PHYTOCHEMICAL POTENTIAL OF BLUEBERRY FROM THE VIEW OF HEALTH CARE PREVENTION

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Abstract: *Authors present contemporary knowledge and concepts concerning beneficial effects of the blueberry on human health. Effects on nervous system, on cognitive and sensory functions, and especially on locomotor functions are analysed. There are detailed contents of micronutrients in blueberry in relation to health. Importance of blueberry micronutrients is explained based on the Recommended Daily Allowance (RDA) value. The outline includes preventive as well as possible curative use of the traditional natural plant product in practice. Basic material is presented elucidating the existing interest in the blueberry accessible to public health. Efficacy of phytochemical substances in the blueberry due to their anti-oxidative potential are mentioned and discussed. Possible effects of the preparation on the efficacy of the blueberry intake in practice (phytochemical intake) are briefly discussed. Experimental verification of the importance of the substances comprised in the blueberry for health is concluded.*

Key words: *health prevention care; blueberry; mental functions; locomotor and physical functions; ageing.*

1 INTRODUCTION

Berry soft fruit in general, particularly blueberry (Vaccinium myrtillus) are good sources of polyphenols, micronutrients and fibre (Beattie et al., 2005; Giongo et al., 2006; Basu et al., 2010; Agarwal, 2011). While in micronutrients - particularly in vitamins and fibre - is the health impact of their food intake widely known and taken into account, remain polyphenols in berries indigenous somewhat overshadowed by the still continuing wave of interest in so-called „French paradox“, namely the positive effect of red wine on human health (Balík et al., 2008). In general we can say that dark-coloured berries contain polyphenols, which owes for its colour (blue, purple, red) and positive health effects of phytochemical intake when ingested into the body (Beattie et al., 2005; Giongo et al., 2006; Ronis et al., 2006; Quideau et al., 2011).

Micronutrients are those food components that, in their absence in the diet cause to the symptoms of deficiency. Therefore it is possible to determine the recommended daily allowance (RDA). Blueberries are a significant source of vitamin C that literally "a handful" of blueberries provide the RDA for an adult (Beattie et al., 2005). Since the vitamin C has significant antioxidant activity and acts as a cofactor hydroxylation reactions, has a positive direct impact on many processes in the body. This is particularly the collagen, hormone synthesis, the activity of the immune system, iron absorption, agglomeration / aggregation of platelet formation and thrombus formation, as well as the preventive effects for protection of CHD, osteoporosis and also of the cancers (Beattie et al. 2005; Quideau et al., 2011). Other micronutrients in blueberries are B-group vitamins and folic acid. Blueberries are therefore good, affordable and an important nutritional factor that may lower homocysteine levels, thereby helping reduce the risk of disorders of the nervous system in newborns, the incidence of coronary heart disease and

possibly cancer (Beattie et al., 2005; Basu et al. 2010; Quideau et al., 2010).

Unlike micronutrients Polyphenols are a group of substances with a beneficial effect on human health, which cannot be set when the RDA and low flow into the body do not produce symptoms of deficiency. Polyphenols present in blueberries and other berries, like anthocyanins, flavonoids and resveratrol, it can be likened to medicines. It is a matter of pharmacological point of view of "xenobiotics" and their supply to the body is referred to as "phytochemical intake". In general, the beneficial effect of polyphenols presents due to their ability to supply the hydrogen from their hydroxyl groups to free radicals, and thereby to reduce their high oxidizing capacity (Balík et al., 2008). The preventive and protective/therapeutic effect of polyphenols can be seen both in the population access, based on the quantification of the incidence of certain diseases and conditions in populations, which differ in terms of the intake of polyphenols in the diet (Beattie et al. 2005; Basu et al., 2010), and so in an experimental arrangement in animal experiments (Sweeney et al, 2002; Wang et al., 2005; Han et al., 2006; Ronis et al., 2006; Xie et al., 2011; Paturi et al., 2012) and in monitoring and evaluating in human (Lotito, Frei, 2006; Karlsen et al., 2010).

2 AIM

Aim of the paper is to analyse contemporary knowledge and concepts concerning beneficial effects of the blueberry on human health, particularly the effects on nervous system, on cognitive and sensory functions, and especially on locomotor functions.

3 METHODOLOGY

The main methods are Qualitative Content Analysis of documented international research studies transformed in subject selection in the form of reference reduction combined with empirical praxis. In the paper aims are exploring and discussing from the view of possibilities of blueberry applying in different study researches, where data material are given. Finally the use of qualitative content analysis for developing of the problematic is examined and evaluated.

