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The Most Commonly Used Diet Supplements for Hair, Skin and Nails in the Opinion of Pharmacy Employees from Different Cities in Poland

Najczęściej stosowane suplementy diety na włosy, skórę i paznokcie w opinii pracowników aptek z różnych miast na terenie Polski

DOI: 10.15611/nit.2022.38.04
JEL Classification: I10, I18

Abstract: Preparations influencing the condition of hair, skin and nails constitute an important group of dietary supplements. They contain active substances that positively influence condition and appearance of skin. The aim of the study was to identify the most frequently used dietary supplements for hair, skin and nails in the form of tablets, and to verify the effects of the active ingredients declared on the basis of the literature. The most common ingredients in hair, skin, and nail supplements were biotin, zinc, copper, vitamin C, and niacin. Most of the selected dietary supplements were multi-ingredient, and the content of ingredients in

one dose of supplements varied greatly. Almost all the ingredients contained in the analysed dietary supplements have an effect confirmed in the literature; one of those (PABA) has no proven effectiveness. There is a need for more research into hair, skin and nail nutritional supplements and into consumer choices.

Keywords: dietary supplements, nutricosmetics, hair, skin, nails, pharmacists.

Streszczenie: Ważną grupę suplementów diety stanowią preparaty wpływające na kondycję włosów, skóry i paznokci. W ich składzie znajdują się substancje czynne korzystnie oddziałujące na stan i wygląd skóry. Celem pracy było wskazanie najczęściej stosowanych przez klientów aptek suplementów diety na włosy, skórę i paznokcie w postaci tabletek oraz zweryfikowanie na podstawie literatury deklarowanego działania składników aktywnych. Najczęściej powtarzającymi się składnikami suplementów diety na włosy, skórę i paznokcie były biotyna, cynk, miedź, witamina C i niacyna. Większość wybieranych suplementów diety było wieloskładnikowych, a zawartość składników w jednej dawce suplementów była bardzo zróżnicowana. Niemal wszystkie składniki zawarte w analizowanych suplementach diety mają potwierdzone w literaturze działanie. Jeden ze składników (PABA) nie ma potwierdzonej skuteczności działania. Istnieje potrzeba dalszych badań suplementów diety na włosy, skórę i paznokcie, biorąc pod uwagę wybory konsumenckie.

Słowa kluczowe: suplementy diety, nutrikosmetyki, włosy, skóra, paznokcie, farmaceuci.

1. Introduction

Radiant skin, strong nails and shiny hair are the hallmarks of health. In addition, they look good and improve one's general wellbeing. An impaired condition of the epidermis and epidermal structures can considerably reduce the comfort of living, thus lowering one's self-esteem, and the accompanying stress can further aggravate the problem (Goluch-Koniuszy, 2016). Skin condition is largely determined by the general health status. A balanced diet, rich in macro and microelements, plays a fundamental role in ensuring the correct function of the human body, including skin and its structures (Chruściel and Kubasińska-Sajnóg, 2021). For various reasons, the rules of healthy eating are not commonly followed by society, hence dietary supplements have become very popular (Bojarowicz and Dźwigulska, 2012). Sometimes, nutrient deficiencies can lead to a deterioration of the condition of skin, hair and nails as a general effect of the impaired body condition. Supplying specific nutrients as dietary supplements can contribute to improving skin condition and reducing lesions caused by environmental factors (Marwicka and Gałuszka, 2021). A group of supplements having a cosmetic and conditioning effect are called nutricosmetics (received and acting from within the body) (Bojarowicz and Dźwigulska, 2012). They contain active ingredients that, thanks to their properties and biological functions, can have an influence on the physiological processes occurring in human skin and its structures (Grzyb, Grzyb, and Klonowska, 2019).

The market of supplements in Poland have been developing very dynamically. It is estimated that approximately 20% of Poles use dietary supplements (Grzyb, Grzyb, and Klonowska, 2019). Pharmaceutical concerns are outdoing one another in inventing new formulas promoted in commercials. Therefore, the range of and access to dietary supplements are practically unlimited. The impact of advertising and the willingness to take an easier path towards supplementing diets deficient in nutrients make society use dietary supplements increasingly often, believing in their unique effect (Babiarczyk and Grzywacz, 2020). The composition of dietary supplements available on the market is extremely varied, both in terms of quality and quantity. Due to the absence of accurate definitions of respective categories and legal regulations on the classification of such preparations, various producers use different classifications and descriptions of often identical groups of products (Grzyb et al., 2019).

