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Beneficial properties of snail slime, its use in medicine and cosmetology – a review of current research

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ABSTRACT

The purpose of this chapter is to present the mucus produced by snail in terms of its practical application in modern cosmetology and medicine. Due to the development of the pharmaceutical industry, laboratories around the world carry out research on the acquisition of natural, non artificially synthesized substances that can be used as cosmetics or medicines. The side effects of using synthetic pharmaceuticals are chronic allergic and allergic reactions. Natural substances produced by animals, including e.g. by snails may in future be a cheap, available and alternative raw material used in the cosmetics industry and in medicine (Domínguez-Martín, 2020; Cristiano, 2022).

Due to its antibacterial, regenerative, antioxidant and rejuvenating properties, snail slime is used in cosmetology and dermatology. It is also used in medicine in anti-cancer therapy. Studies have shown antisuppressive effects in skin cancers (melanoma), and also in breast, lung, colon and bladder cancers. Studies have confirmed the effectiveness of snail mucus in allergic skin diseases, e.g. atopic dermatitis, in some respiratory diseases and unusual allergic and asthmatic diseases. It has also found application in the treatment of stomach ulcers and helps in lowering sugar levels in diabetes. It is recommended for extensive burns in the natural stimulation of wound healing. There are also mentions that the copper peptides contained in the snail slime may affect hair growth by stimulating the progenitor stem cells.

The effect of snail mucus in humans on skin viruses, especially the herpes virus HSV, belonging to the family of Herpesviridae, is special, and perhaps, being an affinity for the mucous membranes of the lung epithelium, it may in the future be a breakthrough in the succor of treatment of the SARS-CoV-2 virus. These reports may prompt scientists and biotechnologists to undertake further research (Pons, 1998; Pons, 1999).

The healing effect on human skin was known to the shamans of the indigenous peoples of South America and Africa. Hippocrates also applied it to ulcers and wounds and recommended the use of crushed snails on inflamed skin. Also in the Middle Ages, the health-promoting (immunostimulating) properties of mucus were appreciated.

The properties of snail slime were "discovered" by modern medicine in the 20th century. In Chilean family, the members which had a contact with snail slime, had healthy, well-groomed skin on their hands, despite of the hard work. Abrasions and cuts healed quickly without leaving scars. Analyzes have shown that the mucus extract, containing, among others, Cryptosine has valuable properties for human skin. They began to be used in care and cosmetic preparations.

The effect of cosmetics and drugs with snail slime is diverse and multidirectional. It can be used as a natural raw material in the pharmaceutical industry – an alternative to substances obtained by chemical synthesis. Its acquisition is relatively cheap and has a humane and ecological character. The strong regenerative properties of the mucus can be used on a larger scale in the future for the production of preparations with high care, regenerative and therapeutic values, and at the same time devoid of allergenic properties. The use of the potential hidden in the snail slime is a reference to the practices of well-known etnopharmacies and imitation of nature.

INTRODUCTION

Mucilages are a group of mixtures of substances of a polysaccharide nature. They have been used in medicine as coating, protective and softening agents. In the presence of water, they form sticky colloids. Mucilages are used in inflammation of the gastrointestinal tract and respiratory tract, as coating and protective agents.

Mucilages and raw materials containing them are also used as laxatives. Absorbing water from the lumen of the gastrointestinal tract, they gradually swell, which causes stretching of the intestinal walls and stimulation of their peristalsis by reflex. Slightly less often they are applied externally to the surface of the skin (McShane, 2021).

They occur most often in algae, some fungi and tissues or seeds of plants, mainly from the family: Malvacae Juss., Linacae DC. ex Gray, Fabacae Lindl. and Rosaceae Juss. An interesting group of mucus-containing organisms are slime molds (Myxomycota, Myxomycetes) also called slime molds (Eumycetozoa). These are eukaryotic organisms on the border of plants, fungi, protozoa and animals, belonging to the supergroup Amoebozoa (Stephenson, 1994; Royas, 2021).

