Nutraceutical Significance of Chickpea in Diabetes Mellitus and Dyslipidemia

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Nutraceuticals and functional foods are food components that provide demonstrated physiological benefits or reduce the risk of chronic diseases, above and beyond their nutritional functions. (Kalra, 2003; Gulati and Ottawy, 2006;). Although pulses have been consumed for thousands of years for their nutritional qualities, it is only during the past two to three decades that the interest in pulses as food and their potential impact on human health been revived. They are considerably rich in thiamine, riboflavin and nicotinic acid as compared to cereals. They are also relatively rich in minerals especially calcium and iron,phosphorus, zinc and magnesium (Singh & Singh, 1992; Singh &Khatkar, 2008).Food legumes are good sources of dietary fibre (Ali, 2003; Chopra *et al.*, 2009). The high fibre content, low fat content(excluding oilseeds) and high concentration of polyunsaturated fatty acids (particularly essential fatty acids), make legumes extremely desirable from health point of view. In addition to having high carbohydrate and protein content chickpea is rich in fibre, minerals and vitamins (El Adawy 2002; Iqbal *et al.*, 2006; ICRISAT, 2010). Chickpea is a good source of protein and the protein quality of chickpea is better than other legumes (Jambunathan & Singh, 1990).Chickpea protein is rich in lysine and arginine (Jambunathan*et al.*, 1981; Iqbal *et al.*, 2006; Zia ulHaq*et al.*, 2007;). Its lipid fraction rich in essential fatty acids with beneficial composition of polyunsaturated acids (Costa *et al.*, 2006). Chickpea is relatively a good source of nutritionally important PUFA, linoleicacid and monounsaturated oleic acid. Two polyunsaturated fatty acids (PUFAs), linoleic and oleic constitute almost ~ 50-60% of chickpea fat (Saxena *et al.*, 2002; Zia ul Haq *et al.*,2007).

Although as with other pulses, chickpea seeds also contain anti-nutritional factors like trypsin inhibitors, chymotrypsin inhibitors, alkaloids, tannins, phytic acid, saponins, and a wide range of polyphenolic compounds including flavonols, flavons, glycosides flovanoids, etc. (Singh *et al.*, 2003; Sharma *et al.*, 2002) which reduce their digestibility but these compounds are removed or reduced to a safe level by most of the processing methods (Deosthale, 1981; Singh, 1985; Gupta, 1987; Singh & Singh, 1992; Akande, 2010).

Furthermore, these secondary metabolites considered as antinutrients for a long time have now been established as compounds conferring certain health benefits simultaneously (Ali, 2003; Morris, 2003).

Most whole grain phenolics are in bound form. Chickpea whole grains contain unique phytochemicals that complement the phytochemicals present in fruits and vegetables. Considerable amounts of polyphenolic compounds are present in chickpeas (Jambunathan *et al.*, 1981; Saxena *et al.*, 2002; Khandelwal *et al.* 2009). Phytochemicals like terpenoids, phenolics, alkaloids and fibre could provide health benefits as: substrates for biochemical reactions; cofactors of enzymatic reactions; inhibitors of enzymatic reactions; absorbents/sequestrants that bind to and eliminate undesirable constituents in the intestine; ligands that agonize or antagonize cell surface or intracellular receptors; scavengers of reactive or toxic chemicals; compounds that enhance the absorption and or stability of essential nutrients; selective growth factors for beneficial gastrointestinal bacteria (Dillard and German, 2009).

Chickpea protein digestibility is the highest and best for human consumption. (Singh, 1985; Zia Ul Haq *et al.*, 2007; Khalil *et al.*, 2007; Maheri-Sis *et al.,* 2008). Chickpea is rich in minerals (iron, phosphorus calcium, potassium, magnesium copper and zinc), and B vitamins (thiamine, riboflavin, niacin, folic acid) and the vitamin A precursor, β-carotene. Some chickpea genotypes contain 15-16 mg/ 100g iron which is possibly the highest of all legumes (Sharma *et al.*, 1996). The dietary fibre content in chickpea ranges from 29- 32%, which is one of the highest among legumes (Costa *et al.*, 2006; Chopra, *et al.*, 2009; Dhingra*et al.*, 2011). In chickpea, *kabuli* types have 20–21% and *desi* types 35–37% dietary fibre (Singh, 1984).

