFE film. Duplex structures are PVC/PCTFE and triplex laminates are PVC/PE/PCTFE. Deeper cavities can be formed by using the triplex structures with PE. Typical WVTR values are between 0.06 - 0.40 g/m^2/day.

Cyclicolein copolmers (COC)

Cyclic olefin copolymers (COC) or polymers (COP) can provide moisture barrier to blister packs, typically in multilayered combinations with polypropylene (PP), polyethylene (PE), or glycol-modified polyethylene terephthalate (PET). Cyclic olefin resins are generally amorphous and are noted for good thermoforming characteristics even in deep cavities, leading some to use COC in blister packaging as a thermoforming enhancer, particularly in combination with semi crystalline resins such as PP or PE. Films can be manufactured via co extrusion or lamination. Unlike PVC and other common pharmaceutical barrier resins, cyclic olefin resins do not contain chlorine or other halogens in their molecular structure, being comprised solely of carbon and hydrogen. Cyclic olefin resins are available which comply with pharmaceutical packaging guidelines in the US, Europe, and Japan.

Polypropylene (PP)

There is an increasing trend towards the use of PP as a support material for blister packages. The water-vapor permeability of uncoated PP is lower than that of PVC and is comparable to the water vapor permeability of PVDC coated PVC. Water- vapor permeability of uncoated PP is lower than PVC, and is comparable to PVDC coated PVC. One problem posed by PP processing is thermo forming. The temperature required for thermo forming PP and the temperature of subsequent

cooling process must be precisely controlled. Another problem is warping of package often resulting in the requirement for PP formed packages to be straightened before cartoning.

Product-plastic interactions

Product-Plastic interactions have been divided into five separate categories:

(1) Permeation

(2) Leaching

(3) Sorption

(4) Chemical reaction

(5) Alteration in the physical properties of plastics or products

1) Permeation

Transmission of gases, vapors, or liquids through plastic packaging materials can have an adverse effect on the shelf-life of a drug. Permeation of water vapor and oxygen through the plastic wall into the drug can present a problem if the dosage form is sensitive to hydrolysis and oxidation. Temperature and humidity are important factors influencing the permeability of oxygen and water through plastic. An increase in temperature reflects an increase in the permeability of the gas. Great differences in permeability are possible, depending on the gas and the plastic used. Molecules do not permeate through crystalline zones; thus, an increase in crystallinity of the material should decrease permeability. Two polyethylene materials may therefore give different permeability values at various temperatures. Materials such as nylon, which are hydrophillic in nature, are poor barriers to water vapor, while such hydrophobic materials as polyethylene provide much better barriers. Studies have also revealed that formulations containing volatile ingredients might change when stored in plastic containers because one or more of the ingredients are passing through the walls of the containers. Often, the aroma of cosmetic products becomes objectionable, owing to transmission of one of the ingredients, and the taste of medicinal products changes for the same reason.

2) Leaching

Problems may arise with plastics when coloring agents in relatively small quantities are added to the formula. Particular dyes may migrate into a parenteral solution and cause a toxic effect. Release of a constituent from the plastic container to the drug product may lead to drug contamination and necessitate removal of the product from the market. Plastic containers have one or more ingredients added in small quantities to stabilize or impart a specific property to the plastic and the prospect of leaching, or migration from the container to the drug product is present.

3) Sorption

It is the process that involves the removal of drug content from the product by the packaging material. Sorption may lead to serious consequences when active ingredients are in solution. Since drug substances of high potency are administered in small doses, losses due to sorption may significantly affect the therapeutic efficacy of the preparation. Sorption is seen mainly with preservatives. These agents exert their activity at low concentration, and their loss through sorption may be great enough to leave a product unprotected against microbial growth.

Factors that influence characteristics of sorption from product are chemical structure, pH, solvent system, concentration of active ingredients, temperature, length of contact, and area of contact.

4) Chemical Reactivity

Certain ingredients that are used in plastic formulations may react chemically with one or more components of a drug product. At times, ingredients in the formulation may react with the plastic. Even micro-quantities of chemically incompatible substances can alter the appearance of the plastic or the drug product.

