

Research Article

Human Hair Care Using Products Containing Naturally Obtained Collagen from Salmon Skin Waste

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Abstract

The aim of the articles was to popularize the upcycling trend in the production of sustainable cosmetics and to confirm their effectiveness. For thousands of years, people have been looking for new ways to improve their appearance. To take care of their beauty, women and men around the world, in addition to using the best cosmetics and treatments, want to introduce sustainable care to alleviate the negative impact of consumerism on the environment. One of the most noticeable trends is the development of pro-ecological solutions used in everyday life, but also in industry. Manufacturers emphasize the production of more environmentally friendly raw materials. Conscious consumers choose cosmetics whose production is based on sustainable development. Instead of using waste from various industries, we used it to produce active substances used in hair cosmetics. We created the production of the collagen series in accordance with the assumptions of upcycling, obtaining collagen water that is waste generated during the production of supplements. The main aim of the work was to create cosmetic recipes for styling, washing and conditioning hair based on collagen waste, as well as to compare the results of subjects using the product in question.

Keywords: Biodegradability; Upcycling; Collagen; Cosmetics Formulations; Respect the Nature, Sustainable Cosmetics, Upcycling, Water Less, Zero Waste

Introduction

Sustainable development meets the needs of the present without compromising the livelihoods of future generations. Sustainable cosmetics starts with the product idea. Further steps involve sourcing raw material from sustainable agriculture in accordance with the Fair-Trade principle.

This trend reduces the use of water and chemicals. Production should minimize energy consumption and harmful emissions and the choice of appropriate packaging is important. Transport, sales and use are also part of sustainability. Finally, it is important to consider what happens to the product after it has been used, where the packaging will go, whether it can be reused, how it will affect the environment [1]. Recently, the beauty industry has seen the development of trends that expand the idea of producing cosmetics based on natural, environmentally safe products. We can see water less formulations on the shelves. Cosmetics also contain post-supplementation water, which is a unique post-protein waste. Collagen water filtrate contains the presence of short collagen peptides (>3000 Da) (hydroxypropolin ≥ 300 mg/L and lactic acid <2%. Water being waste from the production of dietary supplements can replace water [2]. Collagen water was obtained by ultrafiltration (MWCO) 3 kDa. The technology introduced purified water into salmon skins and then introduced lactic acid. In the next stage, water extraction of collagen proteins and peptides was carried out - collagen proteins with high molecular weight (<100 kDa) and collagen proteins with low molecular weight (>3000 Da). Then, mechanical filtration was carried out with technical parameters: pore size 5 mm (filtering biomass waste from salmon skins). The MWCO 3 kDa ultrafiltration method consisted in filtering out collagen proteins with high molecular weight (<100 kDa). These proteins are used in the food industry (dietary supplements). However, the waste obtained consists of unfiltered collagen peptides with low molecular weight (>3000Da) (hydroxypropolin) was used as recovered

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collagen water [3]. Below is a diagram of the formation of collagen water (Fig. 1,2).

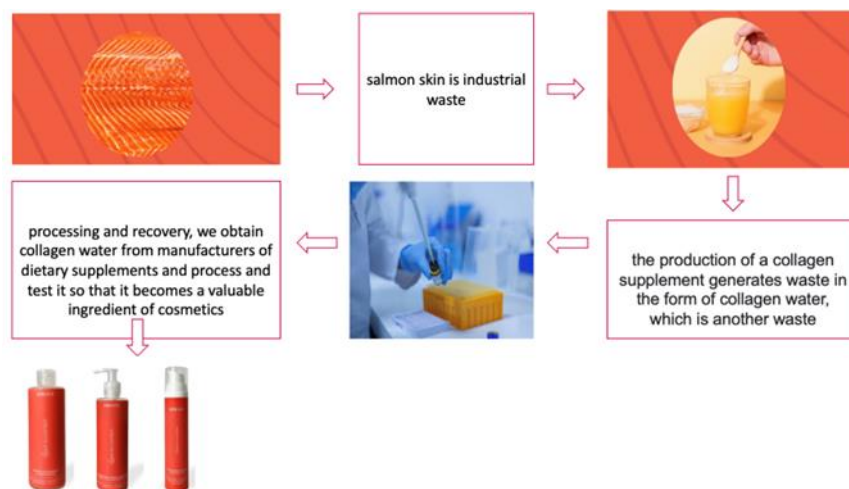


Figure 1: Changing the way of perceiving the ways of obtaining raw materials will introduce them into the economic, global circulation.

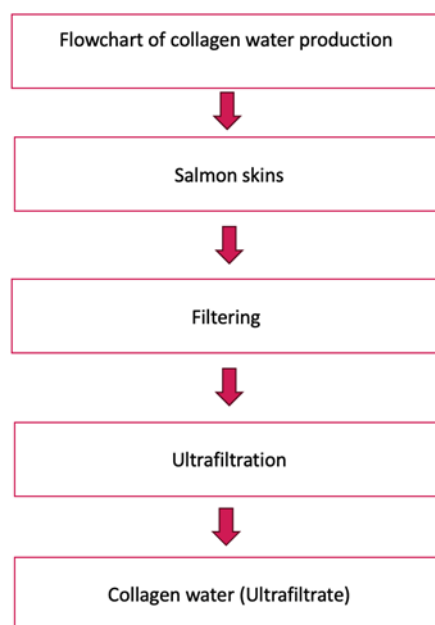


Figure 2: Flowchart of collagen water production.

