BUCKWHEAT IN HUMAN HEALTH - A MEDICAL REVIEW

AJDA IN ZDRAVJE LJUDI – PREGLEDNI ČLANEK

Gunilla WIESLANDER[1]

http://dx.doi.org/10.3986/fbg0067

ABSTRACT

Buckwheat in human health - a medical review

Buckwheat intake has preventive effects at diabetes, obesity, hypertension, high cholesterol levels, stroke, cardiovascular diseases, gallstone formation, cancer, leg oedema as well as level of biomarkers of inflammation in body tissues and remedy in people with gluten sensitivity (celiac disease) as naturally gluten free. A literature review on medical findings is presented.

Key words: buckwheat, health, flavonoids, quercetin, rutin, fiber

IZVLEČEK

Ajda in zdravje ljudi – pregledni članek

Vključevanje ajde v prehrano preventivno vpliva na pojav sladkorne bolezni, visok krvni tlak, visok nivo holesterola, kap, kardiovaskularne bolezni, pojavljanje žolčnih kamnov, novotvorb, kot tudi na nivo bio-označevalcev vnetja telesnih tkiv in je pomebno za ljudi občutljive na gluten zaradi odsotnosti glutena. V delu je predstavljen pregled medicinskih raziskav v zvezi s prehranjevanjem z ajdo.

Ključne besede: ajda, zdravje, flavonoidi, kvercetin, rutin, vlaknine

[1] Department of Medical Sciences, Occupational and Environmental Medicine, Uppsala University, Sweden, gunilla.wieslander@medsci.uu.se

INTRODUCTION

Daily intake of different buckwheat food might prevent or reduce many major chronic diseases. Tartary buckwheat contains more rutin (a quercetin-3-rutinoside) than most fruits, vegetables and grain and fagopyritols (especially D-chiro-inositol), with high value in humans with diabetes and obesity. Daily intake of common and Tartary buckwheat cookies in a Slovenian-Swedish-intervention study during 4 weeks in 62 preschool teachers gave interesting effects. The results were a highly significant reduction of total serum cholesterol, less tiredness, improved lung capacity, reduced blood neutrophil biomarkers, all signs of prevention of chronic diseases.

Medical case studies in Sweden with some modern chronic diseases have confirmed similar effects. The addition of 60 gram buckwheat in daily intake reduced the medication at diabetes mellitus, hypercholesterolemia and at hypertension for example.

Buckwheat intake has preventive effects at diabetes, obesity, hypertension, high cholesterol levels, stroke, cardiovascular diseases, gallstone formation, cancer, leg oedema as well as level of biomarkers of inflammation in body tissues and remedy in people with gluten sensitivity (celiac disease) as naturally is gluten free. A literature review on medical findings is presented.

BACKGROUND

Medical effects of buckwheat intake might be difficult to prove, for example there are many different kinds of biomolecular mechanisms suggested and medical research methods for seeking evidence of these effects suggested. An immense coordination of different sciences, and vast diverse disciplines to understand and develop evidence for these mechanisms has been accomplished the last 10 years. Decades ago a study in the Yi people showed effects of buckwheat against hypertension and hypercholesterolemia (He et al.1995). About 2000 years ago the earliest record of the medical function of Tartary buckwheat, TB, came in Chinese history (Lin, 1994). Recently a very interesting study uncovered the relationship and mechanisms of TB and type II diabetes, hypertension and hyperlipidemia. They were using advanced comprehensive systemic approach integrating drug target prediction methods from pharmaceutical research network analysis, so called docking, on biomolecular level pathways between 97 targets and 20 TB composite compounds found in 63 references (Lu et al., 2018). It came as a result of attention as to mechanistic approach in many publications on TB buckwheat health effects in modern chronic diseases. Effects of daily intake of food with healthy effects or functional food indicating prevention or reduction of many major chronic diseases is not at all new modern knowledge as the use in Chinese medicine for thousands of years have been practised. The new thing is that modern food industry is very complicated and concerned with cheap food for consumers than with multidiversity in agriculture for individual diversified needs in different human beings with diverse genetics, some explanation for this will be notified under gluten sensitivity. The importance for minor crops like buckwheat to survive and expand in modern agriculture is major.

