CHAPTER 1

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1. INTRODUCTION

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1.1 Skin

Skin is the outermost organ of the human body. As a result, people are very aware of, and very sensitive to, the appearance of their skin. Skin also has aesthetic relevance. The desire to have beautiful and healthy looking skin has been a centuries-old quest for humans. Skin with brighter complexion and smoother surface tends to be perceived as being healthier and more attractive (Igarashi et al. 2005). The most important role of the skin is to protects the organism from the outside environment and maintain the homeostasis between inside and outside the body. The appearance of the skin and hair is the "first image" that others have of us. Personal expression changes with variations in the condition of our hair and skin hence modern cosmetology has the task of interacting with physiology in maintaining its "good condition" (Celleno & Tamburi 2009). The skin is a cutaneous membrane, covers the body and is the largest organ of the body by surface area and weight. Its area is about 1.7 square meters and it weighs 4.5-5 kg, about 10% of body weight of an average person. It is 0.5 – 4 mm thick, thinnest on the eyelids, thickest on the heels; the average thickness is 1 – 2 mm (Williams 2003).

1.1.1 Structure

Human skin is mainly divided into three layers: Epidermis, Dermis, and Hypodermis (Fig.1.1)

![Fig. 1.1: Structure of the skin](Copyright © 2006 Pearson Education, Inc., publishing as Benjamin Cummings)
Epidermis

The epidermis is the outermost layer of the skin. There are no veins and capillaries in this layer. Its thickness is about 0.2 mm on average and this thickness varies depending on the location on the body. The epidermis is further divided into five sublayers. From the bottom (innermost), these sublayers are stratum basale (basal cell layer), stratum spinosum (prickle cell layer), stratum granulosum (granular cell layer), stratum lucidum (clear layer) and stratum corneum (horny cell layer) (Fig. 1.2)

**Stratum basale (basal cell layer):** is the deepest sublayer of the epidermis and is composed of a single layer of basal cells. This forms the boundary to the dermis. Keratinocytes and melanocytes are produced in this sublayer. With aging, this layer becomes thinner and loses the ability to retain water.

**Stratum spinosum (prickle cell layer):** This layer lies on top of the basal cell layer. Basal cells, through the process of turn-over, make their shape somewhat flatter (multi-sided) and form this layer. These cells are called prickle cells and have little spines on the outside of their membrane

**Stratum granulosum (granular cell layer):** is composed of 2 to 4 granular cell layers. In this sublayer, cornification called keratinization of keratinocytes begins.

**Stratum lucidum (clear layer):** can be found only in soles and palms. It is a highly refractive sublayer. Its cells become flatter and more densely packed during turn-over (Anderson & Parrish 1982).

**Stratum corneum (horny cell layer):** is the exterior sublayer of the epidermis. This sublayer is composed of several layers of hexagonal-shaped flat and hard cells named horny cells or corneocytes. Horny cells are surrounded by intercellular lipids. A principal constituent is ceramide, which plays a crucial role in water retention. Horny cells also contain special chemical compounds called natural moisturizing factor (NMF) that also plays an important role in retaining skin moisture. NMF is composed of sodium PCA, sphinolipids and ceramides, phospholipids, fatty acids, glycerol, squalane and cholesterol. Skin that lacks NMF and ceramide tends to be very dry (Lees 2001).
Dermis

The dermis is positioned below the epidermis and is the tissue that supports the skin and its annexes (hair nails, etc.). Its thickness varies from area to area, being thinnest on the eyelids and thickest on the back. It has two sublayers, papillary layer which is the upper layer and consists of connected tissues, nerve fibers, capillaries and fibroblasts. The other layer is reticular layer constitutes the lower part of the dermis and represents a continuous transition to the subcutis. In this sublayer, collagen fibers are aggregated into thick bundles which are mostly aligned parallel to the surface of skin. The dermis tends to become progressively thinner with age. The dermal extracellular matrix (ECM) has a dynamic and complex structure composed of an interlocking mesh of fibrous proteins (collagens and elastic fibres) and glycosaminoglycan rich proteoglycans. The main constituent of the dermal ECM is collagen. Collagen fibres make up 70% of the dermis, giving it strength and toughness particularly collagens I and III, which provide skin with tensile strength. The collagen fibres are the most abundant fibres and are collected together into variably orientated bundles. Under the electron microscope these fibres show characteristic transverse
striations owing to their peculiar structure. The principle function of the collagen fibres is to support the internal structure of the skin (Fig. 1.3).

