

NOAGE NUTRITIONAL SUPPLEMENT IMPROVES FACIAL SKIN AND OXIDATIVE STRESS INDICATORS: A RANDOMIZED, PLACEBO-CONTROLLED STUDY

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Summary

Recently, it has been noticed that women's desire is increasing not only to maintain a youthful appearance but also feel good and healthy. In society, it is relevant to stop the ageing process. One of the ways to strengthen the body and delay skin ageing is the use of food supplements. As the population ages, nutritional supplements are becoming more popular. In addition to traditional cosmetic and dermatological facial skin care, nutritional supplements have emerged as a new strategy to improve the condition and look of the skin.

The NoAGE nutritional supplement, which helps counteract the main processes underlying ageing, was selected for the study. The study aims to evaluate the impact of NoAGE on the changes in the indicators of moisture, elasticity and oxidative stress in women's facial skin.

The results revealed that the nutritional supplement has an effect not only on changes in facial skin but also on blood parameters. The NoAGE nutritional supplement positively impacts the elasticity of and moisture in the facial skin. The first positive changes are observed after taking the supplement for 5 weeks. When assessing the dependence of the improvement of the indicators on time, it has been found that as the duration of the use of the supplement increases, the indicators gradually improve. NoAGE nutritional supplement has a positive

impact on the body and slows down the inflammatory processes, reduces the levels of malondialdehyde - marker of oxidative stress - and has an antioxidant effect. It effectively reduces inflammatory processes in the skin, especially erythema.

Introduction

According to surveys, 63 per cent of respondents agree that society is obsessed with the cult of youth [1]. The manufacturers of nutritional supplements are taking these trends into account and offering consumers supplements designed not only to improve skin conditions but also support overall body function [2]. Although many factors contribute to the acceleration of the ageing process, one of the main ones is the free radicals formed mainly by external factors [3]. The antioxidant intake helps neutralise free radicals and is, therefore, essential to slow down the ageing process [4]. In addition to addressing the consequences of irregular dietary intake or maintaining physiological functions of the body, nutritional supplements based on vitamins and antioxidants, when combined with a balanced diet, can be an effective complement to conventional pharmacological therapies [5].

Nutritional supplements are also gaining popularity in the world, as they are developed considering the principles of complexity and impact not only the skin but also the whole body. Foreign manufacturers of such supplements work closely with scientific institutions to develop and prove the effects of their products on the condition of the skin and blood parameters. In the market many nutritional

supplements are available; however, their impact on the skin and body is not scientifically proven. They are only described based on the literature sources that investigate individual components and not their synergistic or complex effects. This study is useful to encourage the manufacturers of nutritional supplements to work closely with scientific institutions to assess the impact of their products on skin and blood parameters. The development of products based on scientific research allows the consumer to anticipate the benefits of using a product/nutritional supplement. Modern marketing is very aggressive and sometimes misleading, so it is important for more companies to be willing to evaluate, i.e., scientifically substantiate, the impact of their products not only on the skin but also on blood parameters so that they can comprehend the complex impact of the product on the whole organism. It is only properly balanced nutritional supplements that can bring positive benefits to the human body. NoAGE, developed by Akxes Swiss GmbH and manufactured by Aconitum UAB, is a complex of five product pairs (capsules and single-dose containers) in one box. The supplement NoAGE contains various antioxidants, vitamins, minerals, botanical components, and amino acids.

The research aims to evaluate the impact of the NoAGE nutritional supplement on the changes in the indicators of moisture, elasticity and oxidative stress in women's facial skin.

Study participants and research methods

The biomedical research No BE-2-112 was approved by the Kaunas Regional Biomedical Research Ethics Committee. The study involved 70 women who had not had botulinum toxin or tissue filler injections for at least 6 months before the study and had not taken any other nutritional supplements for 1 month before the study, aged 35-45. To objectively assess the impact of the NoAGE nutritional supplement, the participants were divided into two groups: NoAGE group with 35 women (after 5 weeks, one participant withdrew from the study, leaving 34 women) who had taken the NoAGE nutritional supplement for 15 weeks, and Placebo group with 35 women who had taken a Placebo for 15 weeks. The distribution of the women in the two groups was randomised to reduce the influence of subjective factors on the study. The study was single-coded or 'single-blind'. The women participating in the study did not know whether they were taking the NoAGE nutritional supplement or a placebo. This method was chosen to avoid bias in the study results. The main parameters considered to assess the impact of the NoAGE supplement on the condition of the facial skin were moisture, elasticity, and visual and inflammatory changes, measured by the skin diagnostics devices. To evaluate the

impact of the product on the internal changes in the body, blood tests were carried out, and oxidative stress markers such as malondialdehyde (MDA), Interleukin-6, and high-sensitivity C-reactive protein (hs-CRP) were assessed.