COMPONENTS OF HUMAN HEALTH IMPORTANCE

This will be focused in other proceedings, but a few remarks are here noticed. Buckwheat is very rich in trace elements (Zn, Cu, Mn and Se), although different milling fractions have different content of minerals and proteins, starch content (Kreft, 2001). The very low content of prolamins has also been known and is important as it has become a valuable source of dietary protein for gluten-sensitive individuals (Skerrit, 1986). Not to underestimate the comparingly high content of dietary fibers, (3.4-5.2%) out of which 20-30% are soluble. Probably the fiber content is important for the beneficial medical effects in hypertension and hypercholesterolemia. Also the resistant starch, slowly digestable carbohydrates was seen to flatten the glycaemic response curve (Skrabanja and Kreft, 1994). The anti-colon cancer effect might be an effect of the resistant starch in the colon, as it gives fermentation into butyrate in the short chain fatty acids produced by the micro-flora. The molecular composition of buckwheat diets and products has been thoroughly evaluated and studied (Ikeda, 1997).

PHENOLIC COMPOUNDS AND BUCKWHEAT

The importance and content of antioxidant phenolic compounds. Especially Tartary buckwheat (TB) contains more rutin (a quercetin-3-rutinoside) than most fruits, vegetables and grain crops. Epidemiological studies have shown that diets rich in phenolic compounds are connected to a lower risk of diseases associated with oxidative stress, such as cancer and cardiovascular diseases. In a clinical intervention study in 62 teachers 2005 highly significant health effects were found. Before, in between and after eating common or Tartary buckwheat cookies two weeks and then changing (cross-over study) without knowing which type, they were extensively examined. This intervention study during 4 weeks (daily intake), established a highly significant reduction of total serum cholesterol (both types of buckwheat), less tiredness and improved lung capacity (Tartary buckwheat). Buckwheat also may reduce neutrophil inflammation according to blood biomarkers (Wieslander et al., 2011; Wieslander et al., 2012). A major dietary flavonoid, quercetin, abundant in buckwheat, is metabolized after oral intake into its conjugates, such as quercetin–3–*O*–glucuronide and quercetin–3'–*O*–sulfate, whereas no aglycone was found in the human plasma. Therefore, to understand the mechanisms of the biological activity of quercetin focus is on the molecular actions of these conjugates. In the last decade, it has been demonstrated the unique actions of quercetin–3–*O*–glucuronide at sites of inflammation, including specific accumulation in macrophages and the following deconjugation into active aglycone, catalyzed by the macrophage–derived β–glucuronidase.

BUCKWHEAT AND CARDIOVASCULAR DISEASE RISK MARKERS: A SYSTEMATIC REVIEW AND META-ANALYSIS

This study will be described here because of medical importance, as to the vast amount of data gathered. A comprehensive literature search for prospective studies of great interest evaluated the correlation between buckwheat intake and CVD risk between 1960 and 2018 and published in PubMed, Scopus, Ovid, EBSCO, Web of Science, ProQuest databases, Science, JSTOR, Medline and China National Knowledge Infrastructure, were searched using the search terms 'buckwheat' and 'cardiovascular disease' or 'cholesterol' and 'human' or 'animal', and the same terms were applied in each database during the search phase. Thirteen randomized, controlled human studies, two cross-sectional human studies and twenty-one animal studies were identified. In addition manual search was done for all additional potentially relevant papers. CVD was defined to include stroke, aortic disease, peripheral arterial disease and coronary heart disease. The search was restricted to studies on humans and animals and included those that were written in many different languages including English or Chinese. The studies included in this review met the following criteria: (1) a prospective cohort study, (2) normal laboratory animals or free living humans, (3) buckwheat-intake exposure, (4) the results included markers of CVD risk, such as plasma glucose and insulin concentrations and lipid profile. They considered cholesterol was the most common indicator of CVD response to whole-grain foods, cholesterol was used as a primary outcome marker in this review. The result was from using random-effects models, that is the weighted mean difference of post-intervention concentrations of blood glucose, total cholesterol and triglycerides. Significantly decreased values were detected following buckwheat intervention compared with controls [differences in blood glucose: -0.85 mmol/L (95% CI: -1.31, -0.39), total cholesterol: 0.50 mmol/L (95% CI: -0.80, -0.20) and triglycerides: 0.25 mmol/L (95% CI: -0.49, -0.02)]. Responses of a similar magnitude were seen in two cross-sectional studies, which is a remarkable result. For animal studies, nineteen of twenty-one studies showed a significant reduction in total cholesterol of between 12% and 54%, and fourteen of twenty studies showed a significant reduction in triglycerides of between 2% and 74%. There was inconsistency, not surprisingly in HDL cholesterol outcomes in both human and animal studies, the studies were very heterogenous in methodology. The authors hold that it remains unclear whether the outcome on increased buckwheat intake significantly benefits as well other markers of CVD risk, such as weight loss, blood pressure, insulin-, and LDL-cholesterol levels, and they suggest even more studies. This type of studies is of course very recommended to share especially for people in position to be care-giver in outpatient clinics, nutritionists and dietitians in hospitals and in restaurants for the prevention of diseases in the immensely growing elderly populations world-wide, especially in the rich countries to prevent early development of the chronic diseases.