In Poland, abusing dietary supplements has become a clear trend, irrespective of the age of consumers (Kostecka, 2015; Kowalik et al., 2016). The consumption of various over-the-counter formulas is increasing, which can be due to a prevailing trend encouraging a healthy lifestyle. The media play an important part here as promoters of the cult of beauty, life without wrinkles, ideal body shape and wellbeing. This makes people use dietary supplements as a recipe for improving their beauty and health. Since no tools and regulations to monitor the use of dietary supplements are in place in Poland, the exact scale of this phenomenon is difficult to estimate. However, the issue can be analysed from the perspective of general trends observed in society. According to the report of the Supreme Audit Office (NIK) issued in 2017, many people see dietary supplements as an inseparable, innovative part of their lifestyle and often – unfortunately – a factor compensating for physical inactivity, fast pace of living, stress, and ill-balanced diet, or even poor health (NIK, 2017).

2. Purpose

This work aimed to identify the most popular, in the opinion of pharmacists and pharmaceutical technicians, dietary supplements improving the condition of hair, skin and nails used by customers of pharmacies in the form of tablets, and to verify, based on reference literature, the effects of the active ingredients declared by nutricosmetic manufacturers.

3. Materials and methods

The survey was conducted from April to May 2022 among the staff of three pharmacies in Suwałki, Lublin and Warsaw. The interviews were voluntary and anonymous, which was made clear to the participants in advance. The staff of pharmacies were requested to name ten nutricosmetic supplements in the form of tablets most often purchased by customers. The analysis covered the ingredients of the dietary

supplements and information on their effects declared by the manufacturers on the product label. This information was verified against current reference literature. A literature review in June 2022 made use of databases such as PubMed and Google Scholar. In each database, the keywords: “dietary supplements”, “hair”, “nails”, “nutricosmetics”, and “skin” were entered in Polish and in English. The search was limited to articles published from 2012 to 2022. Papers making no reference to the above-mentioned content criteria were excluded and other texts were thoroughly analysed to identify the most essential publications. Ultimately, 61 publications were analysed, including 20 original scientific papers and 41 review articles.

4. Results and discussion

4.1. Analysis of the ingredients of nutricosmetic supplements

Ingredients are the crucial criterion determining the choice of a specific dietary supplement. Other important criteria include price, packaging and advertising (Karkoszka, Banach, Beberok, and Wrześniok, 2020; Matysek-Nawrocka, Bernat, Dyczewski, and Chmiel, 2016). The analysed dietary supplements varied greatly in terms of their ingredients. The formulas contained vitamin-like compounds, minerals, plant extracts, powdered leaves of plants, amino acids, proteins, polysaccharides and yeasts. Ingredients determine the purpose of a dietary supplement, and most often multi-ingredient formulas are chosen on account of their universal effect (Kostecka, 2015). Most (77%) formulas covered by this survey were multi-ingredient ones (containing more than three ingredients). Unfortunately, the main source of knowledge about the effects of supplements is the media (Karkoszka et al., 2020; Korzeniowska, Pawlaczyk, and Jablecka, 2012). Nutricosmetics are among the most popular dietary supplements selected by customers of all ages, mostly women (Matysek-Nawrocka et al., 2016; Korzeniowska, Pawlaczyk and Jablecka, 2012). They are also frequently recommended by dermatologists (Dickinson, Shao, Boyon, and Franco, 2011).