Results and discussion

Skin ageing is an inevitable multi-systemic degenerative process that does not depend on a person's biological age. It is influenced by internal and external environmental factors. Ageing processes can cause wrinkles, a disorder in pigmentation, skin elasticity, and impair moisture levels [6].

Facial skin elasticity, resilience/tension

Skin elasticity is a physical property of the skin that allows it to change its volume, shape or length in response to a force that causes the skin to stretch or deform. When this force disappears, the skin resumes its original shape [7]. The connective tissue of the skin provides structural support for its blood vessels, cells, and epidermis, which are vital for the functions of the skin. The biomechanical properties of the skin, such as elasticity, are impacted not only by the epidermal, dermal, and subcutaneous layers but also by the moisture of the skin, collagen, elastin, and glycosaminoglycans [8]. To determine skin elasticity, it is important to assess different skin parameters, such as viscoelasticity and resilience/tension. Viscoelasticity protects against injury by allowing additional skin structures to move further from their position and return to it without damage [9].

The viscoelasticity index was assessed in all the participants before the study. The initial results of the facial skin viscoelasticity test showed similar results for both groups, the Placebo group and the women who took the NoAGE nutritional supplement. Measurements after 5 weeks showed that the Placebo group showed no change in skin viscoelasticity, whereas the NoAGE group had a slight increase in viscoelasticity. On the other hand, after 15 weeks, the viscoelasticity of the participants in the study who took the NoAGE nutritional supplement increased in comparison with the initial results (Figure 1).

The study of the viscoelasticity indicators of the Placebo group revealed a decrease compared to the initial results. Taken together, the findings of the study suggest that the NoAGE nutritional supplement impacts viscoelasticity when taken for at least 15 weeks. After 15 weeks, the viscoelasticity increased by 7.38 per cent from the initial value. Bocheva et al. (2019) suggest that ageing processes are closely linked to metabolic and intercellular matrix changes in the dermis [10]. The use of nutritional supplements can have a positive impact on the body, slowing down ageing processes and improving the look of the skin. According to Abendrot et al. (2018), glycation is a biochemical process during which

the excess sugars in the blood bind together with proteins and lipids, resulting in sticky compounds that can damage cells and lead to premature skin ageing [11]. Premature ageing is characterised by wrinkles, sagging, and a lack of radiance. To stop this process, the nutritional supplement contains chromium and vitamin B6. The study findings reveal that the supplement improves the resilience and elasticity of the facial skin (Figures 1-2).

The facial skin resilience/tension of the study participants who took the NoAGE nutritional supplement improved after 5 weeks, while the skin resilience/tension of the study participants taking the placebo showed a gradual decrease of 4.5 per cent from the initial results after both 5 and 15 weeks. The facial skin resilience/tension of the NoAGE subjects increased by 2.4 per cent in the first 5 weeks but only by 0.3 per cent at the 15-week follow-up (Figure 2). To sum up, the findings of the NoAGE nutritional supplement group showed a 2.67 per cent increase from the initial results of facial skin resilience/tension, with the highest increase occurring within 5 weeks and no significant change in longer use. A statistically significant change was found when comparing the change in facial skin resilience/tension between the NoAGE and Placebo groups, demonstrating that the nutritional supplement positively affects facial skin resilience/tension levels.

Moisture in facial skin

Moisture in the skin is one of the most important factors for the skin to be able to perform its basic functions properly. A lack of moisture in the skin impairs one of the most important functions of the skin, i.e., protection against the penetration of toxic substances and microorganisms into the body.

