Research article

Development of a recipe and production method for enzymatic hand peeling

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Abstract: *The study focused to develop an enzyme hand peeling. The first stage of the investigation dependent on selecting the qualities that the cosmetic should have. When creating the product, the assumption was made that it would have an exfoliating, moisturizing, firming and even-toning effect. The peeling was developed in several stages starting with the consideration of the cosmetic formulation, the selection of suitable raw materials and the execution of the formulation according to the adopted method. For the preparation of the peeling, the emollients used were so-called oily emollients, including sweet almond oil, Shea butter, coconut oil, oil/water (O/W) emulsifier, stabilizers, moisturisers, rheology modifier, filler, active substances, preservative and solvent. The peeling was prepared on the principle of O/W emulsion. The formulation was made using the classic "hot" method. More than a dozen trials were performed to obtain a product with the desired properties. Subsequently, the peeling was subjected to sensory and hedonistic analysis. Its density, viscosity and stability were evaluated. The formulation was also tested for pH.*

The final scrub was characterized by an intense but pleasant fragrance, very easy spreading on the skin, light texture, pleasant sensation after use. Hedonistic research has shown that obtained enzyme peeling was fully acceptable in terms of application, color, consistency and feelings after use. The final cosmetic product was also characterised by poor moisturisation and too strong abrasiveness.

Key words: *cosmetic technology; hand care cosmetic; enzyme peeling; cosmetic formulation;*

Introduction

The skin is the largest coating covering the human body and an organ that performs many key functions [1]. The average skin thickness ranges from 0.5 to

7 mm (not including subcutaneous tissue) and depends on the body, age, sex, diet and living conditions. The thinnest skin is on the face, mainly around the eyes (up to 0.5 mm). In turn, the thickest occurs around the heels and hands. Its thickness can be up to 7 mm [2, 3]. Not only exogenous factors, such as chemical, physical, biological ones, but also endogenous factors, which include genetic, innate factors, diet, impact of hormones and many others [1].

The skin is a cover of the human body against external factors, separating the interior of the system from the environment that surrounds it. Its functions can be divided into passive and active ones[4]. The passive functions include thermal and mechanical protection, protection against the effects of chemicals, as well as the protection of against microorganisms. In turn, active functions include receiving stimuli, the production of vitamin D_3 and melanin, combating pathogenic microorganisms that have already penetrated the skin, or diagnosis of allergens [4]. In addition to passive and active functions, the skin participates in immune processes, metabolism of fats, proteins, vitamins and hydrocarbons [1]. Also corresponds to for protecting internal organs against mechanical, chemical, biological and physical injuries. Protection against mechanical damage is provided by the wavy structure of the papillary layer, which ensures stretching of the skin, elasticity and strength. It also has the ability to overgrow in recurrent mechanical damage. The leather lipid coat and acidic reaction protect against chemical factors [5].

One way to proper care for the skin of the hands is the removal of calloused cells from the skin surface and thinning and unifying the stratum corneum. Such a process is called exfoliation. Its purpose is to facilitate the penetration of cosmetically active ingredients. Exfoliation results in healthier skin with an improved aesthetic appearance [6]. In addition to chemical exfoliation, in which selected solutions of organic acids with a pH below 5 or mechanical, where an abrasive is used, enzymatic peeling deserves attention. Enzymatic exfoliation involves the use of enzymes, mainly proteolytic to the breakdown of proteins contained in callous skin cells. This process is one of the most subtle forms of exfoliation of the epidermis. It is recommended for people with sensitive and vascular complexion because it does not cause skin irritation [7].

The use of enzymes in cosmetics has been recommended for many years. One of the areas, in which the local use of enzymes brings significant benefits is the skin of the hands and face. Enzymes in cosmetics are used in the form of enzymatic peels, rich in proteolytic enzymes. These enzymes are responsible for the hydrolysis of peptide bonds of proteins in the stratum corneum. They support the biological peeling of the epidermis and faster skin regeneration. Thanks to natural exfoliation, they ensure deep purification, while enabling the penetration of cosmetically active substances. The use of peels is aimed at stimulating microcirculation of blood, stimulating fibroblasts, increasing the amount of glycosaminoglycans, increasing skin tone (eliminating fine wrinkles) and removing the stratum corneum. The goal of these actions is to cause the slight

tissue necrosis, which in turn will stimulate the production of new ones [8]. Substances used in enzymatic peels are mainly plant enzymes. Papain, pineapple bromelain and ficine are most often used [6, 9].

Papain is a natural fruit extract obtained from papaya (*Carica papaya*) at a concentration of about 8%. It is a single -stanch polypeptide with 3 disulfide bridges and a sulfhydryl group, necessary for the activity of the enzyme. The main amino acids of papain are glycine, valine and tyrosine. Papain used on the skin is mainly used in medicine. Removes dead tissues, accelerating wound healing and burns. Added to proteins and fats found in cosmetic products, it can whiten the skin, brighten freckles and improve circulation. Applied in peels prevents the skin of the epidermis, breaks the aging cells, exfoliates them and whitens the skin [10].

