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Hair and Scalp Health in Modern Lifestyle: Challenges and Natural Solutions

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Abstract

Introduction and Purpose

Hair, as epidermal appendages, serve protective, aesthetic, and psychosocial functions. Their condition reflects the health of the scalp, whose proper structure and function are essential for normal growth. Accurate diagnosis of scalp type and the selection of appropriate care methods constitute the foundation of effective trichological management. The aim of this study is to present natural methods of hair and scalp care in the light of available literature, with particular emphasis on the role of plant-derived ingredients and the importance of scalp diagnostics.

Material and Methods

This study was prepared using both international and Polish literature. Selected articles were reviewed from databases including PubMed, Google Scholar, EBSCO, as well as Polish- and English-language scientific sources.

Description of the State of Knowledge

The hair growth cycle consists of anagen, catagen, and telogen phases, and its disturbances may lead to weakening and hair loss. Structural damage results from mechanical, chemical, and thermal factors, as well as improper care practices. Increasing importance is attributed to natural preparations rich in antioxidants, micronutrients, and fatty acids, which support hair shaft regeneration and follicle function. An equally important aspect is the adjustment of care methods to the scalp type-dry, oily, normal, or sensitive-which helps maintain balance and improve hair quality.

Conclusions

Optimal hair condition requires a holistic approach, including scalp diagnostics, individualized care, and the use of natural preparations. Systematic and consistent therapy is essential to achieve lasting results and to support healthy hair growth.

Keywords

hair, scalp, trichology, hair care, scalp health, natural cosmetics

1.Introduction

Trichology is the scientific discipline focused on disorders of the scalp and hair, aimed at improving their condition and selecting appropriate care strategies. Hair plays an essential aesthetic and psychosocial role, constituting an important element of individual

appearance. Therefore, maintaining healthy hair has not only medical but also psychological and social significance. Inadequately selected cosmetics may contribute to structural damage and deterioration of hair quality. In recent years, growing interest has been observed in natural preparations, which, compared to synthetic ones, are generally better tolerated and associated with a lower risk of adverse effects. The biologically active substances they contain demonstrate therapeutic potential and may support proper scalp and follicle function. Proper hair care should always be individually tailored to hair type and scalp condition. A properly balanced diet, providing essential vitamins and minerals, also plays an important role. A comprehensive approach that combines external care with internal support of the body is considered fundamental for maintaining hair in good condition.

1.1 Structure of the scalp

The skin is the largest organ of the human body, with an average surface area of 1.5–2 m^2 in adults[1]. It performs numerous functions: protective, thermoregulatory, secretory, absorptive, and sensory (perception of tactile, pain, and temperature stimuli). It consists of three layers: the epidermis, dermis, and subcutaneous tissue.[2]

Epidermis

The epidermis is the outermost layer, 0.1–2 mm thick, composed mainly of keratinocytes undergoing keratinization. Several strata can be distinguished: the basal layer (stratum basale), where intensive cell divisions occur; the spinous layer (stratum spinosum), in which cells are connected by desmosomes; the granular layer (stratum granulosum), containing keratohyalin granules and Odland bodies responsible for lipid production; and the outer stratum corneum, built of dead corneocytes. The entire process of keratinocyte differentiation and migration from the basal to the corneal layer is termed turnover time, averaging 26–28 days.[3]

At the interface between living and dead epidermis lies the so-called Reina barrier, responsible for limiting transepidermal water loss, maintaining acidic pH, and enabling selective penetration of fat-soluble vitamins (A, D, E, K). This mechanism ensures elasticity and proper barrier function of the skin.[4,5]

Dermis

It is much thicker than the epidermis and constitutes the main bulk of the skin. It is composed of connective tissue containing collagen and elastin fibers, which are responsible for its strength and elasticity. Two zones can be distinguished: the papillary layer (stratum papillare) with a loose structure, and the deeper reticular layer (stratum reticulare), dominated by dense collagen fibers.[5] This layer also contains blood and lymphatic vessels, nerve endings, and skin appendages—sebaceous glands, sweat glands, and hair follicles. Various types of collagen are present in the dermis, with type I collagen playing a dominant role, constituting more than 90% of its mass, followed by type III. Elastin is another important component, providing elasticity and resilience to the skin.[3,5]

