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Rosmarinic acid as a bioactive compound in adult acne therapy: A controlled pilot clinical study

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ABSTRACT

Acne vulgaris is a common chronic inflammatory skin disease that increasingly affects adults, particularly women. Therefore, there is growing interest in natural bioactive compounds with anti-inflammatory, antioxidant, and antimicrobial properties. One such compound is rosmarinic acid, a polyphenolic substance naturally present in plants of the Lamiaceae family. The aim of this study was to evaluate the effectiveness of rosmarinic acid in the treatment of acne vulgaris and to analyze the relationship between acne severity, dietary habits, and psychosocial factors. The study was conducted between February and June 2025 in a cosmetic clinic in Katowice, Poland. Thirty women diagnosed with acne vulgaris participated in the study and were randomly assigned to a study group (n=15) and a control group (n=15). The study group underwent a series of five cosmetic treatments using 5% rosmarinic acid. Acne severity was assessed using the Global Acne Severity (GEA) scale and the Global Acne Grading System (GAGS) before treatment and after three months. The results demonstrated a statistically significant reduction in acne severity in the study group according to both the GEA and GAGS scales ($p < 0.05$). Additionally, a significant correlation was observed between acne severity and the Healthy Diet Index, as well as a negative correlation between acne severity and the frequency of fruit and vegetable consumption. The results of the T-QoL questionnaire indicated that acne had a measurable impact on the psychosocial functioning of participants.

INTRODUCTION

Acne vulgaris is one of the most common chronic inflammatory skin diseases, affecting approximately 9-10% of the global population. Although it is most commonly associated with puberty, recent years have seen a marked increase in its prevalence among adults [1]. It is estimated that acne symptoms may persist or develop for the first time in as many as 25-35% of women over the age of 25 [2].

Adult acne (acne tarda) is often characterized by a chronic and recurrent course, with inflammatory lesions located mainly on the lower part of the face, particularly around the jawline, chin, and neck, commonly referred to as the U-zone. It is also associated with an increased risk of post-inflammatory hyperpigmentation. In addition, adult acne can significantly affect patients' quality of life, contributing to reduced self-esteem, psychosocial difficulties, and poorer mental well-being [3,4].

The pathogenesis of acne is complex and multifactorial. Four major mechanisms play a key role in the development of acne lesions: excessive sebum production by the sebaceous glands, abnormal keratinization within process the sebaceous gland duct and hair follicle, excessive colonization by *Cutibacterium acnes*, and activation of inflammatory processes and the cutaneous immune response [5].

Standard acne therapy includes both topical and systemic medications. The most commonly used topical treatments include retinoids, benzoyl peroxide, and antibiotics, whereas systemic therapy includes oral antibiotics and hormonal treatment. Despite the high efficacy of many of these approaches, their use is associated with several limitations. Long-term antibiotic use may contribute to the development of bacterial resistance, while retinoids and isotretinoin may cause skin irritation and excessive dryness [6]. Consequently, there is growing interest in therapeutic approaches based on naturally derived bioactive compounds, which

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may offer a favorable safety profile, multiple mechanisms of action, and high therapeutic efficacy.

Among naturally occurring bioactive substances, particular attention has been given to polyphenolic compounds, which exhibit a broad spectrum of biological activities, including antioxidant, anti-inflammatory, antimicrobial, and immunomodulatory effects [7]. One representative of this group is rosmarinic acid, an ester of caffeic acid and 3,4-dihydroxyphenyllactic acid. This compound occurs naturally in many plants of the Lamiaceae family, including rosemary (*Rosmarinus officinalis*), sage (*Salvia officinalis* L.), lemon balm (*Melissa officinalis* L.), and mint (*Mentha* L.). Rosmarinic acid has been extensively studied because of its biological properties and potential applications in the treatment of various inflammatory, allergic, and dermatological conditions [8].