While evaluating the effect of the NoAGE nutritional supplement on skin moisture (Figure 3), it was found that moisture increased significantly after 15 weeks of taking the supplement, with a change of 20.25 per cent from the initial value. A statistically significant change was found when comparing the change in facial skin moisture between the NoAGE and Placebo groups, demonstrating that the nutritional supplement posi-

tively affects facial skin moisture levels. The findings reveal that NoAGE effectively improves the moisture content in the facial skin when taken for 15 weeks. A study conducted by Bolke et al. (2019) revealed that the supplements containing coenzyme Q10, resveratrol improve skin moisture and elasticity and reduce skin roughness [12]. These findings were also confirmed with the NoAGE nutritional supplement.

Facial skin erythema

Redness of the skin indicates inflammatory processes. While measuring facial redness (erythema) of the study participants, it was found that there was a significant reduction in the skin redness of the women who took the NoAGE nutritional supplement after 5 and 15 weeks, with a 12.96 per cent reduction compared to the initial value, which proves that the NoAGE nutritional supplement reduces inflammatory processes in the skin. In the

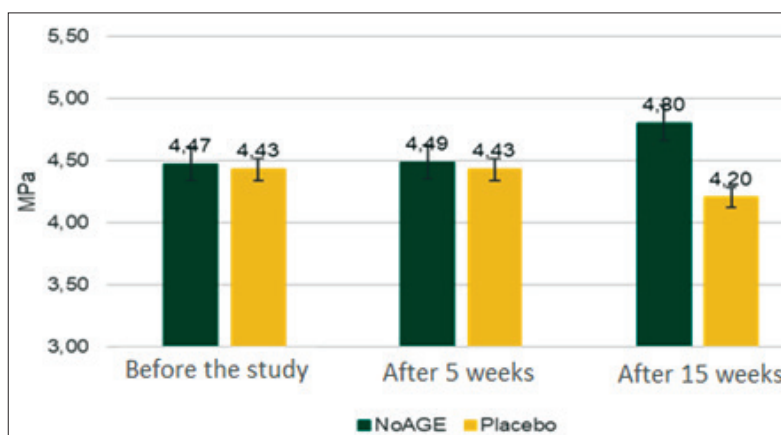


Fig. 1. Evaluation of the changes in the viscoelasticity of the facial skin of the participants in the study after taking the NoAGE nutritional supplement (N=69)

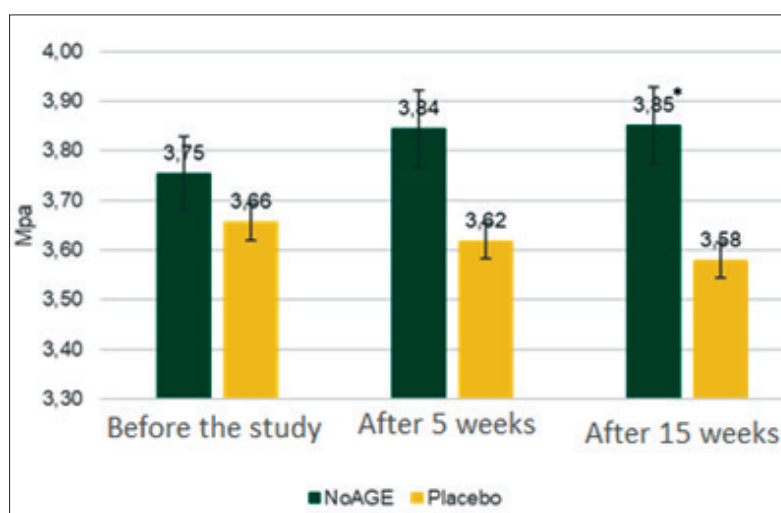


Fig. 2. Evaluation of the changes in the resilience/tension of the facial skin of the participants in the study after taking the NoAGE nutritional supplement (N=69)
* $p < 0.05$, in comparison of NoAGE to Placebo group

Placebo group, however, this indicator remained almost unchanged compared to the initial value (Figure 4).

