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Health benefits of herbal extracts and beverages

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Abstract

Introduction: Herbs has been used for thousands of years mainly due to the high content of bioactive compounds. Predominant bioactive compounds of herb extracts and beverages are polyphenols, including phenolic acids and flavonoids. Data shows that antioxidant activity is mostly related to these compounds.

Aim: The aim of this work was to provide an overview of health benefits of selected herbal extracts and beverages. Due to large amount of available herbs on the market, only four were chosen and described in details.

Results: Based on literature data, depending on the type of the plant and its morphological part different activities occur. Also, the type of extractant and extraction is of great

importance. Health benefits of white mulberry, milk thistle, dandelion and ST. John's wort were described in details. It was indicated that white mulberry show hypoglycemic and hypolipidemic activity, milk thistle and dandelion can be used to treat liver disorders, while St. John's wort can help with depression.

Conclusions: Herbal extracts and beverages can be considered as nutraceuticals due to their positive effect on human health.

Keywords: herbal infusions, white mulberry, milk thistle, dandelion, St. John's wort, phenolic compounds

Introduction

For the thousands of years herbs have been used for culinary purposes and health benefits. Evidence of this was found in Egypt, China, Iraq and Iran (Mesopotamia), Greece, Rome, India and Ethiopia. Herbs and spices, such as of coriander, fennel, juniper, cumin, garlic and thyme, have been used by ancient Egyptians from 1555 BCE. However, as early as 5000 BCE Sumerians (citizens of Mesopotamia) were using thyme for its health benefits. The first written version of using herbs for disease prevention and health promotion was made in India around 1500 BCE (Tapsell et al. 2006).

The term herbs refers to different morphological plant parts of, this include flowers, leaves, buds, stems, branches, rhizomes, seeds, fruits or roots (Farzaneh and Carvalho 2015, Kogiannou et al. 2013, Chandrasekara and Shahidi 2018). However, this term can also be used to shrubs, woody vines or extracts of the plant parts mentioned above (Kogiannou et al. 2013). Herbs are often consumed as beverages, an infusion of dried herbs with warm or boiling water (Chandrasekara and Shahidi 2018, Oh et al. 2013). The renewed interest in herbs can be related to their properties. It is known, that herbal extracts reduce the risk of non-communicable diseases, for example type II diabetes, cancer, brain dysfunction and

autoimmune diseases (Chandrasekara and Shahidi 2018, Atoui et al. 2005). Furthermore, in contrast to chemical medicines, herbal treatments show minimal side effects to human health (Farzaneh and Carvalho 2015). The biological effects, promoting human health are mostly related to the content of bioactive compounds, which are produced in plants through secondary metabolism. To this group belong a board range of compounds, such as phenolic acids, flavonoids, tannins, terpenoids, and vitamins, which have antioxidant activity (Oh et al. 2013). They can act in two ways: as primary antioxidants – scavenging free radicals, or as secondary antioxidants – prevent formation of free radicals. In terms of herbs polyphenols are thought to be most important, because there is a high correlation between their content and antioxidant activity of plants (Oh et al. 2013).

Aim

The aim of this work was to provide an overview on health benefits of selected herbal extracts and beverages. Due to large amount of available herbs on the market, only four were chosen and described in details.

Comparison of herbal beverages

There is a very wide range of herbs with health potential. Researchers from national cancer institute diagnosed about 30 thousands herbs with anticarcinogenic activity (Kaliora et al. 2014). Depending on the type of herb infusion they can exhibit antidiabetic, anti-carcinogenic, antimicrobial and antioxidant potential (Farzaneh and Carvalho 2015).

Oh et al. (2013) compared antioxidant and antimicrobial activity of various leafy herbal tea extracts (water, ethanol). The material included: rooibos, green tea, black tea, rosemary, lemongrass, mulberry leaf, bamboo, leaf, lotus leaf, peppermint, persimmon leaf, and mate tea. They concluded that ethanol extracts of green tea, rosemary, mate, and persimmon leaf teas exhibited considerable antioxidant potential. At the same time radical

scavenging activity of water extracts were found to be the highest for green tea, black tea and peppermint tea. Additionally, green tea ethanol extract had antimicrobial activity against both oral pathogens (*Streptococcus mutans, Streptococcus sobrinus*) and three food-borne pathogens (*Listeria monocytogenes, Shigella flexneri, Salmonella enterica*). Mate tea water extract also had antimicrobial potential, but only against Gram-positive bacteria.