Bromelain is another enzyme obtained from plants. It is a protease obtained from pineapple (*Ananas comosus*). It digits the proteins of dead cells in the upper layers of the skin, contributing to replacing them with young cells from the lower layers. The main amino acids of the enzyme include mainly alanine, glycine and aspartic acid. In the cosmetics industry, it is used to treat acne, wrinkles and dry skin. In addition, it helps to reduce bruises and swelling [11, 12].

Ficain, from the stalks of the fig tree, called ficus (*Ficus carica*) is also used in the cosmetics industry. Ficain has enzymatic activity as an exfoliating agent. In addition, it also has antioxidant and whitening effects in skin cells [13, 14].

Cosmetics for hand care can be emulsions. The type of emulsion is expressed on the principle of providing the distributed phase first and then the dispersion phase. Among the emulsions, the oil in water type can be distinguished (O/W). In that kind of emulsion a dispersion of drops of non-polar oil phase in the water phase occur.

The aim of the work was to prepare enzymatic peeling for the hands. When creating the preparation, it was assumed that its action would be exfoliating, moisturising, firming, leveling color and supporting the regeneration of the skin of the hands. Peeling design included the selection of appropriate raw materials and formulation in accordance with the adopted method. The obtained product was subject to physicochemical assessment, including viscosity analysis, density and pH. The product was subjected to sensory and hedonistic assessment, during which parameters such as application, consistency, color, smell, feelings after use, skin hydration and abrasive were assessed.

Experimental

Enzymatic hand peeling recipe

The composition of the enzyme hand peel is shown in Table 1. Due to the poufousness of the data on the exact composition of final product prepared in Indigo Nails Company, the amount of individual raw materials has been given in percentage ranges.

Table 1. Chemical composition of enzymatic peeling

Phase	raw material *INCI*	concentration [% range]
A	Cocos Nucifera (Coconut) Oil	1-5
	Butyrosperum Parkii (Shea) Butter	1-5
	Prunus amygdalus Dulcis (Sweet Almond) Oil	0.1-1
	Coco-Caprylate/Caprate	0.1-1
	Cetearyl Alcohol, Ceteareth-20	1-5
	Cetearyl Alcohol	1-5
B	Aqua	50-75
	Sodium Polyacrylate	0.1-1
B'	Xanthan Gum	0.1-1
	Glycerin	1-5
C	Silica	1-5
D	Papain, Glucose	≤ 0.1
	Tocopheryl Acetate	0.1-1
	Sodium Hydroxide	≤ 0.1
	Phenoxyethanol, Caprylyl Glycol	1
	Parfum (Fragrance)	2

Preparation of enzyme hand peeling

The designed enzyme peeling was an oil/water (O/W) emulsion and was prepared on the basis of the classic hot method. Stages of enzyme peeling production are as fallowed: weighing out the components of the individual phases (A, B, B ', C, D) in separate beakers, preparing a dispersion of xanthan gum in glycerin (B 'phase) and leaving for about 15 minutes, heating the phase A in a water bath to a temperature of about 70-80 °C, while stirring slowly, heating the phase B water bath to a similar temperature, introducing the B 'phase into the B phase, after obtaining a homogeneous consistency, introducing the A phase (combining the oil phase with the water phase), homogenization with a 7000 homogenizer rev./ 3-5 min, cooling down to a temperature of about 40°C, adding silica (phase C), introduction of thermally sensitive ingredients (phase D), rehomogenisation of 2000 rpm / 1-2 min, cooling down to room temperature, transferring the preparation to the packaging, resting for 24 hours, product inspection and testing.

Initial product evaluation

The initial evaluation of the product was carried out 24 hours after preparation of the formulation. In the sensory analysis, the enzyme peeling was assessed in terms of its application to the skin, consistency, color, smell, feelings after use, skin hydration and abrasive. The research was carried out on a group of eight probationers experienced in conducting sensory analysis of cosmetic products, who assessed the product's features according to a 3-point rating scale, where the highest rating is 3 and the lowest is 1.

Physicochemical analysis and stability of product

The pH was measured using a Voltcraft pH-100 ATC pH meter. Viscosity was tested using an RM100 CP2000 PLUS viscometer. The density test was performed using the Rudolph Research Analytical DDM 2911 automatic density meter. The stability study was performed using the SBS-LZ-5000LS laboratory centrifuge by Steinberg Systems. All of the analyses were performed in triplicate.

Results and Discussion

Preparation of hand peeling

It was intended that the peeling would be an oil/water (O/W) emulsion, thus the hydrophobic phase was dissolved in the hydrophilic phase. In creating subsequent samples from raw materials (Table 1), only the percentages of a given component have changed.