5) Modification

Polyvinyl chloride is an excellent barrier for petroleum solvents, but the plasticizer in polyvinyl chloride is extracted by solvents. This action usually leaves the plastic hard and stiff. Sometimes, this effect is not immediately perceptible because the solvent either softens the plastic or replaces the plasticizer; later, when the solvent evaporates, the full stiffening effect becomes apparent. The changes in physical and chemical properties of the packaging material by the pharmaceutical product are called modification. Such phenomena as permeation, sorption, and leaching play a role in altering the properties of the plastic and may also lead to its degradation. Deformation in polyethylene containers is often caused by permeation of gases and vapors from the environment or by loss of content through the container walls. Some solvent systems have been found to be responsible for considerable changes in the mechanical properties of plastics. Oils, for example, have a softening effect on polyethylene; fluorinated hydrocarbons attack polyethylene and polyvinyl chloride. In some cases, the content may extract the plasticizer, antioxidant, or stabilizer, thus changing the flexibility of the package.

Metal containers

Metal is the most adaptable of all the materials used in the packaging; however it is used to dispense only the non parental medicinal products since it poses the threat of possible shedding of

metal particles into the product. Different metals like tin, aluminum and tinplate are used in pharmaceutical industries. Metals provide superior protection against contamination as they are impervious to light, moisture and gases. They are also lighter in weight when compared to most materials. The containers made from metals include tubes, packs made from foil or blisters, cans, aerosol and gas cylinders.

The major disadvantage that they pose is that they are highly expensive**.** The collapsible metal tube is an attractive container that permits controlled amounts to be dispensed easily, with good reclosure and adequate environmental protection to the product. The risk of contamination of the portion remaining in the tube is minimal, because the tube does not "suck back." It is light in weight and unbreakable, and it lends itself to high-speed automatic filling operations. Metals used for collapsible tubes are tin (15%), aluminum (60%), and lead (25%). Tin is the more expensive than lead. Tin is the most ductile of these metals. Tin containers are preferred for foods, pharmaceuticals, or any product for which purity is an important consideration. Tin is chemically inert of all collapsible tube metals. Laminates of tin-coated lead provide better appearance and will be resistant to oxidation. They are also cheaper compared to tin alone. The tin that is used for this purpose is alloyed with about 0.5% copper for stiffening. When lead is used, about 3% antimony is added to increase hardness. Lead has the lowest cost of all tube metals and is widely used for nonfood products such as adhesives, inks, paints and lubricants. Aluminum work hardens when it is formed into a tube, and must be annealed to give it the necessary pliability.

Aluminium

Aluminum is the most abundant metal on the earth’s surface, but it is one of the most costly constituents in a laminate. Foil is obtained from metal of 99% purity and above. The gauges range from 0.006 mm to 0.040 mm. The foil is annealed to give a soft foil with a ‘dead fold’ property. Hard tempered (non-annealed) foil occasionally finds special applications, i.e. push-through lidding for blister packs. Lubricants are removed from hard foil by either solvent washing or controlled heating. For any nominal gauge +8% variations is normally allowed. For solid dosage form (i.e. tablet, capsules, and powders) aluminum foil is the most commonly used packaging material due to its protective characteristics with respect to the effects of moisture, heat and light. Aluminum offers significant saving in the product shipping costs because of their light weight; they provide the attractiveness to the tin at somewhat lower costs.

The different types of aluminum packaging materials include lidding aluminum foil containers, casserole, lid punching machine, disposable kitchen foil, cling film, lidding pharma foil, lidding

packaging material, cigarette foil, lidding blister foil, aluminum lidding foil, paper laminated foil, heat sealable lidding foil, foil lidding casserole, triple laminate for ORS pouch, strip packing, foil panes, aluminum foil and alufoil lidding. A number of alufoil properties combine to provide a convenient, safe and versatile packaging format for tablets, creams, liquids and powders covering an enormous variety of pharmaceutical products. Alufoil unrivalled barrier properties totally exclude moisture, oxygen and other gases, microorganisms and light, thus maintaining sensitive products in peak condition for long periods.

Rubber

Natural rubber consists of long chain polymers of isoprene units linked together in the *cis*-position. Its most important source is the tree *Hevea braziliensis* from which a latex, containing 30 to 40% of rubber in colloidal suspension, exudes when shallow cuts are made in the bark. These are the elastomers which are obtained naturally. It is made up of solids particles suspended in milky white liquid, called latex that drips from the bark of tropical and subtropical trees. This latex rubber is mainly found in the countries like Brazil, India, Indonesia, Malaysia and Sri Lanka. It is made by the polymerization of isoprene (2 methyl-1, 3-butadiene) which has a chemical formula $(C_5H_8)_n$ and it is known as cis- 1, 4- polyisoprene. In simple words, we can say that they are made by loosely joining the monomers of isoprene (C_5H_8) in the form of a long tangled chain.

