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WILD FRUITS – A REVIEW OF FOOD AND MEDICAL IMPORTANCE

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ABSTRACT

Wild fruits can be consumed in different forms, both fresh and integrated into processed foods such as spreads, juices, or even pastries and confectionery. Introducing them as functional foods into the daily menu can contribute to postponing or avoiding the onset of certain diseases, constituting an important source of vitamins, minerals, and antioxidants, with significant prophylactic effects. The wide range of benefits brought by consuming these fruits represents an important source of food supplements useful in primary medicine. The purpose of this paper was to review the specialized literature regarding the methods of consuming wild fruits and the beneficial effects of this habit on human health.

INTRODUCTION

Many wild fruit species are edible and can be used for food production. They can be used fresh, processed into juices, preserves, jams, or even in pastries. Many wild fruits have a delicious taste and aroma and can serve as an excellent component that imparts special aromatic properties to food products (Stabnikova et al. 2024). Malnutrition is inadequate, excessive, or unbalanced consumption of energy and/or nutrients. Certain types of malnutrition, such as childhood malnutrition, adult obesity, and micronutrient deficiencies, may be more likely in those experiencing moderate food insecurity (Mekonen & Reta 2024). Food is one of the necessities of human life. Human consumption of food from wild flora is a very old phenomenon that predates agricultural practices. Wild species are nutritionally valuable compared to many of the domesticated species and have a direct impact on the security of human livelihoods (Khan et al. 2024). Over the past century, the rapid evolution of global food systems, driven by significant social and ecological changes, has led to a profound decline in biological and cultural diversity. This decline also had negative repercussions on the conservation of the tangible and intangible elements that form the food heritage of local communities (Zocchi et al. 2024). Some tree species in the wild flora produce edible fruit or have medicinal properties. Conservation of these plants can contribute to diversifying the human diet and providing access to natural resources useful for human health, and the growing global demand for natural medicines has led to their widespread recognition and appreciation (Ngurthankhumi et al. 2024). Wild fruits are of undoubted interest as food products with valuable medicinal properties. But most importantly, wild fruits are

a concentrated source of antioxidants, vitamins and minerals, and their inclusion in the human diet can strengthen the immune system and resistance to infection (Stabnikova et al. 2024). Due to their high fiber and antioxidant content, peer-reviewed literature has identified that wild berries can treat a variety of ailments, including diabetes, cardiovascular problems, inflammation, and disorders of the digestive and urinary tracts. The purpose of this paper was to review the specialized literature regarding the methods of consuming wild fruits and the beneficial effects of this habit on human health.

MATERIAL AND METHODS

The study was carried out based on bibliographic sources, books and scientific articles, but also on scientific databases, to access recent research. The method used was documentary research, by reviewing the published literature on wild fruits, focusing on aspects such as nutritional composition, beneficial health effects and dietary importance. The synthesis of the scientific information obtained in the documentary research allowed the presentation of coherent conclusions about the importance of wild fruits in nutrition and health.

RESULTS AND DISCUSSION

Results regarding the valorization of wild fruit species

Valorification of wild fruits through preservation. To be able to consume fruit all year round, both the food industry and home consumers turn to their preservation. While canned foods are often considered less nutritious than fresh or frozen produce, research shows that this is not always true. The effects of processing, storage, and cooking are highly variable depending on the fruit used. In general, while the canning process often decreases the content of these water-soluble and heat-labile nutrients, storage and cooking of fresh and frozen produce can also significantly decrease the nutritional content. The reduction of the number of bioactive compounds is inevitable with the passage of time, for example, both vitamin C, B complex vitamins and ascorbic acid degrade over time, regardless of the preservation method. By freezing, the content of polyphenols and flavonoids in fruits is lost in much smaller quantities than by keeping pasteurized products, but in this case, it was found that these bioactive products migrate from the pulp of the fruit into the syrup in which they are preserved, as in the case of compotes (Rickman et al. 2007). Fresh fruits and the juices obtained from them offer various advantages by consuming them. From the experiment of Zuo et al. (2024) on the juice fermented by *Rosa roxburghii* with the help of lactic bacteria, it was observed in mice affected by induced ulcerative colitis, that regular feeding with this type of juice had a positive effect on the microbiota, there being signs of a potential immunological and anti-inflammatory modulator for the treatment of this pathology. On juice fermented with *Lactobacillus plantarum* from the fruits of the same species in the study by Zikela et al. (2024) several effects on liver cell damage, lipid accumulation, and markers of oxidative stress were identified. Additionally, the juice enhanced antioxidant activity by increasing superoxide dismutase activity, glutathione and catalase levels, while reducing reactive oxygen species and malondialdehyde levels. And the analyzes carried out by Luo et al. (2024) also showed an increase in the concentration of phenolic compounds in the fermented juice of *R. roxburghii* with the help of *L. plantarum* and *L. paracasei*.