Subcutaneus tissue

It is composed of loose connective tissue containing collagen fibers, proteoglycans, and numerous adipocytes. It performs insulating, cushioning, and energy-storing functions, and its thickness depends on age, sex, diet, and lifestyle. The subcutaneous tissue also contains portions of sweat glands, blood vessels, and nerve endings .[6]

1.2 Structure of hair

Hair are epidermal appendages of complex structure, present on almost the entire surface of the skin except for the soles of the feet, palms, vermilion border of the lips, clitoris, and the inner surface of the foreskin.. Each hair consists of a subcutaneous part – the root, embedded in the follicle – and a supracutaneous part – the shaft, visible above the skin surface.[7,8]

The hair root extends into the subcutaneous tissue and is surrounded by the follicle, which creates the environment for growth and keratinization. At its end lies the hair bulb – the site of intensive cell division, responsible for the formation of a new hair. [7,8] Within the bulb, the inner root sheath, outer root sheath, and connective tissue sheath can be distinguished.

The inner sheath consists of three layers: the cuticle, Huxley’s layer, and Henle’s layer, which undergo keratinization as they move toward the skin surface.[9] The outer sheath

represents a continuation of the epidermis, lining the follicular canal. Attached to it is the arrector pili muscle, whose contraction is responsible for the so-called “goosebumps” effect and stimulates sebaceous gland secretion. [10] The entire follicle is surrounded by the connective tissue sheath, containing the glassy membrane as well as collagen and elastic fibers. [11]

The hair shaft is the non-living part, composed of keratin and protruding above the skin surface. It is formed of the cuticle, cortex, and medulla. The cuticle constitutes the protective layer made of keratin scales, preventing water loss and mechanical damage. The cortex is the main mass of the hair, with a diameter of 40–100 μm, and contains keratin rich in amino acids such as cysteine, lysine, tyrosine, and glutamic acid, which determine mechanical strength and functional properties. The medulla, present only in thicker hairs, is a central structure filled with dispersed cells. [3]

1.3 Hair physiology

An important property of hair is sorption, i.e., the ability to absorb various substances. This depends on several factors, for example, the size of the molecule – the smaller the molecule and the greater its affinity to keratin, the better the absorption. Temperature also has a significant effect: the higher the temperature, the greater the hair’s absorptive capacity. The age of the hair shaft is also important – hair ends are the oldest and the most susceptible to damage. Damaged hair with open cuticle layers shows facilitated absorption. [10]

Another characteristic of hair is hygroscopicity. The water content in healthy hair should be about 10% to maintain adequate elasticity and reduced susceptibility to damage. The more damaged the hair, the more moisture it can absorb, but it also loses it more rapidly, becoming dry and brittle.[9]

Hair is also characterized by extensibility, which reflects mechanical resistance. Under load, the hair structure may stretch up to 10%. Alpha-keratin is transformed into beta-keratin through rearrangement of disulfide bonds. Once the load is removed, the hair returns to its original length. [10]

Each hair differs in diameter and texture. The diameter of human hair ranges from 17 to 180 μm. Hair below 40 μm is classified as vellus hair. Texture is a less precise term but is usually categorized as:

a) fine – below 60 μm

b) medium – 60–80 μm

c) thick – 80–150 μm

Many women consider their hair to be thinner than it actually is, which may influence improper choices of hair care products. [12]

2. Hair growth

In humans, three types of hair are known: fetal (lanugo), primary (vellus), and terminal hair. Lanugo hairs are thin and soft, without a medulla, and may have varying length. These are replaced after birth by primary or terminal hairs. Primary hairs are also soft but short, usually not exceeding 2 cm, and often colorless. They represent superficial body hair. Terminal hairs are large and thick, contain pigment and color. At birth, these include scalp hair, eyebrows, and eyelashes. [12]

Hair grows at different rates depending on the body area. On the vertex of the scalp the rate is 0.44 mm/day, on the temples 0.39 mm/day, and on the beard 0.27 mm/day. [13]Age plays a significant role in average daily hair growth. Measured across four body areas (scalp vertex, pubic area, axilla, thigh), it is 0.34 mm/day between ages 40–49, 0.36 mm/day between 50–59, reaches the highest value of 0.38 mm/day between 60–69, and then decreases to 0.33 mm/day between 70–79. The daily growth rate varies across regions: 0.29 mm on the thigh, 0.35 mm on the scalp, 0.36 mm in the pubic region, and 0.40 mm in the axilla. Average daily growth is 0.37 mm in men and 0.34 mm in women. Many factors influence growth, such as age, time of day and year, nutrition, and genetic predisposition. [14]

