



## **DRY SKIN, ITS ETIOLOGY AND TREATMENT REMEDIES: A COMPREHENSIVE REVIEW**

**Rashmi V. Trivedi<sup>1</sup>, Shraddha R. Samrit\*<sup>1</sup>, Karandeepkaur R Rai<sup>1</sup>, Sushmita R. Tripurneni<sup>1</sup>, Milind J. Umekar<sup>1</sup>, Jayashri G. Mahore<sup>2</sup>**

<sup>1</sup>Department of Quality Assurance, Smt. Kishoritai Bhoyar College of Pharmacy, Kamptee, Nagpur-441002 Maharashtra, India

<sup>2</sup>Dr. D. Y. Patil Institute of Pharmaceutical Sciences and Research Pimpri, Pune-18, Maharashtra, India.

\*Corresponding author E-mail: [ssamrit70@gmail.com](mailto:ssamrit70@gmail.com)

### **ARTICLE INFO**

### **ABSTRACT**

#### **Key Words**

Dry skin, stratum corneum, Xerosis

Access this article online Website:  
<https://www.jgtps.com/>  
Quick Response Code:



Dry skin is defined as a disturbance of the surface of the skin due to inadequacy in water or oil content. It is not a unique, well defined condition, but represents a medley of total; unrelated changes in the structure of the stratum corneum which is associated with decreased in water content. Now a day's dry skin in most common in all age group mostly in an elderly group. Xerosis causes pruritis, which then leads to excoriation and risk of skin infection. By adopting preventive measures like increasing the humidity, modifying the bathing technique and products, and using emollients to replace the lipid components of skin, the impact of xerosis can be minimized. Hydration of the stratum corneum modulates both the mechanical and optical properties of this epidermal layer. It is necessary to select an emollient that solely soothes and rehydrates the skin and offers numerous dermatological supporting roles, especially induction of required epidermal differentiation. As a matter of fact, many moisturizing, hydrating and emollient products show efficacy in treating some of the dry skin conditions. The present review covers the different aspects of dry skin including its cause, management and treatment.

### **INTRODUCTION**

Xerosis is the medical term used for chronically dry skin. Xerosis, xeroderma, asteatosis, and "winter itch" dermatitis hiemalis, etc. have been used for dry skin. Amongst all, dry skin is self-descriptive term is well accepted compared to others. Initially the skin appears to have an increased skin marking, as the stratum corneum (SC) is less pliable and smooth which feels rough and tight to touch<sup>[1]</sup>. Flaky and accentuated skin lines may be reddened when inflamed. Darked toned skin may appear grey or ashen after drying with the burning sensation or

pruritus in most of the severe cases. These cracks or fissures may develop unbearable pain<sup>[2]</sup>. The legs, hands, and dorsal forearms are usually the first to be affected by dry skin, which can extend to the trunk and face<sup>[3]</sup>. Later, this can develop irregular erythematous lines which can progress to either lichen simplex chronicus or eczema and finally pruritis. Basically, the dry skin condition is linked to abnormal corneocyte cohesion and desquamation. Experimental studies attempted to attribute the roughness and chapping of the skin to the relative and/or absolute environmental humidity. However, the role of water in the physiopathology of the SC is not fully understood. In particular, the subject of dry

flaking skin is a matter of debate regarding its direct relationship and causality with the water content in corneocytes. At the clinical inspection, the human eye cannot see water in the SC. By contrast, xerosis is characterized by a rough surface with or without a scaly presentation. Its histological presentation differs according to the presence in various combinations of intercorneocyte cohesion impairment, parakeratosis, serum deposits, follicular involvement, disturbed corneocyte transit time and micro-inflammation. Hence, xerosis is not a single condition but rather encompasses a wide spectrum of disorders distinct in origin and pathomechanism<sup>[4]</sup>. Environmental factors are also responsible for dry skin. Anything that decreases the water content of the SC, such as cold or less humid climates, exposure to wind can accentuate dry, “chapped” skin which are all said to worsen xerosis. In some instance, it has shown link to genetic components. It can be a life-long problem that can worsen with advanced years. It has also shown link to hypothyroidism or uremia. In such circumstances treatment with medications such as lithium or isotretinoin can provide relief from dry skin. Chronic illness are sometimes associated with dry skin condition<sup>[5]</sup>. Many causes can induce dry skin through a number of biologic pathways.

### **Physiology of Ageing Skin**

Dry skin conditions are common in older people because of the physiological changes to the skin that occur with advancing age. These changes can be caused by intrinsic and extrinsic factors. Intrinsic factors that affect the ageing process appear to be genetically determined<sup>[6]</sup>. The outer layer of the skin, the epidermis, becomes thinner with age and the cells of the SC (horny layer) change their shape. The rate of cell turnover slows, which means cell loss occurs more quickly than cell replacement<sup>[7]</sup>. Therefore, the epidermis becomes less protective and more vulnerable to outside elements. A common analogy used for describing the skin is that of bricks and mortar. The corneocytes (flat dead cells which have lost their nucleus) act as the bricks, the corneodesmosomes lock the bricks together and the lamellar lipids are the waterproofing cement<sup>[8]</sup>.