Table 1 lists the ingredients of dietary supplements for hair, skin and nails, in the form of tablets appearing in nutricosmetics were the most popular choices in the survey. Twenty-three supplements contained biotin, twenty-one – zinc, fifteen – copper, vitamin C and niacin, fourteen – vitamin B₆ and pantothenic acid, thirteen – common horsetail and riboflavin, twelve – vitamin B₁₂ and thiamine, eleven – selenium and folic acid, ten – vitamin E, eight – nettle, iron, manganese, bamboo shoots and iodine, and seven – para-aminobenzoic acid (PABA). The content of ingredients in a single dose was extremely varied. Looking at RVS% (the percentage of Reference Value of Consumption) for vitamins and minerals, these values ranged from 18% for riboflavin to 5000% for biotin in a single dose of the formula. The biggest difference in the amount of a single ingredient in the analysed formulas was observed for biotin – some formulas contained 25 µg (25% RVCWS), and some as many as 2500 µg (5000%

RVC), irrespective of whether they were single or multi-ingredient formulas. Biotin can be purchased in any amount, but since toxicology tests did not reveal any side effects of its high intake, the risk of overdosing on biotin is negligible (Ostrowska et al., 2019; Directorate-General Health and Consumer Protection, 2007). In contrast, the smallest difference was observed for zinc, thiamine and iodine (25-100% RVC). The RVC value indicates the amount of nutrients to be consumed by most people per day (Państwowa Federacja Producentów Żywności, n.d.).

Table 1. The most common ingredients of hair, skin and nail supplements in tablet form, ordered from the most common to the least common ingredients in the analysed preparations
Tabela 1. Najczęściej występujące składniki suplementów diety na włosy, skórę i paznokcie w formie tabletek, uporządkowane od najczęściej do najrzadziej występujących składników w analizowanych preparatach

Ingredient	Content in one dose	%RVC*
Biotin (vitamin B ₇)	25 µg-2500 µg	25-5000%
Zinc	2.5 mg-15 mg	25-100%
Copper	0,25 mg-2 mg	25-200%
Ascorbic acid (vitamin C)	20 mg-120 mg	25-150%
Niacin (vitamin B ₃)	3.05 mg-35 mg	19-219%
Pyridoxine (vitamin B ₆)	0.35 mg-10 mg	25-714%
Pantothenic acid (vitamin B ₅)	3 mg-100 mg	50-1666.7%
Horsetail (contains silica)	30 mg-440 mg	–
Riboflavin (vitamin B ₂)	0.25 mg-1.4 mg	18-100%
Cobalamin (vitamin B ₁₂)	0.625 µg-6 µg	25-240%
Thiamine (vitamin B ₁)	0.275 mg-1.1 mg	25-100%
Selenium	13.75 µg-110 µg	25-200%
Folic acid (vitamin B ₉)	50 µg-400 µg	25-200%
Alpha-tocopherol (vitamin E)	3 mg-30 mg	25-188%
Nettle (contains silica)	27 mg-100 mg	–
Iron	3 mg-15 mg	21.4-107.1%
Manganese	0.5 mg-5 mg	25-250%
Bamboo shoots (contains silica)	13.35 mg-150 mg	–
Iodine	37.5 µg-150 µg	25-100%
PABA*	5 mg-40 mg	–

* RVC – Reference Value of Consumption; PABA – para-aminobenzoic acid.

Source/Źródło: own study/opracowanie własne.

Recently, several studies have been published concerning the most common ingredients of nutricosmetics, mostly based on the opinions of consumers. Szyszkowska et al. (2014) mentioned antioxidants (including vitamins A, E, and C),

B-group vitamins, peptides, lipids, macro and microelements (zinc and silica), amino acids (L-arginine, taurine, cysteine, cystine, methionine, and tryptophan), enzymes (lactase and papain), prebiotics (inulin) and probiotics (bacteria cultures and yeasts), essential fatty acids EFA (fish oil, gamma-Linolenic acid, eicosapentaenoic acid and docosahexaenoic acid) among the biologically active compounds most commonly present in nutricosmetics. No EFA were found in the dietary supplements listed in this survey (only supplements in the form of tablets were analysed), although they do have a beneficial effect on the condition of hair, skin and nails (Grzyb et al., 2019) since EFA in capsules and liquids are more assimilable. Kania-Dobrowolska, Baraniak, Kujawski, and Ożarowski, (2017) reported various ingredients of the diet improving the condition of hair, skin and nails, including ingredients of plant-origin such as: chamomile flowers, pennywort, nettle, heartsease flowers, common horsetail extract, borage seed oil, and vitamins (vitamin E, carotenoids, vitamin C, and vitamins from the B group) and bio-elements (silica, zinc and selenium). Dini and Laneri (2019) stated that essential active ingredients of dietary supplements for hair, skin and nails include lipids, peptides, polysaccharides, minerals and vitamins, flavonoids, phytoestrogens and herbal extracts. In the survey by Karkoszka et al. (2020) 40% of respondents claimed that sulphur-containing amino acids were the key ingredients improving the condition of hair. Sulphur-containing amino acids (mainly L-cysteine) stimulate hair growth and reinforce hair structure (Komsta et al., 2021), but in this survey supplements containing such ingredients were not very popular consumer choices.

