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LEGUME PROTEINS AND THE PREVENTION OF CARDIOVASCULAR DISEASE – PLENARY LECTURE

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Cardiovascular disease (CVD) is the leading cause of death in most developed and developing countries. Epidemiological studies indicate that enhanced intake of pulses is associated with a lower CVD risk. Observational and clinical studies have shown that legume proteins possess significant hypocholesterolemic and hypotensive activity. These proteins influence also carbohydrate metabolism and plasma glucose levels. Other beneficial health effects of enhanced legume consumption have been reported. Therefore, legumes and legume proteins can play an important role in CVD prevention.

INTRODUCTION

Cardiovascular disease (CVD) is the leading cause of death in most developed and developing countries. The underlying pathology is usually atherosclerosis. CVD development is generally due to the occurrence of a combination of several risk factors. Epidemiological and clinical studies revealed many factors contributing to the high prevalence of CVD. Elevated plasma levels of total and low density lipoprotein (LDL) cholesterol, enhanced triglycerides and low high density lipoprotein (HDL) cholesterol, as well as hypertension, overweight and obesity, cigarette smoking and diabetes belong to the factors occurring with high frequency, which are significantly and independently associated with increased CVD risk [Third Joint Task Force, 2003]. Clinical trials have convincingly shown that reduction of major risk factors lowers the incidence of CVD.

It is well accepted that a clearly defined eating pattern is an important precondition for a high population rate of CVD [Joint WHO/FAO experts, 2002]. This pattern is characterized by enhanced energy intake, a high content of saturated fat, sugars and salt. Such a diet is closely related to the high prevalence of disturbances in lipid and lipoprotein metabolism, hypertension, overweight and central obesity. Through overweight and obesity it is associated with development of non-insulin dependent diabetes mellitus an established source of CVD risk.

Diet is widely recognized as the key step in interventions targeted to reduce CVD risk [Kris-Etherton, 1999; De Lorgeril *et al.*, 1999; Ornish *et al.*, 1998]. There is no doubt that to achieve this goal diet has to be rich in fruits and vegetables, low in saturated fatty acids and cholesterol, contain adequate amount of polyunsaturated fatty acids with an optimal balance of *n*-6 and *n*-3 PUFA. Total calories intake has to meet the energy requirements suited to maintain body weight in the proper range. In recent years a strong evidence has been accumulated that also plant proteins should play an important role in dietary interventions reducing CVD risk [Sirtori, 1998]. Soy protein has gained considerable attention. However, the regular consumption of different legume proteins can have important protective effects [Arnoldi, 2004].

HYPOCHOLESTEROLEMIC EFFECT OF LEGUME PROTEINS

Soy proteins and also other legume proteins significantly reduce total plasma and LDL-cholesterol levels both in animals and in humans. The most favorable effect is observed when animal proteins are substituted with legume proteins in patients with hypercholesterolemia. Meta-analysis of 38 clinical studies, in which the effects of soy protein intake on serum lipids and lipoproteins was determined, has shown that diet containing about 40 g of soy protein (range of intake from 17 to 124 g/day) decreased total cholesterol by 9.3% (mean drop of 23.2 mg/dL, range: 13–33 mg/dL) and LDL-cholesterol by 12.9% (mean drop of 21.6 mg/dL, range: 11–32 mg/dL), [Anderson *et al.*, 1995]. On soy-protein rich diet a significant fall, by 10.5%, was noted in serum triglyceride concentrations (mean decrease: 13 mg/dL, range: 0.3–26 mg/dL). The observed changes in HDL levels were statistically not significant. In studies with soy-proteins there was no clear dose response. However, it is generally accepted that significant changes in serum lipid and lipoprotein levels can be expected when daily consumption of soy proteins is not lower than 25 g [Sacks *et al.*, 2006]. The reduction of total and LDL cholesterol concentration is related to the initial

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serum cholesterol concentrations. Therefore, no significant changes are noticed in normocholesterolemic subjects, and the highest drop can be observed in patients with moderate and severe hypercholesterolemia.