The solvent used in cosmetics consists of, among others, collagen, which is most similar to our human collagen. It is therefore biocompatible. It has excellent absorption and bioavailability. Natural protein, free from impurities and with much greater cosmetic properties than animal collagen. Collagen is the main structural protein of the extracellular space in various connective tissues of animal organisms. As the main component of connective tissue, it is the most common protein in mammals, constituting from 25% to 35% of the mass of all proteins of the entire body [4]. Depending on the degree of mineralization, collagen fibers can be stiff (collagen found in bones) and more flexible (collagen found in tendons) or may have an elasticity intermediate between both borderline states (collagen found in cartilage) [5]. Collagen in the form of longitudinal fibers is found mainly in fibrous tissues such as ligaments, tendons and skin. Moreover, collagen is also found in the cornea, blood vessels, intestines, intervertebral discs and dentin [5]. Collagen is widely used in industry. Thanks to its properties as a natural moisturizing factor, it helps the skin maintain the appropriate level of hydration, thus protecting it against the loss of transepidermal water (Transepidermal Water Loss), i.e. the amount of water that diffuses through the skin from inside the body to the surrounding atmosphere. The skin aging process involves the gradual transformation of soluble collagen into an insoluble form. Insoluble collagen lost its ability to absorb water. Then the skin becomes less elastic. Soluble collagen consists of three left-

handed helices (Fig. 3), which form a right-handed helix of high molecular weight and has film-forming properties. This means that after applying the preparation to the hair, it creates a thin protective film on its surface. It makes the hair retain moisture and is more pleasant to the touch. Collagen fibers are in the α -trihelical conformation. This structure is formed by three separate α -helices. This structure is called tropocollagen. Each chain contains a characteristic sequence of left-handed amino acids of polyproline, often referred to as type II polyproline in the form of an α -helix. Each chain owes its appropriate folding to the presence of glycine, which is present at every third place of the polypeptide chain. The three chains in the α -helix conformation form a rope-like structure. They are stabilized by intermolecular hydrogen bonds. The length of the tropocollagen strand is 260 nm, its thickness is 1.5 nm and the pitch is 0.3 nm [5]. Each helical chain is surrounded by a hydration layer (not a sphere, but a cylinder), formed by a network of hydrogen bonds between water molecules and collagen peptide groups, which are acceptors [5]. The research used a soluble collagen preparation with the industrial name Collasol TMM. It is an amber-colored liquid. Its molecular weight is 300,000 Da. The preparation contains native soluble collagen similar to that found in the skin. It has hair moisturizing properties. It denatures at temperatures above 28°C. It can be used as biologically active.

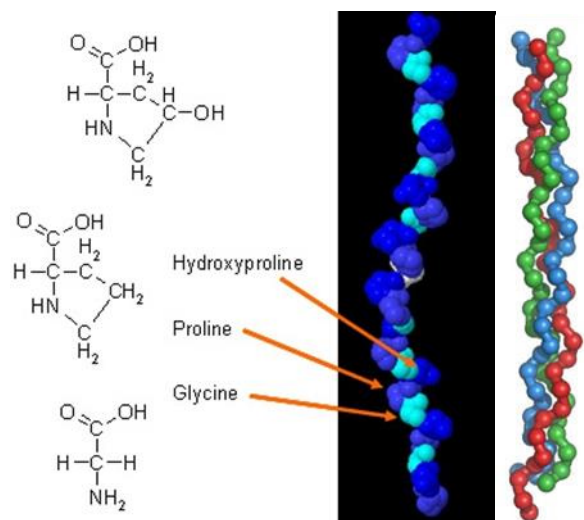


Figure 3: Diagram showing the structure of A: a single collagen fiber; B: tropocollagen - three left-handed helices forming a right-handed helix [5].

Moreover, the solubility of collagen present in fish skin allows the final product to obtain a native form of collagen - collagen hydrogel - using an extremely delicate method of obtaining this protein under conservative conditions [5]. The obtained collagen is used both in home hair care and as an active substance constituting the basis of professional treatments such as "Botox", lamination or collagen hair straightening. According to statistics, in recent years the most frequently chosen care products are hair care products. The aim of the study was to create cosmetic recipes for styling, washing and conditioning hair based on collagen waste, as well as to compare the results of test subjects using the discussed product.

Material and Methods

Materials

In the initial phase of research, cosmetics from the trichological series were created, the aim of which was to effectively eliminate scalp and hair problems. The formulas have been created in such a way as not to cause intolerance to any of the raw materials they contain. The main ingredient of the series is post-collagen water in an amount of 80% of the total weight, depending on the product.