Typical plant mucous raw materials include, a.o.: agar which is a component of Rodophyta red algae mucus, marshmallow root – *Althaceae radix*, comfrey root – *Symphyti radix*, marshmallow leaf – *Althaeae folium*, coltsfoot leaf – *Farfarae folium*, fenugreek seed – *Foenugraesi semen*, flax seed – *Lini semen*, psyllium

seed – *Psylli semen*, forest mallow flower – *Malvae sylvestris flos*, mullein flower – *Verbasci flos* and Icelandic lichen – *Lichen islandicus* (Muller, 2001; Fabricant, 2001; Dias, 2012; Kohlmüzner, 2013).

The properties of mucilages of plant origin have been well known and have found wide application. However, this cannot be said about mucilages of animal origin. They mainly recognize lubricants in the processes of sexual reproduction. In other animals belonging to both invertebrates and vertebrates, mucus covering the surface of the body protects against water loss and drying out. Mucin contained in mucus is part of bile, digestive juices, occurs in saliva and also covers the mucous membrane in the respiratory system. The production of mucus by some animals makes it easier for them to move (Quevauviller, 1953; McShane, 2012; Nouthan, 2021).

GENERAL CHARACTERISTICS OF SNAILS

Molluscs (Molusca) is a type of invertebrate animal that currently numbers more than 125,000 species. They are one of the most numerous types of animals found in the world, second only to arthropods Arthoropoda. They owe their name to the fact that their bodies are soft, without a skeleton (molluscus from Latin means soft), only some of them have an external skeleton, in the form of shells. They live both in the seas, fresh waters as well as on the land. They form an extremely diverse group of animals in terms of appearance and size. The study of mollusks is carried out by a science called malacology (malacozoology). The systematic division of mollusks is based on differences in morphological characteristics. Eight classes have been recognized: Monoplacophora, Polyplacophora, Caudofoveata, Aplacophora, Scaphopoda, Gastropoda, Bivalvia and Cephalopoda. Of the above, the last three are the most characteristic: bivalves, cephalopods and snails (Grabda, 1983; Jura, 2007).

Gastropods (Gastropoda, from Greek γαστήρ – belly, πούς – leg, foot) are one of the most numerous and diverse phylums of molluscs. Due to the development of respiratory organs, snails are divided into lung (terrestrial and freshwater forms), forebronchial (they occur mainly in the sea and less often on the land) and hindbronchi (live exclusively in the sea). There is also a division into naked and shelled snails, but this is not a systematic division (Błaszak, 2009; Jura, 1983; Jura, 2007; Moore, 2006).

Snails are characterized by asymmetry. The snail is made of a head, a strongly muscled leg and a visceral sac, covered with a fold called mantle, which contains most of the internal organs, in most molluscs it also produces a hard external skeleton in the form of shells. On the head there is a mouth and sense organs, among others antennae and eyes. There are three pairs of antennae. The first, larger pair with eyes, located at the top of the head, allows you to distinguish light from darkness. The second, smaller, serves as an organ of touch. The third is transformed into labial lobes, also called cheek. In the mouth there is a fleshy tongue covered with a grater (radula), with teeth arranged in rows for grinding and grinding food. In moments of danger, the snail pulls the antennae, head or whole body deep into the shell. It is covered with ciliated epidermis, except for the part covered by a shell. In the epidermis of the leg there are numerous, different types of mucous glands producing mucous substances of different composition. There may be a single, large mucous gland on the front and back of the leg. The snails moves thanks to a strongly muscled leg, it is a locomotor organ. By creeping, it simultaneously produces large amounts of friction-reducing mucus (Jura, 1983; Lai, 2010).

There are different types of mucous glands in the snails: i) type A glands secreting proteins, ii) type B glands secreting calcium ions, iii) type C glands secreting dye/pigment, iv) type D glands secreting lipids/fats, v) type E glands secreting other substances (Arcardi, 1967; Cook, 1983; Martin, 1986; Gural-Sverlova, 2011; Wondrak, 2012; van Byern, 2018; Yamaguchi, 2000; Greistorfer, 2020).

