SECTION 6. INNOVATIVE TECHNOLOGIES

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6.1 Innovative solutions to improve the consumer properties of cosmetics

Among the most important problems that science and industry must address today, a special place is occupied by providing the population with high quality products with enhanced consumer properties.

An analysis of the range of skin disinfectants and cleansers offered to consumers shows that despite the positive dynamics, the list of products contains mostly low-priced goods with aromatic and cleansing properties, but with a low content of polyphenolic and biologically valuable substances, which generally does not meet modern ideas about the quality indicators of goods [369]. This is especially true for soap, as a product responsible for the purity and appearance of human skin. The way out in this situation for many companies was to expand the range of soaps with improved properties and develop new sub-segments.

Currently, the production of cosmetic hygiene products has moved to a new level of development. Along with well-known foreign manufacturers, Ukrainian hygiene cosmetics production lines have also emerged. Domestic companies recognized the importance of these products and began to produce new cosmetic series [370]. It is known that soaps not only help to cleanse the skin, but also give a beautiful appearance to the skin and confidence to a person, i.e. they have both hygienic, aesthetic and psychological value. Intensive and not always honest advertising often misleads consumers.

Today, there are many methods of soap production that can satisfy all the requirements of customers for a high-quality and safe product. There is also a variety of raw materials, additives, vitamins, flavors, dyes, natural materials and extracts that have begun to be used in the creation of soap. The range of soaps available on the Ukrainian market is very large, with different fillers. However, to enter a new round of competition, it is necessary to develop a new type of product that would be different

from competitors' products and to find a new market segment. To create soap with improved consumer properties, which has antioxidant and immune-stimulating effects, it is advisable to use vitamins A, B, β-carotene, and polyphenolic substances, which will increase the body's resistance to adverse factors.

The quality consumer properties of soap are laid down at different stages, from the idea of creation to packaging and labeling. The studied classification and characterization of consumer properties showed that soap is one of the groups of consumer goods that belongs to the category of "essentials" [371, 372]. It is noted that many types of soap with antibacterial properties are produced, but there is no soap with pronounced antioxidant properties.

It is established that modern production is aimed at quality, safety and, at the same time, price affordability of goods. It is pointed out that high cost of raw materials, the complicacy of the new technologies introduction often contribute to the violation of the balance of these indices toward deteriorating quality, but ensuring affordable prices for a product. The disadvantages of the known soap manufacturing technologies are the scarcity of raw material resources, the presence of alcohol in the composition that causes a drying effect on sensitive skin, does not provide a high degree of foam formation, and does not have the properties as to washing out intense dirtying from skin. Often, samples of soap, presented at the market, lose a high degree of detergent action in cool water; have insufficient cleansing of skin from keratinized keratolyzed epidermis. It is proved that it is reasonably required to search for additional raw material sources and to develop on this basis formulae of the soap that would have stable functional, technological and consumer properties under different conditions of use.

Therefore, it is important to improve the consumer properties of soap by introducing ingredients of natural origin that improve the quality and positive effects on human skin. After all, the use of low-quality raw materials and non-compliance with manufacturing technology can lead to the creation of products that can cause significant harm to consumers.

The research is aimed at enrichment of solid soap by introducing oil extracts of

plant materials and quality assessment. To achieve this goal and obtain scientifically based results, the following tasks were solved: an analytical review of market development and improvement of consumer properties of soap was carried out; a new soap with specified consumer properties was developed and proposed; quality (organoleptic and physicochemical parameters) of the developed soap samples was studied.

Based on the studied theoretical material and patent data, we chose the direction of work, which is to improve the antioxidant and antibacterial properties of solid soap.

The objects of the study were developed soap samples, rosehip oil extract, and nettle oil extract.

The examination of the organoleptic and physicochemical characteristics of the soap was carried out by standard methods in accordance with current regulations. Measurement of the solidification temperature of fatty acids isolated from soap was performed using a Zhukov device; measurement of the primary volume of foam was performed using the RSRIF method. Determination of antioxidant activity was performed according to an improved method based on coulometric bromine titration of the test sample [373]. Skin testing was performed visually and by subjective sensations of the test sample after repeated application to the skin. Attention was paid to dryness, firmness and gloss (for facial skin), peeling and irritation.