Preparation of the Post-Collagen Water Trichological Series

The preparation of cosmetics is presented below (Table 1,2). The series consists of three products. Fig. 4 shows ready-made formulations.



Figure 4: Cosmetics with collagen from salmon skin.

Preparation of Post-Collagen Water Trichological Shampoo

Phase I was prepared in a 100 ml beaker (basis weight and names of substances are given in Table 1). Phase I was heated to the temperature of about 60°C in a water bath, transferred to a magnetic stirrer and allowed to reach the temperature of 40°C. Phase II was heated, combined with phase I and then homogenized to a homogeneous consistency using the IKA T 50 basic Ultra-Turrax homogenizer with rotational speed of 6000 rpm [6,7]. Phase III was then weighed out, heated to 40°C and added to the mixture while stirring. Phase IV and V was weighed, heated to 35°C and magnetically combined with other phases when the target temperature of 35°C was reached. The mixture was continuously vigorously stirred. It was left on the stirrer to cool completely. Straw-colored shampoo was obtained (Fig. 4). Bearing the importance of the pH value in mind, all products are characterized by the pH value of 5.50 [± 0.3].

INCI	Content, % up to 100 [$\pm 6,00$]
Phase 1	
Aqua	Rem
Collagen Water Filtrate	30
Decyl Glucoside	40
Sodium Cocoyl Isethionate	20
Hydroxyproline, Saccharomyces Cerevisiae (Yeast Hulls)/ Hexapeptide-11 Ferment Lysate, Linum Usitatissimum Seed Extract, Pyrus Malus Fruit Extract/Pectin, Lactobionic Acid, Panthenol	0,50 -2,00
Phase 2	
Guar Hydroxypropyltrimonium Chloride Trisodium methylenediamine discuccinate Gluconolactone, Calcium Gluconate	0,50 -1,00
Benzyl Glycol, Ethylhexylglycerin, Raspberry Ketone, Sodium Benzoate, Potassium Sorbate, Sodium Levulinate, Citric Acid	0,50 -1,50
Linalool, d-Limonene, Geraniol, Parfum	0,50 -1,30

Table 1: Ingredients of shampoo.

Preparation of Post-Collagen Water Trichological Conditioner

The oil phase was prepared in a 100 ml beaker (basis weight and names of substances are given in Table 2). Phase I was melted in a water bath (80-85°C). Phase II was heated to the same temperature and then mixed. Both were stirred for 30 minutes. After the mixture had cooled to 55°C, it was homogenized until a homogeneous emulsion was obtained with the IKA T 50 basic Ultra-Turrax homogenizer with rotational speed of 6000 rpm [6,7]. Phase III was heated to 35°C and magnetically combined with other phases when the target temperature of 35°C was reached. The mixture was continuously vigorously stirred. It was left on the stirrer to cool completely. A white homogeneous emulsion was obtained (Fig. 4).

INCI	Content, % up to 100 [$\pm 6,00$]
Phase 1	
Cetearyl Alcohol, Caprylic/Capric Triglyceride, Prunus Amygdalus Dulcis Oil, Polycitronellol, Isodecyl Oleate, Cetyl Palmitate, Cetyl Alcohol, Behentrimonium Methosulfate, Hydrogenated Vegetable Oil	5.00 - 13.00
Phase 2	
Collagen Water Filtrate	Rem
Phase 3	
Trisodium Ethylenediamine Disuccinate, Hydroxyproline, Pyrus Malus Fruit Extract/Pectin, Linum Usitatissimum Seed Extract, Uncaria Tomentosa Extract, Lactobionic Acid, Citric Acid	0,50 -1,50
Benzyl Glycol, thylhexylglycerin, Raspberry Ketone, Sodium Benzoate, Potassium Sorbate, Sodium Levulinate	0,50 -1,50
Linalool, d-Limonene, Geraniol, Parfum	0,50 -1,30

Table 2: Ingredients of conditioner.

Preparation of Post-Collagen Water Trichological Laminate

The oil phase was prepared in a 100 ml beaker (basis weight and names of substances are given in Table 3. Phase I was melted in a water bath (80-85°C). Phase II was heated to the same temperature and then mixed. Both were stirred for 30 minutes. After the mixture had cooled to 55°C, it was homogenized until a homogeneous emulsion was obtained with the IKA T 50 basic Ultra-Turrax homogenizer with rotational speed of 6000 rpm [10,11]. Phase III was heated to 35°C and magnetically combined with other phases when the target temperature of 35°C was reached. The mixture was continuously vigorously stirred. It was left on the stirrer to cool completely. A white homogeneous emulsion was obtained (Fig. 4).