4.2. Analysis of the efficiency of nutricosmetics used as dietary supplements

Producers of nutricosmetics assure – in commercials and on product labels – that these formulas are highly efficient in tackling beauty-related issues. Despite this fact, before using them it is important to read a detailed list of ingredients of the specific product and check if their efficiency has been verified by clinical testing. It is worth adding that some dietary supplements were referred to as nutricosmetics only to raise their attractiveness and prestige on the pharmaceutical market (Bojarowicz and Dźwigulska, 2012).

Table 2 shows the effect of selected, most common active ingredients on hair, skin and nails as declared by the manufacturers of the formulas. The declarations were placed on product packaging. The efficiency of nearly all the ingredients was corroborated by the latest literature.

In the presented survey the most common ingredient of the analysed dietary supplements was biotin (vitamin B₇). The respondents in the survey conducted by Karkoszka et al. (2020) deemed biotin to be an essential active ingredient improving the condition of skin, hair and nails. The popularity of this ingredient can be triggered by popular TV commercials of formulas based on vitamin B₇. The efficiency of biotin in improving the condition of skin, hair and nails is observed

only when the body is deficient in vitamin B₇ (Karkoszka et al., 2020), but labels of dietary supplements do not provide such information to consumers. However, the deficiency of biotin is quite rare and data supporting recommendations to use it in the treatment of hair, skin and nails is limited (Waqas, Wu, Yim, and Lipner, 2022). Many doctors recommend supplementing biotin to their patients in order to improve the condition of their nails and hair, but not all of them remember to mention that taking biotin should be stopped prior to thyroid function and troponin level

Table 2. The effect of active ingredients on hair, skin and nails as declared by the manufacturers of dietary supplements

Tabela 2. Wpływ składników aktywnych na włosy, skórę i paznokcie deklarowany przez producentów suplementów diety

Ingredient	Manufacturer's declaration	Proof in literature
1	2	3
Biotin (vitamin B ₇)	Strengthens the hair, supports the formation of hair bulbs and supports their growth Increases the hardness and thickness of nails	Paul-Samojedny, 2016 Lipner and Scher, 2018
Zinc	Contributes to the proper appearance of nails, skin and hair Supports the protection of cells against the harmful effects of oxidative stress Takes part in the process of cell division	Chruściel and Kubasińska-Sajnóg, 2021
Copper	Contributes to proper skin pigmentation	Ogen-Shtern et al., 2020
Ascorbic acid (vitamin C)	Supports skin elasticity A strong antioxidant, delays the ageing process of the skin and contributes to its renewal and supports the action of collagen	Rattanawiwatpong et al., 2020
Niacin (vitamin B ₃)	Helps to maintain healthy skin and hair Supports hair growth and strengthens its structure	Marwicka and Gałuszka, 2021
Pyridoxine (vitamin B ₆)	Helps to keep the skin healthy	Molski, 2012
Pantothenic acid (vitamin B ₅)	Supports hair growth and strengthens its structure	Muszyńska, Malec and Sułkowska-Ziaja, 2013
Silica	Helps in maintaining the proper condition of hair, skin and nails	Bojarowicz and Dźwigulska, 2012; Grzyb et al., 2019
Riboflavin (vitamin B ₂)	Supports the protection of cells against oxidative stress Helps to keep the skin healthy	Piróg, Joskowska and Lebedzińska, 2016 Biegaj, 2017
Cobalamin (vitamin B ₁₂)	Helps to keep the skin healthy Supports the process of cell division	Brescoll and Daveluy, 2015; Rzepka, Słaby, and Wrześniok, 2021
Thiamine (vitamin B ₁)	Helps to keep the skin healthy	Molski, 2012