Snail mucus performs various functions and exhibits various properties: 1) lubricating and softening – reduces friction when moving, 2) adhesive facilitates attachment to various surfaces, 3) moisturizing – protects against water loss, 4) protective – makes snails unattractive to potential predators, 5) repairing – facilitating the healing of cuts and wounds and prevents infections thanks to bioactive compounds (Mair, 2002; Pawlicki, 2004; Brieva, 2008; Lai, 2010; Becker, 2012; Newton, 2012; Newar, 2015; Li, 2017; Ahmad, 2018).

The composition of the snail mucus varies depending on the species and its role, the path that the snails is currently moving or the need for adhesion. It consists of more than 90% water. The remainder of the mucus consists of a mixture of proteoglycans, glycosaminoglycans, glycoprotein enzymes, hyaluronic acid, copper

peptides (GKH-Cu peptides), antimicrobial peptides and metal ions, a.o. iron, copper, zinc and manganese (Braun, 2013; Greistorfer, 2017; Greistorfer, 2023).

Ones of the most characteristic are: several mucins and also limozine and cryptosine. Snail slime also contains allantoin, collagen, elastin and glycolic acid (Smith, 1999).

The visible wet trace left by a moving, slowly creeping snail solidifies into a transparent or pearl "shell" – it is limozine, which is useless for humans, because it does not contain valuable substances. It is sticky and transparent, although visible to the naked eye. Its task is to reduce friction during the movement of the snail. It is also secreted for protective purposes – in situations of danger and stress and in changing environmental conditions, e.g. in summer, during drought or in winter, when the snail goes into hibernation – it creates a thin film closing the shell called an epiphragm, protecting the snails from drying out or cold. Less visible, thick and foamy mucus – is a cryptosine that protects the delicate body of the snail and regenerates it when it is damaged while moving. It also serves to thermally regulate and hydrate the body of the snail (Adikwu, 2005). That's why it's find application in cosmetology and medicine.

So far, appreciating the taste of snail meat containing a lot of valuable ingredients a.o. microelements (e.g. selenium), snail farms have been carried out, mainly for consumption purposes. The species most commonly consumed by humans include representatives of the family Helicidae, the genus *Helix* and the family Achatinidae, the genus *Achatina* (Ligaszewski, 2005; Szkucik, 2011; Paszkiewicz, 2014).

Each species has its own commercial name: Escargots de Bourgogne for *Helix pomatia*, Escargots Petit-Gris and Gros-Gris for *Helix aspersa*. In Polish, the edible land grey snail (*Helix aspersa*) is bred in two subspecies: the Western European grey snail (*Helix aspersa aspersa, Helix aspersa* Müller) and the North African large grey snail (*Helix aspersa* Maxima). Closely related to them is the naturally occurring grape snail *Helix pomatia*. Its taste qualities are slightly inferior to the other two species. In Poland, this species is also known under another name, accurately reflecting its appearance – small gray snail (petit gris). It is approved for breeding in special in the so-called Eco Snail Farm (Ciszewski, 2012; Skalmowski, 2020).

Natural breeding gives more valuable products. Organic farming of snails should comply with the requirements of the species, provide animals with freedom of movement and comfort – as close as possible to natural living conditions. It is very important to get snails ecological methods, the use of chemicals in cultivation is avoided, they should be microbiologically clean, free from parasites and heavy metals in their tissues (Niewiadomska, 1981; Menta, 2001; Morozińska-Gogol, 2016).

PROPERTIES OF SNAIL MUCUS

Snail mucus is widely used in medicine a.o. in 1) antibacterial, antifungal and even antiviral effects, 2) action in burns and wound healing, 3) action in stomach ulcers, 4) action in atopic dermatitis, 5) action in chronic bronchitis, 6) action in bone fractures and regeneration, rheumatic diseases, toothache, 7) action in the treatment of cancer: skin (melanoma), breast, lung, colon, bladder cancer, 8) actoxidative effect in skin aging processes, 9) action in the treatment of skin lesions, a.o. wrinkles (water pulling), scars, 10) anti-inflammatory and antibacterial effect of mucus in complexes with precious metals (colloidal nanosilver and nanogold) and zinc (Ahmad, 2018; Cilia, 2018; Mane, 2021).