INCI	Content, % up to 100 [$\pm 6,00$]
Phase 1	
Aqua	Rem
Pectin, (Soluble Collagen), Saccharomyces Cerevisiae (Yeast Hulls)/Hexapeptide-11 Ferment Lysate, Pyrus Malus Fruit Extract/Pectin, Lactobionic Acid, Gluconolactone, Panthenol, Calcium Gluconate	5 -15
Phase 2	
Linum Usitatissimum Seed Extract	5-15
Phase 3	
Collagen	Rem
Polysorbate 20, Citric Acid, Trisodium Ethylenediamine Disuccinate,	0,50 -1,50
Phenoxyethanol, Ethylhexylglycerin, Sodium Benzoate, Potassium Sorbate	0,50 -1,50
Linalool, d-Limonene, Geraniol, Eugenol, Coumarin, Parfum	0,50 -1,30

Table 3: Ingredients of laminate.

Studies Confirming the Safety and Manufacturer's Declarations of HISHER Products

Studies confirming the safety and manufacturer's declarations of HISHER products In the further part of the experiment, tests were carried out in accordance with the Act of October 4, 2018 on cosmetic products (Journal of Laws of 2018, item 2227) [8]. Their aim was to assess the impact of the cosmetic on the safety of use for human health - including testing of skin tolerance to

the tested cosmetics at the point of use. The experiment was carried out after obtaining the consent of the Bioethics Committee, resolution No. 692/23. The tests confirm or exclude the properties and effects of the formulation declared by the manufacturer. The experiment was carried out in the homes of the probands and at the Dermatology Center (Centrum Dermatologii Sp. z o. o.) in Poznań, with the participation of a dermatologist, chemist and cosmetologist. Before applying the cosmetics, physical and subjective examinations of volunteers were performed in accordance with the Helsinki Declaration of 1964 (with subsequent amendments), Polish and EU regulations and COLIPA guidelines, using the criteria for inclusion and exclusion from the study. Based on the results of the tests, no strong sensitizing or irritating properties of the tested product were found. A group of 30 probands who met the indications for use of the products were selected for the study. The volunteers were divided into two groups: 15 people received only cosmetic masses. Another 15 people received full-value products. The procedure was performed as a double-blind trial. Methodology of the research: at home (home panel). People qualified for the study received one package of the set (the same weight as well as full-value products). The volunteers committed to using the received samples regularly, in accordance with the rules of use suggested by the manufacturer. Test subjects should not use preparations with the same or similar purpose during the test. The volunteers were to observe the reaction of the scalp and hair at the application sites. They should note in detail their comments regarding the functional properties of the tested cosmetics. If any negative symptoms occurred at the site of application of the formulations, they should stop using them and immediately contact the person conducting the test. The study participants were not given any special requirements, assuming that the effects of this type of cosmetic should be tested in natural conditions in which they will be used in practice. The results of the experiment could only be influenced by such factors as health status, type and condition of hair and scalp skin, genetic conditions, individual characteristics, individual preferences, lifestyle, environmental conditions, etc. The research lasted 100 days [8].

Apparatus Tests Carried Out with the Help of TrichoScope Polarizer Dino-Lite (MEDL4HM)

The research used the imaging method involving a trichological microcamera with the assessment of the condition of the skin and the follicular area. TrichoScope Polarizer Dino-Lite (MEDL4HM) is a device designed for the examination of the scalp and hair analysis. With a very high magnification, up to 200 times, a single hair can be viewed in great detail. The built-in polarization filter minimizes the effect of glare on the scalp or hair [9]. As already mentioned, the collagen laminate study was conducted in cooperation with the Symbiosis Dermatology Center on a group of 30 probands. Before starting the test, each volunteer was assigned a cosmetic sample. For the subsequent 100 days, the study participants were asked to test the samples at home (in-home-use-test methodology). With the help of a microcamera, the experimenter examined the condition of the scalp area and hair of the patients before and after using the preparations. A blank test was performed prior to starting product application. The second test was carried out after 100 days, during which the probands undertook to use the preparation regularly.

Apparatus Test Performed Using the SEM (Scanning Electron Microscope) Method

During the blank test, hair was collected from the probands' both temples, the center of the head and the occiput in order to perform imaging studies using a scanning electron microscope. SEM is a kind of electron microscope enabling the observation of the topography of the tested material (hair). It is used to observe materials on a nanometric to micrometric scale. With scanning microscopy, it is possible to precisely establish the hair morphology, the condition of the hair bulb and stem, the type and size of damage to the hair tissue, as well as to identify factors affecting the hair to determine its structural changes or to analyze its chemical composition. After a hundred days, the test was repeated. Subsequent samples were taken from all probands and imaging was performed using SEM. All participants remained in the study until the end [10].

Results and Discussion

Instrument Tests Performed using the TrichoScope Dino-Lite polarizer (MEDL4HM)

Probands using the collagen series and preparations not containing post-collagen water during the blank test and after 100 days. The research used a trichological microcamera imaging method to assess the condition of the skin and follicular area (TrichoScope Polarizer Dino-Lite (MEDL4HM)). The set of photos presented below shows the difference before the application of the collagen laminate and after the 100-day test. In the most severe cases, the frequency of follow-up examinations has been increased. The Fig. 5-8 show different areas of the scalp. Additionally, as a control group, people who applied synthetic organosilicon polymers to the scalp and hair were examined.

