Review article / Artykuł przeglądowy

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Snail mucus as an innovative ingredient used in the cosmetology and medical industry

Śluz ślimaka jako innowacyjny składnik stosowany w kosmetologii i medycynie

ABSTRACT

Snail slime is obtained from *Helix aspersa* Müller and *H. aspersa var. maxima*. Two types of mucus are obtained: lymosine and cryptosine, the one used in medicine and cosmetology.

The work aimed to present the method of obtaining snail slime, to analyze its qualitative and quantitative composition and properties based on literature data.

This raw material, in addition to antibacterial, antifungal, antimicrobial, antiviral and anticancer properties, also has antioxidant, regenerative, stimulating, moisturizing, nourishing, cleansing, anti-wrinkle and sunscreen properties. This gives the opportunity to widely use mucus in the cosmetic and medical industries.

Keywords: cosmetic industry, medical industry, cryptosine, beauty, health, natural ingredients

STRESZCZENIE

Śluz ślimaka pozyskuje się ze ślimaków z gatunku *Helix aspersa* Müller oraz *H. aspersa* var. *maxima*. Otrzymywane są dwa rodzaje śluzu: limozyna oraz kryptozyna stosowana w medycynie i kosmetologii.

Celem pracy było przedstawienie sposobu pozyskiwania śluzu ślimaka, analiza jego składu jakościowego i ilościowego oraz właściwości na podstawie danych literaturowych.

Surowiec ten, oprócz działania przeciwbakteryjnego, przeciwgrzybiczego, przeciwdrobnoustrojowego, antywirusowego oraz przeciwnowotworowego, wykazuje także właściwości przeciwutleniające, regeneracyjne, stymulujące, nawilżające, odżywcze, oczyszczające, przeciwzmarszczkowe, a także promieniochronne. Daje to możliwość szerokiego wykorzystywania śluzu w przemyśle kosmetycznym oraz medycznym.

Słowa kluczowe: przemysł kosmetyczny, przemysł medyczny, kryptozyna, uroda, zdrowie, naturalne składniki

INTRODUCTION

Snails are a numerous and diverse group of organisms that systematically belong to *Gastropoda*, a class of the phylum *Mollusca*. About 105,000 species of these organisms are known and described so far in the world. The highest contribution in this number are snails found in the seas and oceans, and over 30,000 are terrestrial species. There are about 60 aquatic species in Poland, 6 are marine, and over 175 terrestrial [1]. *Helix aspersa* Müller and *H. aspersa* var. *maxima*, which come from farm breeding, are most often used to obtain mucus as a cosmetic raw material [2].

Snail slime is a clear, slightly amber liquid with a pH value of 4.80 and a density of 1.02 g/ml. It contains many active ingredients, including: allantoin, elastin, collagen, proteins, antioxidants, enzymes, metal ions, proteoglycans, glycosaminoglycans, vitamins, minerals as well as mucin, mitamycin AF and achacin.

The mucus obtained from snails is a cosmetic raw material, rich in many ingredients that exhibit beneficial effects on human skin. It can be found mainly in facial care products as it demonstrates regenerative properties of the skin after mechanical damage or sunburn and reduces imperfections and discoloration [3]. Moreover, snail mucus promotes the longevity of fibroblasts and the structure of the extracellular matrix, thus delaying the symptoms of skin ageing [4]. Such valuable properties of snail mucus for human skin were the reason to describe in this work the production, the qualitative and quantitative composition, features and potential cosmetic and medicinal utilization based on literature data.

To obtain the mucus, electrical stimulation and compounds irritating and stimulating the secretion of mucus by snails are used. This raw material cannot be produced artificially in a laboratory.

SNAIL MUCUS EXTRACTION

The body of snails consists of various furrows and wrinkles of a permanent or temporary nature. Permanent indentations/furrows allow the snails to clear the body or the mucus to pass through. There are two types of mucus, the one produced by all species that permits movement (limosin) and the species-specific secreted in response to severe irritation (cryptosin). The color, structure and density of mucus are taxonomic features [5]. Limosine is a clear mucus made up mostly of water, while cryptosine is foamy and thick. In the cosmetic and pharmaceutical industries, only cryptosin is used, which is obtained in a way not to exert a harmful effect on these organisms [2]. Since the stress affecting the snails causes the release of toxic substances into the mucus, it must be filtered to obtain microbiologically clean raw material [6].

One of the methods of obtaining mucus, as a cosmetic raw material, is electrical stimulation at low voltage [7-8]. This technology is described as modern and harmless to snails. The mollusks, along with distilled water, are placed in a special device and electrically stimulated at low voltage, and then returned to breeding. The obtained mucus is homogenized, centrifuged and filtered. This method enables multiple extractions of the raw material [7-8].