In the course of solving the tasks set, in particular, increasing the antioxidant and antibacterial properties, the expediency of enriching the soap with plant components was established. By analyzing the pharmacological properties and chemical composition [374] and taking into account the distribution and ease of growing plants in our region, nettle and rosehip in the form of a mixture of oil extracts were selected for research.

It is known that nettle is a major plant in terms of its chemical composition. Young nettle leaves are a kind of natural concentrator of vitamins, primarily ascorbic acid, carotenoids (β-carotene, xanthophylls, violaxanthin) K1 (0.2%), B2, pantothenic acid (B3) [375]. At the same time, nettle contains some biogenic amines and tannins, phytoncides, chlorophyll, flavonoids and quercetin glucosides, which have antioxidant

effects. It has been noted that nettle proteins contain 9 out of 10 essential amino acids, which, in combination with minerals and vitamins, allows you to maintain high performance, quickly recover after hard work, fatigue or illness.

A significant amount of substances is also preserved in extracts and dried nettle leaves. Stinging nettle extract has a regenerating, tonic, stimulating, anti-inflammatory, and wound healing effect. In addition, literature studies show that almost all substances with antioxidant, healing, and therapeutic and prophylactic effects are transferred to extracts [376].

Thus, the introduction of the oil extract of nettle will give the soap properties that will have a beneficial effect on the skin, enhance metabolism, improve tone, and allow to obtain soap with antioxidant, tonic, and regenerating effects.

The chemical composition and properties of rose hips were analyzed. It was found that they contain a whole range of vitamins and minerals necessary for humans. Rose hips have the highest concentration of vitamin C (up to 4100 mg/100 g). In addition, rose hips contain up to 1200 mg/100 g of bioflavonoids, 42 mg/100 g of carotene, 200...1500 mg/100 g of P-active substances, 13...19 % of water-soluble substances, 2...3 % of tannins, up to 4 % of pectins and up to 4 % of organic acids (citric, malic, etc.), vitamins B1, B2, B9, K1, E, A, sugars, nitrogen-containing substances and cellulose, as well as tannins and phytoncides. Rose hips contain flavonoids (quercetin, kaempferol, isoquercetin, tilirozide), catechins (epigallocatechin, gallocatechin, epigallocatechin gallate and epicatechin gallate) and minerals (iron, potassium and calcium salts, manganese, phosphates). Rosehip seeds contain fats with health-promoting properties, which include unsaturated fatty acids and aromatic essential oils. These substances determine the antioxidant properties of rose hips [377, 378].

Rosehip extracts enhance tissue regeneration, hormone synthesis, have a beneficial effect on carbohydrate metabolism and vascular wall permeability, provide double skin protection against the damaging effects of UV rays and free radicals; increase skin immunity, slow down the aging process; prevent the appearance of age spots, have a whitening effect; protect soap from spoilage [379].

The conducted studies suggest that the effect of a mixture of rosehip and nettle oil extracts on a product such as solid soap will be quite significant and can be considered as a source of components valuable for the skin, a metabolic stimulator, and a carrier of antioxidant substances.

For further research, it is necessary to choose a rational ratio of components to obtain a product with specified characteristics that would meet the requirements of regulatory documents.

By optimizing the formulation composition of the soap, the amount of the introduced mixture of rosehip and nettle oil extracts was set at 20%.

To establish the rational ratio of rosehip and nettle oil extracts in the mixture, the following model samples were made:

- sample No. 1 - soap base + 5 % rosehip oil extract + 15 % nettle oil extract;
- sample No. 2 - soap base + 10% rosehip oil extract + 10% nettle oil extract;
- sample No. 3 - soap base + 15% rosehip oil extract + 5% nettle oil extract.

The organoleptic evaluation of the developed model samples was carried out according to the method of Tilghner D.E. in our own modification. The scale of organoleptic evaluation of the developed samples, taking into account the weighting factor, is given in Table 1.

Table 1.