Fig 1.3: Collagen fibres in the dermis
(Eel/eno & Tamburi 2009)

Another important constituent of dermis is elastic fibres. The main component of elastic fibres is elastin. The principle function of this type of fibre is to provide the skin with the elasticity fundamental for all our movements (Fig. 1.4).

Fig 1.4: Elastic fibres in the dermis
(Eel/eno & Tamburi 2009)
Hypodermis

Hypodermis or Subcutis in histology is the third layer beneath the dermis. It is an elastic layer and includes a large amount of fat cells that work as a shock absorber for blood vessels and nerve endings. The thickness of this layer is reported to be 4 to 9 mm on average. However, the actual thickness differs from person to person and also depends on the body region.

Derivative structures of the skin

The derivative structures of the skin include hair, nails, sebaceous glands and sweat glands. Hair has a number of important functions like protection, reduction of heat loss and sensing light touch. Fingernails function to protect the tip of the fingers and to aid grasping. Sebaceous glands are associated with the hair follicles (pilosebaceous unit) especially those of the scalp, face, chest and back; they are not found in hairless areas. At puberty, sebaceous glands respond to the increased level of androgen and secret excess of sebum leads to development of acne vulgaris in adolescence. Sweat glands are of two types, eccrine glands and apocrine glands. Eccrine glands are found all over the skin especially on the palms, soles, axillae and forehead. Apocrine glands are larger, the ducts of which empty out into the hair follicles. They are present in the axillae and anogenital region.

1.1.1 Functions (Bensouilah & Buck 2006)

The skin is a complex metabolically active organ, which performs following important physiological functions:

- Provides a protective barrier against mechanical, thermal and physical injury and harmful agents.
- Prevents loss of moisture.
- Reduces the harmful effects of UV radiation.
- Acts as a sensory organ.
- Helps to regulate temperature control.
- Plays a role in immunological surveillance.
- Synthesises vitamin D3 (cholecalciferol).
- Has cosmetic, social and sexual associations.
1.2. Ayurvedic Concept of Skin
Ayurveda, the science of life, was elucidated in India over 6,000 years ago. It was the first record of scientific medicine in the history of the world. The word "Ayurveda" literally means knowledge (Veda) of life (Ayu). The aim of Ayurveda, therefore, is to improve the quality of life and increase the life span (longitivity). Its major emphasis is on prevention of disease and promotion of health by strengthening tissues so that they can withstand exogenous and endogenous factors causing oxidative stress. Phytomedicine plays a prominent role in Ayurveda. Over 600 plants are described in original Ayurvedic compendia like Charaka and Sushruta Samhita. In these texts, plants are classified into groups based on their effects (Dahanukar & Thane 1997).

In Ayurveda, Charaka has described twak (skin) in six layers but named only the first two layers as udakadara (bahyatwak) and astrikdhara. The third layer is the seat of Sidhma (dermatitis) and Kilas Kushta (leucoderma). The fourth layer is the seat of Dadru Kushta (ringworm). The fifth layer produces Alaji (boil) and Vidradhi (abscess) and the sixth layer is the deepest layer of the skin. Sushruta has described the seven layers of skin as avabhasini, lohita, shweta, tamra, vedini, rohini and mamsadhara (Datta et al. 2011). Avabhasini is the outermost layer and reflects the complexion and the quality of the Rasa Dhatu (nutrient fluid, the first of the seven tissues of the body). Avabhasini means to reflect and to enlighten. Thus it is the one which reflects Chhaayaa (aura). Lohita is slightly thicker than Avabhasini. Shweta is the third layer and conditions like psoriasis characterized by scaling. Vedini means to know, to perceive. Thus, this is the true skin which is responsible for perception of sensation. Rohini is the sixth layer and before mamsadhara. Tumours, mumps etc can occur at this layer. Mamsadhara is the innermost layer and it is the platform for the skin's stability and firmness. Mamsa means muscle and dhara is one, which holds or imparts support. This layer is adhering to the muscles. When this layer is in balance, the skin looks young and supple (Lad 2002) (Nanal n.d.).