Compounding rubbers: Some of the properties of raw rubber (e.g. poor elasticity and sensitivity of temperature change) makes it unsuitable for the production of most rubber articles. Physical and chemical properties of rubber are altered by the addition of some additives, such as.

1. **Vulcanizing agent:** Raw rubber has poor elasticity, so its strength is poor. It hardens when cold and becomes soft and sticky when warm. It dissolves in many solvents. Vulcanizing increases greatly the range of stress and temperature over which the material is elastic. Sulphur is a vulcanizing agent and it forms cross-links between the long rubber molecules.
2. **Accelerators:** These reduce the time of vulcanization and the amount of sulphur required. For examples: 2-mercapto benzthiazol (MBT).
3. **Activators:** These are used to increase the activity of accelerators. For examples: Stearic acid or zinc stearate for MBT andzinc oxide for TMT.
4. **Fillers:** Two classes of fillers are added to rubber. Reinforcing fibres are used to improve physical properties.e.g.carbon black (very finely divided carbon), zinc oxide, magnesium carbonate and calcium carbonate. Extending fillers are added mainly as diluents to reduce cost and partly to facilitate manufacture. For examples: Talc and asbestos.

5. **Softeners:** These facilitates the incorporation of fillers, make the compound easier to manufacture. For examples: Pine oil, mineral oil, tar-fractions.
6. **Antioxidants:** The chains are broken at the double bonds and S-links by oxidation, causing softening and weakening. Deterioration is slowed down by including antioxidants. For examples: Phenyl betanaphthyl amine and para-hydroxy diphenyl.

Paper and paperboard

Paper and cardboard is a pillar of traditional packaging materials, consumption of large, wide range of applications, its output accounts for about 45% of the total output value package. Paper and paperboard must be appropriate strength, impact resistance and wear resistance; good sealing and easy to clean; excellent shape and fold, easy to use various processing methods; should be in the mechanization and automation of packaging; have the best printable, easy introduction and landscaping products; lower prices, and light weight, can reduce packaging costs and transportation costs; easy to handle after use, reuse and recycling of recyclable and will not pollute the environment and conserve resources; paper and cardboard containers are mainly large cardboard boxes, cartons, paper bucket, paper bags, paper cans, paper cups, paper plates, etc., are widely used in transport packaging sales packaging.

Caps and closures

Closures that form part of the container-closure system are an important component in the packaging of sterile products. They are also known as stoppers or bungs. Most commonly an elastomeric closure is used. An elastomer is any material that is able to resume its original shape when a deforming force is removed, which is known as viscoelasticity. The primary function of the closure system is to retain or contain the content, safety and security may be necessary to prevent hazards resulting in leakage, seepage, spillage, pilferage, loss of quality, and purity, etc. The ideal closure prevents exposure of the sterile product to both moisture and oxygen thus ensuring the stability of the product and also prevents the contents from escaping the container. The adequacy of the seal is dependent on a number of factors; these include the flexibility of the liner and the torque which is applied. For a closure system to be effective it is essential to consider the nature of material of container, properties of the product and the stability requirements. Closures may be manufactured by a number of means of combination of pressure, temperature and adhesion. The materials used for the formation of closures include:

Metals like aluminium, aluminium alloys, tinplate, tin free steel, stainless steel. Glass is used for formation of stoppers. Rubbers and plastics are also and very commonly and widely used for cap

and closures. Caps or overseals are used to secure the rubber closure to the container in order to maintain the integrity of the seal under normal conditions of handling and storage. These caps are usually made of aluminium and may be equipped with plastic top to facilitate opening.

Functions of closures

The functions of closures in both plastic and glass containers include inviolability, non refill ability, measuring and pouring facilities, child resistance, sales appeal or two or more of these functions in combination. They can also assist in the dispensing of product.

Types of closures

The basic types of caps and closures include:

Thread Screw

This provides physical and chemical barrier to the contents in the container. They are either made of plastic or made of metal.

Lug Cap

This differs from the thread screw closure due to the presence of continuous thread on the container. It is more commonly used in food industries rather than pharmaceutical industry.