Valorification of wild fruits in the food industry. The use of wild fruits in spreads (sweets, jams, marmalades, and jellies) has been extensively studied, so a

variety of spontaneous pome fruits can be included in such foods, either alone or associated with other fruits. For example, the research carried out on *Prunus spinosa* by Nistor et al. (2023) showed that thermal processing of fresh blackthorn fruit to obtain marmalade, jelly and jam resulted in a significant decrease in phytochemical compounds and antioxidant activity. However, the marmalade kept the highest level of phytochemical parameters in terms of total polyphenols, flavonoids and anthocyanins compared to the other products obtained. Significantly, the anthocyanins remained in the monomeric state. The fruit processing industry generates large amounts of unused by-products (e.g. pomace, peel, and seeds), which cause serious environmental and economic problems. In Portugal, a study (Vicente et al. 2024) that developed yeasts from the fruits and leaves of the species *Pyrus communis*, *Malus domestica,* and *Pistacia lentiscus*, presented, following the sensory analysis of the bread obtained with the yeasts from the fruits, a positive response of the respondents compared with bread made with commercial yeast. The dough can be enriched with powder from various dried fruits; by replacing wheat flour with that obtained from rose hips (*Rosa* spp.) in proportions of 5%, 10%, and 15%, a much better response was obtained from the respondents, compared to the control sample (Chochkov et al. 2023). For cookies, research on quince seed gum (*Cydonia oblonga*) by Gholamian et al. (2023), contributed together with licorice (*Glycyrrhiza glabra*) to increase the viscosity of dough samples and the amount of protein, to decrease the density, pH and amount of fat. The microstructure analyses showed that by adding these products, the increase in the number of cavities in the top, the fine structure, and the uniformity of these cavities was induced. The fruits of the spontaneous flora can also be used in the dairy industry. Among fermented dairy products, yogurt is the most popular. It is considered a healthy food due to its high digestibility and bioavailability of nutrients. In recent years, the decrease in the consumption of dairy products has had a negative impact on this sector (Herrera et al. 2023). Because yogurt is versatile, it provides an excellent opportunity for people to add new and healthy products to their diet. Rosehip (*Rosa canina*) has been shown to have antioxidant activity, and sensory scores and antioxidant activity were improved by adding rosehip pulp to yogurt. The sensory attributes of the sample with rosehip addition scored better than the control yogurt (Sahingil & Hayaloglu 2022). Similarly in the study of Herrera et al. (2023), the incorporation of hawthorn (*Crataegus monogyna*) extracts as an ingredient for making yogurt increased the antioxidant capacity and inhibition of alpha-glucosidase enzyme activity of yogurt. Alcoholic beverages have been a distinctive component of many cultures for thousands of years and are still part of traditional knowledge in most human communities. Liqueurs are produced by flavoring distillates of various origins with aromatic components, such as herbs (leaves, roots, seeds, and flowers), fruits (whole fruits, peel and seeds), as well as other food products and sweetened with sugar, honey or other flavoring agents. Research by Łuczaj et al. (2019) documented the most frequently used plants for flavoring traditional drinks, such as *rakija*, in Croatia, among which were noted as spontaneous fruit species: *Prunus* spp. (mainly *Prunus cerasus*, *P. spinosa* or *P. avium*), *Citrus* spp. ., *Juglans regia*, *Rubus ulmifolius*, but also other spirits that are made from a single fruit-based species such as *Ziziphus jujuba*, blackberry (*Rubus ulmifolius*), *Eriobotrya japonica*, rosehip (*Rosa canina*) and dogwood (*Sorbus domestica*). In other European countries, such as Romania (Cosmulescu et al. 2014) or Slovenia (Jakopic et al. 2007), liquor obtained from walnuts (*Juglans regia*) that have not yet reached maturity is also consumed.