Studies have shown that rosmarinic acid exhibits antioxidant activity by scavenging reactive oxygen species and inhibiting lipid peroxidation. In addition, it has been suggested that rosmarinic acid may protect cells by reducing oxidative stress and inhibiting UV-induced inflammatory processes [9]. Furthermore, this compound has been shown to modulate key inflammatory pathways by inhibiting activation of the NF- κ B transcription factor and reducing the production of pro-inflammatory cytokines. In dermatological applications, its antimicrobial activity against Gram-positive bacteria and its ability to limit microorganism-induced inflammatory responses may also be particularly relevant. Because of its multifaceted mechanism of action and relatively low toxicity, rosmarinic acid is currently considered a promising bioactive compound with potential applications in dermatology and cosmetology [10].

AIM

The aim of this study was to evaluate the effectiveness of topical treatment with 5% rosmarinic acid in reducing the severity of acne vulgaris lesions in adult women, as assessed using the GEA and GAGS scales. In addition, the study aimed to analyze the relationships between acne severity, dietary habits, and psychosocial factors associated with the disease.

MATERIALS AND METHODS

Research design

The study was conducted between February and June 2025 at a cosmetic clinic in Katowice, Silesian Voivodeship, Poland. The inclusion criteria were as follows: age ≥ 18 years, a dermatologist-confirmed diagnosis of acne vulgaris, eligibility for treatment with rosmarinic acid, and provision of informed consent. The exclusion criteria included pregnancy or breastfeeding, concomitant systemic treatment for acne, contraindications to rosmarinic acid therapy, and any condition that could prevent adherence to the study protocol.

During the initial visit, participants completed a questionnaire covering demographic characteristics, dietary habits, and the psychological impact of their skin condition. Subsequently, a cosmetologist assessed acne severity using the Global Acne Grading System (GAGS) [11] and

the GEA (Global Acne Severity Scale) [12]. Participants were randomly assigned to either the treatment group or the control group. The treatment group underwent a series of five treatments using 5% rosmarinic acid.

The 5% concentration of rosmarinic acid was selected based on preliminary observations conducted by our research group, which indicated good tolerability and a reduction in acne lesions following topical application of a 5% formulation, as well as published evidence demonstrating the anti-inflammatory and antimicrobial activity of rosmarinic acid relevant to acne pathogenesis [13].

The treatment protocol consisted of a series of five cosmetic procedures performed at 2-week intervals using a professional topical preparation containing 5% rosmarinic acid (Gen Factor). The formulation had the following INCI composition: Aqua, Rosmarinic Acid, Pentylene Glycol, Caprylyl Glycol, Ethylhexylglycerin, and Xanthan Gum.

Before each procedure, the facial skin was cleansed and degreased according to the treatment protocol. The preparation was then applied evenly to acne-affected areas of the face and left on the skin for 10 min while skin tolerance and subjective discomfort were continuously monitored. After the exposure period, the preparation was removed according to the manufacturer's recommendations.

The procedures were performed every 2 weeks for a total of five sessions. During the study period, participants were instructed to avoid introducing any additional anti-acne cosmetic or dermatological treatments. Post-treatment recommendations included the use of gentle skincare products, daily photoprotection with SPF 50, avoidance of exfoliating agents and retinoids for at least 5-7 days after each procedure, and limitation of excessive sun exposure.

Participants in both groups were instructed not to modify their home skincare routines, dietary habits, or lifestyle during the treatment period in order to allow a more accurate assessment of the effects of rosmarinic acid. Two weeks after the final treatment, corresponding to 3 months after the start of therapy, acne severity was reassessed in both groups by the cosmetologist using the GAGS and GEA scales.

Contraindications to treatment with topical rosmarinic acid included pregnancy, breastfeeding, allergic skin diseases affecting the treatment area, known hypersensitivity to any component of the preparation, active herpes simplex infection, severe skin irritation, current systemic acne therapy, and the use of topical retinoids or exfoliating treatments immediately before the procedure.

