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THE STUDIES ON DEVELOPMENT OF THE COMPOSITION OF MASKS WITH THE SAPROPEL PASTE

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Sapropel muds have a different chemical composition and provide the anti-inflammatory, desensitizing effect, they protect the skin from destructive effects of free radicals, give the skin elasticity, firmness and freshness, moisten the horny layer of the epidermis, improve cellular regeneration. In order to use sapropel as part of masks the sapropel paste has been obtained by homogenization, and its physical and chemical properties have been studied. The results of rheological studies have found that the sapropel paste is a plastic mass and has good adhesive properties; therefore, it is a promising raw material for use in the composition of cosmetic masks. The microbiological studies have shown the need for using preservatives and the efficacy of conservative action of the mixture of preservatives – 0.01% of nisin with 0.8% of germaben or 0.01% of nisin with 0.1% of euxyl K 100.

Sapropel muds, which have a unique composition, effectively affect the functions of the whole organism and, especially the skin. They possess the anti-inflammatory, anti-allergic action, protect the skin from destructive effects of free radicals, give it elasticity, firmness and freshness. They also moisten the horny layer of the epidermis, and improve cellular regeneration [4].

Cosmetic products on the basis of sapropel are presented by different forms, but the most often in the form of masks (37.10%) and the natural raw material (15.70%) [5]. Masks are products of an intensive effect, and it causes exactly the spread of masks among the preparations of sapropel considering the diversity of the chemical composition and the pharmacological and cosmetic effects. To provide masks with plasticity and better organoleptic properties (elimination of a specific soil odour, the presence of small particles, the residues of plant life), as well as to expand the range of sapropel masks with the various pharmacological action (lifting, anti-cellulite, antiseborrheic and anti-acne effect, etc.) it was proposed to use one of the products of sapropel – the sapropel paste for the base of masks.

The sapropel paste is a paste-like product of the natural origin made of the lake sapropel, it contains biologically active substances, and the complex of macro- and microelements [6].

By appearance the sapropel paste is a homogenous pasty mass of a dark brown colour with pH – 6.7, the moisture content – 83%, and the content of organic substances – 76.63% [6].

However, the sapropel paste is a medium for development of microorganisms, including anaerobic ones. Therefore, the aim of our study was to substantiate experimentally the choice of an effective preservative in the composition of cosmetic masks with the sapropel paste to prevent microbiological contamination and ensure their stability.

Materials and Methods

The objects of the research were experimental samples of the sapropel paste taken from the Prybych deposit of the Volyn region: Sample 1 (paste of sapropel); Sample 2 (paste of sapropel, 0.1% of nizin); Sample 3 (paste of sapropel, 0.01% of nizin, 0.8% of germaben); Sample 4 (paste of sapropel, 0.01 of nizin, 0.1% of euxyl K 100).

The experimental samples of the sapropel paste obtained from the sapropel powder (the dry anhydrous product obtained from the native (natural) sapropel) and water by the method of cavitation with the speed from 100 to 3500 rpm for 30 min at the temperature of 50°C. Then they were cooled to the temperature of 35-40°C, and the preservatives were added.

For the sapropel paste the structural and mechanical (rheologic) parameters were determined according to the requirements of the SPhU (1.0, 2.2.10). The studies were carried out on a Brookfild HB DV-PRO II rotatory viscometer (USA) using the adapter of the rotatory type with coaxial cylinders (the spindle SS4-21 for the chamber with the volume of 8.3 g) in the range of the gradient of the shear rates from 3.0 to 93.0 c^{-1} [1].

For the comparative study of the effectiveness of preservatives of the experimental samples of the sapropel paste in the conditions *in vitro* the reference strains from the American standard collection of the cultures of microorganisms such as *Staphylococcus aureus* ATSS 6538, *Pseudomonas aeruginosa* ATSS 9027, *Candida albicans* ATSS 10231 were used as the test-strains. In addition, the studies of the effectiveness of preservatives against sulphite reductive *Clostridium perfringens* ATSS 13124 were conducted. The purity of each culture of the microorganism was confirmed by the typical morphological, tinctorial, cultural and biochemical properties.

