Nutritional, functional and health promoting attributes of red kidney beans; A review

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ABSTRACT

Numerous practices of poor nutrition are resulting in under malnutrition and over malnutrition. These conditions caused by a complex array of issues, including dietary inadequacy, infections, and socio-cultural factors. Malnutrition can lead to wasting and stunting, micronutrient deficiencies, as well as diabetes and other diseases. Shifting towards plant based diet is good approach to tackle protein energy malnutrition and health issues. In this context, Red kidney beans consider to be high in component like protein (possess essential amino acid) carbohydrates, dietary fiber, minerals and vitamins. Proteins are normally considered as the prominent macronutrient in red kidney beans. Consumption of red kidney beans has been linked to decreased occurrence of chronic non communicable diseases such diabetes, cancer, obesity and coronary heart diseases. Similarly, red kidney beans contain a variety of phytochemicals. These phytochemicals like, flavonoids, polyphenols and antioxidants are conforming to offer protective physiological effects in the body against numerous ailments i.e. cancer, diabetics, cardiovascular diseases and neurodegenerative. Thus the present aim of this review is to highlight the magnitude of the phytochemicals on such ailments.

Keywords: malnutrition, nutrient deficiencies, kidney beans, neurodegenerative,

INTRODUCTION

Malnutrition is presently prevalent all-around the globe. In this perspective, the extremely thoughtful matter is dietetic issues about protein energy malnutrition (Iqbal et al., 2006). Existence level of malnutrition is challenged and generally shifted from 30 to 60% in elderly people (Smoliner et al., 2008). Malnutrition denotes both the over nutrition and under nutrition latter one is more prominent (Green and Watson, 2005).

The nutritional statistics in Pakistan depicted that low consumption of protein proved to be harmful up to great extent. It has been stated that almost 50% of infants and children mortality is linked to different kinds of malnutrition (GOP, 2015). In Pakistan, it is widespread immensely in Baluchistan, KPK, Sindh and Punjab with the percentage of 73% 69%, 64% and 51% respectively, (NNS, 2011). In order to abolish the issues of malnutrition among the people, various researches have been conducted on the formulation and processing of complementary foods such as beans and maize (Ijarotimi, 2006).

An alternative choice for optimum nutrients requirements for the consumers is the supplementation, fortification, and enrichment of diet with plant proteins. Therefore priority has been given to the nutritional examination of proteins from various plant species (Mubarak, 2005). Protein supply to whole mankind to a satisfactory level is a world level challenge which intensified fears about protein energy malnutrition. Mostly, supplementation of cereal based foods with pulses i.e. green pea, black and white chickpea, red kidney beans and lentils is utilized to minimize this issue (Boye et al., 2010).

Beans have been proved very crucial leguminous crops, efficiently involve in the fixation of nitrogen from atmosphere. Due to high protein content and essential amino pulses are considered as an important source of protein in developing and vegetarian nations. These are also known as poor man meat.
Cereal based diets added with pulses are supposed as supplemented foods in order to enhance their protein content and lysine bio-availability (Bahnassey et al., 1986). Almost 70% of the whole world pulses production is used for human consumption. Commonly known pulses (chickpea, cowpea, lentil, mung bean, mash bean, kidney beans etc) are usually cultivated in rabi and kharif seasons. A very little production is observed in Pakistan due to certain limiting factors (Chaudhry et al., 2002). The globally production of pulses was surveyed to exceed 176 million tons in 2003, of which 40 million produced in Africa and about 63 million in India.