Kogiannou et al. (2013) and Kaliora et al. (2014) analyzed herbal infusions in terms of preventing cancer, by determining phenolic profile, antioxidant activity and chemopreventive properties in colon (HT29) and prostate (PC3) cancer cell lines. In these studies, in total twelve herbs were used, namely rosemary, Cretan dittany, St. John's wort, sage, marjoram, thyme Cretan marjoram, pink savory, oregano, mountain tea, pennyroyal and chamomile. All infusions showed antioxidant effect that is correlated with total phenolic content. Additionally, herbal infusions significantly decreased concentrations of IL-8 in both HT29 and PC3 cell lines. IL-8 is chemokine that promotes cancer development, through inhibiting cancer cell proliferation. Additionally, chamomile and St John's wort was found to inhibit NF-κB p65 subunit, resulting tumor regression in HT29.

Fotakis et al. (2016) compared antioxidant potential and metabolomics in infusions and decoctions. Infusion is made when herb is added to already boiling water and decoctions is made up with cold water and then boiled. From carried out analyzes, it was concluded that both metabolic and antioxidant profiles have higher values for infusions. At the same time, extended time of decoction (from 2 to 15 min) affected releasing bound phenolic compounds from aglycon structures, affecting higher antioxidant capacity.

Wojdyło et al. (2007) studied phenolic compounds and antioxidant activity in 32 herbs, grown in Poland. In terms of antioxidant activity, herbs were proved to act through different types of actions. Generally, plants belonging to the family *Labiatae* showed higher

capacity in reducing ferric ion (Fe^{3+}) to ferrous ion (Fe^{2+}) than to scavenging free radicals. In contrast, *E. hirsutum*, which showed the highest activity in DPPH and ABTS tests, did not show activity in FRAP test.

White mulberry (*Morus alba*)

Morus alba is a medium size tree, that can be found in Europe, Asia, Africa, South and North America. Depending on the country, different parts of the plant can be used. In Europe most popular are fruits, while in Japan leaves (Zafar et al. 2013).

Sánchez-Salcedo et al. (2015b) analyzed phenolic content and antioxidant activity in 4 genotypes of white mulberry. They reported that in fruits predominant antioxidants are phenolic acids, followed by flavonoids. Considerable differences between genotypes were observed. High correlation were found between content of polyphenols and antioxidant activity measured by two tests (DPPH and ABTS). Cited authors concluded, that both antioxidant activity and polyphenol content is comparable with other berries, such as blueberries, with proven health benefits.

Natić et al. (2015) investigated eleven species of *Morus alba* fruits. They concluded that this material is a rich source of secondary metabolites, mostly phenolic acids and flavonoids. These compounds are considered as important antioxidants. However, authors suggested that not only polyphenols are responsible for antioxidant effect of fruit extracts. Additionally, it was shown that among the flavan-3-ols identified in the extracts, epigallocatechin and epigallocatechin gallate showed high positive correlations with antioxidant activity. The effectiveness of these compounds could be linked to the number and the position of hydroxyl groups.

Leaves of white mulberry also contain significant amounts of polyphenols. There is a body of evidence suggesting, that *Morus alba* leaves show significant hypoglycaemic,

hypolipidaemic, and anti-atherogenic effects on humans and on certain animal models (Sánchez-Salcedo et al. 2015a). Ji et al. (2015) investigated effect of leaf extract on diabetes. Authors compared plasma profile of diabetic mousses belonging to normal and model group. They indicated, that polyphenols of white mulberry leaves had exhibited the effects of callback function for diabetic mouse through regulating the amino acid metabolism and sphingolipid metabolism. Furthermore, compounds of *Morus alba* leaves can help with metabolic disorder through inhibiting pancreatic lipase (Jeong et al. 2015). There is also a body of evidence indicating a positive effect of *Morus alba* extracts on kidney, testes, spleen and intestine. It is indicated that, this effect is related with antioxidant potential of phenolic compounds. They decompose free radicals, effecting protection of DNA, protein and lipids (Dkhil et al. 2015). Many studies have revealed that both fruits and leaves have strong antioxidant potential that act *in vivo* contributing to human health. Nowadays, there is a high demand to natural products, with nutritive potential.

Milk thistle (*Silybum marianum*)

Silybum marianum is an annual or biannual plant belonging to family *Asteraceae* (Abenavoli et al. 2010). It is considered to be a therapeutic plant, with several therapeutic applications. The extract of milk thistle fruit, commonly used as supplement, is called silymarin. This term refers to crude extract, in which main part are flavonolignans (65-80%), namely silybin A, silybin B, isosilybin A and isosilybin B (Albassam et al. 2017).