As in all mammals, human hair does not grow continuously but in prolonged series forming the so-called hair cycle. The length of cycles is determined mainly by individual

genetics and internal and external factors. It consists of three main phases: anagen, catagen, and telogen.[15] Anagen usually lasts from 3 to 6 years. It is the phase of the most intensive proliferation in the root and hair growth. The lower part of the follicle is well developed and contains the hair matrix, which consists of the fastest dividing epithelial cells. [16] Catagen lasts from a few days to two weeks. During this time 0.5–1% of hairs are present. The matrix undergoes degeneration, the papilla separates, mitotic activity stops, and melanin synthesis ceases, causing depigmentation of the lower hair part. The bulb gradually undergoes keratinization, is displaced upward, and forms a characteristic bulge composed of inactive cells. These will be transformed into a new bulb during the next anagen. [11] Telogen is the resting phase, lasting from a few weeks to four months, involving 10–20% of hairs. The upper part of the follicle is preserved, but the dead telogen hair moves closer to the surface, in the region of the arrector pili muscle, forming the so-called club hair. [16] At the end of this phase, the papilla approaches the stem cells in the outer root sheath, stimulating the formation of new progenitor cells – the hair matrix. The old hair falls out, a new one enters anagen, and the cycle begins again. [11]

The hydrophobic hair film is formed by the lipid layer, which creates an occlusive barrier protecting the cuticle from damage and water loss. Removal of this covalently bound fatty acid makes the fiber hydrophilic, and therefore more prone to damage. Wet hair can be stretched up to 30% of its original length without damage; however, irreversible changes occur when hair is stretched between 30% and 70%. Stretching to 80% causes breakage. [17]

Factors damaging the hair structure include natural, mechanical, chemical, and physical factors. Natural damage results from adverse environmental influences such as wind, sun, or frost. Mechanical damage is caused by improper use of combs, brushes, tying, or backcombing. Chemical damage arises from improperly used cosmetic preparations, excessive bleaching, permanent waving, or coloring. Continuous bleaching keeps the cuticle scales permanently open, causing excessive water loss and hair dryness. Bleached hair absorbs water very easily, weakening mechanical resistance. In such hair, disulfide bonds in keratin are also destroyed, which contributes to fragility. Physical

damage results from excessive heat and UV radiation. Rapid heating increases the temperature of bound water in the cortex, destroying internal protein structures. [10,18]

All types of damaging factors cause changes in the hair structure, leading to mechanical damage. Excessive or repeated thermal processing, poor care habits, and environmental conditions result in structural changes and may lead to brittleness or splitting. These changes can be observed microscopically as “weathering” of the hair shaft, which contributes to tangling and twisting. Proper cosmetics can prevent hair brittleness by reducing friction and improving hydration. [20]

3. Hair loss

Hair loss is a common problem that affects both women and men. There are many causes of hair loss, ranging from hormonal changes to side effects of medications and improper hair care. Some factors damage the hair only temporarily, while others may lead to permanent alopecia. [13]

It is assumed that in the postpartum period new hair follicles are no longer formed, and their absolute number does not increase. In an adult man, the number of hair follicles is approximately 5 million, of which 1 million are located on the scalp. With age, a progressive reduction in the number of follicles is observed. At the age of 20–30 years, the average follicular density is 615/cm², between 30 and 50 years it decreases to 485/cm², and between 80 and 90 years it reaches only 435/cm². [12]

On average, about 50–100 hairs are shed daily from the scalp, and new hairs grow in their place – this is considered a physiological process. However, excessive shedding (above 100 hairs per day) is a pathological phenomenon, which may consequently lead to hair thinning, partial, or complete baldness. [20]

Numerous herbs are used in the treatment of hair loss, such as hibiscus, amla, shikakai, licorice, nutmeg, fenugreek, henna, musk root, calendula, parsley, thyme, horsetail, nettle, rosemary, and many others. [21]