BUCKWHEAT IS NATURALLY GLUTEN-FREE AND HAS NOTHING TO DO WITH WHEAT.

According to the World Gastroenterology Organization data, celiac disease (CD) is a chronic disease, also called gluten sensitivity by diagnosis and the prevalence in healthy adult population varies a lot, between 1 in 100 and 1 in 300 and has a 2:1 female to male ratio (Devaraja, G., Rashmi, BS. Coeliac Disease - A Chronic Enteropathy). In Middle East, North Africa and in India, the prevalence of CD has been found to be same as in western population. In these regions, the prevalence is 3 to 20% at risk population and 3 to 5% in people with type I diabetes. Trigger factors are from ingested gluten and related cereal (wheat, rye, barley) proteins, presence of the individual tissue type (HLA DQ 2/DQ 8 molecules), and generation of circulatory autoantibodies to tissues transglutaminase (tTG) are essential factors for the precipitation of celiac disease. Unless a person has alleles for encoding HLA DQ 2/ DQ 8 molecules, CD generally does not develop. There are clear geographical differences in the prevalence of CD between and within countries. The only remedy, is to avoid gluten totally and in this regard buckwheat food is a good alternative, as long it is not contaminated with other cereals at the milling process. In Sweden buckwheat flour has been used for decades by people with CD and sold in special health stores. The diagnose CD would preferably be done by a medical investigation, to be correct for this specific diagnosis, but there are many individuals that are generally sensitive to the high gluten levels in western food. Buckwheat in a mix with other gluten-free food is then a recommended protein rich substitute in bread, porridge, and cakes and biscuits. The grain **wheat** eaten in at least Europe and America, and gluten is found also in barley and rye, but wheat is the most common food in western countries. Wheat today is **not** the same grain as 100 years ago, and new research in food allergy clinics find more proteins like globulins and other types of wheat related diseases for humans, not even fully understood medically yet. Some of these give type IgE mediated wheat hypersensitization with typical acute severe symptoms and are more easily detected medically (typical antibodies). However, research on IBS or intestinal bowel syndrome shows that 30% are sensitive to substances in wheat. There are also ATS (antitrypsin-inhibiting-substances) related to adverse reactions or sensitivity. New types of mechanisms in modern wheat production can have contributed mostly because of modern agricultural and food technology makes the medical research far behind in time. To get high yields and low prices for consumers have probably been important. It's a pity if people can confuse the buckwheat name with any kind of wheat content which is absolutely misleading. It couldn't be more wrong. There are many reasons to recommend more diversified food items and avoidance of too much wheat consumption in western world, especially as many never get a proper diagnosis of gluten allergy because lack of knowledge of the root cause for many of its various symptoms. Nowadays, it has improved somewhat because of massive knowledge in society and social media and alternatives in the restaurants in some regions like Scandinavia, during the last 20 years. Advice can be very unscientific and misleading, as medical research and knowledge among medical practitioners are lacking it's a difficult situation. Today in social media there are reported many neurological diseases from wheat including anxiety, depression, dementia, migraines, epilepsy, and neuropathy (nerve damage). Medical doctors knowledge is scarce, having one week of studies only altogether in the 70-ties in nutrition science. The eastern saying "food is medicine" is needed in more cultures else than Asian and will be held as an important truth for prevention of some chronic diseases.

BUCKWHEAT ALLERGY

An update on buckwheat allergy can be found in proceedings in The 13th International Symposium on Buckwheat (ISB) (Norbäck, Wieslander, 2016).