Crown Cap

It is a crimped closure more commonly used in beverage industry.

PACKAGING MATERIALS WITH RESPECT TO DIFFERENT DOSAGE FORMS

1 Strip packages

A strip package is a form of unit dose packaging that is commonly used for the packaging of tablets and capsules. A strip package is formed by feeding two webs of a heat-sealable flexible film through either a heated crimping roller or a heated reciprocating plate. The product is dropped into the pocket formed prior to forming the final set of seals. A continuous strip of packets is formed, generally several packets widedepending on the packaging machine's limitations. The strip of packets is cut to the desired number of packets in length. Different packaging materials are used for strip packaging based on their properties for high-barrier applications;

a paper/polyethylene/foil/polyethylene lamination is commonly used.

Figure 3: Strip Packages

2 Blister packages

The blister package is formed by heat-softening a sheet of thermoplastic resin and vacuum-drawing the softened sheet of plastic into a contoured mold. After cooling, the sheet is released from the mold and proceeds to the filling station of the packaging machine. The semi-rigid blister previously formed is filled with product and lidded with a heat-sealable backing material. The backing material, peelable type is usually heat-seal-coated aluminium foil. The coating on the foil must be compatible with the blister material to ensure satisfactory sealing, both for product protection and for tamper resistance. Materials commonly used for the thermo-formable blister are poly vinyl chloride (PVC), PVC/polyethylene combinations, polystyrene and polypropylene. In tropical areas blister packages with an additional aluminium membrane is used which provide greater protection against high humidity.

Figure 4: Blister Packages

3 Child Resistant Containers

Child resistant containers are commonly referred to as CRC's, which are designed to prevent the child accessing to potential hazarding products.

Legally: “at least 80% of children between the ages of 20 and 42 months forming a test panel are unable to open the packaging within 5 minutes of receiving it”. Up to now, all standards for testing for child-resistant compliance give a definition of such a package as being the immediate packaging

which is resistant to opening by children, but which does not pose difficulties for the elderly to open and, where appropriate, to re-close properly

Figure 5: Child Resistant Containers

4 Bubble Pack

The bubble pack can be made in several ways but is usually formed by sandwiching the product between a thermo formable, extensible, or heat-shrinkable plastic film and a rigid backing material. This is generally accomplished by heat-softening the plastic film and vacuum-drawing a pocket into the film in a manner similar to the formation of a blister in a blister package. The product is dropped into the pocket, which is then sealed to a rigid material such as heat-seal-coated paperboard. If a heat-shrinkable material is used, the package is passed through a heated tunnel, which shrinks the film into a bubble or skin over the product, firmly attaching it to the backing card.

Figure 6: Bubble Pack

5 Film wrapper

A transparent film with a distinctive design is wrapped securely around a product or product container. The film must be cut or torn to open the container and remove the product. Substrates options include ultra destructible films, voidable films that provides image when removed. For example: Solvent sensitive papers.

6 Shrink tubing

A packaging concept capable of providing not only a package that is tamper-resistant, but also, by the proper selection of material, a package with a high degree of environmental protection is called as flexible pouch. A flexible pouch is usually formed during the product filling operation by either vertical or horizontal forming, filling or sealing equipment.

Figure 7: Shrink Tubing

7 Collapsible Metal and Plastic Tubes

A. Its narrow orifice prevents serious contamination of unused parts of contents.

B. Wastage is reduced, since the patient is less likely to remove an excessive amount.

C. When part of the preparation is expelled it is not replaced, as in other containers, by equivalent volume of air; consequently, microbial contamination and oxidative or hydrolytic degradation of the remaining contents are reduced.

D.Nozzle type applicators can be fitted to facilitate administration into body cavities such as nose or vagina. Most collapsible tubes are made of aluminium, although tin, lead, tin coated lead and plastics are also used. Aluminium tubes have good resistance to corrosion because the surface of film of oxide.

Figure 8: CollapsibleMetal and Plastic Tubes

8 Glass Plastic Pots

Suitable alternatives are wide mouthed squat, cylindrical pots made from glass or suitable plastics having a plastic (or occasionally metal) screw (or, sometimes in case of plastics, slip over cap). Glass pots may either be colorless and either clear or amber color or opal white. Glass is inert, hygienic and provides stability considerations allow transparency, the content can be seen. Unless

returned by patient for reuse, they are more expensive than plastics.

