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THE EFFECTIVENESS OF GREEN TEA AND SONOPHORESIS ON OILY SKIN: A CASE REPORT

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A – study design, **B** – data collection, **C** – statistical analysis, **D** – interpretation of data, **E** – manuscript preparation, **F** – literature review, **G** – sourcing of funding

ABSTRACT

Background: Oily skin can be extremely problematic for sufferersand presents a great challenge for cosmetologists. This condition is characterized by an excessive amount of sebum on epidermal surface and enlarged skin pores.Modern cosmetology is able to offer a wide range of treatments that are able to reduce excess sebum secretion, and an appropriate diagnosis and cosmetic interview will allow for the selection of a suitable cosmetic treatment. If there are no contraindications for device treatments and the client is not allergic to cosmetic products, an ultrasound treatment called sonophoresis may be used. Green tea is obtained from both the leaves and buds of the *Camellia sinensis* plant. The active ingredients of green tea are polyphenols, which have antimicrobial, anti-inflammatory, and antineoplastic properties. Thanks to modern cosmetic devices, we are able to use green tea and sonophoresis to introduce this preparation into the skin.

Aim of the study: The aim of this study was to evaluate the effectiveness of a sonophoresis treatment on oily skin in a 20-year-old female.

Case report: The participant reported issues with too much sebum on the epidermis. The sebum level was measured before and after a series ofsonophoresistreatments using a sebumeter (DermaUnitSCC3). For the treatment, an ultrasound device and a cosmetic ampoule containing green tea extract were used. The entire cosmetic procedure consisted of 4 treatments performed at weekly intervals.

Conclusions: After the series of cosmetological treatments, there was a significant reduction in sebum secretion.Thus, the use ofsonophoresis and a green tea ampoule turned out to be a great help in reducing epidermal sebum. The participant also noticed that her skin had less sheenfollowing the series of treatments.The resultsindicate that the sonophoresis procedure is safe and effective.

KEYWORDS: sonophoresis, oily skin, sebumeter

Background

The problem of excessive sebum production begins in adolescence and can also be a problem in adulthood. It is a distinctive feature of oily skin, which is characterized by a "shining" of the skin and enlarged pores, most often in the T-zone (forehead, nose, and chin).Sebum is an oily material that is produced in the sebaceous glands. It is a mixture of triglycerides, wax esters, squalene and cholesterol esters. High levelsof sebum can be present on the face (forehead, nose, chin), and also on the shoulders and back. We know that a normal amount of sebum has a protective function, but too much can cause anincrease in acne. Thus, maintaining a normal level of sebum is very important forthe human body, and we shouldn't

reduce it too much withcosmetological procedures [1].Care for this type of skin is a great challenge for a cosmetologist, which is why apparatus treatments combined with cosmetics that contain active ingredients with sebum-regulating effects are increasingly used. An ingredient that has found a very good use in cosmetology is green tea,as it hasantimicrobial, anti-inflammatory, antioxidant, and antineoplastic properties [2,3].

Many cosmetological treatments can be used to effectively reduce the sebum discharged from sebaceous glands. Among the most popular are fruit acids. Chilicka et al. conducted research on the effects of azaleic and pyruvic acid on a group of 120 people. They showed that both acids had a positive effect on the reduction of sebum on the surface of the epidermis[4].

Another relatively new procedure used in cosmetology is hydrogen purification. Chilicka et al. examined a group of 60 people (30 people suffering from acne vulgaris and 30 healthy people) and showed that the treatment significantly reduced sebum and skin eruptions that occur in the course of acne vulgaris [5].

An additional treatment that effectively reduces sebum is ultrasound; more precisely, the sonophoresis procedure, which promotes the movement of active substances in the cosmetic preparation into the skin. Ultrasound is an acoustic wave with vibration frequencies exceeding 20 kHz. The range of these frequencies is not audible to humans, but may be perceived by some animals [6].