### **Clinical Assessments in Perspective:**

Although xerosis may appear to be heterogeneous in nature and poorly defined biologically, the concept of dry skin is firmly rooted in the appreciation of lay people. The European Expert Group on Efficacy Measurement of Cosmetics and Other topical products (EEMCO) group has presented guidelines to assess the severity of xerosis using different methods<sup>[4]</sup>. The clinical assessment by the subject or by a trained assessor can be performed under casual or controlled conditions<sup>[9]</sup>. The casual condition is relevant although it includes a wide range of environmental variables. Such a test procedure is essentially descriptive under the actual circumstances and is used for product documentation when a reference situation is established. A controlled test condition aims at eliminating variations due to specified factors and highlights the defined situation with improved signal-to-noise ratio<sup>[10]</sup>. The assessments are performed according to a precise main purpose and with defined inclusion and non-inclusion criteria related to the panelist and to the environmental conditions of the trial. Visual assessment can be greatly improved in sensitivity and reproducibility using dry dermoscopy or video recording of the skin surface under ultraviolet light<sup>[11]</sup>.

### **EEMCO Guidelines**

Distinct types of clinical assessments can be made. One type corresponds to the subject evaluation of a given anatomical region using a visual analogue scale. The clinician's evaluation of the test site also benefits from a visual analogue scale. In general, no more than a 5-point descriptor scale should be used because expert proficiency diminishes as the number of assessment classes increases above this number. One of these assessment scales are represented by the overall dry skin score (table 1). The clinician's evaluation of the whole skin may further benefit from the dry skin area and severity index (DASI). After correction for the body area involvement (table 2), the scores are added giving the DASI value which ranges from 0 to 1600.

**Table 1: Overall dry Skin score in the dry flaking skin assessment**

<b>0</b>	<b>Absent</b>
<b>1</b>	mild scaling, roughness and dull appearance
<b>2</b>	few larger scales in combination with small scales, slight roughness, whitish appearance
<b>3</b>	small & large uniformly distributed, precised roughness, possibly redness and few external cracks
<b>4</b>	influenced by large scales, advanced roughness, redness present, eczematous changes and cracks

**Table 2: Area involvement for the DASI score<sup>[10]</sup>**

<b>Head and neck</b>	<b>10% of total area</b>
<b>Upper extremities</b>	20% of total area
<b>Trunk</b>	30% of total area
<b>Lower extremities</b>	30% of total area

**Table no. 3: Types of dermatitis**

<b>Contact dermatitis (CD)</b>	<b>Seborrheic dermatitis (SD)</b>	<b>Atopic dermatitis (AD)</b>
Contact dermatitis develops when there is a skin contact or exposure of skin to some chemical agent such as bleach, nickel which may leads to irritation or allergic to the skin, resulting into inflammation.	Seborrheic dermatitis occurs when large amount of oil is produced in your skin resulting in a red scaly rash or bumps, usually on your scalp, most commonly seen in infants.	Atopic dermatitis is also known as eczema in this condition the skin becomes dry and form dry scaly patches. It's common among young children. Other conditions, such as psoriasis and type 2 diabetes, can also cause your skin to dry out.

**Table 4.selection of skin care products to meet skin care needs**

<b>Need</b>	<b>Product required</b>
<b>Face</b>	Cream rich in water
<b>Extremities</b>	Ointment rich in lipids
<b>Acute dermatitis</b>	Cream rich in water
<b>Chronic eczema</b>	Ointment rich in lipids
<b>Summer</b>	Cream rich in water
<b>Winter</b>	Ointment rich in lipids

Table 5. Rationale for including emollient ingredients: certain ingredients of emollients that have been examined in clinical trials and that address the specificities of dry skin in chronic diseases

<b>Ingredient</b>	<b>Role</b>
<b>Lipids (e.g. mineral oil or vegetable oil)</b>	Act as alternative for lost natural skin lipids
<b>Physiological lipids (e.g. ceramides, cholesterol)</b>	Play a role in epidermal differentiation through signalling; play a role in structural elements of the stratum corneum
<b>Humectants (e.g. glycerol, NMF components)</b>	Restore SC, water content and barrier function
<b>Antipruritics (e.g. glycine)</b>	Break the itch-scratch cycle
<b>Cell/lipid metabolism support (e.g. dexpanthenol)</b>	Support cellular metabolism/protein synthesis/lipid synthesis; support normal epidermal differentiation and skin recovery

Table no 6. Selection of emollient:

Bath oils	Soap substitutes	Moisturisers (light to greasy in ascending order)
Balneum® bath oil	Aqueous cream, BP	Aveeno® cream
Cetraben® bath additive	Dermol® shower emollient	E45® lotion
Dermol® bath emollient	E45® wash cream	Keri® lotion
Diprobath®	Emulsifying ointment, BP	Cetraben® emollient cream
Oilatum® bath emollient	Epaderm® ointment	Diprobath® cream
Oilatum Plus® bath emollient	Hydromol® ointment	Doublebase® gel
		Oilatum® cream
		Emulsifying ointment, BP
		Epaderm® ointment
		Hydromol® ointment
		Hydrous ointment, BP
		Liquid paraffin and white soft paraffin ointment, NPF (50:50)

Table 7: Common skin sensitizers that may be found in emollients

Balsam of Peru  
 Lanolin  
 Propylene glycol  
 Parabens  
 Formaldehyde  
 Fragrance  
 Vitamin E  
 Aloe vera