Among the pulses kidney bean Phaseolus vulgaris is a conventionally consumed human diet. It is derived from common bean ancestor; usually dark red in colour and kidney shaped. Also known as common bean, snap dragon, navy bean, pinto bean, rajma and surkh lobia. Leading producing countries are Brazil, United States, India, China, Turkey and Ethiopia (Sahadevan et al., 2012). In Southeast Asia, consumption of pulses is reasonable and a good variety of species are grown, produced and used as seeds and green vegetative pods in various (Nyau, 2014). Consumption of red kidney beans in Pakistan is 50,000 tons and production is hardly attained about 10,000 tons means importing 40,000 - 50,000 tons, major exporter of kidney beans to Pakistan is China (PARC, 2014). It has an indispensible value in human diet and enhances the nutritional status of low income community up to prestige level. Beans have two or three folds more amounts of protein than cereals and provide suitable path for eliminating the protein malnutrition. Thus potential for beans to be used as nutraceuticals and functional food is thus very promising. The nutraceutical components of food support health and also provide basic nutrients. Various studies have been proved that consuming red kidney beans reduced the risks of diabetes and obesity (Geil & Anderson, 1994). As compared to other starchy foods red kidney beans starch is digested much slowly and possess very low glycemic index (Nyau, 2014). Foods with low glycemic responses intend to produce loss spikes in blood glucose and proved to be beneficial to diabetic patients. Low glycemic foods enhanced adipocyte insulin- mediated sugar usage in in vitro (Wolever et al., 1987), secondly the speed of catabolism of starch from beans is slower (Leathwood & Pollet, 1988). Beans have been observed to have tendency to confer weight management owing to their low glycemic index, resistant starch and great satiety level (Hotamisligil, 2003).

Utilization

Kidney beans show a vigorous role in human diet, mainly enhance the dietetic status of low earning population (Milan-Carrillo et al., 2007). These are utilized in culinary diets as dried beans or canned beans. They have gained much importance in the fruit and vegetable processing factories in the manufacturing of frozen fermented or canned foods. Also, used in salads and appetizers.

Nutritional Aspects

Red kidney beans (Phaseolus vulgaris L.), are splendid sources of energy, proteins, carbohydrates, minerals and vitamins (Rehman & Shah 2004; Yin et al., 2008). These are renowned for their higher dietary fiber, minerals and protein contents. The flour and protein essence these red kidney beans depicted vital functional features (Tang, 2008). These beans possess excellent nutritional profile with 22.7 % protein, 3.5 % mineral, 1 % fat and 57.7 % carbohydrates out of which total carbohydrates have, 38.6 % starch and 18.8 % dietary fiber (60 % insoluble and 40 % soluble). Its protein has highest lysine content about 5 % (Thapa, 2012; Qayyum et al., 2012).

Proteins mostly found in these beans are storage proteins i.e. 75-80%. Important nitrogenous compounds and amino acids are supplied by these proteins to the early seedlings. Kidney beans are excellent source of lysine, and can be used for the fortification of cereal based products (Loggerenberg, 2004). These have higher level of RS in comparison to cereal grains and tuber (Yadav et al., 2010). The merit of this bean is its great caloric index and protein quantity. The scientists have provoked that small amount of phenolic compounds and phytates (available in legumes) may be defensive against CVD and cancer (Ramirez-Cardenas et al., 2008). Carbohydrates Fermentating ability of red kidney beans can results in the generation of SCFAs and lowers the intestinal pH (Fernandes et al., 2010). Red kidney beans are best source of vitamin B group, essential minerals like K, Ca, Mg, P and iron too (Souci et al., 2000). These are prestigious source of plant based dietary protein mainly in areas where utility of meat is prohibited or limited owing to reasons like scarcity, religious restrictions, cultural customs and unaffordable price of meat protein. Most studies have pointed out the health friendly role of these beans including decreased threats of CVD (Flight and Clifton, 2006).

Amino Acid Profile
Red kidney beans show excellent amino acid profile mainly rich in lysine, leucine, aspartic acid, glutamic acid and arginine. Beans provide optimum amount of essential amino acids when utilized with cereals and other sulphur containing products (Boye et al., 2010a). The glutamic and aspartic acids are mainly acidic in nature and present in raw as well as processed beans. Except for cysteine, methionine and tryptophan, the raw and processed red kidney beans replenish the FAO/WHO amino acid needs for teenagers. Red kidney beans provide 10.2g glutamic acid, 9.5g aspartic acid, 1.2g cysteine, 1.7g methionine, 3g histidine, 4.4g alanine, 5.2g glycine, 3.4g threonine, 3.3g proline, 3.7g isoleucine, 3.1g tyrosine, 4.6g phenylalanine, 4.1g valine, 3.1g serine, 6.9g arginine, 7glycine and 7.2g leucine per 100g (Audu and Aremu, 2011). Cowpea is methionine and threonine rich legume. It also contains glutamic acid & aspartic acid which are non-essential amino acids. Cowpea has essential amino acids in higher quantity whilst lentil is rich in non-essential amino acid (Iqbal et al., 2006). Broad bean has methionine/cystine as the limiting amino acids. However, mostly all other EAAs fulfill the people needs though the quantity in contrast to egg is lower (Mortuza et al., 2009).