Among them, amla is a major source of vitamin C; it also contains phosphorus, calcium, and iron, which nourish the hair bulb and stimulate growth. Hibiscus provides calcium, iron, vitamin B1, phosphorus, riboflavin, niacin, and vitamin C, which prevent premature graying and strengthen the hair structure. [22]

Horsetail is rich in silicon, potassium, and calcium. These components strengthen the hair, improve circulation, thereby accelerating growth and reducing shedding. Another herb that prevents and limits hair loss is nettle, which strengthens the hair and gives it shine due to the presence of mineral salts, vitamins, carotenoids, and silicic acids. [23]

4. Scalp and hair care

The condition of the scalp is a key factor determining hair health. Proper care should be tailored to the scalp type, which is shaped by both genetic and environmental factors. Four main scalp types are distinguished: sensitive, dry, normal, and oily.[8]

Sensitive scalp is characterized by symptoms such as itching, burning, or redness, which may occur even when the skin appears normal. It often reacts poorly to chemical treatments and certain cosmetics, and its hyperreactivity is associated with disturbances of the epidermal barrier. [24]. In care, it is recommended to use gentle plant-based ingredients with anti-inflammatory and soothing properties, such as Matricaria chamomilla (chamomile), which contains apigenin, bisabolol, and azulene that support regeneration and balance of the scalp.[25] Studies also indicate the potential benefits of jojoba oil, due to its chemical similarity to human sebum and excellent moisturizing properties. [26]

Dry scalp is thin, often flaky, and prone to irritation. Increased transepidermal water loss requires the use of strongly moisturizing and protective preparations. Natural plant oils, such as argan or camellia oil, contain significant amounts of unsaturated fatty acids and antioxidants, which support the reconstruction of the lipid barrier. [27] Clinical studies

have also confirmed the efficacy of argan oil in improving skin elasticity and hydration.[28]

Normal scalp is considered the optimal type, characterized by balance between sebum secretion and maintenance of appropriate hydration. Care for this scalp type should focus on prevention and protection against environmental factors. Lightweight oils, such as sunflower or sesame, may help maintain equilibrium due to the presence of essential fatty acids and vitamin E. [29,30]

Oily scalp is associated with excessive sebaceous gland activity and manifests as greasy hair, shiny skin, and increased susceptibility to follicular inflammation. Treatment involves the use of gentle cleansing agents with keratolytic and anti-seborrheic effects, containing, among others, salicylic acid or zinc pyrithione, whose efficacy in the therapy of dandruff and seborrheic dermatitis has been confirmed. [31,32]

The literature also indicates the beneficial effects of watermelon seed oil (Citrullus lanatus) and baobab oil (Adansonia digitata). Watermelon seed oil is characterized by a high linoleic acid content (approx. 60%) and antioxidant and anti-inflammatory properties. [33] Baobab oil, which contains about 36% linoleic acid, has demonstrated a significant reduction in transepidermal water loss (TEWL) and an increase in skin hydration after topical application, and is further characterized by a light consistency and favorable lipid profile.[34]

Additionally, herbs with anti-inflammatory properties, such as common sage (Salvia officinalis) or turmeric (Curcuma longa), have demonstrated potential in supporting the reduction of seborrhea due to their antioxidant activity. [35,36]

4.1 Scalp massage

Scalp massage is one of the simple, non-invasive, and natural methods supporting hair care. Its main effect is to improve microcirculation within the scalp, which promotes better supply of oxygen and nutrients to hair follicles and facilitates the removal of metabolic waste products. Proper blood perfusion plays a significant role in the hair

growth cycle, particularly in the anagen phase, which is accompanied by increased angiogenic activity. [37]

Experimental studies suggest that regular scalp massage may induce beneficial changes in hair morphology and in the expression of genes responsible for hair growth. In a study published in 2016, it was demonstrated that a daily four-minute massage performed over a period of 24 weeks in healthy volunteers led to an increase in hair shaft diameter. Additionally, significant modifications were observed in the activity of genes related to the hair growth cycle – some of them (including NOGGIN, BMP4, SMAD4, IL6ST) showed increased expression, while others associated with the hair loss process (e.g., IL6) were downregulated. This mechanism was explained by the effect of mechanical stretching of dermal papilla cells, which may act as a stimulus promoting hair growth. [38]