In the experiments the one-day cultures of the abovementioned microorganisms grown on the solid media –

Table

The research results of the effectiveness of preservatives for the sapropel paste samples studied

No.	Samples of sapropel	Test microorganism	Culture control	Logarithmic reduction value				
				The initial inoculation	2 days	7 days	14 days	28 days
1	Paste of sapropel	*S. aureus*	7.71×10^5	1.01	1.01	1.01	n/i	n/i
		P. aeruginosa	7.20×10^5	1.03	1.01	1.01	n/i	n/i
		C. perfringens	2.80×10^6	1.16	1.03	2.52	n/i	n/i
		C. albicans	1.43×10^5	1.25	1.06	1.02	0.97	0.92
2	Paste of sapropel, 0.1% of nisin	*S. aureus*	7.71×10^5	1.01	1.18	2.09	2.20	n/i
		P. aeruginosa	7.20×10^5	1.03	1.01	1.01	1.02	n/i
		C. perfringens	2.80×10^6	2.16	2.83	3.01	n/d	n/d
		C. albicans	1.43×10^5	1.25	0.66	0.58	0.58	0.42
3	Paste of sapropel, 0.01% of nisin, 0.8% of germaben	*S. aureus*	7.71×10^5	1.01	2.01	2.15	3.20	n/i
		P. aeruginosa	7.20×10^5	1.03	1.28	2.01	n/d	n/d
		C. perfringens	2.80×10^6	2.10	2.93	3.21	3.49	n/d
		C. albicans	1.43×10^5	1.25	2.07	2.92	n/d	n/d
4	Paste of sapropel, 0.01% of nizin, 0.1% of euxyl K 100	*S. aureus*	7.71×10^5	1.01	2.02	2.32	3.20	n/i
		P. aeruginosa	7.20×10^5	1.23	1.48	2.23	n/d	n/d
		C. perfringens	2.80×10^6	2.21	2.68	2.91	3.18	n/d
		C. albicans	1.43×10^5	1.54	2.07	2.11	2.87	n/d

Note: ND – the viable cells of the test-organisms are not detected; NI – the number of the viable cells of microorganisms does not increase.

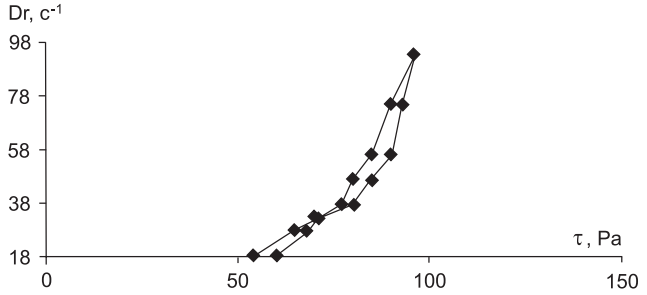

Fig. 1.The rheogram of the dependence of the yield stress (τ_r) on the shear rate (Dr) of the sapropel paste.

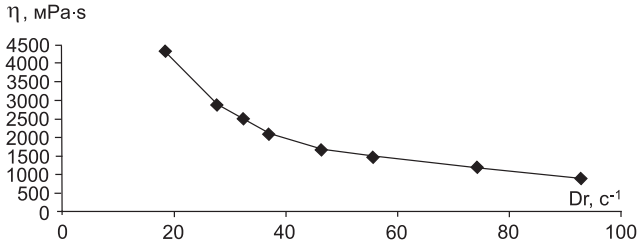

Fig. 2. The dependence of the structural viscosity of the sapropel paste (η, mPa · s) on the shear rate (Dr, c^{-1}).

meat-and-peptone agar (for bacteria), Wilson-Blair agar (individually for clostridia) and Sabouraud agar (for *Candida albicans* fungi) were used.

Each container with the test sample was inoculated by the suspension that contained one of the test-strains providing the microbial load of 10^5-10^6 CFU per 1 ml. The samples were selected immediately after the inoculation and at certain intervals indicated in the SPhU: in 2 days, 7 days, 14 days and 28 days. The effectiveness of preservatives was studied according to the standard methods of the SPhU by the logarithmic reduction value of viable counts for the specific period after the inoculation of samples [2].

Results and Discussion

According to the results of the rheological studies the sapropel paste is a plastic mass, it has the ability to a certain dilution in the physical effect (Fig. 1, 2) and good adhesive properties.

The microbiological studies have shown that the sample that does not contain antimicrobial preservatives (Sample 1) has no antimicrobial action. It is proven by either the increase in the number of viable cells (the *Candida* genus fungi), or their constant level (*Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Clostridium perfringens*) for 28 days of the study (Table).