In the Republic of Moldova, the documentation made by Zocchi et al. (2024), provided important information regarding the utility of plants in traditional food and alcoholic preparations for the ethnic groups found in the south of this country, thus, hawthorn fruits and stalks, walnut kernels, cherries and plums are also found in alcoholic preparations. Other traditional fruit-based alcoholic beverages are those found in Bulgaria (*rakia*) (Nashar & Ivanova 2024), Serbia (*rakija*) (Stanojević et al. 2024), and Romania (*țuica*) (Muică & Turnock 2008) which can be mixed with cherries, nuts, berries, honey or various herbs.

Results regarding the contribution of fruit species to human health

Polyphenols found in fruits have the property to protect the heart. Regarding this action, it is noted in the literature *Crataegus* sp., *Eriobotrya japonica* and *Rubus idaeus* (Celiński et al. 2024). Cardiac arrhythmia is the condition in which the normal rhythm of the heart is disturbed, and hawthorn fruit extracts (*Crataegus meyeri*) had in vivo antiarrhythmic properties identified in male rats in the study of Garjani et al. (2000). A clinical study (Alipour et al. 2024) conducted in Iran recorded a percentage of 81.7% of 120 adolescents between the ages of 13 and 19 who complained of heart palpitations, in whom the cardiac manifestations improved after they were administered a treatment based on *Crataegus oxyacanta*. High blood pressure is the main clinical sign of hypertension, and both the edible and non-edible parts of the fruit contain biochemical compounds that can lower blood pressure. Chukwuma (2024) documented that sour cherry (*Prunus cerasus*) seed protein isolates had a hypotensive effect by inhibiting angiotensin-converting enzyme and reducing cholesterol in laboratory mice. Following the study by Kumari et al. (2024), the Siberian apple (*Malus baccata*) as the entire *Malus* genus, was identified as a species with hypotensive properties, its fruit having a high content of essential amino acids (tyrosine, serine, cysteine, alanine), fatty acids (ethyl palmitate, linolein, ethyl palmitate, palmitic acid and methyl petroselinate), sugars (glucose, inositol, fructose, sucrose and arabinose), phenolic acids (caffeic acid, *p*-coumaric acid, cinnamic acid, gallic acid, phlorizin, phloretin, rutin) and amino acids (alanine, cysteine, histidine, glycine, serine and tyrosine). The study by Cui et al. (2023) identified that the fruits and leaves of species of the genus *Crataegus* have significant hypotensive effects by increasing the bioavailability of nitric oxide (NO), thus producing antihypertensive activity. And in the study by Choi et al. (2024), extracts from the bark of *Prunus yedoensis* are found to reduce blood pressure and have a vasodilator effect in aortic rings in rats. Blood coagulation is the crucial process in hemostasis, which plays the role of transforming the state of blood from liquid to solid through the presence of clotting factors. The data presented by the study of Shatoor et al. (2012) confirmed that hawthorn (*Crataegus aronia*) extracts can have antiplatelet effect in rats, as they effectively inhibit platelet aggregation. A similar study (Xie et al. 2017) determined the anticoagulant activity of *Rubus* spp. extracts both *in vitro* and *in vivo*, noting inhibitory effects on the formation of thrombi, associated with the regulation of the active substance of the vascular endothelium, the activation of the flow of blood, and the anticoagulant effect. Hyperlipidemia is a metabolic disorder characterized by elevated levels of one or more types of lipids and/or lipoproteins in the blood and is a causative factor in cardiovascular disease, hypertension, and diabetes. The fruits of *Rosa* species such as *R. roxburghii* (Wu et al. 2024) have significant hypolipidemic effects due to the high content of flavonoids, a fact highlighted by Wu et al. (2024) through the study carried out on the species *R. sterilis* from China. Another study (Song et al. 2024) indicated that hawthorn (*Crataegus* spp.) extracts are effective