The availability of essential amino acids in significant quantity ameliorates the nutritional level of the plant based protein. Microwave cooking method does not cause any adverse effect on the essential amino acid however; intensive and frequent processing of bean at high temperature reduced the availability of essential amino acids (Gurumoorthi et al., 2008; Hadjipanayiotou and Economides, 2001).

Flavonoids

Flavonoids are secondary metabolites of plants and have polyphenolic structure. They are synthesized through the polypropanoid pathway having phenylalanine its primary component (Manach et al., 2004). They consist of C15 atoms in their main nucleus and two aromatic rings which are linked through a heterocyclic pyran ring. All flavonoids have a C6-C3-C6 basic structural skeleton with two aromatic C6 rings (A and B) and a heterocyclic ring (C) which has a one oxygen atom (Cushnie et al., 2005). They can be classified into flavanols [monomeric (catechin, epicatechin)] and flavonols (quercetin) on the base of oxidation state of rings and the link between the aromatic rings (Williams et al., 2004).

Flavonoids are naturally present in fruits and other foods from plant sources. They are used for some technological purposes and organoleptic characteristics. But different experimental and epidemiological results indicate that they also pose potential health benefits (De Pascual-Teresa et al., 2010). They have a beneficial role in many diseases such as neurodegenerative conditions, cancer and cardiovascular disease (Williams et al., 2004). 1g of flavonoids should be consumed from diet based on fruits and vegetables per day. The beneficial actions of flavonoids are driven from their antioxidant property and affinity for proteins (De Pascual-Teresa et al., 2010).

Phenolic acids

Phenolic acids are classified as aromatic secondary metabolites of plant (Tomas-Barberan and Espin, 2001) and universally present in plants kingdoms (Dai and Mumper, 2010). They are generally referred to as phenols that have carboxylic acid functionality. These compounds are important for growth and reproduction of plants and are synthesized as a response to environmental factors such as moderate chilling and pollution (Valentine et al., 2003). Naturally phenolic acids consist of two different carbon structures: (1) the hydroxycinnamic and (2) hydroxybenzoic structure. Hydroxycinnamic acids are formed as simple esters with hydroxyl-carboxylic acid (Mandal et al., 2010) and their derivatives have more antioxidants ability as compared to hydroxibenzoic acid derivatives. Hydroxycinnamic acid derivatives has more potential for delocalization of the phenoxy radical (Steenkamp et al., 2013). Phenolic acids are usually included in study due to their beneficial role against oxidative damage and degenerative diseases such as inflammation, cancer and cardiovascular diseases (Battisti et al., 2008). They have gained more importance due to their antioxidant properties and used in food products (Dai and Mumper, 2010). Phenolic acids also have unique taste, flavor and health-promoting effects found in fruits and vegetables (Tomas-Barberan and Espin, 2001).

Antioxidant

Antioxidants are the compounds that prevent the human, animal and animal cells from harmful effects of free radicals (Kukic et al., 2006). Phenolic acids and flavonoids are the natural source of antioxidants which are produced from plants. They are considerable sources of antioxidants and more efficient than Vitamin C, E and carotenoids (Dai and Mumper, 2010). The antioxidant characteristics of phenolic and flavonoid compounds are driven from their capability to regulate the antioxidant defense, scavenging the radical species (Cotelle, 2001). The reduction property of phenolic compounds rely on the number of free hydroxyl groups present in molecular structure (Ghasemzadeh and Ghasemzadeh, 2011),
whereas flavonoids capability as antioxidants depends on position of hydroxyl groups and some other features in chemical structure (Saxena et al., 2012).