Patient A and B (day 0) - a group of patients who applied cosmetic masses.



Figure 5: (A): Photo of the probands' scalp before applying cosmetic masses; (B): Photo of the probands' scalp before applying cosmetic masses.

Patient A and B (100-day) - a group of patients who applied cosmetic masses.



Figure 6: (A): Photo of the scalp of subjects who applied cosmetic masses; (B): Photo of the scalp of subjects who applied cosmetic masses.

In the above patients, the symptoms of epidermal exfoliation disappeared. Improper hair care increases its pH value. Alkaline pH leads to the development of many dermatoses. The consequence of which is the occurrence of seborrheic dermatitis of the scalp. In some probands, the lesions developed into irregular erythematous macules with yellow crusting. There were also extensive inflammatory lesions covering the entire surface of the scalp [11]. A scab is formed from a dried layer of dead skin and sebum. Additionally, patients complained about itchy wounds that they often scratched. My hair was also thinning. After using cosmetic masses carefully selected according to the recipe, we can notice that the changes have calmed down. Properly selected emollients and non-aggressive auxiliary substances are responsible for this effect.

Patient X and Y (day 0) - a group of patients who used a series with collagen obtained from salmon skin.



Figure 7: (A): Photo of the probands' scalp before applying series with collagen obtained from salmon skin; (B): Photo of the probands' scalp after applying series with collagen obtained from salmon skin.

Patient X and Y (100-day) - a group of patients who used a series with collagen obtained from salmon skin.



Figure 8: (A): Photo of the scalp of probands V and X who used the salmon skin collagen series; (B): Photo of the scalp of probands V and X who used the salmon skin collagen series.

Patients using the collagen series can see complete elimination of excessive sebum secretion, restoration of normal pH and reduction of skin inflammation. Based on the tests carried out, it can be concluded that the active substances used confirm the effects declared by the manufacturer. After just one application of the series, the scalp was cleansed [12]. The substances used in the product are responsible for this effect. One of the few forms of collagen that is not subject to chemical processing in cosmetology and trichology is type III collagen - alternatively called native collagen or tropocollagen [13]. Type III collagen is most often obtained from fish skin. Recently, the consumption of marine collagen isolated from fish processing waste, such as skin, bones, fins, scales, etc., has been increasing. Using waste instead of throwing it away allows for maximum use of resources and is undoubtedly an environmentally friendly approach [14]. The source of marine collagen created by our laboratory was fish. It is also important that collagen obtained from marine resources is biocompatible and has a low risk of allergy; Moreover, it is soluble in water, biodegradable and easy to obtain [15]. It is these features of collagen obtained from seawater resources that made it the main ingredient of the product. The preparation uses collagen derived from fish skin, which plays a role analogous to tropocollagen. Moreover, it is characterized by a low molecular weight, thanks to which it effectively soothes irritations and supports skin regeneration [16-20]. Unfortunately, after 100 days of the study, no improvement was achieved in the control group using only preparations with synthetic organosilicon polymers. As already mentioned, these polymers create a strong occlusive film that does not allow the scalp to breathe and active substances that could improve the condition of the probands' skin penetrate deeper.

Apparatus Test Performed Using the SEM (Scanning Electron Microscope) Method

Based on tests carried out using a Scanning Electron Microscope (SEM), which allows the observation of the topography of the examined hair, differences in their condition can be noticed (blank sample and tests after 100 days). The list of photos below shows the difference before applying the cosmetic mass (without active substances) and after the 100-day test (Fig. 9,10). The next compilation of photos shows the difference before using the collagen series and after the 100-day study (Fig. 11,12). In the most severe cases, the frequency of follow-up examinations has been increased. The photos below were taken for different areas of the scalp.

Patient A and B (day 0) - a group of patients who applied cosmetic masses (Fig. 9).

