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Short communication

The effect of different formulations with colloidal oatmeal on the epidermal barrier function and hydration

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Introduction

The topical application of semi-solids can influence several epidermal functions, such as movement of water and electrolytes, as well as creation of barrier against microorganism invasion and harmful environmental factors. In that direction, correlation between epidermal barrier impairments and compromised skin, including those related to specific skin disorders was observed in literature and the importance of developing topical skin products that are "barrier friendly" has been recognized from cosmetic and pharma industry. Moisturizers have multiple functions executed by a great variety of ingredients. Apart from moistening the skin, they affect the structure and barrier function of diseased and healthy looking skin. Application of moisturizers to the skin induces changes in epidermis (mainly in *stratum corneum, SC)* as well as in deep skin layers (Rosso et al., 2016). Knowledge about the interplay between ingredients in moisturizers is essential to get a stable and cosmetically attractive product with desired impact on the skin (Lodén, 2005).

Oats (*Avena sativa*) have been cultivated since the Bronze Age, and the use of oats as a topical therapy for variety of dermatological conditions dates from Roman times. In 1945, a ready-to-use colloidal oatmeal (COA) became available, and soon after several clinical studies demonstrated its benefits as a remedy for inflamed, dry and itchy skin dermatoses. In 2003, the FDA approved the use of COA as a skin protectant, and currently colloidal oatmeal is commonly used for skin rashes, erythema, burns, itch and eczema. COA can increase skin's expression of epidermal differentiation targets and lipids involved in barrier function, can provide pH-buffering capacity for skin and can clinically improve skin barrier function. Thus, COA as an active ingredient provides a multi-therapy approach for dry and compromised skin by strengthening skin barrier (Ilnytska et al., 2016).

Several non-invasive techniques could be used to measure skin biophysical properties such as transepidermal water loss, hydration, melanin, erythema, elasticity, collagen, sebum and skin pH. The pH value of the skin surface is mainly associated with the quality of formed hydrolipid film. Basically, the pH of *SC* regulates three epidermal functions, which are antimicrobial barrier, permeability barrier homeostasis, and barrier integrity/cohesion. Therefore, pH alterations on *SC* could lead to abnormal epidermal barrier function. Also, sebum production on the skin surface and sebum lipids have major impact on the protective and mechanical properties of the epidermal barrier (Mohd Ariffin and Hasham, 2020).

Therefore, the main objective of this study was to compare the effectiveness of three formulations (cream, gel and ointment) containing COA using blank formulations (without COA) as a control on healthy human subjects by monitoring changes of skin pH and sebum production with non-invasive techniques**.**

Materials and methods

The products (cream, gel and ointment) were prepared using 2% colloidal oatmeal (Making cosmetics,USA), glycerol (Carl Roth, Germany), xylitol (Roquette,France), Benzoic Acid Dehydroacetic acid Phenoxyethanol (Kalekimya, Turkey), liquid paraffin (Carl Roth, Germany), petrolatum (Carl Roth, Germany), Glyceryl Stearate (and) Ceteareth-20 (and) Ceteareth-12 (and)

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Cetearyl Alcohol (and) Cetyl Palmitate (BASF, Germany) and carbomer (Carl Roth, Germany) as main ingredients.

Human subjects (n = 10) of both genders, age 21-46 (mean 33.4 ± 9.18 SD) with all skin types, were included in the study. Exclusion criteria were: females who are pregnant/nursing, those who have active skin diseases or those who are allergic/sensitive to frequently used cosmetic products. Human subjects provided their consent to participate in the study strictly voluntarily. Eligible subjects were instructed not to apply any other cosmetic products on their skin at least 24 hours before the study, neither during the test period (4 hours after first application and after 3 days of continuous product usage (twice daily)). The tests were done in such a way that each product with COA was applied to defined regions on one arm and on the other arm. blank formulations (without COA) were applied. The three formulations were applied to the upper hand (gel), forearm (cream) and upper arm (ointment), respectively. Before the assessments being performed, the study participants acclimatized to study laboratory conditions (25 ± 2 °C and 40 ± 4% RH) for 10 min. Skin-pH-Meter PH 905 and Sebumeter® SM 815 (Courage-Khazaka electronic GmbH, Germany) were used for non-invasive skin measurement.

Obtained data were tabulated using Microsoft Excel® (Microsoft Corp. Redmond, WA, USA) and were computed and consequently evaluated using statistical software STATGRAPHICS Centurion XVI evaluation (StatPoint technologies Inc., USA). The p-value <. .05 was accepted as the threshold to discriminate significant.

Results and discussion

The pH plays an essential role on the cutaneous anti-microbial defense and regulating the skin barrier function, with a physiological range of 4.1–5.8. In all volunteers, no differences were observed in the measured pH and sebum of the different parts of the hand/arm before the start of the experiments (pH 4.18-5.89).

Regarding the time period of application (after 4 hours from the first application and after 3 days), no differences were observed in the pH of the skin after application of the gel and cream sample, while a significant change (but in the normal pH range) was observed for the ointment with COA after 3 days of continuous use. At the same time, between all blank formulations no significant differences of measured pH were observed during the entire time period of the study. In contrast, significant differences were observed between the cream and the ointment with COA, but only after 3 days of continuous application.

Regarding the measured values of sebum, all formulations with COA and blank formulations (gel, cream and ointment) did not showed significant differences at 4 hours. At the same time, after applying the ointment, regardless of whether it was with COA or blank ointment base, an increase of the level of sebum (measured after 4 hours) was observed. After 3 days, in all subjects, the level of sebum, regardless of the applied formulation, was normalized.

Conclusion

Obtained results suggested that COA product, especially in a form of cream or gel can improve the skin physiological and intercellular lipid properties.

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