Before participation, all respondents were informed about the purpose of the study, the anonymous nature of data collection, and the principles governing data processing and sharing. Information regarding voluntary participation and informed consent was provided at the beginning of the questionnaire. All participants provided written informed consent to participate in the study.

The study was conducted in accordance with the ethical principles of the Declaration of Helsinki. Ethical approval was obtained from the Bioethics Committee of the Medical University of Silesia in Katowice (decision no. BNW/NWN/0052/KB1/44/I/23, dated July 11, 2023), in accordance with the Polish Act of December 5, 1996, on the Professions of Physician and Dentist.

Study participants

The study included 30 women with a mean age of 21.93 ± 1.88 years, all of whom had been diagnosed with acne vulgaris. The mean baseline acne severity was 2.47 ± 0.62 on the GEA scale and 22.07 ± 5.94 on the GAGS scale. Participants were randomly assigned to a treatment group ($n = 15$), which underwent five treatments with rosmarinic acid, or a control group ($n = 15$).

The final assessment of skin condition was performed in both groups on the same day, 3 months after the start of the study.

Research tools

The study used a questionnaire comprising sections on demographic characteristics, acne severity assessment, dietary habits used to determine healthy and unhealthy diet indices, and questions regarding the impact of the skin condition on psychological aspects.

1. Global Acne Severity Scale (GEA)

The GEA is a six-point scale ranging from 0 to 5, with each grade corresponding to a specific level of acne severity. Grade 0 indicates the absence of acne lesions and completely clear skin. Grade 1 corresponds to very mild acne, characterized by isolated comedones and occasional inflammatory lesions, usually limited to a small area of the face. Grade 2 indicates mild acne, with several comedones and a small number of papules or pustules. Grade 3 corresponds to moderate acne and is characterized by a greater number of both non-inflammatory and inflammatory lesions, including papules and pustules, without nodules. Grade 4 denotes severe acne, with numerous inflammatory lesions and the presence of nodules, often involving a substantial portion of the face. Grade 5 represents very severe acne, characterized by numerous inflammatory lesions, nodules, and cysts, often accompanied by pronounced skin inflammation.

In clinical studies, the GEA scale is commonly used to assess acne severity before and after treatment. Comparison of pre- and post-treatment scores allows treatment effectiveness to be evaluated based on changes in GEA grade or the proportion of patients who achieve an improvement of at least one or two grades. Therefore, the GEA scale is a useful tool for the objective assessment of treatment outcomes in clinical research. The GEA scale is presented in Table 1.

Table 1. Global Acne Severity Scale

Global Acne Severity Scale (GEA)		
Score	Level of acne	Description
0	Skin free of acne lesions	Redness
1	Almost free of acne lesions	A few open or closed comedones, very few papules
2	Mild	Lesions cover less than half of the face, a few open or closed comedones, a small number of papules and pustules
3	Moderate	Lesions cover more than half of the face, many open and closed comedones, many papules and pustules, one nodule may be visible
4	Severe	Covers the entire face, many comedones, papules, and pustules, several nodules
5	Very severe	Presence of a large number of nodules, inflammation covering the entire face

2. Global Acne Grading System (GAGS)

The Global Acne Grading System (GAGS) is a widely used clinical tool for assessing the severity of acne vulgaris. Unlike scales based solely on an overall visual assessment, GAGS provides a more detailed and partially quantitative evaluation of acne lesions by considering both lesion type and anatomical location. This approach enables a more objective comparison of acne severity among patients and facilitates monitoring of treatment outcomes in clinical studies.

The GAGS assessment is based on six anatomical regions: the forehead, right cheek, left cheek, nose, chin, and chest and upper back. Each region is assigned a location factor reflecting the relative density of pilosebaceous units and the typical distribution of acne lesions. The forehead and each cheek are assigned a factor of 2, the nose and chin a factor of 1, and the chest and upper back a factor of 3.