Owing to its high dietary fibre content, and many other phytochemicals, chickpea consumption is reported to have some physiologic benefits that may reduce the risk of chronic diseases and optimize health (Soni, 1982; Zulet and Martinez, 1995; Kushi *et al.*, 1999; Venn and Mann, 2004; Thilakavathy, 2007). Legumes generally have a GI of less than half that of

white and whole meal bread (Kozlowska *et al.*, 2001) and chickpea probably has the lowest GI among the food grains. Lowering GI is an important aspect in reducing both the incidence and severity of type II diabetes (Jenkins *et al.*,1982) Further, increased consumption of resistant starch is related to improved glucose tolerance and insulin sensitivity. (Wheeler and Pi- Sunyer, 2008). Pulses like chickpea have a higher amount of resistant starch and amylose. which lower availability of glucose. The lower bioavailability of glucose results in lowering the glycemic index (GI) and insulinemic postprandial response (Pittaway*et al.*, 2007). Chickpea contains fairly good amount of soluble dietary fibre which have been shown to be beneficial in lowering the risk of atherosclerotic coronary artery disease and slows the postprandial rise in blood glucose, improve glucose tolerance, reduced insulin requirements and increased peripheral tissue insulin sensitivity thus improving glycemic control (Kaul *et al.*, 2009).

Obesity is strongly related to major cardio vascular risk factors such as raised hypertension, type 2 diabetes mellitus and dyslipidemia. Risk of CVD and diabetes type 2 increase steadily with an increasing BMI (Body mass index).Intake of foods which are rich in dietary fibre is associated with lower body mass index [BMI](Kushi, *et al.*, 1999; Pittaway *et al.*, 2007).chickpea being a low GI food also contributes in weight loss and obesity reduction, as diets with low GI foods result not just in reduced insulin levels but also higher weight loss compared to those with higher GI (Marchesi *et al.*, 2008; Bazzano *et al.*, 2009).

Among all non communicable diseases, CVD remains the biggest cause of morality (52%) and disability worldwide. (Global Altas on CVD prevention and control WHO).

The causes of CVD are diverse, but atherosclerosis and/or hypertension are the most common ones. Lowering total serum cholesterol levels is an ideal strategy for reducing the burden of CVDs. Experimental evidence has demonstrated the beneficial activity of pulse components in the prevention and treatment of various diseases. In general, increased consumption of soluble fibre from foods results in reduced serum total cholesterol and low density lipoprotein-cholesterol (LDL c) and has an inverse correlation with coronary heart disease mortality (Kushi *et al.*, 1999). Whole grains have high fibre contents than their processed counterparts; hence their consumption offers many health benefits (Shahidia, 2008). Chickpea seeds are a relatively cheap source of dietary fibre and bioactive compounds (e.g. phytosterols, saponins and oligosaccharides) Their nutritional characteristics have been associated with a reduction in the incidence of HDL cholesterol, type-2 diabetes and heart disease (Roy *et al.*, 2010). Linoleic acid, a dominant PUFA in chickpea, is biologically important due to its involvement in production of prostaglandins which are involved in lowering of blood pressure and smooth muscle constriction. Foods rich in saponins are reported to reduce plasma cholesterol by 16-24 %. The mechanism of cholesterol reduction is by binding to dietary cholesterol or bile acids, thereby increasing their excretion through faeces (Zulet and Martinez, 1995). β-sitosterol (dominant phytosterol in chickpea) is helpful in decreasing serum cholesterol levels and incidence of coronary heart disease (Rocio *et al.*, 2010). Higher intake of folic acid helps in reducing the serum homocysteine concentrations, a risk factor for CHD (Aruoma, 2010). Fibre-rich chickpea-based pulse (non-soybean) diet has been shown to reduce the total plasma cholesterol levels in obese subjects (Bazzano *et al.*, 2009). It is found that people with higher fibre intakes (26g/day) had a 27% lower risk of cardiovascular diseases compared to those with low intakes (12g/day). Inclusion of chickpea in high-fat rodent feed reduced the deposition of visceral and ecotopic fats resulting in hypolipidaemia and insulin-sensitizing effects in the rats (Marchesi *et al.*, 2008; Zulet and Martinez, 1995).

Chickpea consumption is reported to have some physiologic benefits that may reduce the risk of chronic diseases. Therefore, chickpeas could potentially be considered as a 'functional food' in addition to their accepted role of providing proteins and fibre.

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