According to Ayurveda, Twak (skin) is a Matruja Avyaya i.e. derived from mother or having maternal origin. It is the mirror of an individual’s health. Ayurvedic concepts of skin diseases are based on the tridoshas i.e. Vata, Pitta and Kapha. Imbalance in
any one dosha leads to various types of skin i.e. Vata skin, Pitta skin, Kapha skin and Combination skin.

**Vata skin:** - is dry, thin, fine pored, delicate and cool to touch. It easily gets dehydrated, and is very vulnerable to the influence of dry weather. It tends to develop wrinkles earlier than the other skin types.

**Pitta skin:** - is fair, soft, warm and medium thickness. It tends to be more prone to freckles and moles than the other skin types. It is photosensitive and has least tolerance to sun and is most likely to accumulate sun damage over the years.

**Kapha skin:** - is thick, oily, soft and cool to touch; tends to develop wrinkles much later in life than Vata or Pitta type but because of its thickness and oiliness, is more prone to accumulate ama (toxins) under the skin. It has dull complexion, enlarged pores, excessive oil, blackheads, and pimples, moist types of eczema and water retention.

**Combination skin:** - is combination of two types of skin; Vata-Pitta skin which is both dry and sensitive, Kapha-Pitta skin is oily and sensitive and Vata-Kapha skin is generally dry with some oily zones.

### 1.3 Skin Problems

Skin is very sensitive organ and can easily get damage by infection and diseases. Facial skin problems can arise due to various factors such as environmental pollution, over exposure to UV rays, age of individual, harmful microorganisms, eating habits, stress, chemicals etc. Skin treatment and care is essential; not only to have a healthy skin, but also for the overall well being of the person (Grossbart & Sherman 2009). There are various facial skin problems which include acne vulgaris, eczema and dermatitis, scars, irregular pigmentation, under eye circles, sunburns and wrinkles. Though facial skin problems are painless, they can be particularly stressful because they are easily visible and can seriously affect confidence and quality of life (Anon n.d.). Gupta and Gupta reported that psychological impact of facial skin problems is very high and non-cystic facial acne can be associated with significant depression and suicidal ideation (Gupta & Gupta 1998). Cotterill and Cunliffe reported, patients with longstanding and debilitating skin disease may become depressed enough to commit suicide and there is always an attendant risk of suicide in patients with established, severe psychiatric problems. It is important to recognize that patients with
dermatological non-disease, and particularly women with facial complaints, may be extremely depressed and at risk of suicide. Facial scarring, particularly in men, may be an ‘at risk’ factor for suicide (Cotterill & Cunliffe 1997). Most common and significant skin problems are acne vulgaris and wrinkles. Wrinkles formation is a visible effect of skin aging and acne vulgaris is a common skin condition of adolescence. These two skin problems play major role in affecting an individual’s self esteem and confidence level as they mainly target the face and change the individual’s appearance.

1.3.1 Skin aging

Skin aging is particularly important because of its social impact. Due to its outside visibility and aesthetic value people tend to give a lot of attention to skin (Magnenat-Thalmann et al. 2002). The skin and internal organ gets affected by the “Biological clock” but its visible effects are seen on the skin in the form of wrinkles (Perricone 2008). Skin aging is of two types, intrinsic aging and extrinsic aging (Krutmann 2011). Intrinsic aging occurs due to individual’s genetic background as well as many endogenous factors including inflammatory mediators, cytokines, endothelial cells respiration and intense exercise etc. Extrinsic aging is cause due to external factors or exogenous sources such as smoking, excessive alcohol consumption, pollution, and chronic exposure to the sun. i.e. UV radiation (RM Lavker 1995) (Fig. 1.5).

![Fig. 1.5: Endogenous and exogenous sources of ROS generation](Pomarede 2009)
These endogenous and exogenous factors lead to the oxidative stress which in turn causes the generation of free radicals i.e. Reactive Oxygen Species (ROS) in the skin. Oxidative stress is the single most harmful contributor to skin aging, leading to loss of cells and degeneration of extracellular matrix. These two are the most prominent features of chronologically aged skin (Poljšak et al. 2012). The structural changes occur in the chronologically aged skin. These include formation of fine wrinkles, thinning of all layers of the skin, progressive decrease in melanocytes and Langerhans cells, collagen and elastin degradation in the dermis etc. Elastin is degraded slowly and accumulates in intrinsically aged skin (Raschke & Elsner n.d.). Clinical manifestations of photoaging or extrinsic aging include dryness; irregular, dark or light pigmentation, sallowness, either deep furrows or severe atrophy, telangiectases, laxity and a leathery appearance (Helfrich et al. 2008).