Within each anatomical region, the most severe type of acne lesion is identified and assigned a grade: 0 for no lesions, 1 for comedones, 2 for papules, 3 for pustules, and 4 for nodules. The lesion grade is then multiplied by the location factor assigned to that region. The sum of the local scores for all assessed regions constitutes the total GAGS score, reflecting the overall severity of acne.

The results are interpreted based on four categories of disease severity. Scores of 1 to 18 correspond to mild acne; 19 to 30 correspond to moderate acne; 31 to 38 correspond to severe acne; and scores above 39 correspond to very severe acne. Thus, the GAGS system not only allows for determining the severity of acne, but also for monitoring changes in disease severity during treatment. The scale is presented in Table 2.

Table 2. Global Acne Grading System

Global Acne Grading System (GAGS)			
Location	Coefficient	Grade	Result (coefficient $\times$ grade = score for a given game; sum of all listed games = GAGS)
Forehead	2	0 = no lesions 1 = ≥ 1 blackhead 2 = ≥ 1 whitehead 3 = ≥ 1 pustule 4 = ≥ 1 nodule	0 = no acne 1-18 = mild acne 19-30 = moderate acne 31-38 = severe acne ≥ 39 = very severe acne
Right cheek	2		
Left cheek	2		
Nose	1		
Chin	1	4 = ≥ 1 nodule	≥ 39 = very severe acne
Chest and upper back	3		

3. Healthy diet index

This section uses questions from the QEB questionnaire (Questionnaire for the Study of Eating Behaviors and Opinions on Food and Nutrition), numbered 1-12, 15-20, 22-23, 25-26, 30, 32, 34, and 36-41.

The QEB questionnaire was developed by the Behavioral Determinants of Nutrition Team of the Committee on Human Nutrition Sciences of the Polish Academy of Sciences under the direction of Prof. Jan Gawęcki in 2013-2014. This tool is used for a comprehensive assessment of dietary habits, the frequency of consumption of selected food groups, and knowledge and opinions regarding food and nutrition [14].

The Healthy Diet Index was determined according to the frequency of consumption of food products considered beneficial to health, including wholemeal bread, milk, fermented dairy beverages, cottage cheese, fish, legumes, fruits, and vegetables. In contrast, the Unhealthy Diet Index was based on the frequency of consumption of products regarded as potentially adverse to health, such as fast food, fried foods, yellow cheese, sweets, canned meats, sweetened beverages, and energy drinks.

Points were assigned according to the frequency of food consumption. The frequency “never” was assigned 0 points, “1-3 times a month” 0.06 points, “once a week” 0.14 points, “several times a week” 0.5 points, “once a day” 1 point, and “several times a day” 2 points. The maximum number of points that could be obtained was 16. According to the procedure for analyzing dietary data from the QEB questionnaire developed by Lidia Wądołowska and Beata Krusińska, a score of 0-5.33 indicated a low intensity of health-promoting/health-damaging traits (depending on the index), 5.34-10.66 indicated moderate intensity, and 10.67-16 indicated high intensity [14].

4. Psychological aspects of skin diseases

This section used the validated T-QoL (Teenagers' Quality of Life Questionnaire). It consisted of six questions regarding the impact of skin appearance on various aspects of daily life, with the following response options: “never,” “sometimes,” and “always.” Points were assigned to each response. In accordance with the questionnaire validation, the response “never” received 0 points, “sometimes” 1 point, and “always” 2 points. The higher the total score, the greater the impact of the skin condition on quality of life [15].

Statistical analysis

Statistical analysis was performed using Statistica 13.3 software (TIBCO Software Inc., Palo Alto, CA, USA). The distribution of continuous variables was assessed using the Shapiro-Wilk test. As the majority of variables did not meet the assumption of normality, nonparametric methods were applied. Changes within groups before and after treatment were evaluated using the Wilcoxon signed-rank test for paired observations. Comparisons between the study and control groups were performed using the Mann-Whitney U test for independent samples. Spearman's rank correlation was used to assess the relationship between the severity of skin lesions and diet quality, as well as the frequency of consumption of various food groups.