Fig. no. 1: Components of NMF

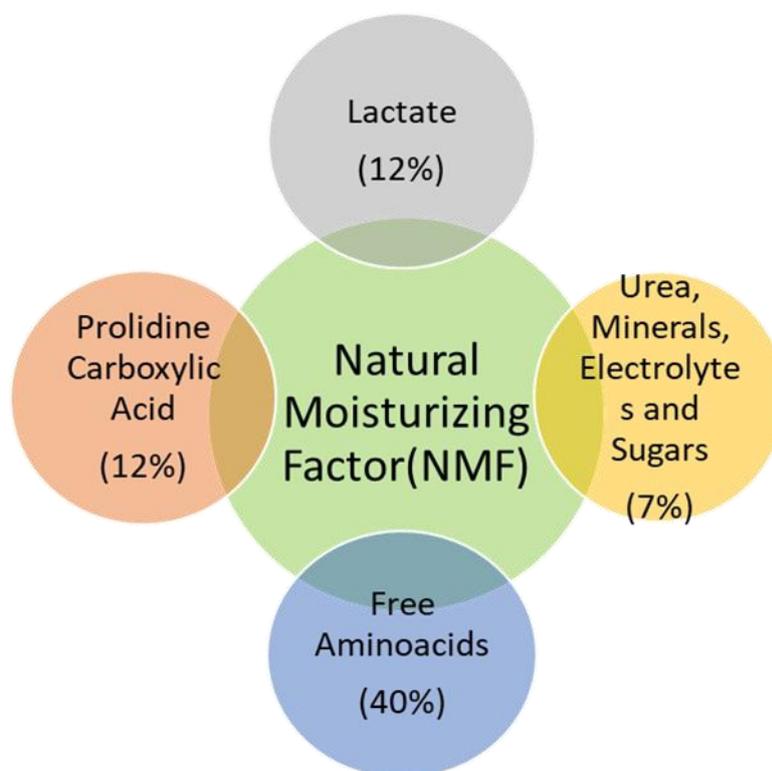


Fig. no 2: Causes of Dry skin



### Subjective assessment

As the concept of dry skin is well-established, but the subjective evaluations of the condition are needed to elaborate. Generally, four- or five-point graphic scales are used as reliability reduces with the increase in number of assessment points<sup>[12]</sup>. The extent of the condition is assessed using a four point scale: Grade 1: healthy skin, no visible signs of dryness and a healthy sheen and glow.

Grade 2: indicates mild xerosis, characterized by small flaky skin

Grade 3: moderate xerosis; looks like dry flakes causing a powdery appearance.

Grade 4: well-defined xerosis with large, dry flakes. Roughness & redness are apparent<sup>[13]</sup>.

### Tape stripping

Tape stripping is a method of sampling which involves the episodic removal of the external scaling portion of the SC using an adhesive substrate. In vivo, tape stripping is carried out by repeated application and removal of an adhesive tape to the surface of the skin. Analysis of samples so obtained can lead to the determination of factors such as SC mass, composition, pH, gene expression, barrier function and percutaneous drug penetration or distribution can be determined<sup>[14]</sup>

### The objective assessment of dry skin

In the past 30 years, there has been an explosion of the development of research tools available for the investigation of numerous

parameters relating to skin function, damage and responsiveness treatment<sup>[15]</sup>. Various bioengineering methods have been developed which allow assessment of SC hydration and identifying epidermal abnormalities including; Trans-epidermal water loss, electrical impedance, Raman spectrometry, confocal spectroscopy, OCT and magnetic resonance imaging

### Trans-epidermal water loss (TEWL)

TEWL measurement is an important non-invasive tool frequently used to monitor changes in SC barrier function. TEWL measurements are based on the estimation of the water vapour gradient in an open chamber<sup>[16]</sup>. Concentration of water in the skin and flux may be related by Fick's law:

$$J = -\frac{1}{4} K_m D \frac{dc}{dx}$$

Where,

$K_m$  = Partition coefficient

$D$  = Diffusion coefficient

$c$  = Water concentration

$x$  = Distance across the SC

$dc/dx$  = Water concentration gradient

When assessing skin TEWL no. of variables are ought to be taken into consideration including anatomical variations, age, sex, race, sweat(duct) gland activity, circadian clock, relative humidity, temperature of the measurement probe and environmental variables<sup>[13]</sup>. Early strategies for the assessment of TEWL placed a precisely weighed quantity of a hygroscopic salt on the surface the skin, in an unaired chamber for a defined period of

time. TEWL was measured by weighing the salt before and after treatment<sup>[17]</sup>. The measurement of TEWL is a widespread and useful method; however, conflicting data have prevented the comprehensive correlation of barrier function with TEWL<sup>[18]</sup>. The plastic occlusion stress test (POST) was devised in order to achieve an improved interpretation of TEWL data. The POST is an occlusive method used, in order to enhance water flux through the skin and thereby increase the whole skin structure response<sup>[13]</sup>.

### **Pathogenesis**

The exact aetiology of xerosis is not easily understood; but there are several intrinsic, genetic, and environmental factors that contribute to this problem. As we age, our skin's predisposition towards xerosis increases<sup>[19]</sup>.