The hypocholesterolemic effect of soy protein is related to the changes in LDL receptor activity. In human subjects on soy protein rich diet a significant rise in LDL receptor activity of mononuclear cells was observed. It was also shown that α submit of 7 S soy globulin can directly activate liver and fibroblast LDL-receptor, LDL uptake and degradation [Lovati *et al.*, 2000; Manzoni *et al.*, 2003]. Similar effect of white lupin proteins was described and significant fall in LDL and total cholesterol on lupin protein rich diet was reported [Sirtori *et al.*, 2004; Nowicka *et al.*, 2006]. Hypocholesterolemic effects of different non-soy pulses were observed as well [Anderson, 2002; Nowicka, 2005].

HYPOTENSIVE ACTION OF LEGUME PROTEINS

Hypertension belongs to the major CVD risk factors, and the relation between diet and blood pressure is well documented. Lower blood pressure is observed in vegetarians then in subjects on the so-called "western diet". The results of the DASH-study demonstrated that diet rich in vegetables, fruits, containing low-fat dairy products, whole grains, nuts and fish, with decreased amounts of saturated fat and cholesterol, red meat, sweets and sugar containing beverages significantly lowers blood pressure [Sacks *et al*, 2001]. Experimental and clinical studies have demonstrated that soy and isoflavone-poor soy protein exhibits the hypotensive activity. Reduction of systolic and diastolic blood pressure was observed in hypertensive and also in normotensive persons consuming daily from 20 g to 66 g of soy protein [Burke *et al.*, 2001; He *et al.*, 2005]. Hypotensive effect of lupin protein rich diet was also reported [Nowicka *et al.*, 2006].

It was found that during ingestion of soy protein small peptides are formed, which significantly inhibit angiotensin converting enzyme (ACE) activity. Synthetic ACE inhibitors are widely used for hypertension treatment. ACE inhibitory peptides were isolated also from non-soy food proteins [Wu *et al.*, 2001; Miguel *et al.*, 2006].

It is believed that hypotensive activity of specific food proteins can play a significant role in prevention and dietary treatment of hypertension.

OTHER BENEFICIAL EFFECTS OF ENHANCED LEGUME CONSUMPTION

It was shown that a diet rich in soy protein is associated with lower homocysteine levels as compared to that with a low content of vegetable proteins [Tonsted *et al.*, 2002]. Homocysteine has been shown to be an independent indicator of CVD risk.

It was found that essential amino acids stimulate gene transcription and translation, work as regulators of protein synthesis and degradation. They significantly influence insulin synthesis and secretion. Therefore, enhanced legume proteins intake can affect carbohydrate metabolism and plasma glucose levels. Differences in amino acid composition between legumes may be associated with differences in their specific metabolic actions.

Beside proteins, other components of legumes have also been shown to improve CVD risk factors. The low content of saturated fatty acids and high content of fiber make pulses a good choice for a healthy diet. Their complex carbohydrates together with dietary fiber result in low glycemic indexes of legumes and legume products, and play an important role in the prevention of diabetes. Phytochemicals, especially soy isoflavones, and probably other constituents of pulses possess antioxidant activity and can inhibit lipid oxidation, which is believed to be involved in atherosclerosis development [Messina, 1999; Nowicka, 2005].

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BIAŁKA NASION ROŚLIN STRĄCZKOWYCH – DZIAŁANIA FUNKCJONALNE I MOŻLIWOŚCI ZASTOSOWANIA W PROFILAKTYCE CHOROBY NIEDOKRWIENNEJ SERCA – WYKŁAD PLENARNY

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Choroby układu krążenia należą do głównych problemów zdrowotnych populacji krajów ekonomicznie rozwiniętych i rozwijających się. Badania epidemiologiczne wskazują na związek między spożyciem nasion roślin strączkowych a niskim ryzykiem chorób układu sercowo-naczyniowego. Badania kliniczne pokazują, że białka nasion roślin strączkowych wywierają działanie hipocholesterolemiczne i hipotensyjne, wpływają na metabolizm węglowodanów i poziom glukozy we krwi. Występują także inne pozytywne efekty zwiększonego spożycia tych białek. Białka nasion roślin strączkowych mogą odgrywać istotną rolę w prewencji chorób układu sercowo-naczyniowego.