A p -value < 0.05 was considered statistically significant.

RESULTS

GAGS and GEA scales

The results regarding the efficacy of rosmarinic acid in the treatment of acne were statistically significant for both the GEA scale ($p < 0.001$) and the GAGS scale ($p < 0.001$). These results are presented in Table 3.

Changes in outcome measures Δ = post-treatment value – baseline value were calculated for each participant. Differences in changes between the study and control groups were assessed using the Mann-Whitney U test (Table 4).

Table 3. Comparison of GEA and GAGS scores before and after treatment in the study and control groups

Parameter	Group	Baseline median (IQR)	After 3 months median (IQR)	p-value*
GEA	Study group (n = 15)	2 (2-3)	1 (1-1)	<0.001
	Control group (n = 15)	2 (2-3)	3 (2-3)	0.655
GAGS	Study group (n = 15)	22 (16-26)	9 (6.5-12.5)	<0.001
	Control group (n = 15)	21.5 (16-25.8)	22 (16.8-26.5)	0.229

*Wilcoxon signed-rank test

IQR – interquartile range; GEA – Global Acne Severity Scale; GAGS – Global Acne Grading System.

Table 4. Changes in outcome measures

Parameter	Study group Δ (mean $\pm$ SD)	Control group Δ (mean $\pm$ SD)	p-value**
GEA	-1.20 $\pm$ 0.41	0.07 $\pm$ 0.59	<0.001
GAGS	-11.33 $\pm$ 4.20	0.87 $\pm$ 2.39	<0.001

**Mann-Whitney U test comparing changes between groups

Healthy Diet Index

The mean value of the Healthy Diet Index was 2.84 ± 1.23 , while the mean value of the Unhealthy Diet Index was 2.11 ± 1.08 .

To assess the relationship between the severity of skin lesions and diet quality, Spearman's rank correlation analysis was performed. The analysis revealed a statistically significant relationship between the severity of skin lesions and the Healthy Diet Index ($p = 0.032$, $r = -0.10$).

To examine the relationship between the severity of skin lesions and the frequency of consumption of selected food groups, Spearman's rank correlation analysis was performed. The analysis revealed a significant negative relationship between the severity of skin lesions and the frequency of vegetable consumption ($p < 0.001$) and fruit consumption ($p < 0.001$).

The study also examined whether there was a correlation between the Healthy Diet Index and the Unhealthy Diet Index. It was shown that healthy behaviors are not necessarily the opposite of unhealthy behaviors. Participants with a higher Healthy Diet Index did not necessarily avoid products classified as unfavorable to health. In practice, some individuals who frequently consumed vegetables, fruits, fish, or fermented dairy products also reported consuming fast food, sweets, fried foods, or sweetened beverages. Therefore, the Healthy Diet Index and the Unhealthy Diet Index should be interpreted as two partially independent dimensions of dietary behavior rather than as opposite poles of the same scale.

Psychological aspects of skin diseases

The mean T-QoL score was 2.62 ± 2.37 . The highest mean scores were recorded for questions regarding loss of self-confidence due to skin appearance (0.77 ± 0.66) and feelings of embarrassment related to skin appearance (0.74 ± 0.64). The lowest scores were obtained for concerns about future career prospects (0.20 ± 0.49) and the impact of skin appearance on sleep quality (0.20 ± 0.51). Detailed results are presented in Table 5.