### **Water content**

The water content of the SC is of paramount importance in maintaining the normal appearance and texture of human skin<sup>[20]</sup>. The relative hydration of the SC is a composite of 3 factors viz. the rate of water transport from epidermis to SC, the rate of loss of surface water and the water retention ability of SC<sup>[20]</sup>. SC is soft and pliable when its water content reaches 10mg/100mg dry weight, corresponding to 60 percent relative humidity<sup>[20]</sup>. As relative humidity increases, TWEL falls<sup>[21]</sup>. Surface ventilation and other climatic conditions also accelerates water evaporation with increasing dew point<sup>[22]</sup>.

**Water binding capacity:** Available evidence indicates that the water content of the normal SC is largely dependent upon the intracellular water soluble hygroscopic substances (Natural Moisturizing Factor), enveloped in lipid membranes<sup>[23]</sup>. These substances can be extracted with water only after treating the SC with various lipid solvents or detergents<sup>[22]</sup>. Natural Moisturizing Factor (30%), comprises of several compounds collection which are given in fig. 1; <sup>[21]</sup>SC with decreased water binding capacity, lead to dryness<sup>[23]</sup>.

**Barrier function:** This barrier function located over the stratum compactum of the horny layer,

and depends on both cornified material of the keratinocytes and the intercellular lipids<sup>[24]</sup> that have been released from the lamellar membrane coating granular bodies underlying in the stratum granulosum fusing with each other and the corneocytes to form the skin's lipid barrier<sup>[25]</sup>. In addition the water soluble hygroscopic substances within the keratinocytes allow them to retain moisture and cause them to swell and press into one another, preventing cracks and fissures<sup>[26]</sup>. The fibrous proteins of keratin and a histidin-rich protein known as keratohyalin or filaggrin are synthesized within the keratinocytes<sup>[27]</sup>. An envelope, formed by cross-linking of the precursors-volucrin and keratohyalin around each keratinocyte, forms an exoskeleton and acts as a rigid scaffold for the internal keratin filaments<sup>[28]</sup>. There is evidence that lipids are chemically bound to the surface of the corneocytes<sup>[29]</sup>. Ceramides possess most of the long-chain fatty acids and linoleic acid in the skin<sup>[30]</sup>. Cholesterol sulphate which comprises only 2-3% of the total lipids is important in corneocyte desquamation.

**Environmental factors:** Temperature and climate are important factors to determine the state of the normal skin which affects the hydration of skin leads to abnormally dry skin. There is a gradient between the SC water content and the atmosphere. Relatively Low humidity and high wind velocity removes the water from the SC and cause chaffing or mild scaling among the individuals generally in the summer months because of heat and humidity which gets severe during the winter months

**Surface area:** The volume and surface area of SC shrinks, when it dries than normal, it causes less surface area than skin tissues surface and when the SC is very thick then the cracks form scales or fissures in soles, leading to defective barrier function<sup>[31]</sup>.

**Desquamation of cells:** Horny cells of the SC are cemented together to form a membrane and are continuously shed from the surface, desquamating at fixed level in relatively large clusters at the point where the binding forces between horny cells can no longer withstand external abrasive forces. The binding (or cohesive) forces within the SC cohesion

is abnormally high, cells remain attached instead of separating and scaling or hyperkeratosis occurs. Hyper proliferative or retention hyperkeratosis occur depending upon whether there is increased or normal proliferation of epidermal cells<sup>[32]</sup>.

**Sweat and sebaceous glands:** Sweat glands provides water and sebaceous glands provide the fatty film on the surface of the skin which helps in maintaining the smoothness and suppleness of the skin respectively.

**Causes of dry skin:** The causes of dry skin are centered around three overlapping areas shown in Fig. 2, the SC is desiccated, if the water cannot be stopped or retained at the SC level leads to a defective barrier resulting into dry skin. The 3<sup>rd</sup> major cause is barrier damage of dry skin<sup>[33]</sup>.

Acquired dry skin may cause due to external factors like UV radiation; climatic conditions which includes cold, heat, wind, dryness; exposure to chemicals: detergents; and various therapeutic measures (e.g., retinoids)<sup>[34]</sup>. Ichthyosis constitutes a heterogenous group of genetic and acquired disorders characterized by a generalized persistent non-inflammatory scaling of the skin surface. They are generally disorders of keratinization<sup>[35]</sup>.

Generalized acquired dryness of the skin is symptomatic of the acquired, chronic, wasting, systemic diseases as well as of the generalized cutaneous atrophy in the aged. Interestingly xerosis tends to increase with age due to a lower inherent water content of the SC<sup>[36]</sup> and also probably due to an abnormal desquamatory process<sup>[37]</sup>. Dryness may be due to decreased activity or atrophy of the sweat and/or sebaceous glands (endocrine disturbances, drug effects, cutaneous malnutrition) or to dehydration of the skin caused by water and protein metabolism (toxaemias and wasting disease).