**Role of oxidative stress and free radicals in skin aging**

Oxidative stress is a leading cause of skin aging. Oxidative stress may cause tissue toxicity and accelerated aging, which results in free radical damage to the skin. Intracellular and extracellular oxidative stress initiated by ROS, advances skin aging; which is characterized by wrinkles and a typical pigmentation (Fisher et al. 1997). ROS are reactive molecules that contain an oxygen atom. These are short-lived entities which generate continuously at low levels during normal aerobic metabolism. ROS include free radicals such as superoxide anion (O$_2^-$), hydroxyl radical (OH$^-$), nitric oxide (NO$^-$) and peroxy (RO$_2^-$). Peroxynitrite (ONOO$^-$), hypochlorous acid (HOCl), hydrogen peroxide (H$_2$O$_2$), singlet oxygen, and ozone (O$_3$) are not free radicals but can easily lead to free radical reactions in living organisms. The term ROS is often used to include not only free radicals but also the non-radicals (Poljšak & Dahmane 2012).

Mitochondrion is a main place where ROS production occurs when cells react with oxygen as part of cellular metabolic processes during energy generation (Raha & Robinson 2000). The other key source of ROS generation is sunlight. UV radiations play an important role in photoaging. UVB radiation (290 to 320 nm) affects the superficial layer of the skin (epidermis) and causes sunburns whereas UVA (320 to 400 nm) penetrate deeper in the skin (Pandel et al. 2013). The presence of molecular
oxygen ($O_2$) within skin cells is a primary target for UV light that penetrates the skin. The incoming UV light donates an electron to molecular oxygen in a cell resulting in generation of free radical known as the superoxide anion ($O_2^-$). Further, to stabilize itself, the superoxide anion sets off a chain reaction resulting in further generation of free radicals (Herrling et al. 2007). Infact the recent study showed that, the visible light also induces significant ROS production. Liebe et al showed that this ROS mediates the release of pro-inflammatory cytokines and matrix metalloproteinase (MMP) expression. Skin is exposed to visible light for substantial durations of the day, and as skin contains several chromophores for visible light the cumulative effects of visible light could result in skin damage, which may contribute to premature skin aging (Liebel et al. 2012).

- **Role of enzymes in skin aging**

  Aging skin is characterised with the alterations in the dermal connective tissue. The ECM in the dermis mainly consists of type I and type III collagen, elastin, proteoglycans, and fibronectin. In particular, collagen fibrils are important for the strength and resiliency of skin, and alterations in their number and structure are responsible for wrinkle formation.

  MMPs are a family of endopeptidases, play a vital in many different physiological and pathological processes in the skin. They are also involved in cutaneous aging (Sárdy 2009). These enzymes can be produced by several different types of cells in skin such as fibroblasts, keratinocytes, macrophages, endothelial cells, mast cells and eosinophils (Kahari & Saarialho-Kere 1997). MMPs are zinc dependent endopeptidases show proteolytic activity to degrade matrix proteins such as collagen and elastin. Each MMP degrades different dermal matrixproteins, for example MMP-1 cleaves collagen type I, II, and III, whereas MMP-9, which is also called gelatinase, degrades collagen types IV and V, and gelatine (Krutmann 2009). UV rays lead to the activation of MMPs, which breakdown the collagen, the major structural component of skin, and also inhibits new collagen synthesis (Liebel et al. 2012). Fisher et al demonstrated that matrix metalloproteinases induced by UV irradiation are expressed in the dermis, where they degrade skin collagen (Fisher et al. 1997).
Collagenase is a type of MMP, capable of hydrolyzing fibrillar collagen, within its triple helical domain (Liu et al. 1995). Like MMPs, bacterial collagenases such as Clostridium histolyticum collagenase (ChC) also degrade ECM. ChC belongs to M-9 metalloproteinase family, which is able to hydrolyze triple-helical collagen under physiological conditions, as well as an entire range of synthetic peptide substrates (Kim et al. 2004). Recently, many researchers are exploring the plant resources for anti-aging potential. For this purpose, collagenase inhibition activity of plants can be investigated in vitro by using Collagenase from the bacteria Clostridium histolyticum (ChC). Elastase also plays a critical role in inflammatory processes. It is able to attack all major connective tissue matrix proteins, including elastin, collagen, proteoglycans and keratins (Wiedow et al. 1990). Elastase activity significantly increases with age hence the elasticity of skin is decreases significantly and results in sagging (Bissett et al. 1987).