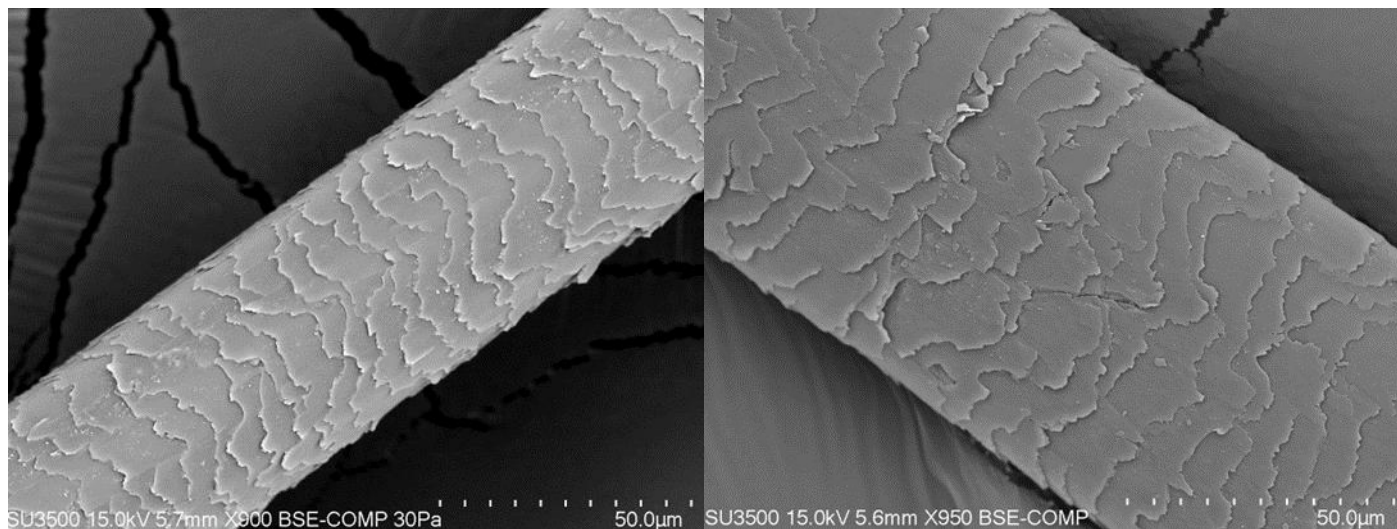


Figure 9: (A): Photograph of proband A's hair before applying cosmetic mass (50 microns × 900, 15 kilowatt hours); (B): Photo of proband B's hair before applying cosmetic mass (50 microns × 560, 15 kilowatt hours).

Patient A and B (100-day)- a group of patients who started using cosmetic masses (Fig. 10).

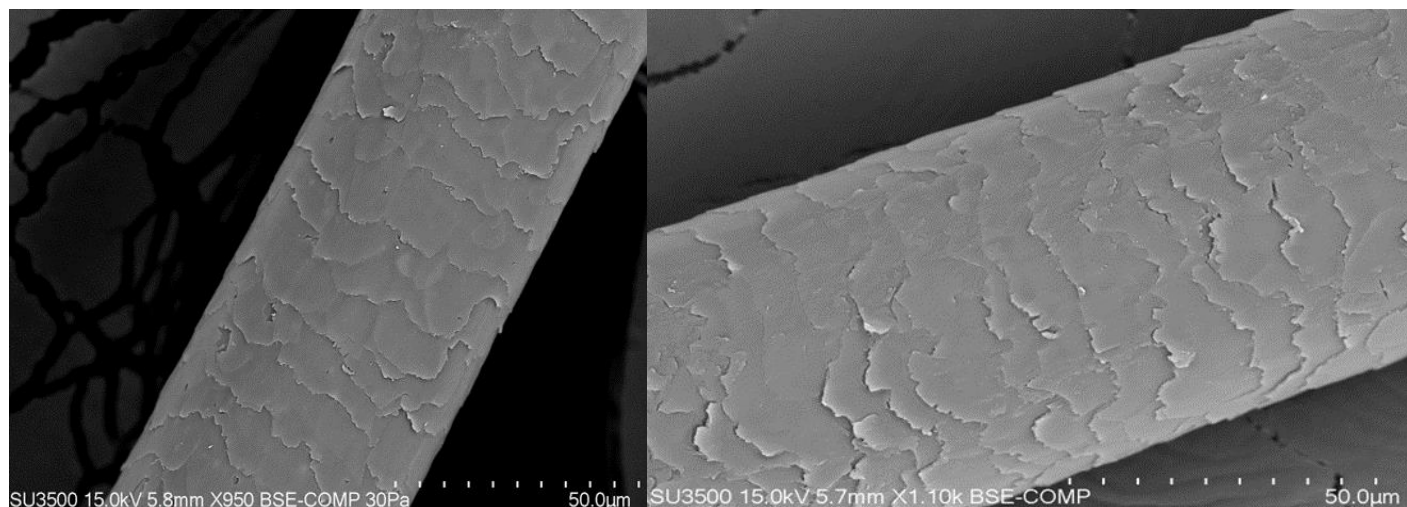


Figure 10: (A) Photograph of proband A's hair after application of cosmetic mass (50 microns × 950, 15 kilowatt hours); (B): Photograph of proband B's hair after applying cosmetic mass (100 microns × 570, 15 kilowatt hours).

SEM analysis of the hair structure using a scanning electron microscope confirmed its layered structure. Fig. 7 and 8 show the outer layer of the hair - the cuticle. Visible torn, cracked and open hair cuticles indicate a high degree of damage. As you can see in the photo showing the hair before using the product, it was damaged and recognizable by the hair cuticle with open cuticles. The covering consisting of open scales gradually ceases to fulfill its protective function. The cuticles open, among others, under

the influence of alkaline pH and heat, which results in excessive sunlight, mechanical treatments and improper styling using aggressive chemicals. The study participants subjected their hair to mechanical and thermal treatments as well as the use of chemicals. Open cuticles cause the hair to lose water faster and become dry, dull, rough and more sensitive to external factors [21-25].

