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A Novel Skin Moisture Management Strategy

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ABSTRACT

An important function of skin is prevention of water loss. When the normal skin barrier breaks down, strategies to treat dry skin include occlusives and humectants. An important physiological process for retaining water in epidermal cells is the taurine transporter (TauT). The TauT is activated within minutes after the skin is exposed to irritation, dehydration, ultraviolet radiation, and other stressors. A novel product comprising two patented technologies delivers cytoprotective osmoregulation and ingredients for optimum moisture management (Tetros® ULTRA, Intense Hydration for Stressed Skin; TetraDerm™ Group LLC, Grosse Pointe, MI).

The product has been formulated with natural physiological lipid ceramides, free fatty acids, and cholesterol esters, which restore and protect the stratum corneum moisture barrier. It also contains a retinoid activator of the TauT to stimulate osmoregulation. The selected lipids and lipid precursors are present in the product in ratios that resemble the natural complexity of biological membranes. The product is also formulated with different nano- and micro-compartments that deliver hydrophilic and hydrophobic actives together, with different rates and depth of delivery, without changing composition or concentrations of excipients. The formulation enables penetration through stratum corneum and epidermis without disturbing normal skin barrier function. Controlled ingredient release and penetration depth enhance the capability of lipid precursors to promote skin lipid biosynthesis. These product characteristics lend themselves to widespread application in numerous dermatologic disorders without compromising the normal barrier function of the skin.

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INTRODUCTION

The primary function of our skin is to protect us from harm by pathogens and environmental insults, and to enable us to have the sensations of touch, heat, and cold. Our skin also forms a barrier to prevent water loss. This occurs by preventing evaporative water loss at the skin surface and retaining water in and around the living cells of the epidermis. The epidermis includes several layers of cells that continuously rebuild the surface of the skin. The basal cell layer (stratum basale) is the innermost and germinative layer of the epidermis. The squamous cell layer (stratum spinosum) contains keratinocytes that are formed by cell division in the stratum basale. As they migrate through the stratum spinosum and stratum granulosum, they differentiate to form a rigid internal structure of the tough protein keratin that makes up most of the skin structure. The outer layer of the epidermis, the stratum corneum, is composed of layers of flattened dead anucleated corneocytes which are eventually shed via desquamation.[1]

Water is essential for the normal functioning of the skin and especially the stratum corneum where the water content is necessary for proper maturation of the stratum corneum and skin desquamation.[2] Several physiological processes are involved in preventing trans-epidermal water loss. One is a thin hydrolipid film of occlusive sebum on the surface of the skin, which is produced by the sebaceous glands. Sebum is comprised of triglycerides, wax esters, squalene, and free fatty acids, which make the skin more impervious to moisture.[3] Another is referred to as natural moisturizing factors, which are derived from filaggrin, or filament-aggregating protein, a class of structural proteins found in the squamous cells in the deeper layer of the epidermis.[4]

As these squamous cells migrate towards the skin surface, the ~400 kDa profilaggrin polyprotein is dephosphorylated and cleaved by serine proteases to form 37 kDa monomeric filaggrin, which binds to keratin cytoskeleton. This process contributes to cellular compaction and permits extensive crosslinking of keratin intermediate filaments by transglutaminases to form a highly insoluble keratin matrix.[5] Filaggrin undergoes physiological interaction with protease enzymes to liberate constituent amino acids and other derivatives such as tyrosine, urocanic acid, and pyrrolidone carboxylic acid. These hygroscopic substances are incorporated into corneocytes during cell maturation and differentiation where they contribute to maintaining hydration of the stratum corneum.[4,6] Finally, the most important means of preventing trans-epidermal water loss is the stratum corneum itself, the outermost layer of skin cells comprised of dead corneocytes. Surrounding the corneocytes is a complex of intercellular lamellar lipids including primarily