1	2	3
Selenium	Helps to keep nails and hair healthy Helps to protect cells against oxidative stress	Lv et al., 2020; Vollmer, West and Lephart, 2018; Wołoncej, Milewska and Roszkowska-Jakimiec, 2016
Folic acid (vitamin B ₉)	Supports the process of cell division	Rzepka, Słaby and Wrześniok, 2021
Alpha-tocopherol (vitamin E)	Strengthening the body's protection against oxidative stress	Czerwonka et al., 2019
Iron	Reduces nail brittleness	Seshadri and De, 2012
Manganese	Helps to protect cells against oxidative stress	Musielńska and Bus, 2019
Iodine	Helps to maintain the proper condition of the skin Supports the maintenance of a healthy scalp	Domagalska, 2021
PABA*	Affects hair pigmentation Protects the skin against the harmful effects of UV rays; efficiency is not scientifically confirmed	Karkoszka et al., 2020

PABA* – para-aminobenzoic acid.

Source/Źródło: own study/opracowanie własne.

tests, as supplementation of biotin interferes with their results (Waqas et al., 2022). Other common ingredients of the supplements were other vitamins from group B. Niacin (vitamin B₃), pyridoxin (vitamin B₆) and riboflavin (vitamin B₂), ranked fifth, sixth and ninth, respectively (Table 1), support the treatment of acne and other inflammatory diseases of skin. Riboflavin is mostly responsible for regulating the function of sebaceous glands, which makes the skin look radiant and healthy and takes part in epidermal keratosis. Niacin has a special anti-inflammatory and anti-ageing effect. Pyridoxin reduces seborrhoea through its intermediate effect on the hormonal balance of the body (inhibiting 5-alpha-reductase) (Biegaj, 2017). Pantothenic acid (vitamin B₅) has an influence on the condition of both hair and skin. It was demonstrated that vitamin B₅ prevented hair loss, inflammation of skin and mucosa, calloused epidermis and ulceration; it also supports wound-healing (Marwicka and Gałuszka, 2021). Cobalamin (vitamin B₁₂) also has an influence on the condition of the skin and epidermal structures. Its effects mostly include a reduction of skin discolouration and lesions in the oral cavity (mouth ulcers), but it can also support the treatment of vitiligo, atopic dermatitis and acne (Brescoll and Daveluy, 2015). In addition, it plays the part in the biosynthesis of coenzyme Q10 contributing to the reduction of wrinkles (Gałka and Ogonowski, 2015). Moreover, cobalamin has a blood-forming effect, thanks to which blood can transport oxygen and nutrients to all tissues, including skin, improving their nutrition and function (Kośmider and Czaczyk, 2010). Thiamine (vitamin B₁) is used as a dietary supplement and in the form of creams, toners and

masks. It has an antipruritic effect on skin and is used in treating infectious and non-infectious skin conditions (Marwicka and Gałuszka, 2021). Folic acid (vitamin B₉), like other vitamins from group B, also makes the skin look healthier. It is used as a dietary supplement mainly by women at reproductive age (Cieślak, Kościej, and Gębusia, 2013), but can also be helpful for other age groups as it reduces hair greying, skin discolouration and sagging (Marwicka and Gałuszka, 2021).

According to literature, alpha-tocopherol (vitamin E) actively slows down the ageing processes, has an antioxidant effect and neutralises free radicals in the body (Czerwonka et al., 2019). Apart from that, vitamin E can reduce skin discolouration caused by UV radiation (Kania-Dobrowolska et al., 2017). In this survey it is only the fourteenth most popular choice among nutricosmetics in the form of tablets (Table 1). However, this vitamin is soluble in fat (Zielińska and Nowak, 2014), so it is more often supplied in the form of capsules.

Ascorbic acid (vitamin C), listed fourth (Table 1), shows several antiageing properties. It is not only a strong antioxidant and a mediator of photodamage and melanogenesis, but also supports biosynthesis and stability of collagen, which improves skin regeneration and stimulates anti-inflammatory activity (Al-Niaimi and Chiang, 2017; Telang, 2013). Vitamin C is recommended in the treatment of atopic dermatitis, acne, couperose skin, bruises and skin discolouration (Marwicka and Gałuszka, 2021).