and safe for reducing body fat and weight, improving the lipid profile in overweight individuals. In experiments on laboratory mice by Triki et al. (2024), it was demonstrated that under the action of the flavonoids present in *C. azarolus* fruits, the level of total serum cholesterol and triglycerides decreases. Obesity is traditionally defined as a weight ≥20% of ideal weight. To combat this phenomenon, spontaneous fruit plants can represent a source of nutritional supplements, which can replace unhealthy foods in the daily diet. In this regard, Kim et al. (2024) conducted a study on *Rosa multiflora* root extracts. In addition to the biochemical analysis from which a variety of bioactive compounds were identified, the study also reported results on rats, in which it was found that lipid accumulation and triglyceride levels in adipocytes were reduced, and the euscaphic acid present in the extracts regulated body fat. Antidiabetic, antioxidant, anti-inflammatory and anticoagulant effects have also been reported. In Turkey, a study (Yalçinkaya et al. 2024) that reported the results of treating diabetic rats with methanolic extract of *Rosa canina* root determined a promising potential in reducing elevated blood glucose levels and body weight in diabetic rats. These data reveal a new insight into the potential use of the plant against obesity. Diabetes is a chronic disease characterized by hyperglycemia. It is a growing global health problem that is associated with various chronic diseases such as hypertension, hyperlipidemia and cardiovascular diseases. Despite traditional treatments, nutrients and nutritional factors are also known to play a significant role in the control and treatment of this condition. The biochemical component of wild fruits can influence the enzymatic activity of the human body, thus Spínola et al. (2019) reported that extracts obtained from the fruits of *Rubus grandifolius*, *in vitro*, showed strong inhibitory activity on glucosides and moderate effects on amylase and lipase. There is clear potential for the use of *R. grandifolius* as a whole fruit and/or source of functional ingredients for the dietary management of early stages of type 2 diabetes. Łysiak & Szot (2023) documented that the fruits, leaves, flowers or cornelian cherry bark (*Cornus mas*); mulberry (*Morus* spp.); the bird cherry (*Prunus padus*); sour cherry (*Prunus cerasus*); plants of the genus *Amelanchier*, *Sorbus* and *Crataegus*; but also common medlar (*Mespilus germanica*); common quince (*Cydonia oblonga*); plants of the genus *Vaccinium* and rosehip (*Rosa* spp.), possess anti-diabetic properties. Their consumption fresh or in preparations has various roles in this regard, such as regulating blood sugar, improving glucose absorption, inhibiting the activity of several enzymes or reducing weight. Diuresis is an increase in the rate of urine flow and the excretion of sodium from the body through urine. It is a necessary excretory process that can prove difficult for people with various conditions such as prostate adenoma (Odimegwu et al. 2024). The use of fruits as natural diuretics can be one of the reasons for their inclusion in the daily diet, in this sense from the experiment carried out by Zhang et al. (2011), it was found that in rats by the administration of *Rubus idaeus* extracts, a significant increase in the volume of urine was observed, compared to the control animal, while at the same time a potassium-conserving diuretic effect was recorded. Wild fruit extracts may contribute to the amelioration of liver diseases and cytotoxicity, thus Chaudhuri et al. (2015), identified in *Prunus nepalensis* species a potential utility as a functional food because after research, it was found that the extract had high efficacy in capturing free radicals, inhibiting reactive free radicals and iron chelation. The research carried out by Khelfi et al. (2024) identified *Rosa canina* extracts as a potential treatment against intestinal inflammation due to the

concentration of vitamins C and B, as well as phenolic compounds with beneficial effects on the digestive tract.