Due to its antibacterial and regenerative properties, snail mucus is widely used in cosmetology and dermatology. It is also used in medicie in some respiratory diseases and atypical allergic and asthmatic diseases (Pons, 1998; Pons, 1999). Studies have confirmed the effectiveness in allergic skin diseases a.o. atopic dermatitis (Min-Jee, 2010). It has also been used in the treatment of stomach ulcers (Mu, 2008; Amah, 2019; Gugliandolo, 2021) and it helps in lowering sugar levels in diabetes (Agu, 2018). There are also scientific reports about its effectiveness in cancer therapy (Antonova, 2014). Studies have shown antisuppressive effects mainly in skin cancers (melanoma), as well as in breast, lung, bladder and colon cancer (Dwek, 2001; Laack, 2002; Lescar, 2007; Boyanova, 2013; Gesheva, 2014; Ekobon, 2016; Matusiewicz, 2018; Ellijimi, 2018; Dolashki, 2019).

Antimicrobial activity is ensured by the specific immunological properties of the snail (survival in environmental conditions – produced by evolutionary changes): antibacterial, antifungal and antiviral are shown especially by water snails. The effect of snail mucus in humans on skin viruses, especially the herpes virus HSV, belonging to the *Herpes* viridae family, is particularly special, and perhaps it may be of breakthrough importance in the succor of treatment of the SARS-CoV-2 virus – constituting an affinity for the mucous

membranes of the pulmonary epithelium. These reports may prompt scientists and biotechnologists to undertake further research (Pons, 1998; Pons, 1999).

Numerous scientific reports indicate the cytotoxic properties of snail mucus in relation to various cell lines especially from fibroblasts, including cancerous epithelial origin. Scientific research has shown that snail slime *Helix aspersa maxima* has antitumor activity against human cells melanoma malignum, while *Cornu aspersum* snail lyophilisate significantly reduces the survival rate of Caco-2 colon cancer cells. In addition, hemocyanins obtained from water snails (*Rapana venosa*) and land snails (*Cornu aspersum* and *Helix lusitanicus*) are immunostimulants with antimicrobial and antitumor properties, cytotoxic to bladder cancer cells of the T-24 line (Boyanova, 2013).

Further comprehensive studies showed that also the hemolymph of aqueous snails *Rapana thomasina* and terrestrial snails *Helix pomatia* has antitumor activity against colorectal cancer cells of the C-26 line, and the mucus of land snails *Achatina fulica* is cytotoxic to breast cancer cells of the MCF-7 line and renal epithelial cells of the Vero-fibroblast line (Dwek, 2001; Ekobon, 2016).

HISTORICAL DATA

Snail mucus does not show potential allergic reactions in humans, and due to its distant evolutionary relationship, it gives a lower risk of cross-reactions. Its healing effect on human skin was known to shamans of indigenous peoples of South America and Africa. Hippocrates also applied it to ulcers and wounds and recommended it the use of crushed snails on inflamed skin. Also in the Middle Ages, the health-promoting (immunostimulating) properties of mucus were appreciated (Gomot, 1998; Ikejiuba, 2005; Ciszewski, 2012; Ahmad, 2018).

The properties of snail slime were once again "discovered" by modern medicine in the 20th century and it was by chance. It was noticed that members of the Chilean Bascuñàn family, breeding *Helix aspersa* Muller snails for food purposes, had healthy, well-groomed skin on their hands every day, despite the fact that for years it was exposed to abrasions and cuts, dried by the scorching sun. It was found that numerous abrasions and cuts healed quickly without leaving scars. Fernando Bascuñàn Ygualt, a doctor and son of one of the breeders, decided to investigate. The analyzes initiated by him proved that mucus extract has valuable properties for human skin. This led to the discovery of cryptosine, which began to be used in care and cosmetic preparations. It has been proven that the characteristic ability of snail mucus to constantly regenerate its body shells also applies to human skin. In addition to cryptosine, snail slime contains ingredients that are found in synthetic form in most cosmetics. Therefore, it can be a better – natural alternative to artificially produced products. Since then, products based on snail slime have gained great popularity. Currently, snail slime extract is listed in the International Nomenclature of Cosmetic Ingredients (Yongeun, 2022).

