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**MODELING OF GELS WITH SALICYLIC ACID AND CANNABIS
SEED OIL FOR THE TREATMENT OF ACNE VULGARIS**

***Abstract.** The aim of this study is to model gels with salicylic acid and cannabis seed oil for cutaneous application, characterized their quality parameters and antimicrobial activity.*

***Keywords:** gel, chitosan, acne*

Lately, acne vulgaris has become one of the most spread skin diseases. On the basis of the global spread of diseases project data, it was determined that 9.4% of the global population develop acne. So, acne takes 8th place in the world according to its spread (Tan & Bhate, 2015). A course of the disease is usually long, therefore it is actual to choose safe daily skin care means in order to alleviate signs of acne

and improve skin condition (Bartenjev et al., 2011). Antibiotics are widely applied in acne treatment, either. The use of antibiotics, however, may promote the emergence and spread of bacterial resistance. That stimulates the scientists to seek new antiseptic and antimicrobial preparations for local treatment of skin infections. The main goal of treatment for *acne vulgaris* is to prevent the emergence of new acne and to gradually treat them by choosing the right cosmetics or medications. The topical treatment is for the treatment of mild to moderate acne. The process of treating acne is time-consuming, so it is important to choose safe daily skincare products to reduce the signs of acne and improve the condition of the skin (Bartenjev et al., 2011). The need for natural products also encourages the search for natural excipients in the production of gels. One such gelatin is chitosan. In our study, salicylic acid was selected as the active ingredient. Salicylic acid promotes the synthesis of skin collagen and elastin, smooths scars, reduces skin pigmentation, reduces skin oiliness, suppresses inflammatory reactions, and cleans clogged pores. Given that salicylic acid does not have moisture-retaining properties, it is important to introduce an additional component to protect the skin from moisture loss. Cannabis oil was selected as an antibacterial, moisture-restoring component in the modeling of gels with salicylic acid. The cannabis plant (*Cannabis sativa L.*) contains a rich profile of bioactive compounds, including cannabinoids, terpenes, phenols, flavonoids, a unique fatty acid profile, which is extracted from the seed by cold pressing (Liu et al., 2022). The extracted cannabis seed oil contains a unique fatty acid profile as linoleic acid and α -linolenic acid. The researchers also found that cannabis seed oil also contained cannabidiol (CBD). In many cosmetics, cannabis seed oil is used as the main ingredient in product. This oil does not allergenic the skin, promotes the natural regeneration of cells, at the same time, restores the balance of moisture, lipids, and pH value. Due to the above properties, it is a suitable component in the production of natural cosmetics (Zhou et al., 2018). Cannabis seed oil may help treat inflammatory skin conditions, such as eczema and psoriasis, acne scarring, and dry skin. Research shows that cannabis extract inhibits the growth of the bacterium *Cutibacterium acnes* (*C. acnes*). The terpenes in cannabis essential oil have antimicrobial activity against *C. acnes*. CBD has been

shown to inhibit the growth of *Streptomyces griseus* and *Staphylococcus aureus* (Ferenczy et al. 1958). Due to its antibacterial and antioxidant properties, the cannabis seed oil is a suitable component in skin preparations. Tasks of the research - to produce a gel with salicylic acid and cannabis seed oil and also evaluate its quality.

Methods of research – A pH meter (ph-meter 766 with Knick SE 104 N electrode) is used to determine the pH value of semisolid preparations. The antibacterial properties of the gels were evaluated *in vitro* by the agar diffusion method. Mueller-Hinton agar was used for this purpose. *In vitro* studies were performed with the referent bacteria strains *S. aureus* (ATCC 25923), *E. faecalis* (ATCC 11778), *E. coli* (ATCC 25922).

Averages and standard deviations were calculated using Microsoft Office Excel 2016 and SPSS 20.4. The significance of statistical differences in results was assessed using a one-way analysis of variance (One-way ANOVA), with a significance level of $p < 0.05$.

Results and conclusions of the study. Salicylic acid was dissolved in ethanol. The ethanolic solution of salicylic acid was incorporated into the prepared chitosan gel and mixed until a homogeneous mass was obtained. Cannabis seed oil is added to the homogeneous gel. The compositions of gels are presented in Table 1.