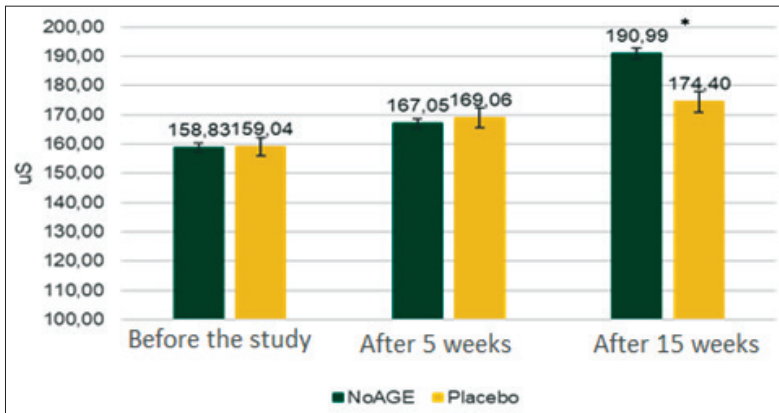


Fig. 3. Evaluation of the changes in the moisture in the facial skin of the participants in the study taking the NoAGE nutritional supplement (N=69)
* $p < 0.05$, in comparison of NoAGE to Placebo group

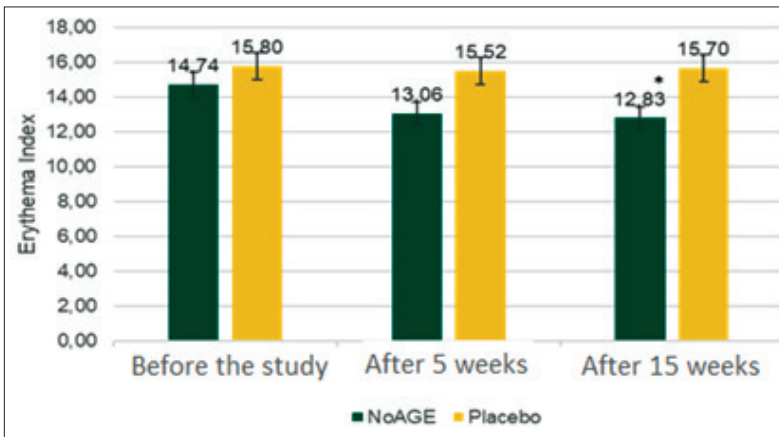


Fig. 4. Evaluation of the changes in the redness (erythema) of the facial skin of the participants in the study taking the NoAGE nutritional supplement (N=69)
* $p < 0.05$, in comparison of NoAGE to Placebo group

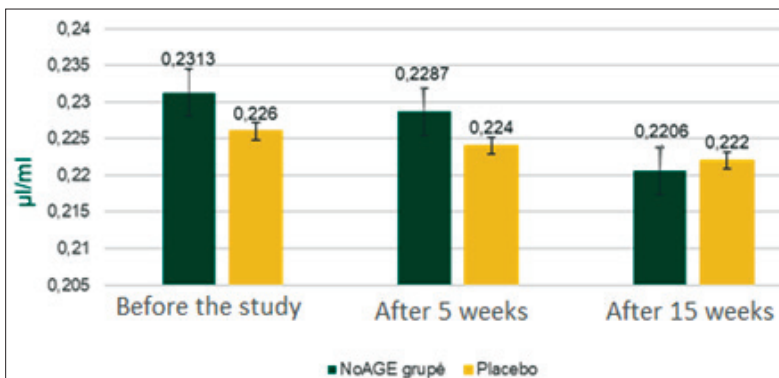


Fig. 5. Evaluation of the changes in malondialdehyde (MDA) of the participants in the study taking the NoAGE nutritional supplement (N=69)

When comparing the NoAGE group with Placebo, there was a statistically significant change in the NoAGE group. The reduction in skin redness indicates that the nutritional supplement diminishes inflammation in the skin. A study by Kayla et al. (2020) found that antioxidants can improve the general condition of the skin and reduce erythema [13]. The NoAGE nutritional supplement is enriched with various antioxidants and, therefore, impacts the reduction of erythema, confirming that nutritional supplements with antioxidants improve the indicators of facial skin.

Markers of oxidative stress - malondialdehyde (MDA)

Malondialdehyde (MDA) levels in blood serum indicate the formation of lipid peroxidation products caused by free radicals, resulting in cell damage [11;14].

