Mammalian skin is constantly adapting to changes in environment. The skin provides sensory, immunologic, physiologic and structural functions. In addition, it provides a barrier function against environmental insults. The epidermal layer of the skin is composed of keratinocytes which after maturing are desquamified. Dietary lipids are used by these cells to produce and maintain a protective barrier. Together these form the stratum corneum, which is the outermost layer of the epidermis (see figure 1).

The macromolecules (principally lipids) which are paramount to barrier function typically consist of long chain fatty acids linked at one end by a head group such as glycerine or sphingosine. While the head groups are hydrophilic, the long chains are hydrophobic. In an aqueous environment the lipids orient themselves such that the polar hydrophilic head groups face into the water with hydrophobic groups arranged away (see figure 2). These structures are called micelles.

The stratum corneum serves as both a barrier to water loss from the body as well as a microenvironment. The stratum corneum is a complex self regulating structure. In addition to its role in keeping environmental insults outside the body, and water inside the body, it also functions to keep essential metabolites inside the body. Numerous chemical processes occur within the stratum corneum in an aqueous environment and some of these are dependant on the tissue water concentration.

Water arrives from the dermis at the base of the epidermis 50-100 times faster than it is lost from the surface of the epidermis, at the stratum corneum. This highlights the barrier function of the stratum corneum, which has a very low diffusability for water. When skin integrity is altered however, the barrier function is compromised resulting in greater water loss than normal. It has been shown that water passes through the skin via sweat glands, either through active sweating or by passive movement through an inactive gland. Studies have demonstrated that the stratum corneum barrier is approximately 1000 times more effective than would be expected from a biological membrane. One of the reasons for this is that the passage of water through the stratum corneum is not direct but rather follows a path about fifty times greater than the thickness of the stratum corneum, traversing a long path between and around the cells as opposed to through them.

Inman et al (2001) have demonstrated that an epidermal barrier defect is likely present in atopic canine skin. The length and thickness of stratum corneum lipid deposits has been demonstrated to be lower in atopic dermatitis animals than in normal subjects. Interestingly this phenomenon exists not only at lesional sites but also at nonlesional sites of AD animals as well. This raises the question as to whether the apparent breakdown in barrier function in AD animals is the cause rather than the effect of environmental onslaught. The majority of the work in this area has been carried out by Chesney who points out that DNA synthesis in the epidermis appears to be dependent
upon transepidermal water loss and the hydration level of the epidermis. The phenomenon of measurably drier skin in both lesional and nonlesional sites of atopic dermatitis patients demonstrated in limited studies has been well documented in human patients. The hydration of a membrane is affected by several factors:

- THE RATE OF WATER SUPPLY
- THE DIFFUSABILITY OF THE WATER THROUGH THE MEMBRANE
- THE CAPACITY OF THE MEMBRANE TO HOLD WATER
- THE RATE OF WATER LOSS FROM THE OUTER SURFACE

In the studies referenced above in human patients with atopic dermatitis the exhibiting of abnormal dryness is believed to occur because of a defective extrusion of the lamellar bodies resulting in changes in the chemical composition of the epidermal lipid barrier and increased transepidermal water loss. Transepidermal water loss (TEWL) is used as an assessment of the integrity of the skin barrier to insensible water loss. TEWL is thus a measure of the rate of water lost through the skin and therefore a measure of the skin's ability to retain moisture. It can also be used as a measure to possible damage to the skin's water barrier function. Since loss of water through the skin is normally a passive process, higher TEWL values indicate greater water loss and are indicative of damage to the barrier function of the stratum corneum. Limited but important studies have shown significantly higher TEWL values during irritant exposure, self mutilation or atopic dermatitis. This highlights the importance of skin hydration under these circumstances for a homeostatic balance.

References:

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