SLIME OBTAINING METHOD

Methods of obtaining snail mucus raise ethical doubts. In the past, very drastic and inhumane techniques were used, such as: treatment with alcohol or vinegar, ozonation, rapid centrifugation and cooling. Currently, the least traumatic method is considered to be very gentle, slow spinning. The method of stimulation with a highly diluted solution of citirc acid is also used (Das, 2022; Ricci, 2023).

The producers reserve the patent rights regarding the details of the methodology of obtaining, purifying and treating the snail slime. There are also non-ethical reasons for this. A stressed snail, in defense against a threat, may secrete harmful substances, e.g. limnousine (Adikwu, 2005). The entire process is carefully monitored. Farms where mainly cryptosine and also other mucins are obtained imitate the natural living environment of snails. After collection, the mucus intended for the production of cosmetics is filtered, standardized and processed, which ensures its appropriate purity. It comes from healthy, free from parasites and microorganisms, specially selected specimens (Niewiadomska, 1981; Morozińska-Gogol, 2016; Lim, 2020).

SNAIL MUCIN

Snail mucins are complex, high-molecular glycoproteins that contain: polysaccharides, hyaluronic acid, elastin, collagen, allantoin, as well as vitamins C and E, A, B6 and B12. The rich composition has become the reason for the popularity of snail mucin in the cosmetics industry. Mucins have the ability to adsorb water, hence they prevent the formation of wrinkles. These substances relieve inflammation and allergic

conditions, counteract the symptoms skin aging, exfoliate dead skin cells. They help heal wounds and reduce scars, reduce wrinkles and reduce stretch marks (Ikejiuba, 2005; Sanchez, 2006; Brieva, 2008; Gabriel, 2011; El Mubaraka, 2013; Dolashka, 2015; Swapna, 2015; Liu, 2017; McDermott, 2021; Khrokalo, 2022; Yongern, 2022).

HYALURONIC, GLYCOLIC ACIDS AND OTHERS

The hyaluronic acid contained in mucin is credited with moisturizing properties that support the skin barrier and help retain moisture. Glycolic acid helps stimulate collagen production, which reduces fine lines and wrinkles, and helps give skin a radiant, youthful glow. It also contains zinc, which has an anti-inflammatory effect, and allantoin, which soothes irritations. Thus, skin can be expected to become softer, more hydrated and radiant with consistent use of snail mucin.

COPPER PEPTIDES

Copper peptide-1 (GHK-Cu) is a naturally occurring peptide complex composed of a copper molecule and the amino acids glycyl-L-histidyl-L-lysine. GHK-Cu tripeptide has a strong affinity for copper and was the first peptide isolated from human plasma. We can also find it in human saliva and urine. Loren Pickart first isolated the Copper Peptide GHK-Cu from human plasma in 1973 (Pickart, 1992).

Pickart noticed that liver tissue taken from people between the ages of 60 and 80 contained increased levels of fibrinogen. However, when the liver cells of these patients were incubated in the blood of young patients, the cells began to function almost exactly like "young" liver cells. In the late 1980s, the copper peptide GHK-Cu began to attract the attention of scientists as a very promising wound healing agent (Pickart, 1973, Aupaix, 1990; Simeon, 2000; Canap, 2003; Cangul, 2006; Simeon, 2009).

In its optimal, picomolar to nanomolar concentration, GHK-Cu stimulates the synthesis of collagen in human fibroblasts (Pollard, 2005; Gruchlik, 2012), increases the concentration of proteins in the skin, glycosaminoglycans and protects the DNA of cells (in the process of wound healing) (Pickart, 2008).