4 RESULTS OF INTERNATIONAL STUDIES

4.1 Blueberries and central nervous system

One of the newest and probably the most interesting findings is that in the mammalian brain, there are specific binding sites for polyphenols, including resveratrol (Han et al., 2006). This is probably the basis for the beneficial effect of polyphenols on the brain and nervous system. Even in man they are observed such beneficial effects, particularly in relation to neurological disorders, which occur more frequently with increasing age. These include for example degeneration, stroke, and dementia (Han et al., 2006). They are especially encouraging findings that dietary supplementation of blueberries has a protective effect on ischemic brain damage (Wang et al., 2005). Beneficial effects of blueberries on neurological function, dysfunction, in particular appear with increasing age, are also reported by Beattie et al. (2005). They document that animal experiments are induced by the beneficial effects of blueberries on learning disorders, memory function, motor function and neuronal conduction (Beattie et al., 2005). Greenwell (2000) brings a comprehensive view of the positive effect of blueberries in terms of slowing down of aging of the brain and brain functions. The latest advances in the license favourable impact of blueberries, which are able to prevent cognitive decline, that occurs with age, documented by Willis et al. (2009). In the foreground is a particularly favourable influence on memory.
Independent circuit research issues remain positive effect of blueberries on the eye, sharpen visual acuity and improve night vision (Greenwell 2000). Blueberries are still in the army stated publicly available as a tool which can favourably affect the eyes and visus (Herbs, 2012). Beneficial effects of blueberries on visus is explained first of a beneficial effect

on rhodopsin (Greenwell, 2000), and further of optimization/lowering of glycemian, especially in diabetic patients. Night vision and its potential positive influence of blueberries is currently studying of the research group of Dr. Wilhelmina Kalt in the research institution of the Atlantic Food and Horticultural Research Centre, Canada (Kalt, 2010).

4.2 Effect of blueberries on cardiovascular health

In research interventional studies is documented also a beneficial effect of blueberries on cardiovascular health (Basu et al., 2010). Results from the INTERHEART Study, which summarizes dietary habits and dietary formulas from 52 countries, show an inverse relationship between the content of fruit and vegetables in the diet and the incidence of acute myocardial infarction (Basu et al., 2010). There is a large field of activity, especially in the field for nutritional therapists. Right on berries, blueberries and polyphenols contained in them is focused the study "Kuopio Ischaemic Heart Disease Risk Factor Study". It shows out the inverse relationship between intake of blueberries and incidence calculated risk for cardiovascular disease, as a relation of deaths with cardiovascular disease (CVD Risk of death-related). Persons with the highest intake of blueberries consumed more than 408 grams berry crops every day, persons with the lowest intake consumed less than 133 grams per day. On the base of laboratory markers is necessary to emphasize a low level of haptoglobin in individuals with high consumption of blueberries. From the view of gender problematic we mention a large non-interventional epidemiological study of 34489 postmenopausal women in Iowa (Iowa Women Health Study), and a study on women-medics as part of Women Health Study, which enrolled a total of 38176 women. It can be concluded, that blueberries consumption, at least once a week, leads to a significant decrease in relative risk (Relative Risk) for cardiovascular death (Basu et al., 2010). In addition to these epidemiological investigations and reports are available results of intervention studies. Untill 2010 twenty of such intervention studies are documented, which deal of influence of berries on cardiovascular health (Basu et al., 2010).

Aging (aging) is lawful and inevitable part of life. Achieve the biological age of individuals were "younger" than his calendar age, in the last 20-30 years has become fashionable obsession. However, it is basically favourable trend. Stave off processes of biological and psychological marks of aging in terms of achieving barrier of the function deficits is a big challenge for health and social work. Age entails a risk of social exclusion. Any intervention that, generally speaking, prevents aging or slowing its manifestations, it is certainly welcomed. Blueberries represent due to the content of micronutrients and phytochemics important tool in these efforts. Thanks to the antioxidant potential generally have a protective effect on tissues. Improving of the mnestic and cognition functions in old age is highly desirable. Memory in old age is suffering, but the micronutrients and phytochemics of blueberry positively influenced and strengthened it. Blueberries are already inherent in the armamentaria for prolonging of life, while preserving its quality - Life Extension (Willis et al., 2009; Greenwell, 2000; Kalt, 2010; Bauer, 2011). In 2005, was described the beneficial effect of blueberries on cellular immunity, particularly increased activity of NK cells (natural killers), and T-lymphocytes in general (Beattie et al., 2005).

4.3 Impact of cousin preparation on the phytochemical properties of blueberries

Blueberries are as a source of phytochemics interesting and important, because that they are used not only in raw state as refreshing fruit (possibly as a juice), but also in the form of stewed or ready-made dishes such as blueberry pie and blueberry dumplings. Encouraging is that heat kitchen preparation, but also by freezing or cooling does not destroy the phytochemical

potential of blueberries. Cooling, freezing and heating to 98 to 100 ° C does not lead to significant decrease of the polyphenols content in blueberries (Beattie et al., 2005; Schmidt et al., 2005). Only the heat treatment, wherein the blueberries are exposed to temperatures higher than 190 ° C and which lasts longer than 18 minutes leads to a reduction of polyphenols, in particular resveratrol, about 17 - 46% (Lyons et al., 2003).

