Skin Tightening with Polymer-Containing Formulations. Mechanical Skin Indentation, Photography-Image Analysis, and Panel Testing

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Abstract

Several skin treatment products were prepared containing high molecular weight polymers, such as Polyimide-1 (Aquaflex® XL-30) and VP/Acrylates/Lauryl Methacrylate Copolymer (Styleze® 2000), which can form thin films on the surface of skin in order to produce a tightening effect. The gel formulations, which contained 1% to 3% polymer were employed to treat the inner forearm of the panelists. The effects were quantified by mechanical skin indentation measurements and photography/image analysis of treated skin sites. Skin indentation, performed at small deformations, was shown to increase the normal skin stiffness by 20% to 90% for deposited amounts of dry polymer in the range from 0.26mg polymer/cm^2 to 1.06mg polymer/cm^2. High-resolution photography/image analysis was employed to detect changes in the textural properties of skin. The images obtained by using crossed polarizers (polarized illuminating light and cross-polarized reflected light) provided evidence for the disappearance of a network of white lines formed as a result of scattering and depolarization of reflected light. The images obtained using parallel polarizers demonstrate a skin tightening effect as well as an increase in skin brightness and broadening of skin tonality. The physicochemical observations were also confirmed by a home use test in which panelists rated tightening attributes of the investigated products.

Introduction

The occurrence of skin tightness by exposure to water and surfactants is a commonly recognized phenomenon and has been described in the literature some time ago[1]. The effect, readily sensed by both untrained, every-day users of cosmetic products as well as by expert panelists, especially on facial skin, was correlated with the removal of amino acids, urocanic acid, squalene, cholesterol, and lipids from skin. The sensation of tightness was assessed qualitatively by the panel ratings and by quantitative measurements of skin luster.

The induction of skin tightness by certain classes of actives, including proteins and polysaccharides, has been utilized in cosmetic practice for a long time but was described more formally and quantitatively only in recent literature[2–7]. The objective of such treatments is to hide or reverse the effects of cutaneous aging by increasing the stiffness of skin as well as by eliminating or hiding the wrinkles, furrows and lines, which leads to the perception of smoother skin.

Jouandeaud *et al*.[3] described the skin tightening or tensor properties of vegetal proteins, which were modified by grafting of synthetic polymers. The tensor effect refers to the ability of a polymer film to act like a tensor muscle, i.e. to stretch the skin or make it tenser and was also found to depend on the type of formulation. The consumers showed preference for the selected tightening active as compared to the placebo, especially in terms of radiant complexion, firmness, and skin vitality.

Gillon *et al*.[4] defined the tightening effect, from a marketing viewpoint, as a real instantaneous lift of the skin, reducing wrinkles and lines, and imparting improved tonality to the skin. The tightening treatment was suggested to be most advantageous for wrinkled, dehydrated, stressed and distended skin, which had lost its tonality and brightness.

Challoner *et al*.[5] employed a Dermal Torque Meter to study the effect of cosmetic proteins on skin moisturization, skin firming and skin elasticity.

In this paper we have explored the induction of skin tightening by employing synthetic, high molecular weight polymers, as film forming agents. Mechanical analysis by Indentometry, high resolution Digital Photography/Image Analysis, and home use panel testing were utilized to probe the behavior of polymer films on the skin surface.

Experimental

Indentometry

Indentometry, which depends on the deformation forces in skin and underlying tissues, has been widely used for skin testing[8–10], especially in relation to skin aging. Zahouani *et al*.[10] has recently presented the results of indentometric experiments carried out