Table 1

Composition of the modeled gels

Substances	Gel formulations		
	N1	N2	N3
<i>Salicylic acid, g</i>	0.5	1.0	2.0
<i>Chitosan, g</i>	3.5	3.5	3.5
<i>Cannabis seed Oil, g</i>	5.0	5.0	5.0
<i>Ethanol 96% (V/V), ml</i>	1.0	1.0	1.0
<i>Purified water, ml</i>	till 100	till 100	till 100

The organoleptic properties, color, odor and appearance of the gels were first evaluated. The results of the study showed that the modeled gels are clear, yellowish in color, and have a semisolid consistency.

The results of the study showed that the highest pH value of gels containing the

lowest amount of salicylic acid (Figure1). The pH value of gels depends on the amount of salicylic acid in them. As the amount of salicylic acid increases, the pH value of the gels decreases. The results of the study showed that all pH values of formulations were suitable for the skin and could be applied on it.

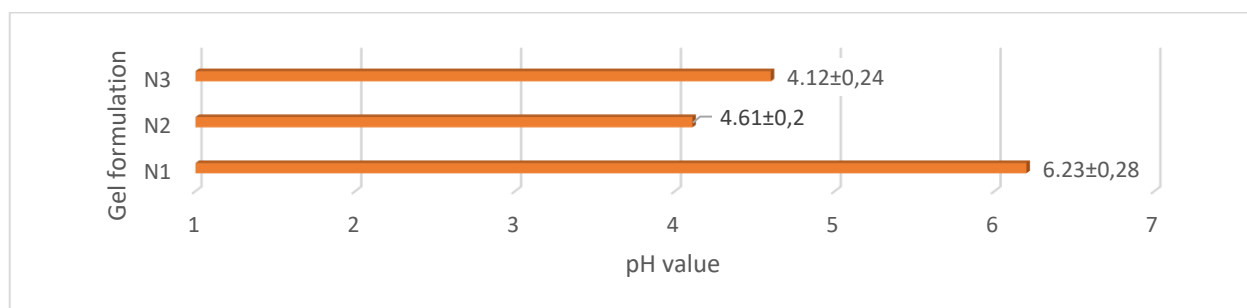


Fig. 1. pH value of the modeled gel formulations

When a preparation exhibits antibacterial activity, its effectiveness can be analyzed by the *in vitro* agar diffusion method (Balouiri, Sadiki & Ibsouda, 2016). In order to validate the suitability of the base for insertion of the active ingredient a test of antibacterial activity was done. The results of the test are shown in table 2.

Table 2

Antimicrobial activity of gel formulations

Formulations	<i>S. aureus</i> ATCC 25923	<i>E. faecalis</i> ATCC 29212	<i>E. coli</i> ATCC 25922
N1	14.2±2.3	12.3±0.6	12.1±0.32
N2	23.8±1.4	16.75±1.4	15.89±0.41
N3	29.75±2.8	23.3±2.2	16.50±0.53
Cannabis seed oil	8.45±1.1	6.78±1.4	6.54±1.2
Chitosan gel	0	0	0

The results showed that gel with salicylic acid makes an influence on the growth of bacteria *S. aureus*, *E. faecalis* and *E. coli*. The strongest effect was determined against reference *S. aureus* bacteria. While testing formulations it was determined that the biggest inhibition zones of the tested bacteria were in gel N3, with 2% of the active ingredient. The results of the tests showed that the bigger the amount of cannabis seed oil, the stronger the inhibition of bacteria. The results of the study confirmed that active substances in cannabis seed oil have an antimicrobial

effect. The base of the gel used as negative control did not show any antibacterial activity. Active substances in cannabis seed oil have an antimicrobial effect. Skin infections are often associated with staphylococcal infections, and in case of weakened immunity and natural protective skin barrier skin tends to be injured by microorganisms (Leekha, Diekema & Perencevich, 2012). The results of the tests confirmed that cannabis seed is effective in the treatment of acne (Dhadwal & Kirchof, 2018). The cannabis seed oil produced pronounced antibacterial activity of inhibition against *B. subtilis* and *S. aureus*, moderate activity against *E. coli*, and high activity against *P. aeruginosa*. So, it is possible to model compositions with salicylic acid and cannabis seed oil, which would have an antibacterial, anti-inflammatory and antioxidant effect. The results of foreign scientists and our research show that cannabis seed oil is a potential antibacterial substance, which can be used in the production of antibacterial semisolid formulations.

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