In cosmetology, ultrasound with a frequency of 750 kHz–3 MHz and an intensity of 0.5–2.0 W/cm^2 is used mainly for tissue micromassage, which leads to local hyperemia and thus improves the functioning of the lymphatic system. Sonophoresis increases the absorption of substances contained in the cosmetic and activates cellular metabolism [7–10]. The active action of acoustic waves within the matter is based on the use of medium and high intensity ultrasound, which has an impact on biological, physical and chemical processes in tissues. The energy absorbed by tissues is converted into heat, which increases the kinetic energy of carbohydrates, lipids and proteins. The ultrasonic waves improve metabolism, contribute to faster healing processes, and they are used in liposuction (non-surgical), body shaping and anti-cellulite treatments [11–13]. The influence of ultrasound on the plasma membranes of erythrocytes induces functional changes that can increase their permeability. The ultrasound waves may also contribute to increasing the kinetic energy of the cosmetic ampoule particles used in the sonophoresis treatment [14]. Sonophoresis treatments can be used for various skin types, including vascular, oily, sensitive, aging, or dehydrated, as well as for acne vulgaris. The effects obtained after the treatment are caused by the impact of the ultrasound waves on the tissues, as well as the active substances used in the cosmetic preparation [15, 16].

Aim of the study

The purpose of this study was to assess the efficacy of sonophoresisfor decreasing sebum levels.

Materials and methods

Study design

This study was conducted in September 2020 at Opole University in Poland.The participant was informedthatshecould abandon the studyatanygiventime, she was alsoinformed of intention of thisstudy, and providedwritteninformedconsent. Thisstudy was approved by the Human ResearchEthicsCommittee at the Opole Medical School (KB/59/NOZ/2019), and is in line with the principles of the Declaration of Helsinki.

Settings

For the treatment, an ultrasound device and a cosmetic ampoule containing green tea extract were used. The entire cosmetic procedure consisted of 4 treatments performed at weekly intervals. Before the treatment, face make-up was removed using micellar fluid and the skin was toned. The ampoule was then combined with the ultrasound gelto increase lubricationduring the procedure, and it was applied to the entire face. The ultrasound power used in the procedure was 0.25 W/cm^2, and the time for insertion of the ampoule was programmed to 10 minutes.

Participant

The participant was a 20-year-old female who reported problems with excessive sebum secretion. The patient reported that she has been struggling with excess sebum (Fig. 1) since the age of 15, and, despite the use of many cosmetics, the problem always returned after some time.

The patient met the following inclusion criteria: aged 19–23 years, a sebum secretion level >200 μg/cm^2, no hormonal contraception, no other cosmetological treatments during the study, and no dietary supplements that could reduce sebum secretion (seboregulating function).

Figure 1. Forehead before the series of of green tea ampoule and sonophoresis treatment

Figure 2. Forehead after the the series of green tea ampoule and sonophoresis treatment

The exclusion criteria were as follows: pregnancy, lactation, active skin inflammation, fungal or bacterial skin diseases, recent surgical procedures in the treatment areas, active herpes, allergies to any of the components in the cosmetics, hormonal contraception, active rosacea, eczema, psoriasis, numerous telangiectasis, having a pacemaker, heart problems, implants (metal, silicone, saline), active tuberculosis, severe acne and propensity to keloids, or any other cosmetological treatment.

Data sources/measurements

The participant was diagnosed with too high a sebum level.Sebum measurement was performed with aDermaUnitSCC 3 sebumeter (Courage+Khazaka electronic GmbH, Germany) before a series of cosmetic treatments and 14 days after the last treatment. The patient was asked to remove make-up and not to apply any cosmetics the evening before the examinations, which were carried out in the morning hours. The temperature in the room where the examination took place was 22 degrees Celsius and the humidity was 40–50%. The participant was acclimated to the conditions for 20 minutes before each examination. The level of sebum was checked between the eyebrows and on the chin.

The patient was informed that during the treatment and two weeks after it other cosmetic procedures, applying new cosmetics, going to a swimmingpool or solarium, or supplementation with any substances reducing sebum were forbidden. It was recommended that she use only micellar fluids and moisturizing creams for homecare. Cosmetics with mattifying or sebum-regulating effects were also strongly contraindicated.

Results

After the series of sonophoresis with green tea extract, there was a reduced sebum level (Table 1). These measurements showed the improvement in the condition of the skin. The level of sebum went down between the eyebrows from240to 160 μg/cm^2, and on the chin from210 to120 μg/cm^2 (Fig. 2).