9 Aerosols

Pressurized packages expel the product through a valve. The pressure exerted for the expulsion of the product is an important consideration while selecting the packaging for any products. Packaging of therapeutic active ingredients in a pressurized system. Aerosols depend on the power of compressed or liquefied gas to expel the contents from containers. A dose can be removed without contamination of materials. Stability is enhanced for these substances adversely affected by oxygen and or moisture. When sterility is an important factor, it can be maintained while a dose is being dispensed.

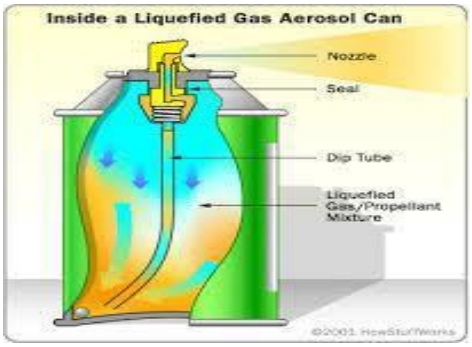

Figure 9: Overview of Aerosols

10 Containers for liquids/ Parenterals

Injectable formulations are packaged in to containers made of plastic or glass. Container system includes ampoules, syringes, vials, bottles, cartridges, bags ampoules are all glass and plastic are all bags. Rubber materials for rubber stoppers for vials and bottles, rubber plungers and rubber seals for syringes, cartridges. Irrigation solutions are packaged in glass bottles with aluminium screw caps. A single-dose container is one that holds a quantity of drug intended as a single dose and when opened cannot be resealed with assurance that sterility has been maintained. These containers include fusion-sealed ampoules and prefilled syringes and cartridges.

Figure 10: Containers for liquids

11 Single dose containers

A container that holds a quantity of the preparation intended for total or partial use as a single administration.

Figure 11: Single Dose Containers

Multi dose containers: It is hermetic containers which permit withdrawal of successive portions of the contents without altering the strength or endangering the quality or purity of the remaining portions (vials). The device is usually a spoon or a cup of volume of 5 ml.

STABILITY TESTING

The purpose of stability testing is to provide evidence on how the quality varies with time under the influence of a variety of environmental conditions such as temperature, humidity and light and to establish a shelf-life, to determine the storage conditions and the in-use stability.

It should be conducted on the dosage form packaged in the container closure system proposed for marketing (including, as appropriate, any secondary packaging and container label). Stability testing of pharmaceutical products is a complex set of procedures involving considerable cost, time consumption and scientific expertise in order to build in quality, efficacy and safety in a drug formulation.

The most important steps during the developmental stages include pharmaceutical analysis and stability studies that are required to determine and assure: the identity, potency and purity of ingredients, as well as those of the formulated products.

Stability testing is termed as a complex process because of involvement of a variety of factors influencing the stability of a pharmaceutical product. These factors include:

- Stability of the active ingredient (s); interaction between active ingredients and excipients, manufacturing process followed, type of dosage form, container/closure system used for packaging.
- Light, heat and moisture conditions encountered during shipment, storage and handling.
- Stability testing is a routine procedure performed on drug substances and products and is

employed at various stages of the product development.

- In early stages, accelerated stability testing (at relatively high temperatures and/or humidity) is used in order to determine the type of degradation products which may be found after long-term storage.
- Testing under less rigorous conditions i.e. those recommended for long-term shelf storage, at slightly elevated temperatures is used to determine a product's shelf life and expiration dates.

The major aim of pharmaceutical stability testing is:

- To provide reasonable assurance that the products will remain at an acceptable level of fitness/quality throughout the period during which they are in market place available for supply to the patients.
- And will be fit for their consumption until the patient uses the last unit of the product.

Protocol for stability testing

- The protocol for stability testing is a pre-requisite for starting stability testing and is necessarily a written document that describes the key components of a regulated and well-controlled stability study.
- Because the testing condition is based on inherent stability of the compound, the type of dosage form and the proposed container-closure system, the protocol depends on the type of drug substance or the product.
- In addition, the protocol can depend on whether the drug is new or is already in the market. The protocol should also reflect the regions where the product is proposed to be marketed.

Pharmaceutical package stability testing

Compression Strength Testing: Packages behave differently when exposed to compressive forces. It uses testing capabilities to apply compressive forces to packages and products and provide a comprehensive report with data on the strength of a package.