The scientists also noted that the GHK sequence is present in the collagen structure and suggested that the GHK peptide is released from the collagen structure in the process of injury. They proposed a whole class of protective molecules that are released from the extracellular matrix at the site of injury.

GHK-Cu also increases the synthesis of decorins – small proteoglycans involved in the regulation of the collagen synthesis process, regulation of the wound healing process and anti-cancer defense (Kang, 2009; Matalka, 2012). Copper peptide GHK-Cu is widely used in so-called natural cosmetics that have the anti-aging acting. Many controlled clinical trials confirm its anti-ageing, wrinkle-reducing and improving skin elasticity and firmness (Wegrowski, 1992; Huang, 2007).

Copper compounds with proteins called copper peptides were also found in the composition of snail slime. Its are used in anti-aging treatments, as an effective rejuvenating agent, an effective stimulator of wound healing and tissue damage. It turned out that it has not only activity in supporting regeneration. To some extent, it also affects gene expression and has anti-cancer effects (Kang, 2009; Matalka, 2012). Copper peptides stimulate collagen production and help reduce the appearance of dark marks, acne scars and UV spots (Abdulghani, 1998). Applied topically, copper peptides act as an antioxidant, stimulate collagen and elastin production, and reduce the appearance of fine lines and wrinkles (Maquart, 1988; Wegrowski, 1992; Simeon, 2000; Gul, 2008; Varvarescou, 2011; Badenhorst, 2016). Copper is an anti-inflammatory agent that accelerates wound healing, great for healing scars, pigmentation and redness caused by inflammation. If you are prone to acne, it can help with blemishes by normalizing the concentration of bacteria on the skin.

Nowadays, there are also mentions that copper peptides can affect hair growth by acting on stem cells (Perez-Menza, 1988; Uno, 1993; Choi, 2012).

BIOGENIC METHOD OBTAINING COLOIDAL PARTICLES

Snail slime can be used in obtaining natural, so-called biogenic method of colloidal silver particles (nano-silver). In cosmetology, nanosilver and nanogold are used primarily because of their biocidal properties. In addition, nanoparticles do not easily penetrate the skin barrier and are effective against various groups of microbes even at low concentrations. Research reports on the environmentally friendly synthesis of silver nanoparticles from the hitherto unexplored mucus of the land snail *Achatina fulica* using an easy,

clean and easily scalable method. Detailed characterization of the obtained samples using spectroscopy techniques confirmed the formation of silver and glod nanoparticles in the snail slime matrix (Onzo, 2021).

The obtained samples were tested against a wide range of Gram-positive and Gram-negative bacteria, such as *Escherichia coli*, *Staphylococcus aureus*, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa* and the fungal strain *Aspergillus fumigatus* by the well diffusion method (Abd-El Azem, 2022). The results indicate that silver nanoparticles in the mucus matrix have a strong antibacterial as well as antifungal effect (Łysakowska, 2009). The antitumor effect was performed *in vitro* using cell lines cervical cancer. Biogenically synthesized Ag nanoparticles in biocompatible slime have demonstrated anticancer activity. The possibility of producing antibacterial and possibly anticancer creams/gels for topical use in skin ailments is suggested. Nanosilver is currently used in anti-acne cosmetics, hair shampoos, shower gels, antibacterial wipes, creams, intimate hygiene wipes colognes, makeup remover wipes, aftershave gels (Bugla-Błoskowska, 2007; Alanzi, 2010; Pokorowiecki, 2012; Arct, 2015; da Silva Martins, 2018; Heckel, 2019; Arroyo, 2020; Gubitoza, 2020; Li, 2020; Mane, 2021; Rizzi, 2021).