Dryness of the skin may also develop in constitutionally predisposed individuals with the exposure to low ambient relative humidity and low temperatures and made worse by frequent bathing and vigorous towelling afterwards. Minor dry skin (xerosis vulgaris), probably of genetic origin, is found frequently

in women, usually those with a pale prototype. Xerosis mainly affects the face, back of hands and limbs<sup>[34]</sup>. The lipid barrier with loss of integrity is a central factor in the development of dry skin conditions and eczema. The apparent sharp rise in the prevalence of eczema in the recent years suggests that environmental factors contribute to promoting barrier dysfunction<sup>[38]</sup>. Washing with conventional soap products can have a drying effect on the skin, removing lipids and reducing the thickness of the SC<sup>[39]</sup>. Many soaps and cleansing products contain sodium lauryl sulphate, a detergent with known irritant properties<sup>[40]</sup>. Low humidity, produced by air-conditioning, induces changes in epidermal proliferation and function<sup>[27]</sup>. Injury to the SC from these causes provides increased opportunity for irritants and allergens to penetrate the skin and promotes the release of inflammatory cytokines<sup>[41]</sup>. These effects, may be influenced by factors like genetic or environmental which are subtle initially, may lead to dermatitis. Various types of dermatitis are shown in the following table no. 3<sup>[42]</sup>. The dryness of the skin, poor complexion and itching is complained by many young and middle aged patients, particularly women due to excessive use of soaps, cosmetics, dyes, perfumes, etc. containing irritating or allergenic ingredients. Often such itching is aggravated on dressing or undressing, after bath or at night. This can be prevented if we use emollient preparations while taking a bath<sup>43</sup>.

### **Dry Skin: it's Impact on Disease**

The presence of dry skin is a skin condition in itself and a key aspect of a number of diseases. Dry skin per se is not a critical condition but its occurrence may have a considerable impact on the patient in terms of discomfort, pruritus and quality of life<sup>[44]</sup>. The impact of dry skin with respect to particular disease will be examined below.

### **Atopic Dermatitis**

AD is an inflammatory skin disease generally occurring in pediatrics (5–20% of AD cases occur in children, compared with 1–3% of cases in adults)<sup>[45]</sup>. Reductions in SC ceramide levels and impaired epidermal differentiation are the main causes of barrier

dysfunction regularly found in AD<sup>[46]</sup>. Barrier disruption allows for the entry of allergens and irritants into the skin, leading to immunological reaction and hence inflammation of the skin<sup>[47]</sup>. Filaggrin is also important for proper epidermal differentiation and skin barrier function<sup>[48]</sup>, and its breakdown products contribute to the formation of natural moisturizing factors (NMF) and a number of molecules such as amino acids which support water binding of the skin<sup>[49]</sup>. Studies have shown that in AD there is a reduction in NMF components in the SC<sup>[50]</sup>. Dry skin is most commonly caused by Low-grade atopic dermatitis. One of its defining characteristics is the presence of pruritus (itching), which can be produced by a number of cellular agents<sup>[51]</sup>.

### ***Psoriasis***

Psoriasis is an inflammatory condition in this, Plaque psoriasis, the most common kind of psoriasis, is characterized by erythematous plaques with silvery scales, most frequently found on the elbows and knees, lumbosacral region and the scalp. Some patients with psoriasis tend to suffer from pruritus<sup>[52]</sup>. Besides inflammation, changes in epidermal differentiation, including the expression of the cornified envelope proteins, also occur, which explain the symptoms of dry skin<sup>[53]</sup>. Also, changes have been observed in epidermal lipids, particularly in ceramide composition<sup>[35]</sup>. These changes in epidermal differentiation and lipid composition result in a disturbed skin barrier function<sup>[52]</sup>.

### ***Diabetes***

Patients with diabetes are at risk of developing dermatological complaints. In fact, as many as one third of patients with diabetes will develop a skin disorder of some kind. Patients often exhibit localized pruritus, which may be due to yeast infections, poor circulation or dry skin. The root cause of dry skin in diabetes is fluctuations in glucose levels; however, autonomic neuropathy may also play a role in the dry skin of patients with diabetes<sup>[54]</sup>.

### ***Kidney Diseases***

Patients with chronic renal failure and particularly those on regular haemodialysis

very often develop severe dry skin, which frequently progresses to eczema. Also, patients who undergo renal transplantation require long-term immunosuppression and, as such, they are at risk of a number of skin complications. Studies have shown that these dermatological conditions, including dry skin, can have a considerable impact on the patients' quality of life<sup>[55]</sup>. In a study of 217 consecutive organ transplant recipients (168 kidney, 29 heart, 19 liver and 1 heart), 193 patients displayed at least one skin disorder. Of these, 21% displayed severe xerosis<sup>[56]</sup>.

### ***Asteatotic Eczema***

This condition usually affects the lower limbs and may also affect the trunk. It is a form of eczema that resembles 'crazy paving' where the skin is scaly, dry and fissured. This itchy, dry skin condition is often seen in patients in nursing homes and hospital due to the low humidity of the atmosphere and the over use of soap<sup>[57]</sup>.

### ***Pruritus***

This can be described as an unpleasant itching sensation in the skin. It is a common symptom of many dry skin conditions and can have a profound effect on a patient's quality of life, regardless of age. In middle-aged and older people itching can be a symptom of an underlying medical condition or malignancy such as non-Hodgkin's lymphoma, hyperthyroidism, anaemia, liver or renal disease<sup>[51]</sup>.