Patient X and Y (day 0) - a group of patients who used a series with collagen obtained from salmon skin (Fig. 11).

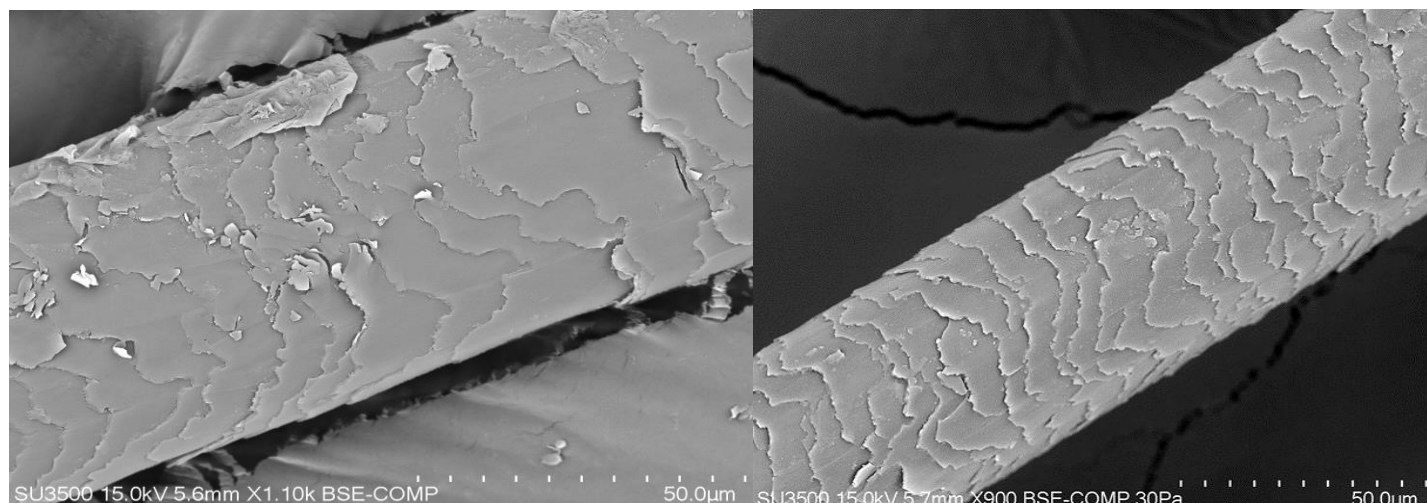


Figure 11: (A): Photo of proband V's hair before using a series with collagen obtained from salmon skin (50 microns × 560, 15 kilowatt hours); (B): Photo of proband X's hair before a series with collagen obtained from salmon skin (50 microns × 570, 15 kilowatt-hours).

Patient V and X (100 days)- a group of patients who started using a series with collagen obtained from salmon skin (Fig. 12).

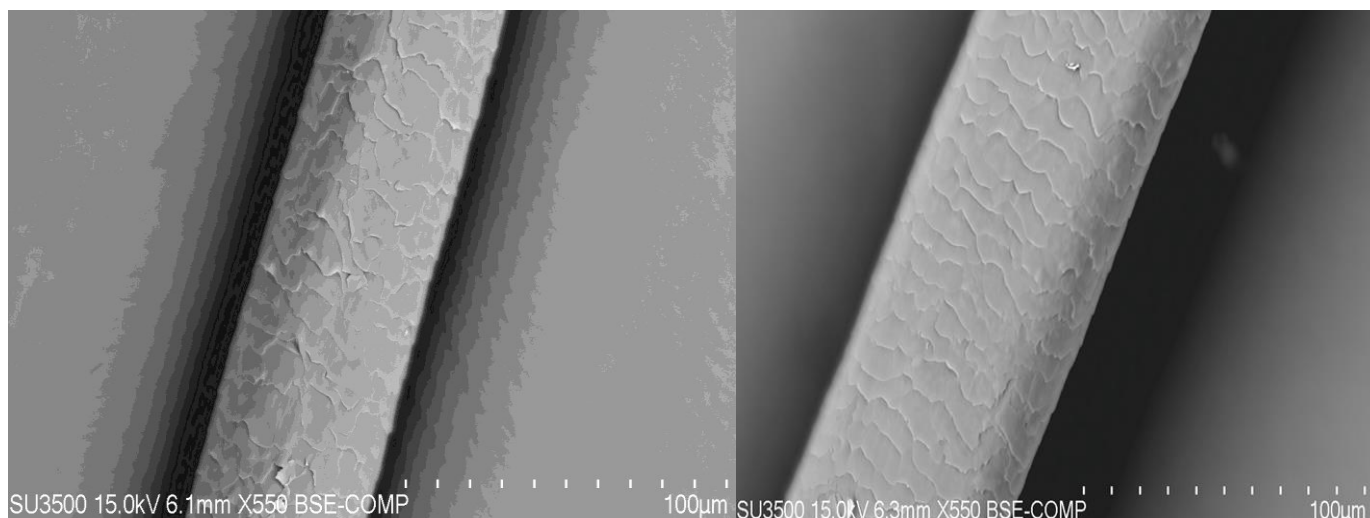


Figure 12: (A): Photo of proband V's hair using a series with collagen obtained from salmon skin (100 microns × 610, 15 kilowatt-hours); (B): Photo of proband X's hair using a series with collagen obtained from salmon skin (100 microns × 630, 15 kilowatt-hours).