Another method of obtaining mucus is the use of 3% sodium chloride (NaCl) as a compound that irritates and stimulates the production of mucus [3]. NaCl also affects the amount of protein in the raw material. This method allows obtaining about 600 ml of extract from 500 snails. In the next stages, the mucus is sterilized and filtered.

THE COMPOSITION OF THE SNAIL MUCUS

The composition of snail mucus varies depending on the species, role and degree of adhesion. Usually, it contains from 90% to about 99.7% of water [9]. The remainder is a mixture of many active substances [10]. The properties and composition of the *Helix aspersa* Müller mucus filtrate are presented in Table 1.

Table 1 Properties and composition of the *Helix aspersa* Müller mucus filtrate

Specification	Values	Specification	Values
Aspect	Clear liquid	Glycolid acid	0.99 g/100 g
Color	Slightly amber	Hyaluronic acid	< 0.1 g/100 g
pH	4.80	Elastin	0.092 g/100 g
Refractive index	1.3405	Collagen	0.32 g/100 g
Density	1.02 g/ml	Trans-retinol	< 0.10 g/100 g
Dry weight	3 g/100 g	13-cis-retinol	<10 g/100 g
Protein content	1.54 g/100 g	Chromium (Cr)	0.007 mg/kg
Vitamin E	< 0.10 mg/kg	Copper (Cu)	5.04 mg/kg
Vitamin C	0.13 mg/kg	Mercury (Hg)	0.22 mg/kg
Vitamin B12	< 10 g/100 g	Cadmium (Cd)	0.012 mg/kg
Vitamin B3	< 10 g/100 g	Cobalt (Co)	<0.001 mg/kg
Allantoin	0.081 g/100 g	Nickel (Ni)	0.820 mg/kg

Source: [11]

Snail mucus contains allantoin, collagen, elastin, glycolic acid, natural peptides and proteins, vitamins A, C and E, as well as antioxidants (e.g. polyphenols) and enzymes (superoxide dismutase - SOD and glutathione S-transferase - GST). Among the metal ions, copper (Cu), iron (Fe) and zinc (Zn) were found [2]. The other ingredients are proteoglycans, glycosaminoglycans - including hyaluronic acid, copper peptides, and antimicrobial peptides [9, 12], as well as lactic acid, matrix metalloproteinases and their inhibitors [13]. Snail mucus also contains mucin, mitamycin AF and achacin [9]. Mucin is the main macromolecular component of mucus, which is responsible for its regenerative properties. Mucin contains active antimicrobial proteins against gram-positive and gram-negative bacteria [9, 14]. Their activity was found against *Pseudomonas aeruginosa* AP9 and *Bacillus laterosporus* BT271 [15], *B. subtilis, Staphylococcus aureus* and *Escherichia coli* [16].

The antibacterial, antifungal and antiviral properties of mucus were confirmed by *in vitro* studies [17]. Moreover, it has an antioxidant effect, and ingredients such as allantoin, hyaluronic acid, polypeptides and proteins show regenerative and stimulating properties. Snail mucus, due to its high content of active substances, is a raw material that cannot be synthetically produced in a laboratory [18].

SNAIL MUCUS IN COSMETOLOGY

Snail mucus is used in skin care products by various companies. The nomenclature given in the Cosmetic Ingredient Database (CosIng) indicates that the following cosmetic raw materials from snail mucus are used in cosmetics in the European Union: Snail secretion filtrate (INCI: *Snail Secretion Filtrate*) and fermented snail secretion/slime filtrate (INCI: *Saccharomyces* / *SnailSecretion Filtrate Ferment Filtrate*). The most common raw material in cosmetics is *Snail Secretion Filtrate* [19].

In the past, pure snail mucus was applied to the skin, today it is not only used in its pure form in beauty treatments, but also as an ingredient in cosmetic products [20]. It is used in lotions, creams, masks and peelings [21]. The mucus obtained from *Achatina fulica* and *Cornu aspersum* is commonly found in Korean cosmeceuticals due to its antimicrobial and skin-regenerating properties [22]. Their mucus is very similar to hydrogel [23].

The effectiveness of snail secretions was already studied by the ancient Greeks. Hippocrates crushed snails and used them to reduce skin inflammation. In Italy, snails were collected and used to treat dermatological diseases such as acne, warts and calluses. The skin-promoting benefits of snail mucus were discovered by Chilean farmers after their wounds healed rapidly on exposure to the secretions. The first cream based on *H. aspersa* mucus was produced in 1993, and two years later the Chilean brand *Elicina* launched the product on the market [18, 24].