These observations were partially confirmed in survey-based studies involving individuals who independently applied a standardized scalp massage technique. The majority of respondents reported a slowdown in hair shedding or even regrowth, and the frequency of reported effects correlated with the duration and regularity of the massage. However, it should be emphasized that results based on self-reports are subject to bias and depend on the correct application of the technique. Despite these limitations, the findings suggest a promising therapeutic potential of standardized scalp massage, whose effect is based, among others, on improved blood flow. [39]

In summary, the available data indicate that scalp massage may represent a valuable adjunct to natural hair care. Its potential effects result primarily from improved scalp circulation and modulation of the hair follicle microenvironment, which may consequently support the improvement of hair condition and quality

4.2 Hair wash

Strong cleansing agents act intensively on the hair, removing approximately 80% of natural lipids, which results in weakened hair structure. [1]

Shampoos are not only products for cleansing the scalp but also help prevent hair shaft damage. Many scalp disorders are treated with active substances incorporated into shampoo formulations. It is desirable that regardless of pathological conditions (seborrhea, alopecia, psoriasis), the hair shafts remain aesthetically presentable, retaining softness, combability, and shine. [40]

Shampoos usually consist of 10–30 ingredients, although products containing as few as four components are also available. Shampoo ingredients can be classified into four categories: a) cleansing agents, b) additives that contribute to product stability, c) conditioning agents intended to provide softness and shine, and d) specialized care ingredients designed for specific scalp or hair problems. [41]

4.3 Hair conditioning

Conditioning is fundamental to improving hair condition; properly nourished hair becomes soft, shiny, smooth, and elastic. Appropriate active ingredients can temporarily fill defects in the hair cortex, making hair appear healthier. Properly selected conditioning products also facilitate combing while providing protection against harmful mechanical factors and UV radiation.

It is worth noting that one of the best sources of active substances is plants, as they exhibit high affinity with compounds naturally present in hair and skin. They are highly effective, safe, and non-irritating. In cosmetic formulations, plants can be incorporated in three ways: as whole extracts, e.g., aloe vera gel; as selective extracts, e.g., wheat germ; or as isolated molecules such as vitamins. [42]

Tab 1. Examples of plants and their applications in hair care [43]

Latin name	Common name	Plant part	Properties
Aloe vera	Aloes	Leaf	Moisturizing agent

Acacia Concinna	Shikakai	Pods	Stimulates hair growth, prevents dandruff
Arctium lappa	Burdock root	Root	Hair growth stimulation
Arnica Montana	Arnica	Flowers	Hair toning, follicle stimulation
Bacopa monneri	Brahmi	Whole plant	Stimulates hair growth
Centella asiatica	Gotu kola	Stem	Hair care, hair darkeningv
Citrus aurantium	Orange	Peel	Cleanses scalp, added to shampoos
Citrus limon	Lemon	Peel	Prevents hair loss
Eclipta alba	Bhringraj	Whole plant	Stimulates hair growth
Ficus racemosa	Cluster fig	Root	Prevents hair loss

4.4 Home hair care methods

Home hair care methods have been known for generations, being easily accessible, inexpensive, and natural. All the necessary ingredients can be found among products available in the garden or kitchen. Effective products include milk and its derivatives, which contain calcium and large amounts of vitamins A and E. They are suitable for delicate and sensitive skin, smoothing the hair, nourishing it, and giving it shine. Another product is honey, which has antibacterial properties and contains valuable minerals that help maintain proper hydration, elasticity, and smoothness of the skin and hair. It is rich in enzymes with antiseptic effects and organic acids. Yeast contains B vitamins and proteins, which influence hair growth and nourishment. Beer, in turn, is rich in proteins and B vitamins. Beer rinses are recommended for oily and weakened

hair, as they cleanse, strengthen, and add shine. Egg yolk contains a large amount of cholesterol, which provides smoothness and elasticity to the skin, as well as minerals such as iron, zinc, sulfur, and phosphorus, along with B vitamins and lecithin, a natural emulsifier that helps remove lipids and other impurities present on the hair. [23]