**Management of dry skin:** The traditional approach to manage dry skin is the out-side in approach in which non-physiological lipids are primarily applied to the skin in order to occlude the surface and reduce TEWL, secondly these lipids are applied to augment the lipid content of the SC. Given the difficulties associated with penetrating the skin barrier and the major role that a disturbed epidermal differentiation plays in dry skin, it is now recognised that the best approach to treating dry skin is rather to try to restore normal epidermal differentiation. This approach requires ingredients and preparation that can easily penetrate the skin and act within the epidermis and promote production of normal intercellular lipids in the SC. This

approach is also known as the inside-out approach and is potentially more effective than the traditional outside-in approach. It is also important to insight the importance of prophylaxis between episodes of xerosis. This has been demonstrated in the management of dry skin associated with occupational contact dermatitis and suggests that preventative strategies should be practised in situation that lead to dry skin. The lipid content of the skin in different body areas varies; the skin in facial and abdominal area have more lipid content than skin on leg and palmoplantar areas. Patients are advised to choose a product that will deliver required amount of lipid to different areas affected by dry skin. In summer, patients are advised to use preparations with higher water content and less physiological lipid which arenon-occlusive and more comfortable to use on the face than products rich in non-physiological lipids (table 4). Prophylactic use of emollients is a well established method of managing work related contact dermatitis with a high degree of success<sup>[45]</sup>.

#### **Avoiding irritants**

In restoration of the water loss, moisturization is important in managing dry skin, and controlling eczema and other dry skin conditions, because it deteriorates the skin conditions leading to secondary inflammatory processes. It is accomplished by;

1. Controlling environmental causes such as room temperature and humidity
2. Discouraging excessive bathing or the use of hot baths or showers
3. Encouraging the use of mild soaps or soap substitutes
4. Moisturizing the skin with appropriate agents on exit from the bath<sup>[5]</sup>.

**Emollient:** Emollients are moisturizing aid which is applied directly to the skin to soothe and hydrate it. It covers the skin with a protective film from further damage by reducing TEWL, irritation itching and encourage the production of normal skin by restoring epidermal differentiation

**Lipid:** Restoring normal skin involves more than simply supplying water to the damaged

area; structural damage to the stratum corneum and the intercellular lipid lamellae must be addressed, lipids are therefore essential components of any dry skin formulation. Non physiological lipids, such as petrolatum, can help manage dry skin by providing an occlusive layer to reduce TEWL. Commonly used lipid like cholesterol, ceramides and free fatty acids which improves the penetration of ingredients into the SC and help reform lipid lamellae.

**Humectants:** Humectants such as glycerol and urea in concentration upto twelve percent have been used effectively in dry skin formulas. Due to changes in TEWL, skin defects can be rectified by topical or systemic application of glycerol. As it is evident that it can correct skin defects its elasticity and barrier function not caused by lipid depletion.

**Antipruritics:** Halting theitch-scratch cycle can reduce damage to the epidermis caused by scratching, and hence contribute to restoring normal epidermal differentiation. An itch has a neurophysiological basis and has been linked to epidermal nerve sprouting and over-expression of some neurogenic factors, it should be addressed by well tolerated agents that can act on those pruritogenic mediators. One such agent is glycine which can block histamine release from mastocytes. Also opioid receptor agonist, topical corticosteroids and plant extract e.g. german chamomile have been used to reduce itching.

**Epidermal Differentiation:** To aid regeneration of the skin through normal epidermal regeneration, and also to aid in recovery after skin-thinning steroid use, Scientific studies have shown that the use of certain ingredients of emollients has promising results (table 5), an ingredient is required that can support cellular metabolism and lipid synthesis. In a study of the use of topically applied dexpanthenol in human volunteers, subjects who received dexpanthenol exhibited a statistically significant improvement in the SC water content and a statistically significant reduction in TEWL<sup>[45]</sup>

**Moisturizers:** Moisturizers in the form of creams, ointments, soap substitutes, and bath oils are commonly recommended as a means to relieve feelings of dryness and pruritus<sup>[5]</sup>. The main ingredients of moisturizers are occlusive compounds and humectants<sup>[58]</sup>. Occlusive ingredients such as petrolatum, mineral oil, paraffin, squalene, and silicone form an epicutaneous greasy film and impede water loss. Humectants provides moisturization from below as it attract water from the dermis into the SC. These include glycerin, propylene glycol, urea, sodium lactate, and PCA. Active humectants are composed of physiological mixes of lipid components present in the lamellar bodies such as sphingolipids, free sterols, and phospholipids, which may beneficially affect epidermal proliferation and signaling. Materials with functions other than simply reducing TWEL or reconstituting the lipid components of the SC can be added to moisturizers. Special moisturizing agents such as  $\alpha$  or  $\beta$  -hydroxy acids promoting corneocyte desquamation and reduce roughness. Urea enhances the water binding capacity of the SC by disrupting hydrogen bonding. PCA mimics a glycosaminoglycan, and functions as a humectant<sup>[3]</sup>

**Moisturizer therapy:** Externally applied lipids intercalate into the intercellular spaces of the stratum corneum and restore epidermal lipids<sup>[59]</sup>. As a result, moisturizers help heal a damaged epidermal barrier and make the skin feel smoother, a property known as emollient. Moisturizers are most effective when applied after bathing when the skin has a high water content. However, their overall clinical effectiveness is short-lived because of quick shedding along with the desquamating corneocytes. This indicates that moisturizers should be applied repeatedly on a daily basis to attain the maximum benefit<sup>[60]</sup>. Moisturizers may have a drug-sparing effect if the moisturizer therapy is continued after inflammation subsides with topical corticosteroids or immunomodulators<sup>[61]</sup>. Furthermore, they decrease inflammation in damaged skin and irritated skin or even prevent irritant contact dermatitis. Externally applied lipids in the form of canola oils and sterol-enriched fractions ameliorate surfactant-

induced irritation<sup>[62]</sup>. It is important to understand that moisturizer formulations are not without problems. Regular users of moisturizers may be susceptible to contact dermatitis induced by preservatives or fragrances incorporated in commercial preparations<sup>[3]</sup>. The decision regarding how often to bathe depends on the individual patient. Daily bathing as part of total emollient therapy is recommended<sup>[27]</sup>. It is also important to advise patients that staying in the bath for longer than 15 minutes can cause water-logging of the skin, which may result in disruption of the epidermal barrier. Soap substitutes should be used and the use of detergents avoided<sup>[63]</sup>.