Oxidative stress has a role in different diseases such as cancer, neurodegenerative diseases and in aging process (Astley, 2003). When antioxidants are present in lower quantity as compared to substrate then they can prevent the oxidisable substrate from oxidation (Lucio et al., 2009). Free radicals have a role in different physiological functions such as defense, signal transduction, cell proliferation and apoptosis. On the other hand, the exposure of main biomolecule like lipid, DNA and protein of human body to surplus quantity of free radicals leads to different physical disorders such as diabetes, cancer and cardiovascular diseases (Lee et al., 2004). Studies related to flavonoids indicated that they have a property to scavenge the peroxyl, alkyl peroxy and superoxide hydroxyl radicals and peroxynitrite in organic and aqueous environments (Duthie et al., 2000). The disturbance of balance between free radicals and antioxidant may induce oxidation and leads to cellular impairment (Kukic et al., 2006). Dietary flavonoids can prevent the DNA damage from free-radicals through a mechanism other than solely direct free radical scavenging. The results obtained from a pulse radiolysis studies and plasmid test system have indicated that they can lower the risk of single strand breaks in double stranded DNA and residual base destruction through fast chemical repair (Anderson et al., 2000). Some flavonoids may chelate the transition metal ions which are required for formation of reactive oxygen species and inhibit the lipoxygenase reaction at initiation stages (Ross and Kasum 2002). Antioxidants are also used in food products to avoid the oxidation of foods, oxidation process of food begin with exposing them to environmental elements like air, light and temperature (Hras et al., 2000).

### Dietary fiber

Dietary fiber was defined by AACC (2000) as edible fraction of plants or carbohydrates (non-starchy), cannot be digested by human body enzymes to absorbable components and undergo partially or fully fermentation in large intestine (Duxbury, 2004). Dietary fibers are considered as an important portion of human diet and has several beneficial physiological functions (Raninen et al., 2011) The daily recommended level of dietary fiber in the diet is 25 to 30 g/day (Gorecka et al., 2010). The highly processed diet results in lower fiber contents (Kendall et al., 2010). In developed countries, the diet with low fiber contents can leads to different diseases such as obesity, diabetes, tooth decay, chronic constipation, appendicitis, polyps, tumors (Rodriguez et al., 2006). The one way to move up the fiber contents in diet is the enrichment of food products with pure isolated fiber. It can be done by the incorporation of cereals, fruits and vegetables by-products which are rich source of non-digestible carbohydrates (Nassar et al., 2008).

Dietary fiber can be classified as insoluble or soluble (Zhang et al., 2011) and each class has different physiological effects (Ajila and Rao, 2013). The ratio between two classes of dietary fiber is important for nutritional and functional properties (Jaime et al., 2002). The soluble dietary fiber faces bacterial fermentation in the GIT and affects the carbohydrates and fat metabolism. Whereas insoluble fraction lower the incidence of constipation by reducing the gastrointestinal transit time and also hinder the development of rectal cancer (Bingham et al., 2003).

### Health benefits of red kidney beans

#### Red kidney bean and cancer

Cancer is referred to as a multi-step disease. Factors such as environmental, physical, chemical, metabolic and genetic factors have a direct or indirect role in the development of cancer (Fimognari et al., 2005). Cancer is attributed to independent DNA replication and cellular division of abnormal cells which leads to induction of cancerous tumors and causes the destruction of adjacent tissue or lymphatic system. It has been reported that phenolic acids present in red kidney beans have anticancer characteristic (Nyau, 2014; Duranti, 2006). They can act as an inhibiting agent and hinder the development of tumors from initiated stages. They can also suppress cell multiplication in vitro (Scalbert et al., 2005).

Cancer metastasis is characterized by spreading of cells and leads to formation of secondary tumors (Weng and Yen, 2012). Gallic acids (3, 4, 5-trihydroxybenzoicacid) have showed anti-metastatic action against different cancer cells. In stomach cancer, they have a hindrance effects on protein associated to metastasis and cytoskeletal redepolfment signal pathways such as Cdc42, Ras, RhoA, RhoB, RhoB, Rac1, PI3K, and p38. This action of gallic acid is driven from their anti-migratory properties against AGS cell migration by inhibiting the expression of MMP-2/9 and cytoskeletal F-actin (Ho et al., 2010). Poly-phenols effect the pro-carcinogens by modifying the manifestation of cytochrome P450 enzymes required for their activation (Scalbert et al., 2005).