TYPES OF PRODUCTS FTOM SNAIL SLIME

The obtained raw material is used to produce cosmetic products in various forms, including: snail slime serum, eye cream, face mask, body lotion, face cream (for daily care) and cream for special skin problems (acne, scars stretch marks, cellulite, uneven skin tone). On the one hand, manufacturers praise their products promising that they will cope with: shadows under the eyes, drooping eyelids, dry skin, swelling, so-called. crow's feet, discoloration, lack of firmness, which is not always true. On the other hand, scientific research has confirmed that snail slime has the following properties: regenerating, protective, brightening skin discolorations, exfoliating, soothing, moisturizing, anti-wrinkle, anti-inflammatory, increasing skin elasticity and promoting the synthesis of collagen and elastin (Quevauviller, 1953; El Mubara, 2013; Krzyżanowska, 2019; Lim, 2020; Leśków, 2021; Khrokalo, 2022; Yongeun, 2022).

Cryptosine contains a number substances with a healing effect: 1) Elastin regenerates and repairs the dermis. 2) Glycolic and lactic acids and sodium lactate are natural agents for cleansing dead cells and increasing the mobility of other bioactive ingredients into the skin. 3) Collagen moisturizes and keeps skin supple. 4) Allantoin has healing and anti-aging properties. 5) Vitamins A, E, C have caring properties. 6) Peptides have healing and anti-inflammatory properties. 6) Folic acid cleanses skin pores and has antibacterial properties. 7) Urea softens and moisturizes the skin and is bacteriostatic. 8) Hyaluronic acid is responsible for moisturizing the skin and retaining moisture in the cells. It is a component of connective tissue, which in combination with collagen and elastin gives the skin elasticity. 9) Free amino acids stimulate skin regeneration processes (Sanchez, 2006). 10) Natural antibiotics are effective against bacteria found in skin infections: *Propionibacterium acnes, Staphylococcus aureus* (golden staphylococcus), *Eschrichia coli* (colon stick) and *Pseudomonas aeruginosa* (blue pus bacillus) (Iguchi, 1982; Pitt, 2015). Based on it drugs are used in cases of severe skin burns (Ahmad, 2018). Specialist beauty salons and beauty salons also use care treatments involving the application of live snails directly to the skin. They are indicated in the following cases: dry, gray, dull skin with the first signs of photoaging, wrinkles, loss of firmness and elasticity, discoloration, age spots, dilated capillaries, acne and rosacea, stretch marks, scars and hyperkeratosis of the epidermis (Wernecke, 2007; Uivavosan, 2011; Fabi, 2013; Dolashka, 2015; Liu, 2017; Lim, 2020).

The main effects of such treatments are: strong hydration of the skin, stimulation of collagen and elastin production, cleansing and brightening of the face, regeneration and smoothing of fine wrinkles, lightening of pigmentation spots, alleviation of inflammation and irritation, and reduction of stretch marks and scars. These treatments are used in conjunction with other methods, e.g. mesotherapy (Brieva, 2008; Fabi, 2013; Liu, 2017; Trapella, 2018; Gentili, 2020; Alogna, 2021, Yongeun, 2022).

CONCLUSIONS

The effect of cosmetics and drugs with snail slime is therefore diverse and multidirectional. It can be successfully used as a natural raw material in the pharmaceutical industry – an alternative to substances obtained by chemical synthesis. Its acquisition is relatively cheap and has a humane and ecological character. The strong regenerative properties of the snail mucus, especially mucins and cryptosine, will be able to be successfully used in the future on a larger scale to produce preparations with high care, regenerative and therapeutic values, and at the same time devoid of allergenic properties.

The use of the potential hidden in the snail slime is a reference to the practices of well-known ethno-pharmacies (Meyer-Rochow, 2017), e.g. 1) in the removal of warts, 2) in the treatment of skin problems (pruritus, acne), 3) in the treatment of injuries, bone fractures (rheumatism, sciatica, edema), 4) in the case of toothache, 5) in respiratory ailments (asthma and tuberculosis), 6) in gastric problems – stomach ache, reflux), 7) in wound healing, 8) in strengthening vitality, 9) in building the body's resistance to infections and also may constitute-make the imitation of nature (Stawarczyk, 2012). Perhaps the topic discussed will constitute another milestone in man's eternal pursuit of the desired achievement of longevity.

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