5. Vitamins and minerals

The appearance of hair reflects the nutritional status of the body, and even minor deficiencies of micro- and macroelements or vitamins negatively affect hair condition. Nutrients are absorbed from food and delivered through the bloodstream to every cell of the body, where they participate in various biochemical processes. In the case of deficiencies, cellular division becomes impaired, which is reflected in the appearance of the hair. To maintain healthy-looking hair, it is necessary to provide an adequate supply of nutrients rich in trace elements. [23]

Among microelements, iron plays a major role. It is a component of many proteins—hemoglobin in red blood cells and myoglobin in muscles. Iron is also present in numerous enzymes responsible for protein synthesis and cell growth. Iron deficiency leads to abnormal development of hair and blood cells, resulting in thinning and brittle hair. To prevent iron deficiency, it is recommended to consume red meat, fish, eggs, and green vegetables such as spinach. Another important trace element is zinc, which is essential for proper protein synthesis, including keratin, the main structural protein of hair. It also contributes to proper hair growth and thickness. Zinc is found in nuts, pumpkin and sunflower seeds, and oysters. Another indispensable element is iodine, whose level should be particularly monitored by individuals with thyroid disorders. Thyroid dysfunction is often manifested by deterioration of hair condition. Iodine affects the elasticity and resilience of hair, while deficiency results in dull, brittle hair prone to shedding. Copper also plays an important role in maintaining proper hair structure. Its deficiency leads to a reduced number of disulfide bonds, resulting in thin and weak hair. Moreover, insufficient dietary copper intake contributes to premature graying. Copper is found in meat products, fish, and seafood. [9,23]

Additional trace element is silicon, one of the fundamental building blocks of skin and hair. A diet rich in silicon promotes faster hair growth, increased strength, and reduced hair loss. Silicon is abundant in horsetail, radish, cauliflower, celery, and kohlrabi. The last trace element discussed here is magnesium, which participates in many biochemical processes in the body, including keratin production. Magnesium deficiency causes hair fragility and split ends. Good dietary sources of magnesium include cocoa, oranges, and bananas. Among macroelements, sulfur deserves attention. It plays a role in keratin synthesis and regulates sebaceous gland function. Its deficiency leads to excessive hair greasiness, shedding, and weakness. Insufficient amounts of sulfur also slow hair growth. A diet rich in radish, cabbage, spinach, and cauliflower is a good source of sulfu. [23, 44]

Another important group of compounds influencing hair appearance are vitamins. B vitamins, particularly vitamin B5 (pantothenic acid), play key roles in the body. They are essential for proper growth and are exogenous, meaning they must be supplied with the diet, as the body cannot synthesize them. Pantothenic acid builds and strengthens the hair shaft and is essential during cell division. Vitamin B7 (biotin) also plays a crucial role, as it promotes sulfur molecule accumulation in the hair matrix and supports hair growth. Deficiency of these vitamins results in excessive hair loss and slowed growth. B vitamins are found in products such as yeast, liver, and whole-grain bread. Vitamin A (retinol) is another important compound for hair health. It maintains the proper condition of skin, hair, and nails. Its deficiency causes weakening, hair loss, and even alopecia. Vitamin A can be found in liver, carrots, pumpkin, and milk. [9,44]

Vitamin E is a powerful antioxidant that neutralizes free radicals, which damage body cells and accelerate aging processes. It also strengthens blood vessel walls and promotes hair growth. Vitamin E deficiency contributes to premature skin aging, slower hair growth, and dull, brittle hair. A diet rich in almonds, nuts, green vegetables, and plant oils such as sunflower oil or olive oil provides a good source of vitamin E. The last vitamin discussed here is vitamin C, another potent antioxidant. It helps maintain skin firmness and elasticity and supports proper hair growth. Its deficiency impairs iron

absorption, leading to slowed hair growth and excessive shedding. Good sources of vitamin C include acerola, parsley, black currant, and dill. [9, 10]

Undoubtedly, an adequate supply of microelements, macroelements, and vitamins has a significant impact on hair condition. However, moderation is essential, as excessive intake of these compounds may have effects opposite to those intended.