CONCLUSIONS

To summarize health effects from food intake of buckwheat (*Fagopyrum* esculentum Moench, *F. tataricum* Gaertner) they are globally used as nutritional foods because of their high levels of minerals, proteins and polyphenols. It has also been used as a functional food in some parts of the world. There are very different kind of studies mentioned here, like epidemiological studies, cost interventional studies, some reports on case studies in sick people, and trials dealing with the effect of buckwheat and its metabolites and hypothesis on the molecular basis for the effect. There are numerous reports of possible potential health benefits with less scientific evidence or control of consuming buckwheat in different kinds of food (groats, biscuits, porridge, supplements or even in the form of pharmaceutical drugs and tea). In this conference security aspects are dealt with and resulting from contamination from pesticides, metals or water contamination or others, and this must be considered. Gluten free buckwheat is important for the coeliac patients (milling must be free of gluten contamination). There are important antioxidative activities of buckwheat, because of high levels of rutin and quercetin. Also anticarcinogenic and preventive effects in coloncancer have been shown. Less hyperlipidaemia, lowering of blood pressure and improved weight regulation have been suggested because of fiber content and resistant starch. The mechanisms behind beneficial effects on diabetes, since lower postprandial blood glucose and insulin response have been reported. Interestingly, buckwheat metabolites, such as rutin, may have beneficial protective effects in preserving insulin signalling. Rutin might have potential therapeutic applications for the treatment of Alzheimer's disease. This is not an overview of the tremendous work to evaluate Buckwheat in Health done over the decades, just some few selection of studies known to me, completed with reviews and meta-analysis of the evidence for health effects in about 30 studies on TB intake in humans (and animals). These are some sign-posts for the new methods coming for new reseachers in "food as medicine" research. However, the literature indicates that buckwheat is safe to consume for most people and may have various beneficial effects on human health.

REFERENCES

Devaraja, G., Rashmi, B.S. Coeliac Disease - A Chronic Enteropathy, Its Management with an Emphasis on Probiotics *Corresponding to: Gayathri Devaraja, Department of Microbiology, Davanagere University, Shivagangothri, Davangere-577002, India: Email: gayathridevaraja@gmail.com

He, J., Klag, M.J., Whelton, P.K., Mo, J.P., Chen, J.Y., Qian, M.C., Mo, P.S., He, G.Q. (1995). Oats and buckwheat intakes and cardiovascular disease risk factors in an ethnic minority of China. Am. J. Clin. Nutr. 61: 366–372.

Ikeda, K. (1997): Molecular Cookery Science.: Cookery Science for the 21 Century, Vol.4, Kenpaku-Sha Press, Tokyo, Japan.

Kreft, I. (2001). Buckwheat Research, Past, Present and Future Perspectives - 20 years of Internationally Coordinated Research. The proceeding of the 8th ISB: 361-366.

Li, L.K., Lietz, G.,Seal, C. (2018) Buckwheat and CVD Risk Markers: A Systematic Review and Meta-Analysis. Nutrition.

Lin, R.F. (1994). Buckwheat in China. Agriculturing Publishing House, pp 226-243.

Lu, C.L., Zheng, Q., Shen, Q., Song, C., Zhang, Z-M. Uncovering the relationship and mechanisms of tartary buckwheat (*Fagopyrum tataricum*) and Type II diabetes, hypertension, and hyperlipidemia using a network pharmacology approach. PeerJ Published online 2017 Nov 21.

Norbäck, D., Wieslander, G. (2016). An update on Buckwheat Allergy. In: The proceedings of The 13th International Symposium on Buckwheat (ISB) p. 499.

Skeritt, J.H. (1986) Molecular comparison of alcohol-soluble wheat and buckwheat proteins. Cereal. Chem. 63: 365-369.

Skrabanja, V., Kreft, I. (1998) Resistant starch formation following autoclaving of buckwheat (*Fagopyrum esculentum* Moench) groats. An in vitro study. J. Agric. Food Chem. 46: 2020-2023.

Wieslander, G. , Fabjan, N., Vogrinčič, M., Kreft, I., Janson, C., Spetz-Nyström, U., Tagesson,C., Leandersson, P., Norback, D. (2011). Eating buckwheat cookies is associated with the reduction in serum levels of myeloperoxidase and cholesterol: A double-blind crossover intervention study in day-care centre staffs. The Tohoku J. Exp. Med., 225(2): 123-130.

Wieslander, G., Fabjan, N., Vogrinčič, M., Kreft, I., Vombergar, B., Norbäck, D. (2012) Effects of common and Tartary buckwheat consumption on mucosal symptoms, headache and tiredness: A double-blind cross-over intervention study. J Food Agr. & Environ. 10: 107-110.

Wieslander, G. (2016). Some case reports in chronic disease on buckwheat health effects after prolonged daily intake. In: The proceedings of The 13th International Symposium on Buckwheat (ISB) p. 499.