Distribution Simulation Testing: Packages experience many different forces during the shipping and distribution process. It is the product manufacturer's responsibility to evaluate and document the ability of the package to withstand the distribution and storage environments.

Package Integrity Testing: It uses established tests to test the integrity of a pharmaceutical package. Such tests include dye leak, visual inspection, vacuum leak and bubble leak testing to inspect the package's integrity capabilities.

Vibration Testing: Packages and products experience a wide range of dynamic forces and stresses during distribution that could harm a product. It performs vibration tests on samples to simulate the stresses and forces a package/product would experience during the distribution process.

Shock and Vibe Testing: Dropping, rotational edge dropping and rotational flat drop tests to simulate real world exposure of the package to shock forces by fork lifts, package handling or other factors in the pharmaceutical package's distribution cycle.

QUALITY CONTROL

Chemical resistant of glass containers

1 Powdered Glass Test

It is done to estimate the amount of alkali leached from the powdered glass which usually happens at the elevated temperatures. When the glass is powdered, leaching of alkali is enhanced, which can be titrated with 0.02N sulphuric acid using methyl red as an indicator

Step-1: Preparation of glass specimen: Few containers are rinsed thoroughly with purified water and dried with stream of clean air. Grind the containers in a mortar to a fine powder and pass through sieve no. 20 and 50.

Step-2: Washing the specimen: 10 gm of the above specimen is taken into 250 ml conical flask and wash it with 30 ml acetone. Repeat the washing, decant the acetone and dried after which it is used within 48hr.

Procedure: 10 gm sample is added with 50ml of high purity water in a 250 ml flask. Place it in an autoclave at 121 ± 2 ºC for 30 min.Cool it under running water. Decant the solution into another flask, wash again with 15 ml high purity water and again decant. Titrate immediately with 0.02N sulphuric acid using methyl red as an indicator and record the volume.

2 Water Attack Test

This is only for treated soda lime glass containers under the controlled humidity conditions which neutralize the surface alkali and glass will become chemically more resistant. Principle involved is whether the alkali leached or not from the surface of the container.

Procedure: Rinse thoroughly with high purity water. Fill each container to 90% of its overflow capacity with water and is autoclaved at 121ºC for 30 min then it is cooled and the liquid is decanted which is titrated with 0.02N sulphuric acid using methyl red as an indicator. The volume of sulfuric acid consumed is the measure of the amount of alkaline oxides present in the glass containers. The containers to be examined and the volume of the test are indicated in the following

Table 1

Table: 1 Types of Glass and their test limits

Test	Container	Volume of 0.02 N H_2SO_4
Powdered glass test	Type 1 Type 2 Type 3	1.0 8.5 15.0
Water attack test	Type 2 (100ml or below) Type 3 (above 100 ml)	0.7 0.2

3 Test for surface hydrolytic resistance

Surface hydrolytic resistance test is conducted on unused glass containers. The number of containers to be examined and the volume of the test humid necessary for final determination are indicated in the following Table 2.

Initially each container is rinsed three times carefully with carbon dioxide free water. Then the container is allowed to drain and it is filled with the carbon dioxide free water to the required volume. If vials and bottle are used they are covered with neutral glass dishes or aluminum foil which is previously rinsed with carbon dioxide free water. If ampoules are used, they are sealed by heat fusion. The containers are then placed on the tray of the autoclave a containing a quantity of water in such a way that the tray remains clear and temperature is maintained between 100- 120 ºC over 20 minutes. Then the temperature is adjusted between 120-122 ºC for 60 minutes and finally the temperature is lowered from 120ºC for 40 minutes.

Table 2: Number of containers to be examined and the volume of the test are indicated

Nominal capacity of container	Number of containers to be used	Volume of test solution to be used for titration ml
3 or less	At least 10	25.0
3 to 30	At least 5	50.0
More than 30	At least 3	100.0

Remove the containers from the autoclave once the pressure reaches the atmospheric pressure and cool under running tap water Combine the liquids obtained from the containers being examined. The following titration should be carried out within 1 hour after removing the container from the autoclave. Introduce the prescribed volume of liquid in to a conical flask. Add 0.05 ml of methyl red solution for each 20 ml liquid. Titrate with 0.01M hydrochloric acid taking as the end point the

color obtained by repeating the operation using the same volumes of carbon dioxide free water. The result is not greater than the volume state in Table 3.