Truchuelo and Vitale [25] indicated that the use of products containing snail mucus reduces the risk of side effects associated with laser therapy, e.g. erythema, burning sensation and dryness. The product containing 40% mucus of *Cryptomphalus aspersa* was applied on the skin of 20 women in the 45–65 age group. The effect on the skin regeneration process after product application, and in combination with a series of treatments using a non-ablative fractional laser was assessed. The women applied serum containing snail mucus to the facial skin for 28 days. It was found that the value of transepidermal water loss decreased by 11%, and the depth of wrinkles in the area of the skin treated with the snail mucus serum also decreased by approx. 38%.

Snail mucus has moisturizing, nourishing, soothing, exfoliating, cleansing, anti-wrinkle and ultraviolet radiation-absorbing properties. It reduces acne, wrinkles and stretch marks [26-28] as well as the signs of skin photoaging and also damage caused by free radicals [29-30]. Trapella et al. [3] proved that mucus obtained from HelixComplex can promote cell migration and support the wound-healing process. *H. aspersa* mucus has an antibacterial effect and accelerates the reconstruction of damaged skin [3, 31-32]. In turn, Gentili et al. [33] proved that the mucus obtained from this snail species was protective against damage caused by ozone, thus highlighting the possibility of using a given raw material as a new method of protection against contamination. Lim et al. [34] showed in *in vitro* studies that the active snail mucus extract had a positive effect on skin ageing (including transepidermal water loss (TEWL), number of wrinkles, skin roughness and elasticity). Whereas Mencucci et al. [35] showed that the solution extracted from snail mucus (GlicoPro ®) reduces the biomarkers of inflammation and eye damage. The anti-inflammatory, analgesic and moisturizing properties of the cornea were proven. Due to the above, the mucus can be used in the treatment of atopic dermatitis, psoriasis, burns, ulcers and acne [2].

SNAIL MUCUS IN MEDICINE

The healing properties of snail mucus were mentioned in antiquity by Hippocrates and Pliny [12], but the possibility of its use in medicine is still the subject of many studies. The mechanism of action of many substances contained in snail mucus is still not well understood. Nevertheless, it is used in skin care products, wound healing agents, surgical adhesives and for the treatment of gastric ulcers [36]. In turn, mucin which is isolated from snail mucus has a wide range of applications in chemistry, biology, biotechnology and biomedicine. It affects the healing of wounds, facilitates the formation of new tissues and enhances the natural regenerative response [37-38].

Snail mucus affects the viability of cells, stimulates the proliferation of fibroblasts, and may also participate in the transformation of the extracellular matrix [14]. It increased the migration and expression of cell-cell adhesion and cell-substrate adhesion molecules in keratinocytes and fibroblasts in mammals [9, 39-40]. It is also possible to use cochlear mucus for the reconstruction and repair of bones and teeth, because it increases the expression of osteopontin and NF-$_{K}$B, and induces the expression of typical inflammatory genes in pulp cells [9, 41]. Snail mucus consists of active substances, which include heparan sulfate, isolates, and calcium. Isolates have an analgesic and antibacterial effect, while calcium is responsible for the proper maintenance of constant parameters in the body [42]. Noothuan et al. [43] found that mantle mucus had greater antimicrobial activity than the leg in both *Lissachatina fulica* and *Hemiplecta differa* species.

Helix aspersa mucus inhibits the production of melanin and the action of tyrosinase [43]. Based on the above, it heals melanogenesis and has anti-cancer properties against human melanoma cells [44]. In Italy, snails are used in the treatment of dermatological diseases, their mucus is rubbed into the skin to heal inflammation and acne, accelerate wound healing, and treat warts [45].

SUMMARY

Snail mucus is material of a natural origin that is a source of valuable active ingredients.

Due to the content of vitamins, allantoin, acids and proteins fulfilling specific roles, snail mucus has many applications used in skin care. Snail mucus accelerates the healing of wounds and sunburns. It nourishes the skin, reduces imperfections, and protects against free radicals. The varied composition allows the use of snail mucus according to the needs of the skin.

Products that contain snail mucus make it possible to rejuvenate and beautify the skin. They can be used to treat skin diseases, such as melanoma, acne, and inflammation, as well as burn wound infections.

The presence of a very large amount of nutrients makes snail mucus widely used in cosmetics and medicine, but at the same time, it makes it impossible to produce it artificially in the laboratory.

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