The poly-phenols anticancer effects have been reported in animals. When poly-phenols induced to mice or rats with the application of carcinogenic

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agents they decreased number of tumors and their growth (Yang et al., 2001). These effects were observed at different sites such as skin, lung, duodenum, and colon. Polyphenols including catechins, flavanones and isoflavones were tested for their proactive effects and all of them showed proactive properties (Scalbert et al., 2005). The inverse relationship between flavonol intake and induction lung cancer has been documented in different studies (Knekt et al., 2002). Similarly catechin intake also has inverse relation with rectum cancer in cohort of postmenopausal American women (Arts et al., 2002). Flavonoids can act as angiogenesis inhibitors (Caltagirone et al., 2000) and play an important role as angiogenesis inhibitors. Angiogenesis is referred a controlled process occurs in the human body and it includes endogenous angiogenic and angiostatic factors. Angiogenesis inhibitors interfere the angiogenesis steps such as lumen formation, proliferation and migration of endothelial cells (Paper, 1998).

The vital role of dietary fiber in preventing the numerous diseases has been accepted in well-documented studies. The diets rich in fiber can reduce the risk of different types of cancer (Jimenez-Escribano et al., 2001). Dietary fiber might reduce the prevalence of colon cancer (Eshak et al., 2010) by decreasing the digestion and absorption of macronutrients and reduces the contact time between intestinal lumen and carcinogen (Raninen et al., 2011). Similarly a case-control study from Switzerland also shows the positive effects of fiber intake in lowering the incidences of colorectal cancer (Levi et al., 2001). They prevent from colorectal cancer by producing short chain fatty acids, inducing fermentation in large bowel and speedy passage of food material from the large intestine (Sharma et al., 2008).

The oesophageal cancer is the sixth leading reason of cancer related deaths. The case of oesophageal cancer varies according to area (Ferlay et al., 2010). The prevention of oesophageal cancer becomes important and dietary fiber has a protective effect against the oesophageal cancer (Jessri et al., 2011). The oesophageal cancer patients reported less use of total dietary fiber and regular intake of fiber has an inverse relationship with oesophageal risk (Tang et al., 2013). Dietary fiber impedes the oesophageal cancer by eliminating the damaged cells and carcinogens from the oesophageal epithelium (Coleman et al., 2013) and by inhibiting cellular proliferation and enhancing apoptosis (McFadden et al., 2008).

Red kidney bean and cardiovascular disease

By 2030, 23.6 million people will die from cardiovascular diseases mostly from stroke and heart diseases (Williams et al., 2004). Cardiovascular diseases occur due to irregularity of heart and blood vessels and include heart attacks, stroke, hypertension, rheumatic heart disease and heart failure. The major risk factors for development of CVD are unhealthy diet, physical inactivity and tobacco consumption (WHO, 2013). Cardiovascular disease refers to inflammatory disease and leading cause of mortality and morbidity in developed countries. The development of CVD depends on the concentration of oxidized lipoproteins in arterial sub endothelium (Sanchez-Muniz, 2012).

The beneficial actions of phenolic acids and flavonoids in preventing CVD are due to their antioxidant activity (Heim et al., 2002), prevention of atherosclerosis (Tripoli et al., 2007), effects on platelet aggregation (Lamuela-Raventos et al., 2005). Antioxidants play an important role in prevention of CVD. Atherosclerotic plaques start at a damaged endothelial site. They have a crucial role in preventing endothelial abnormality (Thomson et al., 2007) and limited the lipid peroxidation (Griendling and FitzGerald, 2003) which is a key step in atherogenesis (Wootton-Beard and Ryan, 2011). The intakes of flavonoids can prevent ischaemic stroke and possibly decreased CVD mortality (Mursu et al., 2008).

Flavonoids as antiatherogenic can impede the LDL oxidation and introduced endothelial apoptosis by different cellular apoptotic mechanism (Choi et al., 2008). It has been indicated in animal atherosclerosis model that flavonoids have a capability to delays the development of atherosclerotic plaque. It can reduce the endothelial abnormality which is the main step in atherosclerosis development (Grassi et al., 2008). Flavonoids have an interaction with membrane lipids, and modify the membrane fluidity which leads to antiagregatory and disaggregatory impact on human platelets (Furusawa et al., 2003). They can also inhibit the platelet function by antagonism of definite membrane receptors in these cells (Navarro-Nunez et al., 2009). The intake of catechin can lower the chances of coronary death but it has no effects on stroke (Arts et al., 2002).