**Treatment:** Emollients are the first-line treatment for all dry skin conditions. A selection of commonly used emollients is given in Table 6. Emollients act by producing an occlusive film on the surface of the skin, preventing water loss and therefore increasing the amount of water trapped within the SC<sup>[64]</sup>. Total emollient therapy can help to restore the epidermal barrier function, as the emollient used can replace some of the natural oils that are lost in dry skin<sup>[9]</sup>. Emollients come in a variety of different formats and can be applied to the skin in a number of ways<sup>[63]</sup>. Involving the patient in the choice of emollient and letting them try different products will aid concordance and prevent confusion. Complete emollient therapy should be prescribed for patients and consists of a bath oil, soap substitute and leave-on emollients. Bath oils can be added to the bath water or applied directly to damp skin in the shower and washed off. When prescribing or recommending bath oils for older patients it is important to remind them that bath oils can make baths slippery and that they may need assistance when bathing. It is also important to ensure that older people have the dexterity to apply emollient lotions or creams themselves<sup>[65]</sup>. The role of bath oils has been questioned recently, focusing on the lack of randomized controlled trials on their efficacy in conditions such as eczema (DTB, 2007). However, many elderly patients live alone and find it difficult to apply emollient lotions to their skin. In such cases, using emollient oil in the bath will enable them to hydrate the whole body. The greasier the emollient the more

occlusive they are as they take time to be absorbed into the skin and require less frequent application. Ointments are mostly greasy, as they contain more oil than water. Caution with certain paraffin based ointments (emulsifying ointment and 50% liquid paraffin and 50% white soft paraffin) is advised as dressing and clothing soaked in the ointment are easily ignited by a naked flame. Creams are lighter, are absorbed into the skin quickly and require more frequent application. They are made up of a combination of water and oils and contain preservatives such as chlorocresol and parabens, which are added to keep them chemically stable<sup>[64]</sup>. Some confusion exists over which emollients to choose, how much to prescribe and when to apply them. Older people are usually dependent on prescribed emollients, and these should be products that suit the patient's skin, are ones they like and will use. It is helpful to show patients a range of different emollients and allow them to try various products, sometimes 'testers' can be provided for patients to try at home. The recommended amount of emollient that should be prescribed for adults with generalized eczema is 600g per week (PCDS/BAD, 2006). The best time to apply emollients is after bathing, which will trap moisture in the skin<sup>[63]</sup>. Topical steroids should be applied to only active areas of eczema after the emollient has been absorbed into the skin, which may take anything from 20 minutes to one hour, dependent on the type used<sup>[7]</sup>. Applying topical steroids and emollients at the same time should be avoided as this can dilute the topical steroid and reduce its effectiveness. As well as relieving the symptoms of pruritus, eczema and other dry skin conditions, emollients will also improve the way the skin looks and feels<sup>[63]</sup>. Total emollient therapy can help to restore the epidermal barrier function, as the emollient used can replace some of the natural oils that are lost in dry skin<sup>[9]</sup>. The prevention of dryness of the skin is centered on the maintenance of proper hydration of the SC. Restoration of barrier function is of utmost importance in controlling skin conditions and eczema. The important first step is removal of irritants and soap products. The soap shows detrimental effects which are widely recognized by the sufferers of eczema. In U.K. the recent survey

shows 38% of respondents with eczema after washing with soap<sup>[38]</sup>. In case of cleansing creams, they are spread on the skin surface with the fingers and then wiped with a tissue or water-rinsed if they are water rinsable cold creams, made of natural waxes and mineral oils with borax as an emulsifier<sup>[66]</sup>.

Emollients and moisturizers perform similar functions to the skin i.e. provide moisturization. Amongst them Emulsions are one of the most commonly used preparations. The rate of water loss from the horny layer may be controlled by using O/W emulsions. These prevent or at least sustain evaporation of water from the surface of the skin and slow down the rate at which water is evaporating from the skin, and trapped in the layers of SC, leads to soft and smooth skin surface. Emulsion is nothing but a form of cream that is being used by no. of people suffering from dry skin and the people who are frequently exposed to cold weather. The traditional humectants such as glycerine and glycols are now replaced by biocompatible agents such as hyaluronic acid and mucopolysaccharides. Retention of water at the skin surface does not solve the dry skin problem, but can be improved by increasing internal water retention capacity. Modern moisturizers containing derivatives of retinol (Vit. A) such as retinyl palmitate, which can increase water retention in both the epidermis and dermis by stimulating the synthesis of glycosaminoglycans. The aspect of dry skin condition, which is caused by chronic irritation, can be effectively handled by incorporating agents such as combination of vitamin of vitamin-A palmitate and 7-dehydrocholesterol that help to regulate and re-established equilibrium of the skin<sup>[33]</sup>.