In order to obtain the effect of light texture, good spreadability and a pleasant feeling on the skin, sodium polyacrylate was used in the formulation. It is an emulsifying polymer with stabilising, thickening and emulsifying properties. It provides high precision during emulsification, it is easy to spread and at the same time gives great flexibility. Difficulties in creating the formulation appeared already at the stage of dissolving the polymer in the water. As a rule, the raw material is easily dispersed as it is in the form of a white powder. It can be processed both hot and cold, ensuring the stability of the formulations obtained. It can be used alone as well as in combination with other emulsifiers.

In the first sample, the proper peeling consistency was not obtained. The cosmetic gave a nice feeling of hydration, but after application the consistency was too greasy, sticky and lumpy. The change in the amount of emulsifying polymer (sodium polyacrylate) was taken into account. In the next trial, the amount of polymer was increased by 0.2% and the entire formulation was repeated. The obtained peeling was lumpy and its consistency was rejected due to too much clumping.

The next test was performed in the same way as the first one, and the content of sodium polyacrylate was increased by 0.1%. The obtained peeling had a perfect texture and color (Picture 1). The finished cosmetic has been placed in a glass jar and transferred for probants' testing.

Picture 1. Enzymatic hand peeling (final product)

Physicochemical analysis of enzymatic peeling

The conducted physicochemical tests were provided to determine the density, viscosity and pH of the final cosmetic product. The assessment of consistency, color, smell, abrasion was also conducted. The results were presented in Table 2.

Table 2. Properties of enzymatic peeling

Parameter	Value ± SD
density [g cm^{-3}]	0.999 ± 0.100
viscosity [mPa s]	3282 ± 1
pH	6.50 ± 0.10
consistency	homogeneous mass with abrasive particles
color	white
smell	consistent with the fragrance note used
abrasive	fine-grained

Based on the data obtained from Indigo Nails Company for other cosmetic products that have similar application purpose it can be stated that the density and viscosity of enzymatic hand peeling were appropriate for this product group. The peeling viscosity affects the amount of the substance released with a skin care product. The lower the viscosity value of the cosmetic mass, the easier the ingredients are released into the skin. The consistency and color of the peeling were visually assessed. The white color resulted from the colors of the raw materials that were used referring to the created recipe. The enzymatic hand peeling was characterised by high stability. The pH value of this type of cosmetics should be within in the range of 5.50-6.50. The pH value for the obtained product was 6.50, which from the point of view of cosmetic preparations makes it possible to classify the created formulation as safe for the skin. The smell and the abrasive were organoleptically assessed. The obtained product had a smell and abrasive consistent with the assumptions.

Sensory analysis

The sensory analysis was carried out by the group of probants. The results of these tests were presented in Table 3.

Table 3. Sensory characteristic of enzymatic hand peeling

Properties	**Visual/organoleptic evaluation**	**Average assessment value ± SD [scale 1-3]***
application	easily spreading	3.0 ± 0.0
consistency	light	3.0 ± 0.0
color	white	3.0 ± 0.0
smell	intensive	2.6 ± 0.5
feeling after use	very good	3.0 ± 0.0
skin moisturising	weak	2.0 ± 0.8
abrasive	too strong	2.4 ± 0.5

* scale 1-3, where 1 is the lowest rating; 3 is the highest rating

The sensory analysis provided by probants showed that the enzymatic hand peeling met the initial assumptions for the product. Application, consistency as well as probants feelings after cosmetic use were evaluated the highest. The lower rating was observed for smell of the enzymatic hand peeling. This parameter was evaluated as too intensive. Based on the probants' product assessment it can be seen that enzymatic hand peeling had the too strong abrasive, which can exclude the product from the group of consumers with sensitive skin. Moreover, the probants' evaluation of hand skin moisture after peeling use was average with the comments that enzymatic hand peeling give the weak feeing of skin hydration.

Conclusions

The research was provided to obtain the enzymatic hand peeling that is characterised by good exfoliating, moisturising, firming, leveling color and supporting the regeneration of the skin of the hands. The production process was carried out several times to develop the recipe of appropriate product. The obtained enzymatic hand peeling was investigated on its physicochemical properties. Moreover, the sensory analysis on the group of probants was also conducted.

The results of the study showed that using selected raw materials enabled to obtain the enzymatic hand product with the density, viscosity and pH appropriate to other cosmetic products of similar use. The sensory analysis confirmed that emulsion was acceptable in the terms of its application, color and consistency. The fragrance composition used in the formulation could be less intense. Moreover, peeling poorly moisturised the skin, which could be caused by too little moisturising substances. This problem can be solved by increasing the emollient ratio during development of new formula, which would contribute to increasing the moisturising properties of final product. The abrasive was

accepted but assessed to be too strong. In creating the next recipe, smaller abrasive particles could be used to obtain the product that is acceptable by consumers with sensitive hand skin.

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