5 DISCUSSION

Blueberries antioxidative effects are probably possible because the polyphenols contained therein give to free radicals in human body a hydrogen atom of their hydroxyl groups (Balík et al., 2008). They reduce LDL cholesterol oxidation and peroxidation of lipids (Basu et al., 2010). Polyphenols from different berries, especially blueberries, lead to a direct reduction in serum glucose in interventional individuals (Greenwell, 2000). This also reflects the ancient folk practice of recommending consumption of blueberries in diabetics. US Ministry of Agriculture has included research of the effects of polyphenols on insulin metabolism and on glykemia as a first priority in the plan interdepartmental research ARS Agricultural Research Service (ARS-US Dept. of Agriculture, 2010). Special attention should be revealing to a surprising finding of the Working Group Chena of Lazarenkova and collaborators in 2010, namely that polyphenols improve bone metabolism and bone growth.

It is discussed particularly beneficial effect of blueberries on postprandial oxidative stress. Similar or identical conclusions of blueberries benefits on oxidative stress found out also Schmidt et al. (2005), Lotito and Frei (2006) Quideau et al. (2011) and Xie et al. (2011). The importance of this intervention in oxidative stress and the favourable impact on metabolism of lipids is seen especially in the anti-sclerotic effect of blueberries, that helps to atherosclerosis prevention (Beattie et al., 2005; Schmidt et al., 2005; Basu et al., 2010; Wood, 2011; Xie et al., 2011). Besides the oxidative stress and metabolism of lipids, as a risk factor or even the mechanism of atherosclerotic changes development, are stressed markers of inflammation.

Maintaining and keeping the balance and with that related fall prevention is one of the major problems of contemporary preventive care. Especially in the elderly is the balance development best prevention of falls and related injuries, as reported Klán - Topinková (2003), Tinetti (2003), Topinková (2005). Any intervention or measures which can improve balance and reduce the risk of a fall, has a great social significance. Balance improving associated with the intake of blueberries is probably due not only to their direct effects on neural tissue, but also due the effect of improving spatial imagination and memory (Bauer, 2011).

The beneficial anti-tumour effects of blueberries Julie Beattie discusses in her extensive work. Particular type of cancer tumours in vitro experiments demonstrated the direct effects of extracts from blueberry and other soft berries on carcinoma cells. She demonstrates the inhibition of growth and proliferation of cancer cells and their disappearance - apoptosis. Yet fails to convincingly reproduce these in vitro results or accumulated in animal experiments (Beattie et al., 2005). Resveratrol reduces angiogenesis and reduces the ability of tumour to metastasis. Resveratrol can obviously enhance apoptosis, leading to cell death of tumour cells. The concentration of resveratrol in the blood, which can be achieved due diet, have in terms of tumour growth anti-invasive effects. This phenomenon is discussed because of demonstration of enterohepatic recirculation of resveratrol in mammals. What is surprising is the finding that the effect of resveratrol is prolonged in time, which is explained due its relatively highly bound to plasma proteins.

5 CONCLUSION

Blueberries are proven in humans or reasonably anticipated positive effects on the brain and nervous system, on mnestic and cognitive function. Positively affect the senses, especially sight. Have a positive effect on maintaining of the balance and the ability of regular rhythmic gait. It helps prevent crashes and help prevent injuries as a result of the fall. Have significant beneficial effects on the cardiovascular system. Reduce the risk of atherosclerosis and coronary heart diseases, have generally angioprotective and cardioprotective effects. There is also interesting their possible beneficial anti-tumour effect.

To the demographic trends is potentially very promising and important their generally protective effect on the human body, which prevents marks of aging (anti-ageing effect). For these characteristics, and for the excellent culinary/organoleptic qualities, blueberries are hardly domesticated. Most experience in this regard has been collected in the United States and Canada. Basic fundus of the literature concerning the domestication of blueberries is stored in a "Historic Collection of the National Agricultural Library (Kaplan, 2011). Content of the phytochemics in particular cultivars of blueberry vary dramatically. The lowest level of polyphenols including blueberries domesticated in British Columbia and Canada, while European blueberries are very rich in polyphenols (Lyons et al., 2003).

Accumulated knowledge about the beneficial effect of blueberries on human health and the proof of this influence in many areas of human bio-psycho-social dimension may not remain only on the level of scientific knowledge and applied research. The next logical and necessary step is to transform this knowledge in simple and accessible to the practice of nutrition and health educationalists at all levels.

Together with the development of the functional food concept (Petr, Kalová, 2006), is developing a concentration interest on soft berries in general, and especially on blueberries (ARS-US Ministry of Agriculture, 2010). It is emphasized that it is the fruit of local origin, with traditional kitchen treatment (Beattie et al., 2005). US Ministry of Agriculture has included research on polyphenols in these fruits on the first and second place in the priorities of research in Nutrition - Human Nutrition (ARS-US Ministry of Agriculture, 2010). The first is the polyphenols research related to diabetes, especially their effect on insulin and glucose metabolism in general. On the second place is research of blueberries and their impact on aging and cognitive function.

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