It can be said that the mechanism of action of collagen with a low degree of hydrolysis ($M = 125,000$) consists in the production of a protective film that closes the exposed cuticles and the cortex of the hair. It was found that further application would result in an increased protection through the closure of hair cuticles, i.e., improvement of their condition [25-28]. These substances strengthen the hair fibers, smoothen the hair surface, improve resistance and give shine. Biomimetic ceramides are combined with avocado and grape oil. They contribute to the strengthening of the hair structure. Fig. 8 shows the test subjects who continued to use only the cosmetic masses, in whom no major changes in the hair structure were observed [29,30].

Conclusion

Our hair is exposed to many negative factors. Knowledge of the biochemical structure of collagen results from knowledge of its amino acid composition. The triple helix of collagen is composed of three chains of tropocollagen connected to each other by covalent bonds by introducing glycine into the middle. The helical structure can be obtained with alanine, glutamine, histidine, leucine, methionine, tyrosine and tryptophan. Valine and isoleucine, due to the large size of their chains, cannot participate in the formation of the helix generator structure. Serine, threonine, proline and hydroxyproline provide good helix structures. The first two groups combine hydrogen bonds to form their hydroxyl groups. In the case of proline, the atomic atoms are located in a heterocyclic compound, which excludes the possibility of rotation around the carbon-nitrogen bond and the formation of hydrogen bonds inside. Proline's first proposition is that the chain can bend or even form a loop. Thanks to the use of natural, biodegradable collagen combined with Hexapeptide-11 peptide encapsulated in yeast (INCI: *Saccharomyces Cerevisiae* (Yeast Hulls)/ Hexapeptide-11 Ferment Lysate), Linseed extract (INCI: *Linum Usitatissimum* Seed Extract), UPCYCLING apple pomace pectin (INCI: *Pyrus Malus* Fruit Extract/Pectin) Glucanolactone (INCI: Gluconolactone), Biodegradable silicone analogue (INCI: Polycitronellol+Hydrogenated Vegetable Oil), Fluffy cap tuber extract (INCI: *Uncaria Tomentosa* Extract) and Sweet almond oil (INCI: *Prunus Amygdalus Dulcis* Oil) an alternative to controversial synthetic organosilicon polymers has been created. This alternative also creates an occlusive film that prevents the negative effects of solar radiation, temperature changes, pollutants, pathogens and aggressive hair styling products. Additionally, the product is obtained from natural waste, which protects our environment. Collagen cosmetics are universal products that can be used for washing, conditioning and styling hair. The developed method allows obtaining native collagen in the final product. Obtained in this way. In this way, collagen can be used not only in the form of a gel or solution, but also in solid form, replacing the previously used bovine collagen. The obtained collagen in the form of a gel was used as a hair care product. Based on the assessment of the situation, the condition of the hair and skin can be improved 100%.

The effectiveness declared by the manufacturer for shampoos was confirmed in terms of assessing cleanliness, cleaning and giving a slight shine. The shampoo also prevents static electricity, tangling and drying of the hair. This effect can be achieved thanks to the content of hydroxyproline. On the contrary, research on mask and laminate is checked for its effectiveness in imparting thickness, secondary softness and shine. These products were delivered to end devices and eliminated wireless conditions, peeling and itching. In the future, the authors intend to present further apparatus tests confirming the effectiveness of the tested products containing upcycled collagen water.

Conflicts of Interests

The authors declare that there is no conflict of interest for this paper.

Funding

This research received no external funding.

Ethical Statement

Institutional Review Board Statement: Bioethics Committee consent, resolution number 692/23 (Ethical Approval and Consent to participate and Human Ethics).

Informed Consent Statement

Not applicable.

Supplementary Materials

The following supporting information can be downloaded at: www.mdpi.com/xxx/s1, Figure S1: title; Table S1: title; Video S1: title.

Data Availability Statement

The data presented in this study are available on request from the corresponding author.

Institutional Review Board Statement

Bioethics Committee consent, resolution number 692/23.

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Author Contributions

Conceptualization, J.I.-K.; methodology, J.I.-K. and E.K.-P.; software, J.I.-K., E.K.-P. and M.S.; validation: J.I.-K. and E.K.-P.; formal analysis, J.I.-K.; investigation, J.I.-K.; resources, J.I.-K., E.K.-P. and M.S.; data curation, J.I.-K.; visualization, J.I.-K.; supervision, E.K.-P. and M.S.; project administration, J.I.-K.; writing-original draft preparation, J.I.-K.; writing-review and editing, J.I.-K., E.K.-P. and M.S. All authors have read and agreed to the published version of the manuscript.

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