- **Topical antioxidants for skin care.**
  Antioxidants protect the skin from the inside by neutralizing ROS generated by UV radiation. Antioxidants are present at the site of the initial ROS-mediated injury or reaction. They can neutralize the oxidative stress and prevent the harmful chemical reaction. In the course of the reaction, the antioxidant is depleted. In time, the antioxidant capacity of skin becomes inadequate, resulting skin damage. Therefore, topical antioxidants formulated to enter the skin can add to the skin’s own antioxidant pool and increase protection (Oresajo et al. 2010). Currently antioxidants are widely incorporated into a variety of antiaging skin care systems. The commonly used cosmeceutical antioxidant ingredients include vitamins A, B, C, and E; CoQ 10 and its analogues; and plant polyphenols such as tannins and flavonoids (Francis et al. 2009).
1.3.2 Acne vulgaris

- **Prevalance and social impact**

Acne is the most common skin disease in adolescence. As sebaceous glands become overactive, it produces excess oil. Follicles become plugged, resulting in blackheads and whiteheads. These plugged follicles can then become inflamed, causing pimples, nodules and cysts. Although acne is not harmful to health and will usually go away after time, moderate to severe acne can leave scars.

*Propionibacterium acnes* (*P. acnes*) are identified as a major causative agent for acne vulgaris (Sukatta et al. 2008).

The condition usually starts in adolescence, peaks at the ages of 14 to 19 years and frequently resolves by mid-twenties (Adityan & Thappa 2009). Acne affects approximately 80% of people aged between 11 to 30 years (Truter 2009). The onset of acne typically occurs at puberty, when many physiological changes like hormone-level changes take place in the body. Approximately 95-100% of adolescent boys and 83-85% of adolescent girls aged 16 to 17 years are affected by this condition (Burton et al. 1971).

Adityan and Thappa reported that, in Indian scenario, most acne patients were in the age group of 16-20 years (59.8%) and facial acne were predominant and observed in almost every case (Adityan & Thappa 2009). Biswas et al conducted the study to report the clinical profile of acne vulgaris in Eastern part of India and shown that higher prevalence (75%) was observed in adolescent male than female.

Acne vulgaris is a troubling skin condition that can affect individual’s confidence and self-esteem. Acne makes significant impact on the patient’s psychosocial well-being. For the majority of acne patients, who have mild to moderate acne, the psychosocial effect may be the most prominent morbidity. Teenagers are generally more vulnerable to the negative psychologic effects of acne because generally their self-esteem, level of confidence regarding social interactions, and their identity are in a precarious, formative stage hence, even a mild case of acne can be stressful for them (Koo 1995).
Semyonov reported that the number of patients with acne appears to be increasing, although the reasons for this increase are uncertain and concluded, the social and economic effects of acne are mostly related to the high prevalence of its pathology and acne can be considered as a public health problem (Semyonov 2010).

- **Pathophysiology of Acne vulgaris**
  The pathogenesis of acne is multifactorial and centers on the interplay of increased sebum production, follicular hyperkeratinisation, the action of *P. acnes* within the follicle, and release of inflammatory mediators into the skin.

**Increased sebum production:**
At puberty sebaceous gland secretes excess of sebum in response to the increased androgen level. The main influence of androgen on acne pathogenesis relates to the proliferation of sebocytes and keratinocytes (Kurokawa et al. 2009). Sebum is a mixture of cholesterol, cholesteryl esters, squalene, fatty acids, diglycerides, triglycerides, and wax esters. Sebum acts as a protective agent for skin and hair by retarding water loss and forming a barrier against external agents (Youn 2010).

**Follicular hyperkeratinization:**
Follicular hyperkeratinization is a key element in the pathogenesis of acne. The hair follicle is lined with epithelial cells that become keratinised as they mature. At puberty, when testosterone level rises, sebaceous gland becomes sensitive and produces excess oil. Skin becomes greasy and keratin of follicular epithelial cells undergo changes and hyperkeratinization occurs when these cells become cohesive and partially plug the opening in the epidermis and effectively reduce the sebum outflow (Thiboutot 2000) (Carruthers 1974).