Table 1. Sebum levels before and after treatment

Area of measurement	Sebum level before the treatment [μg/cm^2]	Sebum level 14 days after the end of the last treatment [μg/cm^2]
Between the eyebrows	240	160
On the chin	210	120

These results show that the applied treatments are very helpful when it comes to oily skin. They reduce sebum secretion and, thus, the amount of sebum on the surface of the epidermis. This gives hope to people who struggle with excessive oily skin, which can lead to significant discomfort.

Thanks to the use of a sebumeter, we were able to objectively assess the amount of secreted sebum on the surface of the epidermis. Pre-treatment measurements showed that the skin was very oily. Following a series of sonophoresis treatments with a green tea ampoule, the amount of sebum was reduced to 160 μg/cm^2. Thanks to the use of the professional measuring equipment, we have shown that our treatment brought about the expected results.

Discussion

Keyresults

Sonophoresis treatmentsusing a cosmetic ampoule are useful for people with a high level of sebum on the skin.

Interpretation

A series of cosmetic treatments using sonophoresis and green tea ampoules contributed to a reduc-

tion in sebum on the surface of the participant's skin. Other studies have also shown the effectiveness of this plant for reducing sebum on the surface of the epidermis. For example, Mahmood et al. conducted studies on men aged 22–28 years and showed that the external application of green tea extract and lotus contributed to a reduction in sebum [17]. Similarly, Lu et al. used green tea in the form of cellulose capsules in people with acne vulgaris and showed that it reduced skin eruptions [18]. The use of green tea lotions has also shown good results in a study by Elsaie et al. In this study, there was a significant improvement in acne-prone skin after 6 weeks of using the preparation [19]. In 2010, Mahmood et al. used a 3% green tea gel on men with excess sebum production over a period of 8 weeks. It was reported that there was a significant reduction in sebum on the epidermal surface, thus demonstrating that this plant has a sebostaticeffect [20].

There are a number of cosmetic treatments that can positively reduce sebum and the amount of eruptions on the surface of the skin. Maciuszek-Malinowska et al. used a microdermabrasion treatment combined with cosmetic acids to reduce skin eruptions and excess sebum on the epidermal surface. The number of skin eruptions on the GAGS (Global Acne Grading System) scale was reduced from 20 to 14. There was also reduction in the amount of sebum on the surface of the epidermis between the eyebrows from206 to 98 μg/cm^2, on the chin from 178 to 112 μg/cm^2, on the right nose petal from 128 to 244 μg/cm^2, on the left nose petal from 225 to 158 μg/cm^2, on the right cheek from 183 to 114 μg/cm^2, and on the leftcheek from 213 to 146 μg/cm^2 [21].

To our knowledge, no other studieshave examined the impact of sonophoresis on oily or acne-prone skin. However, sonophoresis itself has been used to move other active substances into the epidermis. For example, Zasada et al. showed the effect of a combination of 0.3% and 0.5% retinol in a liquid crystal formula on a group of 16 healthy women. The treatment contributed to a reduction in sebum of the epidermal surface, and a reduction of erythema and hyperpigmentation of the skin [22]. Park et al. also used a combination of sonophoresis treatment withiontophoresis to improve the permeability of drugs through the stratum corneum.In addition, the enhanced effect of sonophoresishas been evaluated for various cosmeceutical drugs using a Franz diffusion cell [23]. Jung et al. examined the effects of ultrasound and heat on the percutaneous absorption of l-ascorbic acid. The combination of ultrasound- and heatsignificantly enhanced LAA (l-ascorbic acid) transdermal penetration when the treatment duration was sufficient [24].

Generalizability

Generalizing the effects of sonophoresis with green extract is currently difficult, as this is the first time this treatment has been described in literature. We hope that, in the future, it will be possible to discuss this treatment with other researchers. As expected, the synergy between the two treatments reduced epidermal sebum.

Study limitations

Our research results are promising; however, it would be useful to verify the effectiveness of this treatment in a larger sample of participants, and to include the male sex. The effect of cosmetics with the green tea applied externally in the sonophoresis treatment, which introduces the cosmetic deep into the skin, could also be compared. We would then get an answer to the question of whether the preparations applied externally work in the same way as those introduced with the use of ultrasound.

Recommendations

We recommend this treatment for people who have issues with too high a level of sebum.

Conclusions

The sonophoresis treatment with the use of cosmetic ampoules containing plant extracts is an effective treatment for people with oily skin. This treatment reduces the amount of sebum on the surface of the epidermis.

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