The initial results of the average malondialdehyde values revealed that women who took the NoAGE nutritional supplement had a 2.3 per cent higher indicator of malondialdehyde than the Placebo group. In the 5-week follow-up study, the Placebo group showed a 0.9 per cent decrease in average malondialdehyde values, while the NoAGE group showed a 1.1 per cent decrease. In the 15-week follow-up study, the NoAGE group showed a 3.7 per cent decrease in mean malondialdehyde levels compared with the second stage, i.e., the 5-week follow-up measurement, and a decrease of 4.9 per cent compared with the initial study results (Figure 5).

Inflammation markers: Interleukin-6, high-sensitivity C-reactive protein

According to Varadhan et al. (2014), ageing is directly related to an increase in pro-inflammatory cytokines such as Interleukin-6, CRP, and TNF [15].

High-sensitivity C-reactive protein (hs-CRP) is one of the most accurate and reliable methods for detecting low-grade inflammatory processes. The hs-CRP assay reveals the microinflammation of blood vessel walls, which promotes the rupture of blood vessels damaged by atherosclerosis, leading to the prediction of coronary heart disease, peripheral vascular diseases or stroke [16].

Although all C-reactive protein values

were within the normal range, the initial C-reactive protein results revealed a 30.3 per cent lower C-reactive protein level in the women taking the NoAGE supplement compared to the Placebo group. After 5 weeks, hs-CRP increased by 6.5 per cent in the Placebo group. The mean C-reactive protein level of the subjects taking the NoAGE supplement decreased by 70.3 per cent compared to the second measurement after 5 weeks and by 17.8 per cent compared to the initial results (Figure 6). CRP is an excellent biomarker of inflammation and also acts as a direct participant in the pathological process [17]. As shown in figure 6 NoAGE supplement had a positive effect on the body's healing process and speeding up the recovery of the hs-CRP index after viral diseases.

Interleukin-6 is involved in transmitting the immune response signal from one cell to another. Its increase is always associated with inflammation, sepsis, and active connective tissue disease [18].

The initial results of measuring the interleukin average showed that both the Placebo and NoAGE groups had similar indicators of Interleukin-6, with the average Interleukin-6 values being within the normal range. The 5-week follow-up showed a significant increase in mean Interleukin-6 levels in both the Placebo and the NoAGE groups but within acceptable limits. The increase in Interleukin-6 was attributed to the fact that the majority (97 per cent in the NoAGE group and 68 per cent in the Placebo group) of the subjects had a viral infection before the interim measurement. After 15 weeks, the mean Interleukin-6 of the participants in the study who took the NoAGE nutritional supplement decreased significantly and returned almost to the initial value compared with the second stage, i.e., the value obtained in the measurement after 5 weeks (Figure 7).

Concluding, it could be stated that the compounds of NoAGE food supplements distinguish in pleiotropic effect on the organism. Alongside with the improvement of phenotypic expression of the skin functions, modification in metabolic pathway as well as less acute inflammation were observed. It is

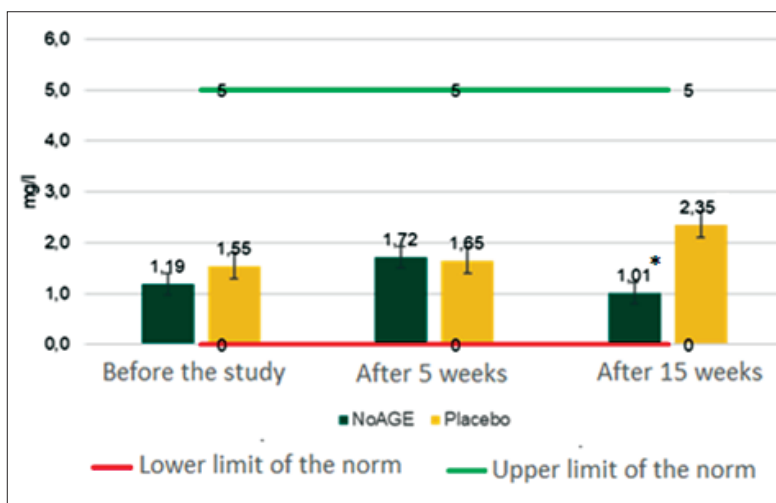


Fig. 6. Evaluation of the changes in the C-reactive protein (hs-CRP) of the participants in the study taking the NoAGE nutritional supplement (N=69)
* $p < 0.05$, in comparison of NoAGE to Placebo group