6. Conclusions

Hair serves key protective, aesthetic, and psychosocial functions, and its condition closely reflects the state of the scalp and the overall balance of the body. The starting point for effective therapy and care is precise scalp diagnostics, enabling the selection of appropriate preparations suited to its type and needs. Natural formulations are playing an increasingly important role, as they are not only characterized by a favorable safety profile but also support the proper functioning of hair follicles. Internal nutrition remains an integral component of management, since even minor deficiencies of vitamins, microelements, and macroelements disrupt hair structure and the growth cycle. A holistic approach, combining external care with a diet tailored to the body's needs, forms the foundation for maintaining strong and healthy hair. However, achieving lasting results requires systematic care, patience, and consistency in following recommendations.

Author's contribution:
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6. References

1. Sybilski AJ. The skin – the most important organ of our body. Let's take care of it! Pediatr Med 2012; 8: 375–379.
2. Bender S., Budzisz E. Body care. MedPharm, Poland 2011.
3. Martini MC., Placek W. Cosmetology and pharmacology of the skin. PZWL, Warsaw 2006.
4. Kowalska-Wochna E. Why do we age? Cabines 2009; 35: 21–26.
5. Padlewska K. Aesthetic medicine and cosmetology. PZWL, Warsaw 2014.
6. Sobolewska E., Godlewska R., Michalski J. Practical cosmetology step by step. Hands and nails. PZWL, Warsaw 2017.
7. Jazenicka I., Chodorowska G., Budzyńska J. Hair – physiology and structural disorders. Aesthetic Dermatology 2006; 2: 90–94.
8. Szklarczyk M., Goździalska A., Jaśkiewicz J. Diseases and care of the scalp and hair. AFM Publishing House, Kraków 2012.
9. Kołomycew A. How to take care of your hair. A guide for a beginner hair enthusiast. Helion, Gliwice 2017.
10. Siemiątkowska J. Outline of cosmetic trichology. Trichomed, Stargard 2014.
11. Ambroziak M., Szymańczyk J. Laser systems in the treatment of excessive hair growth. Aesthetic Dermatology 2001; 6: 278–279.
12. Marsh J., Gray J., Tosti A. Healthy hair. Springer, Switzerland 2015.
13. Saitoh M., Uzuka M., Sakamoto M. Rate of hair growth. Hair growth. Adv Biol Skin 1969; 9: 161–168.

14. Pelfini C., Cerimele D., Pisanu G., et al. Aging of the skin and hair growth in man. Adv Biol Skin 1969; 9: 153–160.
15. Bochenek A., Reicher M. Human anatomy. Vol. V. PZWL, Warsaw 2007.
16. Jabłońska S., Chorzelski T. Skin diseases. PZWL, Warsaw 2002.
17. Kim S., Jeong K., Ryu S., et al. Panax ginseng prevents apoptosis in hair follicles and accelerates recovery of hair medullary cells in irradiated mice. In Vivo 1998; 12: 219–222.
18. Noszczyk M. Cosmetic and medical cosmetology. PZWL, Warsaw 2013.
19. Dawber R. Hair: Its structure and response to cosmetic preparations. Clin Dermatol 1996; 14: 105–112.
20. Styczeń P. Rescuing the hair. Art of Beauty 2015; 2: 33.
21. Bhatia S. Perfumes, soaps, detergents and cosmetics. A handbook of cosmetics. New Delhi 2001.
22. Adhirajan N., Ravi Kumar T., Shanmugasundaram N., et al. J Ethnopharmacol 2003; 88: 235–239.
23. Bodenstein K. Natural cosmetics in my garden. WAM, Poland 2017.
24. Guerra-Tapia A., González-Guerra E. Sensitive Scalp: Diagnosis and Practical Management. Actas Dermosifiliogr. 2023 Feb;114(2):141–146. English, Spanish. doi: 10.1016/j.ad.2022.09.009.
25. Sah A., Naseef P.P., Kuruniyan M.S., Jain G.K., Zakir F., Aggarwal G. A Comprehensive Study of Therapeutic Applications of Chamomile. Pharmaceuticals (Basel). 2022 Oct 19;15(10):1284. doi: 10.3390/ph15101284.
26. Gad H.A., Roberts A., Hamzi S.H., Gad H.A., Touiss I., Altyar A.E., Kensara O.A., Ashour M.L. Jojoba Oil: An Updated Comprehensive Review on Chemistry, Pharmaceutical Uses, and Toxicity. Polymers (Basel). 2021 May 24;13(11):1711. doi: 10.3390/polym13111711.
27. Moore E.M., Wagner C., Komarnytsky S. The Enigma of Bioactivity and Toxicity of Botanical Oils for Skin Care. Front Pharmacol 2020; 11:785. https://doi.org/10.3389/fphar.2020.00785.
28. Bensouda Y., Qiraouani Boucetta K., Charrouf Z., Aguenaou H., Derouiche A. The effect of dietary and/or cosmetic argan oil on postmenopausal skin elasticity. Clin Interv Aging 2015: 339. https://doi.org/10.2147/cia.s71684.