Emollients are often used incorrectly. Ideally it should be applied after bathing, re-applied regularly throughout the day for maximum benefit. However, it is important to note that the use of emollients alone is unlikely to control inflammation and topical corticosteroids should be used for a short period until signs of inflammation are faded away. (emollient therapy)<sup>[38]</sup>. The choice of emollient depends upon the body type and level of dry skin (mild, moderate, severe). Bath oil causes deposition of a thin layer of oil on the skin upon rising from the water<sup>[1]</sup>.

### **Problems with topical treatments for xerosis**

It is important that patients with xerosis should avoid skin sensitizers. This is primarily due to concern that these patients may develop wounds later on, either due to the increasing fragility of the skin with age or self-inflicted wounds from excessive scratching. Table 6 lists common skin sensitizers found in emollients. Studies have shown that few of these are common skin sensitizers that should be avoided [67].

**Education strategy:** Although the benefits of emollients in eczema and other dry skin conditions are widely accepted, they are often used incorrectly. Personal preferences, for example for creams over greasier oil-based ointments, can have a large influence on patient compliance, but some lighter water based cosmetic lotions may aggravate dry skin. Encouraging patients to try a limited range of appropriate emollients may help raise compliance and also gives the patient a level of control in their own care. In addition, it is essential that emollients be supplied in sufficient quantities (at least 500 g per week for creams and based on a usage of 15–30 ml per bath for daily bathing, 150 ml per week for bath oils), and that all patients receive a thorough demonstration of how to apply them. Adequate quantities of soap substitute/aqueous creams should also be supplied to encourage usage at each washing occasion. Surprisingly, results of the recent National Eczema Society survey revealed that only one-quarter of respondents who had been prescribed emollients had received a demonstration on their effective use (data available from the National Eczema Society). Taking the time to discuss the objectives and benefits of emollient therapy, along with consistency of advice from all health professionals involved in the care of patients with eczema and other dry skin conditions will help ensure the successful implementation of any emollient treatment regimen. In order to facilitate effectiveness and consistency of emollient care, we propose a set of simple best practice guidelines for the use of emollients which can be applied to both primary and specialist care services.

All health care professionals involving patients care with dry skin, eczema and other conditions should understand the basic principles of emollient use.

- Patients with dry skin, eczema and other skin conditions should avoid use of emollient soap substitute while washing and bathing.
- Application of emollient in daily routine is an integral part of the patients suffering from dry skin, eczema and other skin conditions even when the skin is under control. They should be applied at least twice daily (500 g or more per week).
- It is important that the patients should understand relative benefits of steroid creams (to reduce inflammation) and emollients (to combat dry skin).

The objectives are:

- (1) to give patients consistent advice on the management of their skin on a day-to-day basis, not just when they experience flare-ups;
  - (2) to use language and explanations that are clear and easy to understand; and
  - (3) to provide patients with a written summary of the advice they have received, which can be referred back to and serve as a memory prompt.
- The ultimate aim is that over time, patients learn to manage their skincare therapy and are able to prevent flare-ups in their condition, consequently reducing the frequency of healthcare consultations. Based on these guidelines, the ABC patient leaflet was developed as an educational tool which doctors can use with and distribute to patients in support of objective 3 above. The ABC patient leaflet is a three-step solution for eczema and dry skin care supported by the National Eczema Society and accredited by the British Skin Foundation, which encourages patients to:
- A Avoid soap
  - B Benefit from emollients, and
  - C Control inflammation.

Any treatment regimen following these basic guidelines can then be tailored according to the patient's individual needs and preferences. Both the guidelines and the ABC patient leaflet support the recommendations of the Dermatological Care Working Group report, which highlighted training and patient education as areas for concern<sup>[40]</sup>.

## CONCLUSION

Dry skin is a common condition with a complex background. We have reviewed the etiology and pathophysiology involved in xerosis and highlighted disturbed epidermal differentiation as a root cause of dry skin. As more is known about the process that leads to the induced skin hydration and barrier function in dry skin, ingredients known to play a vital role in reversing these processes can be formulated and included in the emollient preparations, as emollients still play a vital role in the treatment of dry skin in disease despite of advancement in the treatment. Visual evaluation of xerotic conditions, remains a key technique to record the effects of any disruption in the dry skin cycle. It is also important to point out that patients with AD, psoriasis, as well as chronic renal failure and diabetes also exhibit dry skin, and in these patients emollients may be a better and more effective therapeutic option than steroids, but also exhibit a greater side effect profile. In these dry skin situations, moisturization is needed, but there are also some specificities linked to these diseases (pruritus, inflammation, diminution of humectants) that need to be addressed by the emollient. To conclude, though emollients play a key role in management of dry skin within disease, but it may give rise to some problems due to the common skin sensitizers used in the emollients which may worsen dry skin in diseased conditions by causing hypersensitivity reaction. So, in the modern emollients, it is important that each ingredient in the preparation is carefully chosen and that it plays a major part in restoring normal epidermal differentiation, which when used proactively in a comprehensive skin care regime, can help patients avoid the burden of dry skin.

**Acknowledgement:** The author wishes to thank Smt. Kishoritai Bhoyar College of Pharmacy, Kamptee, Maharashtra, India, for providing guidance and support for this study.

**Conflicts of interest:** The authors declare that there are no conflicts of interest.

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