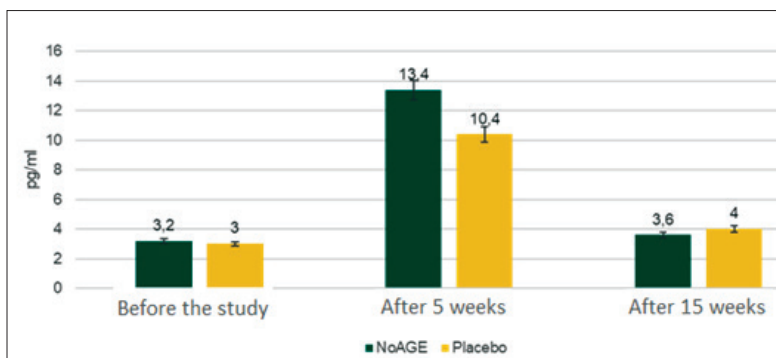


Fig. 7. Evaluation of the changes in Interleukin 6 (IL - 6) of the participants in the study taking the NoAGE nutritional supplement (N=69)

regarded that the latter plays a significant role in the aging process of blood vessels and the organism itself.

Conclusions

1. The NoAGE nutritional supplement positively impacts viscoelasticity, resilience/tension, and moisture in the facial skin. The first positive changes are observed after 5 weeks of consuming it, with a significant improvement noticeable after 15 weeks.

2. NoAGE positively impacts the body, effectively reducing micro-inflammatory processes, especially erythema, and speeding up the recovery of the hs-CRP index after viral diseases. The NoAGE nutritional supplement reduces malondialdehyde, a marker of oxidative stress, and has an antioxidant effect.

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**NoAGE MAISTO PAPILDAS GERINA VEIDO
ODOS IR OKSIDACINIO STRESO RODIKLIUS:
ATSITIKTINIŲ IMČIŲ, PLACEBU
KONTROLIUOJAMAS TYRIMAS**

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Raktažodžiai: odos elastingumas (stangrumas), drėgmė, odos eritema, malondialdehidai Interleukinas-6, C-reaktyvinis baltymas.

Santrauka

Pastaruoju metu pastebima, kad visuomenėje didėja noras ne tik išsaugoti jaunatvišką išvaizdą, bet ir gerą savijautą bei sveikatą. Senėjimo procesų stabdymas yra aktualus visuomenėje. Vienas iš būdų sustiprinti organizmą ir atitolinti odos senėjimą yra maisto papildų vartojimas. Senstančiai visuomenei maisto papildų vartojimas tampa populiariesnis. Be tradicinės kosmetologinės ir dermatologinės veido odos priežiūros, maisto papildai atsirado kaip nauja strategija siekiant pagerinti odos būklę ir išvaizdą. Tyrimui buvo pasirinktas NoAGE maisto papildas, skirtas sulėtinti pagrindinius senėjimą lemiančius procesus. Tyrimo tikslas – įvertinti NoAGE maisto papildų įtaką moterų veido odos drėgmės ir elastingumo bei oksidacinio streso rodiklių pokyčiams. Tyrimo rezultatai atskleidė, kad maisto papildas turi įtakos ne tik veido odos pokyčiams, bet ir kraujo rodikliams. NoAGE maisto papildas turi teigiamą poveikį veido odos elastingumui, drėgmei. Pirmieji teigiami pokyčiai pastebimi pavartojus maisto papildą 5 savaites. Vertinant rodiklių gerėjimo priklausomybę nuo laiko nustatyta, kad ilgėjant maisto papildų vartojimo trukmei, rodikliai laipsniškai gerėja. NoAGE maisto papildas turi teigiamą poveikį organizmui ir lėtina organizme vykstančius uždegiminius procesus, mažina oksidacinio streso žymenį – malondialdehidą ir pasižymi antioksidaciniu poveikiu. Efektyviai mažina uždegiminius procesus odoje - ypač eritemą.

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