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DEVELOPMENT OF COSMETIC CREAM STRUCTURE USING PEPTID AND EXAMINING ITS EMULSION PROPERTIES

The search for new compounds to prevent or attenuate skin aging and enhance self-image is a priority of current research on active cosmetics. The modes of the cosmetic creams production such as "oil-water" on the basis of self-emulsifying basis Lipoderm 4/1 were worked out. Matryxil peptide was used as active substance. A novel aspect of Matryxil is its ability to act via topical application, which offers multiple advantages in comparison to formulations based on botulin toxin. We studied the colloidal stability, thermal stability, pH, particle size of the dispersion phase. It was found out that the best one is to disperse the fat phase with the rotor speed of 10,000 min^{-1}. Lower rotation leads to the production of emulsions with a wide range of dispersion phase sizes, higher rotation leads to the airing of the cream, which is reflected in its consistency. When stored for 60 days, the pH value does not undergo significant changes, which indicates the absence of hydrolytic processes in the emulsion, leading to deterioration of the finished product. Use of Matryxil peptide in an amount up to 5% in cosmetic cream formulation does not reduce the emulsion properties of the cream.

Key words: cosmetic cream, emulsion properties, Matrixyl polypeptide, dispersion, colloidal stability, thermal stability, dispersion phase.

Introduction. Wrinkles are one of the characteristics of human skin aging. The reasons for the formation of folds in the skin are a number of factors, among which are both internal: genetic, constitutional, hormonal changes, and external, such as food and environmental. Strong influence on the formation of wrinkles has repetitive facial movements like laughing, smoking, talking, eating, and so on. The search for new substances that slows the aging of the skin and improve its appearance is one of the priorities of the production of cosmetics for skin care.

Deep wrinkles are formed due to frequent muscle contractions that cause skin atrophy and fibrosis hypodermal appearance. Thus, fibroblasts are attached to a network of collagen and elastin fibers, also are subjected to the same reduction, resulting in the extracellular matrix of collagen and elastin lose of its elastic properties [1].

Thus, the wrinkles and skin folds appear due to a decrease or loss of collagen and elastin and because of deformation of their elastic properties.

One solution to the problem of the appearance of wrinkles and folds in the skin is to exposure to it such drugs that help restore elastic deformation properties of collagen and elastin.

Currently, there are two basic approaches to restore aging skin. The first is the use of botulinum toxin type A produced by the bacteria Clostridium botulinum. It irreversibly destroys the SNAP-25 protein in a SNARE complex, thereby prevents the release of acetylcholine and paralyzes the muscles involved. Between 15 and 20 days after the botulinum toxin penetration of new nerve endings are formed and become active for two or three months. From 3 to 6 months of nerve signals to the muscles are fully restored. However, the use of botulinum toxin has several disadvantages, among which are the possibility of allergic reactions of the body, accompanied by fever and skin irritation for several days after the subcutaneous injection of the drug.

The second method for restoring aged skin is associated with low molecular weight peptides, such as matrix, which affects the biosynthesis of collagen and elastin. Matrixyl (palmitoyl pentapeptide) is a peptide consisting of five amino acid units (lysine-threonine-threonine-lysine-serine). This amino acid sequence is a signal, prompting the skin cells to activate the biosynthesis of collagen and elastin, necessary to maintain the structure of the skin [2].

Unlike botulinum toxin which is administered subcutaneously, Matrixyl can actively influence the skin via topical application and has a low toxicity.

Furthermore, the matrix can be used for skin treatment time between injections of botulinum toxin, as it prolongs the effect of Botox and reduces the frequency of microinjection. Synthetic peptides are cheaper and can be successfully used for treatment of skin in cases where the organism has developed immunity to the botulinum toxin after prolonged use.

From a practical point of view, the most effective way of applying the matrix is its use in the composition of cosmetic skin creams.

Thus, the development of formulations of cosmetic cream with peptides, slowing skin aging and reducing the ability of collagen and elastin to the tension and compression, it is a topical research direction on the development of new cosmetic products.

The purpose of work is to research and develop modes of producing the composition of cosmetic creams based on advanced ingredients with peptide Matrixyl and explore its emulsifying properties.

Main part. Development of cosmetic cream composition was performed using a self-emulsifying bases for the production of creams and emulsions such as "oil-water" Lipoderm 4/1 (producer of "Teresa Inter", Russia). Isopropyl myristate, myristyl myristate (beeswax), vegetable oil (palm oil), paraffin oil (fragrance), cyclomethicone, glycerine (cosmetic) and propylparaben as preservative were introduced into a cosmetic emulsion as additional ingredients. The peptide Matrixyl was provided by "Rekish-Cosmetics" Ltd. (Zaslavl).

Mastering of modes produce emulsion cream was carried out using a dispersant IKA T 25 DIGITAL ULTRA TURRAX (dispersing nozzle S25N-10G) and a mechanical agitator IKA RW (stirring element R130). These installations are different from each other dispersing ability and allow to obtain an emulsion with fat phase particles of different sizes.

The first phase was investigated the influence of the conditions for obtaining a cosmetic emulsion colloidal and thermal stability. Cosmetic emulsion formulation is presented in Table 1. The matrix content in the cream emulsion was 5%.