Results regarding the beneficial effects on the human body

Oxidative stress refers to an imbalance between the production of reactive oxygen species (peroxides, superoxide's, hydroxyl radicals, and singlet oxygen) and antioxidant defense mechanisms in cells. Under normal physiological conditions, the production of reactive oxygen species is balanced by the presence of antioxidants, which neutralize these species and maintain cellular homeostasis (Iqbal et al. 2024). Antioxidant properties and high concentrations of polyphenols are identified in various studies, especially in the genus *Crataegus*. Razola-Díaz et al. (2024) identified three species of this genus with increased antioxidant activity, namely: *C. monogyna*, *C. azarolus,* and *C. laciniata*. This type of activity was also noted in the genus *Prunus*, from the research of Blando et al. (2016), a strong antioxidant activity was identified in *Prunus mahaleb*, and the reported results followed the oxygen radical scavenging capacity. Other spontaneous fruit species in which a high antioxidant activity has been identified are *Rosa canina*, *Mespilus germanica*, *Prunus spinosa*, *Cornus mas,* and *Rubus* spp. (Cosmulescu et al. 2017). The immune system is an interactive network of lymphoid organs, cells, humoral factors and cytokines. The essential function of the immune system in host defense is best illustrated when it is deficient; underactivity leads to severe infections and immunodeficiency tumors, and hyperactivity leads to allergic and autoimmune diseases. The implications of functional foods on the immune response and the strengthening of the immune system by eating fresh fruit, is not a recent habit, but has already been known for a long time that science can add this type of reactions as a topic of interest. According to Kostecka-Gugała's study (2024), which documented the properties of some fruit plants such as quince (*Cydonia oblonga*), a series of changes in the human body were noted by consuming the fruits of this species, such as modulation of the immune reaction and effects antihistamines. Cancer is a major societal, public health and economic problem in the 21st century, responsible for nearly one in six deaths. Cytotoxic effects on tumors were investigated in the study by Turker et al. (2012), who identified a tumor cell response by treating with aqueous and ethanolic extracts from the fruits of *Crataegus monogyna* and *Rubus caesius*, which were noted to have the best results of the 8 types of wild fruits analyzed from the territory of Turkey. The research carried out by Çoruh & Özdoğan (2017) showed that breast cancer cells show a cytotoxic response by treating with ethanolic extract obtained from the root of *Rosa heckeliana*. Despite the many lives saved after the discovery of antibiotics, exposure to these drugs also favors the development of bacterial resistance. The excessive use of antibiotics in veterinary and agricultural environments, as well as their presence in the environment, leads to the development and spread of resistance genes. In addition to this perspective, another well-known and highly relevant factor of antimicrobial resistance is the misuse of antibiotics in clinical settings (inappropriate prescription, self-medication). Extracts from fruits or other parts of plants can play the role of an adjuvant in addition to this type of medicine, due to the antimicrobial activity they present. In this sense, the research carried out by Grabek-Lejko et al. (2024) on extracts of leaves and fruits of some species of the genus *Rubus*, recorded the fact that there is an inhibition by their application on the bacterial cultures of *Staphylococcus aureus* and less on the cultures of *Escherichia coli*, noting a much better response in the presence of extracts obtained from leaves compared to those

obtained from fruits. Instead, the research carried out by Lapiz-Culqui et al. (2024) reported increased inhibitory activity against both pathogens in the presence of fruit extracts of *Rubus* species from Peru, such as *R. floribundus*, *R. weberbaueri* or *R. andicola*. Testing of *Cornus mas* fruit extracts by Aurori et al. (2024) proved their utility as viable natural remedies for treating resistant bacteria seen in pets, expressing good activity against gram-negative bacteria. Their antimicrobial efficiency could be determined by the increased content of polyphenols, which suggests a role as adjuvants to commercial antibiotics, especially amoxicillin, stimulating antimicrobial activity. Other research (Güven et al. 2006) on extracts obtained from fruits of *Crataegus tanacetifolia*, *Crataegus* x *bornmülleri*, *Pyrus serikensis* and *P. communis* subsp. *communis*, collected from Turkey, showed a wide range of antimicrobial activity in different degrees. In particular, *P. serikensis* extract showed significant antifungal effects.

CONCLUSIONS

The specialized literature provides important data regarding the nutraceutical composition and the beneficial effects brought to human health by the consumption of wild fruits regardless of form. They can be found integrated in combination with various other probiotic foods, such as dairy products or fruit mixes, as in the case of natural juices. The beneficial effects and bioactive composition of these fruits are of great interest to researchers, due to the great variety of these fruits found in each type of climate. Many edible wild fruits have not yet been introduced into the daily diet, which is why their research and domestication remain a current topic in the literature and future research, to highlight the consumption potential and the prophylactic effect produced by them.

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