**Comedone formation:**
As hyperkeratinization progresses, a microcomedone develops due to blockage of follicle opening. If the orifice of the follicular canal opens sufficiently, the keratinous material extrudes through it and an open comedone results. This is known as a blackhead as the keratinous material darkens in contact with the air. Because this material can escape, the comedone does not become inflamed. If the follicular orifice
does not open sufficiently, a closed comedone (whitehead) results, within which inflammation can occur. Most acne patients have a combination of both open and closed comedones (Truter 2009). (Fig. 1.6 – Fig. 1.9).

Fig. 1.6: Normal pilosebaceous unit.  
Fig. 1.7: Microcomedo  
Fig. 1.8: Open comedo  
Fig. 1.9: Closed comedo  

(Source: www.medscape.com)
Action of *P. acnes* within the follicle:-

Acne lesions are mainly colonised by two coexisting bacteria i.e. *Staphylococcus epidermidis* (*S. epidermidis*) and *P. acnes*. *P. acnes* contribute to the inflammatory acne by inducing phagocytes to secrete pro-inflammatory mediators. Chemotactic factors induced by *P. acnes* attract neutrophils (PMNs) to the pilosebaceous unit. Further, PMNs phagocytise the bacteria and lysosomal enzymes are released and cause damage to the follicular epithelium (Marcinkiewicz et al. 2006).

*P. acnes* also releases lipases, protease and hyaluronidases that contribute to tissue injury. *P. acnes* lipase plays an important role in pathogenesis of acne by hydrolysing sebum triglycerides and releasing free fatty acids causing irritation in the pilosebaceous follicles. *P. acnes* lipase has some interesting properties. It cleaves at α and β positions of triglycerides simultaneously, producing free fatty acids and glycerol. During this process, ROS are generated and cause auto-oxidative damage at the site of acne inflammation. Therefore, acne therapy must address the etiological factors involved in the pathogenesis of acne (Dessinioti & Katsambas 2010).

Topical therapy for acne vulgaris

Topical therapy is considered first-line therapy for acne and is indicated in patients with non-inflammatory comedones or mild to moderate inflammatory acne (Lolis et al. 2009). Topical retinoids are most commonly used in the treatment of acne. These agents reduce obstruction within the follicle and therefore are useful in the management of both comedonal and inflammatory acne (Mills & Berger 1998).

Benzoyl peroxide is a bactericidal agent that has proven effective in the treatment of acne. It has the ability to prevent or eliminate the development of *P. acnes* resistance. It is often used in the management of patients treated with oral or topical antibiotics. Topical antibiotics are mainly used for inflammatory lesion and include clindamycin, erythromycin and tetracycline (Strauss et al. 2007). Clindamycin and erythromycin exert their antibacterial effect by irreversibly binding to the bacterial 50S ribosomal subunit, thus inhibiting translocation during protein synthesis. Tetracycline includes doxycycline and minocycline. These drugs exert their antibacterial properties by blocking the 30S ribosomal subunit and in turn inhibiting translation during protein
synthesis. Decreased microbial sensitivity to these antibiotic agents is a limitation to their use as a monotherapy (Webster & Graber 2008).

❖ The Problem of Antibiotic Overuse

Overuse of antibiotics has received increased attention in past decade as antibiotic resistant strains are rising rapidly (Webster & Graber 2008). P. acnes resistance to systemic antibiotic treatment are emerging and increasing worldwide. P. acnes resistance had increased from 20% in 1978 to 62% in 1996 and that resistance to several commonly prescribed antibiotics such as erythromycin, clindamycin, and tetracycline (Rosso 2008). Coates et al reported that, resistance to erythromycin was the most common and the majority of erythromycin-resistant strains were cross-resistant to clindamycin and suggested that, resistant propionibacteria are widely distributed on acne-prone skin and it will be very difficult to eradicate these resistant strains using existing therapeutic regimens (Coates et al. 2002).