Introduction of nizin as a preservative into the composition of samples provided the effective antimicrobial action against bacteria of *Staphylococcus aureus* and *Clostridium perfringens*. At the same time introduction of nisin did not provide protection of the samples against the *Candida* genus fungi, and the efficiency against *Pseudomonas aeruginosa* was low (Sample 2).

A comparative study of the antimicrobial action of the combinations of nisin and germaben, and nisin and euxyl showed practically the absence of the difference in the manifestation of the antimicrobial effect (Samples 3, 4). The combination of these preservatives provides the synergic effect of the antimicrobial action in relation to the test-strains of bacteria (*Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Clostridium perfrin-*

gens) and protection from the *Candida* genus fungi. Therefore, these samples of the sapropel paste can be promising for developing the composition of the masks.

According to the analysis of the literary data concerning the use in cosmetology and the results of studying the chemical composition of sapropel the sapropel paste is a promising raw material for creating masks with the lifting, anti-cellulite, tonic, antiseborrheic and anti-acne action.

To intensify the effectiveness of masks from the sapropel paste a number of active substances, such as vegetable oils (wheatgerm, apricot, castor, avocado, jojoba), essential oils (orange, grapefruit, lemon, sage, rosemary, pine, ylang ylang, bergamot, tea tree oil, verbena, myrrh, peppermint), the extracts (flowers of chamomile, yarrow, daisies, marigold, balm, nettle, ivy, cocoa, horse chestnut, eucalyptus, ginkgo, calamus, sticktight, aloe vera, hops, burdock) the extract of pepper, sodium hyaluronate, proteins of wheat soy, triclosan, kaolin, zinc oxide, glycerol, tocopheryl acetate, D-panthenol, were introduced to their composition [3, 7].

CONCLUSIONS

1. The results of the study of rheological properties have shown that the sapropel paste has a plastic structure that is capable to rarefy with the physical impact and recover, and it indicates the presence of thixotropic properties.

2. To provide the conformity of the requirements of the current normative documents for microbiological purity and stability of the sapropel paste and masks during the storage it is necessary to use the complex of preservatives – 0.01% of nisin with 0.8% of germaben or 0.01% of nisin with 0.1% of euxyl K 100.

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ДОСЛІДЖЕННЯ З РОЗРОБКИ СКЛАДУ МАСОК З САПРОПАСТОЮ

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Ключові слова: *сапропаста; маски; мікробіологічні дослідження; консерванти*

Сапропелеві грязі мають різноманітний хімічний склад та виявляють протизапальну, десенсибілізуючу дію, захищають шкіру від руйнівної дії вільних радикалів, надають шкірі еластичності, пружності та свіжості, зволожують роговий шар епідермісу, покращують клітинну регенерацію. З метою використання в складі масок сапропелю шляхом гомогенізації отримана сапропаста та досліджені її фізико-хімічні властивості. За результатами реологічних досліджень встановлено, що сапропаста є пластичною масою та має добрі адгезивні властивості, тому є перспективною сировиною для використання в складі косметичних масок. Мікробіологічними дослідженнями показані необхідність використання консервантів та ефективність консервуючої дії суміші консервантів 0,01% нізину з 0,8% гермабену та 0,01% нізину з 0,1% еуксилу К 100.

ИССЛЕДОВАНИЯ ПО РАЗРАБОТКЕ СОСТАВА МАСОК С САПРОПАСТОЙ

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Ключевые слова: *сапропаста; маски; микробиологические исследования; консерванты*

Сапропелевые грязи имеют разнообразный химический состав и обладают противовоспалительным, десенсибилизирующим действием, защищают кожу от разрушительного действия свободных радикалов, придают коже эластичность, упругость и свежесть, увлажняют роговой слой эпидермиса, улучшают клеточную регенерацию. С целью использования в составе масок сапропеля путем гомогенизации получена сапропаста и исследованы ее физико-химические свойства. По результатам реологических исследований установлено, что сапропаста является пластичной массой и обладает хорошими адгезивными свойствами, поэтому является перспективным сырьем для использования в составе косметических масок. Микробиологическими исследованиями показана необходимость использования консервантов и эффективность консервирующего действия смеси консервантов 0,01% низина с 0,8% гермабена и 0,01% низина с 0,1% эуксила К 100.