Table 5. Results of the T-QoL questionnaire

Question	Mean±SD
1. Does the appearance of your skin make you feel embarrassed?	0.74 ± 0.64
2. Does the appearance of your skin affect your studies or work?	0.39 ± 0.61
3. Does the appearance of your skin make you worry about your future career?	0.20 ± 0.49
4. Does the appearance of your skin affect the quality of your sleep?	0.20 ± 0.51
5. Do you ever cry because of the appearance of your skin?	0.40 ± 0.57
6. Does the appearance of your skin make you lose your self-confidence?	0.77 ± 0.66
Total	2.62 ± 2.37

SD - standard deviation

DISCUSSION

The results indicate that the use of rosmarinic acid may be effective in the treatment of acne vulgaris in young adult women. This study demonstrated a statistically significant reduction in the severity of acne lesions following a series of treatments with 5% rosmarinic acid on both the GEA and GAGS scales ($p < 0.001$). The results suggest that this substance may have a beneficial effect on reducing the clinical symptoms of acne.

Rosmarinic acid is a natural phenolic compound found in many plants of the Lamiaceae family and is known for its anti-inflammatory, antioxidant, and antibacterial properties. These mechanisms may play a significant role in the treatment of acne, a disease with a complex etiology involving excessive sebum production, colonization of the skin by *Cutibacterium acnes*, and the development of inflammation. The anti-inflammatory action of rosmarinic acid may lead to a reduction in the inflammatory response within the pilosebaceous follicles, while its antioxidant properties may contribute to reducing the oxidative stress observed in acne lesions [16,17].

The results of this study are consistent with the literature, which indicates the potential use of plant-derived compounds in the treatment of skin diseases. Many studies emphasize that substances with anti-inflammatory and antioxidant properties may support the treatment of inflammatory skin conditions, including acne vulgaris [17,18].

The potent anti-inflammatory effect of rosmarinic acid is associated with its ability to inhibit activation of the NF- κ B pathway, which contributes to the suppression of pro-inflammatory cytokines such as IL-1 β , IL-6, IL-8, and TNF- α . These factors are involved in the development of inflammation within the pilosebaceous unit. Additionally, rosmarinic acid may modulate the activity of enzymes involved in lipogenesis in the sebaceous glands, resulting in reduced activity. These properties may contribute to a reduction in the inflammatory response in patients with acne vulgaris [16,17].

Disruptions in antioxidant mechanisms and increased levels of oxidative stress markers in patients with acne are well documented in the literature [17]. Rosmarinic acid has the ability to chelate iron ions, which may contribute to a reduction in oxidative stress. It also inhibits lipid peroxidation and protein carbonylation and protects DNA from damage associated with reactive oxygen species [18,19]. Such multifaceted antioxidant activity may contribute to its efficacy in the treatment of acne vulgaris, both by reducing

inflammation and by protecting skin structures from further oxidative damage [19].

Rosmarinic acid is also used in the treatment of aging skin and skin showing signs of photoaging [19]. In such skin, reduced expression of the MFAP-4 protein is observed, which may affect proper elastin formation. Studies have shown that rosmarinic acid stimulates MFAP-4 expression, affecting both the early formation of microfibrils and mature elastin fibers. Furthermore, this compound stimulates the synthesis of fibrillin and elastin in mature fibroblasts and accelerates the formation of elastin fibers by stimulating transforming growth factor β 1. These properties indicate the potential of rosmarinic acid to reduce signs of photoaging and suggest its possible application in skin regeneration and healing processes [19,20].

The study also analyzed the relationship between the severity of skin lesions and diet quality. A statistically significant association was found between acne severity and the Healthy Diet Index ($p = 0.032$), which may suggest that diet plays a role in the course of the disease. Furthermore, a negative correlation was observed between the severity of skin lesions and the frequency of fruit and vegetable consumption. These results are consistent with the observations of other authors, who indicate that a diet rich in plant-based foods providing antioxidants, vitamins, and minerals may support proper skin function and reduce inflammatory processes [21].