❖ Alternative approach for new antimicrobials
Antimicrobial drug resistance is a global concern today as the resistant microorganisms have emerged and spread throughout the world because of their genetic ability. During the past two decades, new infectious diseases have appeared and old ones previously thought to be controlled have re-emerged and continue to pose threat in this century (Cassell & Mekalanos 2001). In a view of increasing resistance to existing antimicrobial agents, side effects and sometimes high cost of treatment (Ghosh et al. 2011), discovering an effective treatment for acne that is well tolerated by the patients is a challenge. The use of natural remedies dates back thousands of years. It is estimated that there are 250,000–500,000 species of plants on Earth (Cowan 1999) offers a great hope in the identification of potential phytotherapeutic agents for acne vulgaris (Azimi et al. 2012).
1.4 Cosmetics
The concept of beauty and cosmetics is as ancient as mankind and civilization. Women are obsessed with looking beautiful (Gediya et al. 2011). Now days, cosmetics are considered to be one of the essential commodities of life. It is the fulcrum of Fast moving consumer’s good (FMCG) sector. Cosmetics are substances which are defined under the Drugs and Cosmetics Act 1940 and Rules 1945 as “Any article intended to be rubbed, poured, sprinkled or sprayed on, or introduced into, or otherwise applied to the human body or any part for the purpose of cleansing, beautifying, promoting attractiveness or altering the appearance.” (Drug act Ref).

1.4.1 Facial skin care cosmetics
Cosmetics are used regularly and universally in different forms to enhance beauty. Skin care cosmetics treat the surface layer of the skin by providing better protection against the various environmental factors (Anctzak et al. 2001). There is an increasing demand for facial skin care cosmetics. According to data monitor, global spending on skincare products in 2012 was 82 billion $, where two-thirds of spending comprised of facial skin care. A report by research and market, expects the global skin care products industry revenue to cross 100 billion $ in 2018. Facial care segment is expected to continue to dominate the market. The increasing demand for anti-aging products and growing concern for the use of natural and organic skin care products are the major factors driving the skin care industry (Anon 2013). For various types of skin ailments, cosmetics like sunscreen, anti-acne, anti-wrinkle and anti-aging products are use. These can be synthetic or natural. Synthetic cosmetics are use because of their instant effects but they have limitations like unwanted side effects, skin allergies and cost effectiveness (Ashawat et al. 2009). Cosmetics alone are not sufficient to take care of skin and body parts, it require association of active ingredients to check the damage and aging of the skin. Cosmetics with herbal actives are now emerging as an appropriate solution to the current problem.

1.4.2 Cosmetics with herbal actives
There are several synthetic skincare products containing active ingredients including monoethanolamine, diethanolamine, sodium laureth sulfate, triethanolamine, etc. have adverse reactions such as allergic contact dermatitis, irritant contact dermatitis,
phototoxic and photo-allergic reactions (Mukherjee et al. 2011). Herbal cosmetics are the preparations which represent cosmetics associated with active and bioactive ingredients from plant origin. The botanical ingredients present, influence the biological function of skin and provide nutrients necessary for the healthy skin. In general, plants provide different vitamins, antioxidants, essential oils, dyes, tannins, alkaloids, carbohydrates, proteins, terpenoids and other bioactive molecules. Herbal cosmetics are topically applied and preferred more to synthetic or chemical cosmetics for their adverse reactions.

The vast array of knowledge of medicinal plants mentioned in ayurvedic texts is very helpful in the development of the new cosmetics products for present and future cosmeceuticals industry (Kumar et al. 2013). In India, we have a vast biodiversity and different climatic conditions which provide a variety of plants that can be used in the formulations. Our traditional knowledge about the use of plant wealth is described in Ayurveda, Siddha, Unani and Tibetan system of medicine.

Several herbs have been mentioned in Ayurveda which can be used to obtain healthy skin and glowing complexion. Ayurvedic literature i.e. Charak Samhita, Sushruta Samhita and Astang Sangrah describes over 200 herbs, number of minerals and fats to maintain and enhance the health and beauty of the skin. Ayurvedic cosmetics are in use and practice since thousands of year in India, without any side effects and are well proven and documented (Kumar et al. 2013). Charak samhita classified cosmetics drugs as Varnya, Kustagna, Kandugna, bayasthapak, udardaprasamana, etc. The Ayurvedic cosmetics are classified as cosmetics for enhancing the appearance of facial skin, cosmetics for hair growth and care, cosmetics for skin care, especially in teenager (for acne, pimples etc) and shampoos, soaps, powders and perfumery, etc (Hazra 2013).

This ancient knowledge is of great help to identify the phytochemicals for skin and body care preparations. Necessary efforts are required to associate the modern cosmetology with bioactive ingredients based on our traditional system of medicine leading to the emergence of novel cosmeceuticals for skin care (Tripathi & Srivastava2010) (Patkar 2008).