29. Lin T.K., Zhong L., Santiago J.L. Anti-inflammatory and skin barrier repair effects of topical application of some plant oils. Int J Mol Sci 2017 Dec 27;19(1):70. doi: 10.3390/ijms19010070.
30. Wei P., Zhao F., Wang Z., Wang Q., Chai X., Hou G., Meng Q. Sesame (Sesamum indicum L.): A Comprehensive Review of Nutritional Value, Phytochemical Composition, Health Benefits, Development of Food, and Industrial Applications.Nutrients 2022 Sep 30;14(19):4079. doi: 10.3390/nu14194079.
31. Lodén M., Wessman C. The antidandruff efficacy of a shampoo containing piroctone olamine and salicylic acid in comparison to that of a zinc pyrithione shampoo. Int J Cosmet Sci 2000 Aug;22(4):285–9. doi: 10.1046/j.1467-2494.2000.00024.x.
32. Borda L.J., Wikramanayake T.C. Seborrheic Dermatitis and Dandruff: A Comprehensive Review. J Clin Investig Dermatol 2015 Dec;3(2):10.13188/2373-1044.1000019. doi: 10.13188/2373-1044.1000019.
33. Petchsomrit A., McDermott M.I., Chanroj S., Choksawangkarn W. Watermelon seeds and peels: fatty acid composition and cosmeceutical potential. OCL 2020; 27:54. https://doi.org/10.1051/ocl/2020051.
34. Komane B.M., Vermaak I., Kamatou G.P.P., Summers B., Viljoen A.M. Beauty in Baobab: a pilot study of the safety and efficacy of Adansonia digitata seed oil.
35. Ghorbani A., Esmaeilizadeh M. Pharmacological properties of Salvia officinalis and its components. J Tradit Complement Med. 2017 Jan 13;7(4):433–440. doi: 10.1016/j.jtcme.2016.12.014.
36. Vaughn A.R., Branum A., Sivamani R.K. Effects of Turmeric (Curcuma longa) on Skin Health: A Systematic Review of the Clinical Evidence. Phytother Res. 2016 Aug;30(8):1243–64. doi: 10.1002/ptr.5640.
37. Murphrey M.B., Agarwal S., Zito P.M. Anatomy, Hair. StatPearls Publishing; Treasure Island, FL, USA: 2022.
38. Koyama T., Kobayashi K., Hama T., Murakami K., Ogawa R. Standardized scalp massage results in increased hair thickness by inducing stretching forces to dermal papilla cells in the subcutaneous tissue. Eplasty 2016;16:e8.

39. English R.S., Barazesh J.M. Self-Assessments of Standardized Scalp Massages for Androgenic Alopecia: Survey Results.Dermatol Ther 2019;9:167–178. doi: 10.1007/s13555-019-0281-6.
40. Malviva R., Sharma P. Advancement in shampoo (a dermal care product): Preparation methods, patents and commercial utility. Recent Pat Inflamm Allergy Drug Discov 2014; 8: 48–58.
41. Draelos Z. Essentials of Hair Care often Neglected. Hair Cleansing. Int J Trichology 2010; 2: 24–29.
42. Goswami S., Sharma P., Soni P. Phytopharmaceuticals as Cosmetic Agents: A Review. Res J Topical and Cosmetic Sci 2011; 2: 11–13.
43. Saraf S., Jharaniya M., Gupta A., et al. Herbal hair cosmetics: advancements and recent findings. WJPR 2014; 3: 3278–3294.
44. Detka K. Natural cosmetics. A guide to health and beauty. Treasury of knowledge. Warsaw 2005.