Literature data suggest, that silymarin have anti-inflammatory, immunomodulating, antifibrotic, antioxidant, and liver regenerating properties. Extract from *Silybum marianum* plant acts through different antioxidant mechanisms. These include: direct scavenging of free radicals, preventing free radicals formation and activating antioxidant enzymes. It also decreases inflammatory response, by inhibiting NF-κB pathways, therefore, it can help

patients with liver diseases (Surai 2015, Abenavoli et al. 2010). Additionally, Shaker et al. (2010) observed effect of milk thistle extracts on decreasing rat liver enzymes. They also noticed, that extracts influence levels of LDL and HDL. It decreases LDL levels and increases HDL levels. Soto et al. (2010) suggested that silymarin may be considered in the treatment of diabetic nephropathy. This is related with increase of antioxidant in the activity and recovery of gene expression of antioxidant enzymes.

Dandelion (*Taraxacum officinale*)

Taraxacum officinale, known as dandelion, is a perennial herb belonging to *Asteraceae*/*Compositae* family. Due to its antidiabetic, choleretic, antirheumatic and diuretic properties it has been used in folk medicine to treat hepatic disorders, inflammation, breast and uterus cancers (Mir et al. 2013, You et al. 2010, Choi et al. 2010).

Hu and Kitts (2005) investigated effect of dandelion flower extract against common oxygen radicals, i.e., superoxide radical and hydroxyl radical. Authors showed, that dandelion flower extracts suppresses reactive oxygen species and reactive nitrogen species. This effect is related to the content of phenolic compounds, that have antioxidant potential.

Mir et al. (2013) compared phytochemicals content and composition in different parts of dandelion, stem, root and flowers. Depending on the part of the plant analyzed, different results were obtained. The alkaloid content was the highest in roots, flavonoid in flowers and saponin in stem. Phenolic content was on the same level in both stem and flowers.

You et al. (2010) investigated effect of hot water extracts of dandelion root, on the cell cultures (HepG2 and CYP2E1) and mousses. This study shows protective effects of dandelion root extract against ethanol induced changes. Ethanol treatment in cells elevate reactive oxygen species in cells, contributing to hepatotoxicity. Protective effect of dandelion root extracts, is related to suppression of an increase in reactive oxygen species. Additionally,

authors observed that mouse livers are protected against ethanol damage by decreasing enzymes, that are markers of hepatocytic damage. Choi et al. (2010) investigated effect of dandelion root and leaves on rabbits fed with a high cholesterol diet. Results confirmed, that both plant parts positively affect lipid profile and improve antioxidant enzyme activity. Therefore, it could be protective against oxidative stress, that is linked with atherosclerosis.

St. John's wort (*Hypericum perforatum*)

St. John's wort is a plant belonging to *Hypericacae* family. This herb has been used in folk medicine for thousands of years. Flowers of this plant are a rich source of phenolic compounds, among them can be distinguished phenolic acids, flavonoids, tannins and others (Gupta and Möller 2003). However, in terms of health benefits, the most important bioactive compounds are hypericin and hyperforin (Lawvere et al. 2005). Both of them are considered to have antidepressant activity (Gupta and Möller 2003). Probably this action is related with impact on neurotransmitters in brain. Clinical trial shows that different types of extracts have antidepressant efficiency (Shmidt and Butterweck 2015). Additionally, Stage et al. (2016) concluded that a long time treatment with St. John's wort may impair glucose tolerance by reducing insulin secretion.

Summary

Herbal plants, have wide range of potentials, such as antioxidant, anticancerogenic and antimicrobial. In general, these activities are mainly linked with phenolic compounds. Depending on the plant and its part different profile of phenolic compounds is found. Additionally, the extraction method is an important factor. Generally, it was found that antioxidant activity is better for infusions than decoctions. Type of extractant is also of great importance. In some cases, better antioxidant activity was, when extracted with ethanol and in another with water. For example peppermint leaves shows better antioxidant activity when

extracted with water and rosemary when extracted with ethanol. In this review four herbs commonly available on market were described in details, namely white mulberry, milk thistle, dandelion and St. John's wort. Both fruits and leaves of white mulberry exhibit considerable antioxidant effect and leaves can help on metabolic disorders and diabetes. Milk thistle and dandelion can help with liver diseases, also those induced by ethanol (dandelion). St. John's wort can help people with depression. Although, bioactivity measured *in vitro* of some herbal beverages is known, further investigations *in vivo* is needed.

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