Table 1

Cosmetic cream ingredients

Name ingredient	Content ingredient weight, %
Phase A (water phase)	
Distilled water	74.39
Glycerol	1.92
Propylparaben	0.19
Phase B (fatty phase)	
LIPODERM 4/1	8.50
Cyclomethicone	0.48
Vaseline oil	1.90
Vegetable oil	2.86
Isopropyl myristate	3.80
Myristyl myristate	0.96
Phase B (active substance)	
Matrixyl	5.00

Methods for producing emulsion cream IKA T 25 disperser DIGITAL ULTRA TURRAX was as follows: the components were weighed separately Phase A and Phase B. Phase A and B were heated on a water bath with a magnetic stirrer IKA RCT basic to 85°C temperature. Phase B and phase A were dispersed at given rpm for 10 min when the temperature reached the phase 85°C. Rotor speed was varied from 5,000 to 15,000 min^{-1}. Then emulsion was cooled to 60°C at a constant dispersion and it Matrixyl was added to it (phase B) and dispersed for 5 minutes, after which the emulsion was cooled to 20°C and transferred to a weighing bottle. The duration of the preparation of an emulsion cream was 30 minutes.

Procedure for the preparation of a cream with a mechanical agitator IKA RW 20n apparatus was as follows: components were separately weighted during the phase A and phase B, they were heated in a water bath at 85°C using a magnetic stirrer IKA RCT. Upon reaching the desired temperature and mixing device included set desired speed stirrer, phase B was added to phase A and they were stirred at 85°C for 10 min. The rotational speed of the agitating element was varied from 100 to 500 min^{-1}. Then after emulsion was cooled to 60°C, Phase B was added and mixed for another 5 minutes. Thereafter, the emulsion was cooled to 20°C and transferred to a weighing bottle. The overall process time was 30 minutes.

The conditions for obtaining a cream and emulsion properties are shown in Table 2. We investigated the colloidal stability, thermal stability and pH value. Hydrogen index was measured at 10% solution of freshly prepared samples of creams and after 60 days of storage at room temperature. The value of this indicator in freshly prepared cosmetic creams was 5.85 at a temperature of 18,3°C.

Emulsion properties of the cream were determined in accordance with GOST R 52343-2005 "Cosmetic creams. General specifications". The droplet size of the fat phase distributed in cosmetic cream was determined using a microscope Optika Mikroskop B-500Tpl at 600 times magnification. [3]. For the preparation of drugs for microscopic examination emulsion cream samples were diluted with distilled water up to 100 times.

Table 2 shows that the creams of all samples were prepared using the disperser at high speed (1–5) and mechanical stirring apparatus at low speed (1a–5a) possess a colloidal stability and heat.

The particles in the fat phase cream samples were prepared using dispersant, more uniform, but this is true only when the rotor speed is from 10,000 to 15,000 min^{-1}. When the rotor rotational speed is from 5,000 to 7,600 min^{-1} the samples of the sizes of large particles present to 9 microns.

The optimal value of the rotor speed, in our opinion, is the rate 10,000 min^{-1}. If this value is not airing cosmetic cream, it is less "shaken up" and has a high homogeneity of the dispersed phase.

Samples cosmetic creams was prepared using the agitating device differed more uniform particle size of the fat phase, they are less "whipping", unlike samples prepared for the dispersant.

Analysis of the hydrogen index (Table 2) indicates that the samples prepared using a preservative is more stable and its change are negligible. However, in sample 3 an intense fungal growth was recorded and reduced to a value of the hydrogen index of 5.52, after 60 days. This increase in acidity was resulted with the action of microorganisms.

Table 2

Conditions for obtaining a cosmetic cream and its properties

Number of the sample	Conditions for obtaining cosmetic emulsions		Properties cosmetic emulsions			
	stirring speed (dispersion), min^{-1}	preservative availability	colloidal stability	thermal stability	pH/°C in 60 days	particle size of fatty phase, microns
Dispersant IKA T 25 DIGITAL ULTRA TURRAX						
1	5000	+	stable	stable	5.84/18.2	2–9
2	7600	+	stable	stable	5.87/18.1	2–7
3	10 000	–	stable	stable	5.52/18.3	2–3
4	12 500	+	stable	stable	5.85/18.1	2–3
5	15 000	+	stable	stable	5.78/18.3	2–3
Rabble IKA RW 20n						
1a	100	+	stable	stable	5.96/17.9	2–3
2a	200	+	stable	stable	6.43/18.2	1–3
3a	300	+	stable	stable	6.00/18.1	1–2
4a	400	+	stable	stable	6.02/18.2	2–3
5a	500	+	stable	stable	6.00/18.3	1–4

Conclusion. Thus, it was found that the best way to have an optimal result is to disperse the fat phase with the rotor at 10,000 min^{-1}. The lower RPM leads to obtaining emulsions with a wide range of particles sizes dispersed phase, higher speed lead to airing cream, which is reflected in its consistency. The emulsion creams was derived form Lipoderm 4/1, it possesses high thermal and colloidal stability. The pH value is not significantly altered when it is stored for 60 days, indicating that the absence of oxidative processes in the emulsion, resulting in deterioration of the final product. Matrixyl peptide in an amount of 5% should be used in a cosmetic cream formulation. Thus, the emulsion does not reduce its characteristics.

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