Observational studies suggest that greater adherence to the Mediterranean diet, as assessed using dietary indices, may be associated with less severe acne. A study conducted by Ah-Thiane *et al.* demonstrated a significant inverse relationship between adherence to the Mediterranean diet and acne severity, indicating that individuals with higher Mediterranean diet index scores had a milder course of the disease. These results suggest that dietary patterns characterized by high quality, a high content of anti-inflammatory components, and reduced consumption of highly processed foods may help reduce the severity of acne symptoms [22].

At the same time, it was shown that health-promoting behaviors are not the direct opposite of unhealthy behaviors, meaning that individuals who report more frequent consumption of health-promoting foods do not always completely eliminate foods considered less beneficial, such as fast food, from their diet.

Another key aspect analyzed in the study was the impact of acne on participants' quality of life. The mean T-QoL score indicates that this skin condition may affect the psychosocial functioning of young people. Acne vulgaris, although often perceived primarily as a cosmetic condition, can lead to reduced self-esteem, poorer mental well-being, and limited social activity [23,24]. These results confirm that effective acne treatment may be important not only from a dermatological perspective but also from a psychological perspective.

Tasoula *et al.* conducted a study among 1,560 adolescents and found that 51.2% of participants had acne. The results showed that the presence of acne affected patients' quality of life and that this impact was proportional to symptom severity. Patients reported reduced self-esteem related to their skin appearance, as well as a negative impact on quality

of life and social relationships. A significant proportion of participants experienced teasing and harassment from peers because of their acne. The study also identified coping strategies for visible lesions: patients, regardless of gender, tended to grow their hair long to cover their faces, while girls were more likely to use makeup to conceal skin lesions [25].

However, several limitations of this study should be noted. First, it was a pilot study involving a relatively small group of participants ($n = 30$), which may limit the generalizability of the results to a broader population. Furthermore, the study included only women within a similar age range, which may also affect the interpretation of the results. Another limitation was the relatively short observation period, which did not allow assessment of the long-term effectiveness of the therapy.

An important limitation of the present study was the design of the control group. While the intervention group underwent a standardized cosmetic procedure involving skin cleansing, application of rosmarinic acid, and post-treatment moisturizing care, the control group did not receive a comparable sham procedure. Consequently, the contribution of nonspecific treatment effects, including professional skincare and skin hydration, cannot be completely excluded. Nevertheless, the findings provide preliminary evidence supporting the potential usefulness of rosmarinic acid in acne management and should be verified in future placebo-controlled trials.

Additionally, the open-label nature of the study may have introduced bias related to participants' and investigators' expectations. Therefore, the results should be interpreted with caution and confirmed in studies employing appropriate randomization and blinding procedures.

Despite these limitations, the results suggest that rosmarinic acid may be a promising ingredient for use in cosmetic treatments supporting the management of acne vulgaris. In the future, studies involving a larger number of participants, a longer observation period, and different concentrations of rosmarinic acid would allow a more accurate determination of its efficacy and optimal treatment parameters.

CONCLUSION

A series of five treatments using 5% rosmarinic acid significantly reduced the severity of acne lesions in the study participants, as confirmed by the GEA and GAGS scales ($p < 0.001$).

The results indicate that rosmarinic acid may be an effective treatment for acne vulgaris in a cosmetic setting.

A statistically significant correlation was demonstrated between the severity of acne lesions and the Healthy Diet Index, suggesting that diet may play a role in the course of the disease.

A negative correlation was observed between acne severity and the frequency of fruit and vegetable consumption, which may indicate a potentially beneficial effect of a plant-rich diet on skin condition.

Analysis of dietary behaviors showed that health-promoting behaviors are not necessarily the opposite of unhealthy behaviors, as individuals with a higher Healthy Diet Index still reported occasional consumption of fast food.

The results of the T-QoL questionnaire indicate that acne may affect psychosocial functioning in young women, underscoring the importance of effective treatment of this condition.

COMPETING INTERESTS

The authors declare that they have no competing interests.

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