Minerals such as zinc, copper and iron were essential components of the nail plate. Zinc, the second most popular ingredient of the analysed dietary supplements for hair, skin and nails, supports the protection of cells against oxidative stress and is involved in the cell division process (Chruściel and Kubasińska-Sajnóg, 2021). Zinc is implicated in the synthesis of prostaglandins and metabolism of fatty acids and collagen, thanks to which it contributes to skin regeneration and regulates its excretory function (Chruściel and Kubasińska-Sajnóg, 2021). It was demonstrated that zinc deficiency increases the concentration of IgE in blood serum and stimulates the synthesis of pro-inflammatory cytokines (Takahashi et al., 2010). One-third of the respondents in the survey conducted by Karkoszka et al. (2020) attributed a positive effect to zinc oxide. Formulas containing inorganic mineral ingredients (e.g. oxides, chlorides, and carbonates) are assimilated by the body less effectively and at a considerably slower rate (Waleśkiewicz-Ogórek, 2018). Zinc overload can cause skin problems such as excessive hair loss (Kuras, Zielińska-Pisklak, Perz, and Szeleszczuk, 2015). Copper, the third ingredient in the list, is responsible for hair pigmentation and its deficiency in the diet contributes to premature hair greying (Szkłarczyk, Goździalska, and Jaśkiewicz, 2012). In addition, it enhances skin elasticity (Ogen-Shtern et al., 2020). Excessive levels of copper in blood serum can lead to hyperthyroidism, allergic reactions, cirrhosis and infections. An increased concentration of copper in the results of laboratory tests can be also associated with pregnancy and breastfeeding. Sometimes it is observed in women using contraceptives (Miniuk, Moniuszko-Jakoniuk, and Kulikowska, 1991; Wołoncej

et al., 2016). Prolonged supplementation of iron reduces brittle nails even in patients showing no clear signs of iron deficiency (Seshadri and De, 2012). Moreover, pale nail bed, brittle nails and onycholysis can be signs of low levels of iron in the body (Cashman and Sloan, 2010). Iron is, on the one hand, necessary for the body to maintain homeostasis, but, at the same time, can be toxic. Excessive amount of iron over-absorbed from the alimentary tract is deposited in the cells of various organs and contributes to the formation of hydroxyl radicals damaging proteins, DNA and lipids (Chifman, Laubenbacher, and Torti, 2014). In addition, the risk of diseases such as diabetes and cardiac diseases, and bacterial and viral infections, is significantly higher in people showing ferritin levels over 100-150 ng/ml (Borkowska and Antosiewicz, 2020). However, since excessive iron is naturally excreted from the body, its deficiency is certainly more frequent (Wołonciej et al., 2016). Low levels of selenium are associated with skin conditions such as vitiligo, psoriasis and alopecia areata (spot baldness). In contrast, selenium at high levels plays a protective role during the above-mentioned diseases (Lv et al., 2020). Selenium is an integral component of glutathione peroxidase, which is associated with its antioxidant properties (Wołonciej et al., 2016). Manganese is a strong antioxidant (Aguirre and Culotta, 2012; Musielińska and Bus, 2019). A deficiency of this element induces skin lesions such as flaking dermatitis, but they only occur if the diet is highly restrictive and deficient (Friedman et al., 1987; Mehri, 2020;). Excess levels of manganese show a toxic effect (Freeland-Graves, Mousa, and Kim, 2016) manifested in disorders of the central nervous system, and the respiratory and reproductive system (Wołonciej et al., 2016) and increased level of superoxide radicals (Zhang, Zhou, and Fu, 2003). One of the main symptoms of hyperthyroidism is dry skin (Koczorowska-Talarczyk and Kordus, 2021). The literature offers no scientific evidence directly corroborating a positive effect of iodine supplementation on dry skin, but Domagalska (2021) claims that iodine deficiency can make the skin rough and flaky.