4 Thermal Shock Test

Place the samples in upright position in a tray. Immerse the tray into a hot water for a given time and transfer to cold water bath, temperature of both are closely controlled. Examine cracks or breaks before and after the test. The amount of thermal shock a bottle can withstand depends on its size and design. Small bottles withstand a temp differential of 60 to 80 ºC and large bottle 30 - 40 ºC. A typical test uses 45 ºC temperature differences between hot and cold water.

5 Leakage Test

Fill 10 containers with water, fit with intended closures and keep them inverted at room temperature for 24 hours. The test is said to be passed if there is no signs of leakage from any container.

6 Internal Bursting Pressure Test

The most common instrument used is American glass research increment pressure tester. The test bottle is filled with water and placed inside the test chamber. A scaling head is applied and the internal pressure automatically raised by a series of increments each of which is held for a set of time. The bottle can be checked to a preselected pressure level and the test continues until the container finally bursts.

For non injectable prepartion

a. Collapsibility test:

Applicable to containers which are to be squeezed in order to remove contents. Yield 90% of its contents at required rate of flow at ambient temperature.

Clarity of aqueous extract: Select unlabelled portion from a suitable container. Cut these portions into strips. Wash it with extraneous matter by shaking with two separate portions of distilled water. Transfer to flask previously washed with chromic acid. Rinses with distilled water add 250 ml distilled water. Cover the flask and autoclave at 121ºĊ for 30 min

For injectable prepartion

a. Leakage test, Collapsibility test (Same as describde in Non- Injectable)
b. Clarity and colour of solution
c. Acidity or alkalinity
d. Light absorption

e. Reducing substance

f. Transparency

Fill a container to its nominal capacity with water and close it, if possible using the usual means of closure; otherwise close using a sheet of pure aluminium. Heat in an autoclave so that a temperature of 121 ± 2 ºC is reached within 20 to 30 minutes and maintain at this temperature for 30 minutes. If heating at 121 ºC leads to deterioration of the container, heat at 100 ºC for 2 hours. Use solution within 4 hours of preparation.

Blank

Prepare a blank by heating water in a borosilicate glass flask closed by a sheet of pure aluminum at the temperature and for the time used for the preparation of solution.

Clarity and colour of solution: Solution is clear and is colorless.

Acidity or alkalinity: To a volume of solution S corresponding to 4 per cent of the nominal capacity of the container add 0.1 ml of phenolphthalein solution. The solution is colorless. Add 0.4 ml of 0.01M sodium hydroxide. The solution is pink. Add 0.8 ml of 0.01M hydrochloric acid and 0.1 ml of methyl red solution. The solution is orange-red or red.

Light absorption: The light absorption in the range 230 nm to 360 nm of solution S using a blank prepared as described under Solution is not more than 0.20.

Reducing substances: To 20.0 ml of solution add 1 ml of dilute sulphuric acid and 20.0 ml of 0.002M potassium permanganate. Boil for 3 minutes. Cool immediately. Add 1 g of potassium iodide and titrate immediately with 0.01M sodium thiosulphate, using 0.25 ml of starch solution as indicator. Carry out a titration using 20.0 ml of the blank prepared as described under Solution. The difference between the titration volumes is not more than 1.5 ml.

Transparency: Fill the container previously used for the preparation of solution S to its nominal capacity with a 1 in 200 dilution of the standard suspension for a container made from polyethylene or polypropylene. For containers of other materials, use a 1 in 400 dilution. The cloudiness of the suspension is perceptible when viewed through the container and compared with a similar container filled with water.

Multiple Choice Questions

1. Most effective sun cream contain

A) TiO_2 B) Para amino benzoic acid

C) Methyl salicylate D) Castor oil

2. Talcum powder is sterilized by

A) Autoclave B) Hot Air Oven

C) Millipore filter D) Radiation

3. Shrinkage of gels by extrusion of water is called

A) Synergesis B) Plasticity

C) Elasticity D) None of the above

4. How much % of Borax should be used for cold cream?

A) 1% of total formula B) 0.5%

C) 2% of total formula D) 4%

5. How much % of Borax should be used as equivalent to the Beeswax?

A) 6 to 8% B) 7 to 9%

C) 11 to 14% D) None of the above

6.How much concentration of flavoring agent should be used in dentifrices?