Scale of organoleptic evaluation of the developed samples

Number of points	Organoleptic quality indicators				
	Visual appearance	Smell	Consistency	Color	Shape
1	2	3	4	5	6
5,0	In the section, it is homogeneous, without cracks on the surface, the cut is even	Light smell of fresh grass, clean, without off-flavors	Solid, dry to the touch	Matte with a green tint	Square with rounded corners

Continuation of the table 1

4,0	In the section, it is homogeneous, without cracks on the surface, the cut is even	A pronounced smell of fresh grass, clean, without off-flavors	Solid, dry to the touch	Matte, with a slightly greenish tint	Square with rounded corners
3,0	In the section, it is homogeneous, but voids are noticeable on the cut, no cracks on the surface, the cut is even	Intense smell of fresh grass, clean, without off-flavors	Solid, dry to the touch	Matte, with a rich green tint	Square with rounded corners
2,0	In the section, it is homogeneous, but voids are noticeable on the cut, with cracks on the surface, the cut is even	Smell of soap base, almost imperceptible smell of impurities	Not solid enough, dry to the touch	Matte, without tint	The mold does not hold
Weighting coefficient	0,5	1,0	2,0	0,5	1,0

During the examination, it was found that in terms of organoleptic and physicochemical parameters, all the experimental model samples have values that do not contradict the requirements of regulatory documents for this product, as shown in Table 2.

Table 2.

Study of the quality of the developed soap samples

Indicator	Model soap samples		
	Model № 1	Model № 2	Model № 3
1	2	3	4
Characteristics of organoleptic quality indicators			
Visual appearance	In the section, it is homogeneous, without cracks on the surface, the cut is even	In the section, it is homogeneous, without cracks on the surface, the cut is even	In the section, it is homogeneous, without cracks on the surface, the cut is even
Smell	A pronounced smell of fresh grass, clean, without off-flavors	Light smell of fresh grass, clean, without off-flavors	Light smell of fresh grass, clean, without off-flavors
Consistency	Not solid enough, dry to the touch	Solid, dry to the touch	Solid, dry to the touch
Color	Matte with a green tint	Matte with a green tint	Matte, with a slightly greenish tint
Shape	Square with rounded corners	Square with rounded corners	Square with rounded corners
Organoleptic assessment, points	24	25	24,5
Testing on the skin (repeat 20 times)	The skin condition after application is satisfactory, it feels pleasant, smooth, lightly moisturized, and a barely perceptible smell of the introduced additives remains on the skin of the hands and face. No sensations of dryness, tightness, gloss, peeling or irritation of the skin were detected		

Continuation of the table 2

Characteristics of physical and chemical quality indicators				
Quality number, %.		79	82	85
Mass fraction of soda products in terms of Na_2O, %.		0,10	0,10	0,11
Freezing point of fatty acids, ^0C		35	37	38
Mass fraction of sodium chloride, %.		0,45	0,45	0,48
Primary foam volume, cm^3		365	370	372
Antioxidant activity (AOA), Cl/100g (n = 3, P = 0.95)		80	130	160
Antibacterial activity, titer of viable Escherichia coli cells (V15), kl/ml 107	k	2,45	2,47	2,52
	f	1,35	1,49	1,64

As can be seen from Table 2, of all the experimental model samples, sample No. 2 (soap base + 10 % rosehip oil extract + 10 % nettle oil extract) scored the highest

number of points (25 points). Also, sample No. 2 had optimal values in terms of primary foam volume and fatty acid pour point. The antioxidant activity was higher in sample No. 1, but this sample did not meet the standard for the fatty acid pour point.

Thus, from the developed model samples of solid soap, a sample (soap base + 10 % rosehip oil extract + 10 % nettle oil extract) with the best consumer properties was selected by quality assessment, which can be recommended as a solid soap with increased antioxidant and antibacterial properties.

The next step was to conduct a study to determine the shelf life of the developed soap with oil extracts of nettle and rose hips. The test conditions were 0 °C, 10 °C, 20 °C, 25 °C and 75% humidity, which is recommended by regulatory documents. Studies have shown that during storage at 25 °C, a softening of the consistency and a feeling of oiliness on the surface were observed after a month. Based on this, 0...20 °C was chosen as a rational storage temperature. Under these conditions, after 12 months, the quality of the developed soap remained unchanged, with a loss of moisture accompanied by a surface extension with the appearance of a barely noticeable surface delamination.

Thus, by introducing a mixture of rosehip and nettle oil extracts, a new type of solid soap was developed that improves the antioxidant, antibacterial properties and stability of soap during storage.