According to Bojarowicz and Dźwigulska (2012), the most popular ingredient of dietary supplements for hair, skin and nails is common horsetail. In the authors' analysis horsetail was not the most popular ingredient of nutricosmetics – seven other ingredients were more popular (Table 1). Common horsetail is an ingredient of dermatological formulas for external and internal use, primarily due to the fact that it contains silica, which is involved in the biosynthesis of collagen and has an antibacterial, remineralising and regenerating effect (Grzyb and Grzyb, 2021). The concentration of silica in the body decreases with age, causing hair pigment loss and brittle nails, and reducing resistance to yeast and bacterial infections. Another source of this element, apart from horsetail, is extracts from nettle and bamboo shoots (Bojarowicz and Dźwigulska, 2015). Surveys conducted by Karkoszka et al. (2020) showed that, according to more than 40% of respondents, extracts from common horsetail and from nettle improved the condition of hair, skin and nails.

Although PABA is present in many skin, hair and nail conditioning formulas, its efficiency is not confirmed. About 20% of the respondents in the survey of

Karkoszka et al. (2020) erroneously perceived that the content of PABA was key to the efficiency of dietary supplements. In this survey, PABA was the least common ingredient of nutricosmetics (Table 1).

4.3. Purpose and safety of using nutricosmetics

A well-balanced diet, rich in vegetables and fruit, should supply all the nutrients essential for the correct function of the human body. Dietary supplements are only meant to supplement a standard diet. If the diet is ill-balanced, supplements are a reasonable solution. However, it is always necessary to check product labels, including information on ingredients, content of active ingredients, coverage of the requirement for respective elements, the purpose, and the contraindications. Dietary supplements should be used carefully, preferably in consultation with a nutritionist, physician or pharmacist. Due to the common availability of dietary supplements and catchy advertising slogans they are purchased too eagerly and their use without clear indications can have adverse consequences for human health (Bojarowicz and Dźwigulska, 2012). Since only part of society has a basic knowledge about dietary supplements, few people use them as intended, thus exposing themselves to aggravated health problems (Karkoszka et al., 2020).

In this survey, interviews with pharmacists concerning the choice of dietary supplements for hair, skin and nails were not accidental since most consumers (72%) buy dietary supplements at a pharmacy (Karkoszka et al., 2020). Other places where people buy supplements are the Internet – 13%, chemist's – 14% and grocery stores – 1%. The vast majority of consumers (85%) seek information about supplements in the Internet, 36% rely on data available in newspapers and TV commercials, and only a quarter consult a pharmacist or physician for professional advice (Karkoszka et al., 2020).

Multi-ingredient supplements give rise to many doubts, particularly if the diet is well-balanced and varied and laboratory test results do not show any nutrient deficiency. A thoughtless supply of dietary supplements through using more than one multi-ingredient formula at the same time without reading the labels results in multiplying these ingredients and unconsciously supplying a higher dose than assumed. A major problem affecting the quality of multi-ingredient formulas is their contamination with heavy metals (such as mercury, lead, and arsenic). Sometimes, even if respective ingredients contained standard levels of heavy metals before blending, such levels can be exceeded in the finished multi-ingredient product (Baraniak, Kania-Dobrowolska, Górska, Wolek, and Bogacz, 2020). The Regulation of the European Commission (2008) established the highest admissible levels of certain contaminants in foodstuffs. Nevertheless, on some occasions the admissible levels are still found to be exceeded upon inspection. Exceeded upper levels of vitamins and macro and micro-elements can entail a risk of overdosing on them and poisoning (Baraniak et al., 2020).

Currently, data on using dietary supplements to improve the condition of skin, hair and nails is scarce. Most surveys refer to the consumption of over-the-counter drugs and dietary supplements, and not strictly to nutricosmetics (Karkoszka et al., 2020; Simundic et al., 2019). Research on dietary supplements for hair, skin and nails, taking consumer choices into account, should be continued.

5. Conclusions

1. Most (77%) dietary supplements for hair, skin and nails selected by consumers were multi-ingredient formulas.

2. The content of ingredients in a single dose of dietary supplements was extremely varied.

3. The most common ingredients of dietary supplements for hair, skin and nails were biotin (23 dietary supplements contained biotin), zinc (21 dietary supplements contained zinc), copper, vitamin C and niacin (15 of the supplements each contained copper, vitamin C, and niacin).

4. Nearly all the ingredients of the analysed dietary supplements have a nutricosmetic effect corroborated by reference literature, and only the efficiency of PABA is not scientifically confirmed.

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