A) 0. 4 to 2% B) 0.5 to 3%

C) 0.5 to 2% D) 0.5 to 4%

7. Which is the best humectant in the dentifrices?

A) Glycerin B) Sorbitol

C) Propylene glycol D) Alcohol

8. What is the concentration of sodium benzoate as a preservative in dentifrices?

A) 3% B) 1.5%

C) 1.5 to 2% D) Not used

9. In cleansing creams which surface active agent is added with detergent to remove the dirt?

A) Tweens B) Sodium lauryl sulphate

C) Quaternary ammonium compounds D) None of above

10. What is the use of stearic acid in vanishing cream?

A) Increases the consistency B) Decreases the consistency

C) Increases pearly white shinning D) None of the above

11.What is the concentration of ammoniated mercury in bleaching cream?

A) Less than 5%
B) Less than 8%
C) More than 5 %
D) More than 9%

12. Which vegetable oil is most useful in lipisticks?

A) Castor oil
B) Liquid paraffin
C) Almond oil
D) None of the above

13.Which viscosity (poise) of mineral oil is appropriate for lipisticks?

A) 400
B) 250
C) 300
D) 200

14. Tetrabromofluorescein produces which kind of stain during the application on the lips?

A) Bluish red
B) Reddish blue
C) Pinkish yellowish
D) Yellowish green

15. In cosmetic preparations, an antioxidant used in an aqueous system is

A) Sodium formaldehyde sulphoxylate
B) Methyl paraben
C) Propyl paraben
D) None of the above

Answers

1	**A**	**2**	**B**	**3**	**A**
4	**B**	**5**	**D**	**6**	**C**
7	**A**	**8**	**D**	**9**	**A**
10	**C**	**11**	**A**	**12**	**A**
13	**D**	**14**	**A**	**15**	**A**

1. Water resistance of glass containers are tested by measuring:

A) Amount of alkali released into water.
B) Amount of acid released into water.
C) Both A and B
D) None of the above

2. Water attack test is used to identify the alkalinity in

A) Type I glass
B) Type II glass
C) Type III glass
D) All of the above types

3. What is the residue wt. limit of non-volatile residue in plastic containers?

A) 12.5mg
B) 12.8mg
C) 12.4mg
D) None of the above

4. U.S.P. recommended Biological Tests for plastic containers. Mention it:

A) Biological reactivity test for in vivo B) Biological reactivity test for in vitro

C) For both in vitro and in vivo D) None of the above

5. Self sealability tests are applied on which types of container/closure?

A) Glass containers B) Plastic containers

C) Rubber closure D) Plastic closure

6. As a packaging material for parenteral products, plastic offers all of the following advantages over glass except

A) Unbreakability B) Improved clarity for visual inspection

C) Rubber closure D) Decreased weight

Answers

1	**A**	**2**	**D**	**3**	**A**
4	**C**	**5**	**C**	**6**	**B**

SHORT ANSWER QUESTIONS

1. What are dentifrices? Give examples
2. What type of mineral oils are used in cream formulation?
3. Write the ingredients in toothpaste.
4. Enumerate the properties of lipstick.
5. What is Medicated Shampoo explain?
6. Mention the ingredients of lipstick.
7. What is a Foundation Cream?
8. Write the properties of vanishing cream?
9. Write the method of preparation of toothpaste?
10. Define Opacifying Agent with example?
11. What are the evaluation parameters of hair colourant?
12. What are Abrasive Agents?
13. Define Pharmaceutical Packaging.
14. What is Primary and Secondary Packaging with examples?
15. What is Composition of Glass?
16. What is the classification of Plastics?

17. Mention the chemistry of Natural rubber.
18. What is the use of type 1V glass container?
19. What is strip packaging?
20. What is Child Resistant Container?
21. Mention the principle of water attack test of glass containers.

LONG ANSWER QUESTIONS

1. Describe the structure and function of skin.
2. Discuss the preparation of shampoo.
3. What are the ingredients and evaluation of a shampoo?
4. Enlist various ingredients used in lipsticks. Give examples of each type of ingredient. Write briefly about the quality control tests conducted on lipsticks.
5. Write note on Cosmetics for skin.
6. Classify hair preparations and explain with examples.
7. Discuss the evaluation of glass containers according to U.S.P.
8. How packaging materials could be tested?
9. Discuss use of plastic for packaging of drug products.
10. How packaging testing could be correlated with stability of dosage forms?