Researchers suggested that positive effects of dietary fiber on heart diseases are based on the associations of dietary fiber with cholesterol and bile acid absorption (IFIC, 2008). Total dietary fibers intake can lower the serum LDL cholesterol values while soluble fibers have a link to reduce the systolic blood pressure and total cholesterol values (He et al., 1995). The increased consumption of soluble and insoluble dietary fibers have direct effects on CVD by targeting...
risk elements. Numerous epidemiological and clinical studies showed that higher consumption of dietary fibers can lower the CVD events due to their effects on LDL-cholesterol. It was demonstrated that 1% reduction in LDL-cholesterol levels corresponds to 1-2% reduction in development of CVD (Kendall et al., 2010).

Dietary fiber can affect the bile acid metabolism (Ridlon et al., 2006). In small intestine dietary fiber comes into contact with bile acids that reduce re-absorption and increases their movement towards the large intestine (Dongowski et al., 2003). In intestinal lumen hydrated fibers form a layer of thick unstirred water and this work as physical barrier that results in lowering the re-absorption of cholesterol and bile acids, finally this result in increased fecal yield of cholesterol and bile acids (Theuwissen and Mensink, 2008). They can also reduce the concentration of cholesterol and some other lipids by increasing aqueous phase viscosity and changes the droplet disruption (Mun et al., 2005). Some fibers inhibit the emulsification of lipids in the small intestine by binding the bile salts (Thongngam and McClements, 2005) which have the direct contact of fiber and lipase enzyme that leads to reduction in enzymatic activities (Klinkesom and McClements, 2009).

GI tract and red kidney bean phytochemicals

Phenolic compounds and their bacterial fermented products show beneficial effects in colon. The diets rich in flavonoids also affect the microbial composition of gut flora (Gee and Johnson, 2001). Flavonoids and some other phenolic compounds have a protective function in GI tract due to their ability of scavenging the reactive oxygen and chlorine species. They can hinder the heme protein based peroxidation in the stomach and also able to impede the DNA induced domination. Usually dietary iron is not properly absorbed in the body. Phenolic compounds can chelate iron and prevent from peroxidation effects of colonic iron. They can also chelate the redox active transition metal ions and reduce their pro-oxidant capability (Halliwell et al., 2005).

Soluble viscous dietary fibers normalized the stool condition (firms loose / liquid stool in diarrhea, softens hard stool in constipation) due to their gel-formation and water holding properties (Marlett and Fischer, 2003). The insoluble fibers effectively increase the fecal mass and also promote the regularity (Cummings, 2001). Fermentable fibers increase bacterial mass in the colon and promote health beneficial bacteria such as bifidobacteria and lactobacilli (Roberfroid, 2005). Dietary fibers can act as pre-biotic agent, due to their chemo-protective functions which include fecal bulking, speedy transit and the frequency of evacuation (Spiller and Spiller, 2001). Ingested fiber changes the gastrointestinal environment by affecting on fecal micro-biota through short chain fatty acids production, lowering colonic pH and supporting the beneficial bacterial growth. Carbohydrates (inulin) as pre-biotics agents can alter or stimulate the growth of health beneficial species which are already present in colon (Roberfroid, 2007) and leads to irritable bowel syndrome (Silk et al., 2009).

Red kidney bean and diabetes

The presence of polyphenols in plants demonstrates their therapeutic property. They impede the absorption of glucose in small intestine and its re-absorption in kidney. Catechin enhanced the tolerance against glucose induced from sucrose or starch ingest in rats (Scalebert et al., 2005). World health organization reported that type 2 diabetes refers to resistance against insulin or its deficiency (WHO, 2006). Insulin removes the glucose from blood by liver cells and muscles. Antioxidants can improve the insulin sensitivity by carbohydrates utilization through their link with digestive enzymes (Bryans et al., 2007).

The regulation of blood glucose level is the main objective in diabetes management. The glycaemic control has a great importance in management of type 2 diabetes. The soluble fiber fraction can control the glycemic by slowing down and decreasing the absorption of glucose from intestine (Brown et al., 1999). Several studies related to diabetics have shown that diets contain higher fiber contents and low GI rating lead to better glycated proteins levels which are helpful in controlling the glycaemic index (Kendall et al., 2006). They can reduce the incidence of diabetes type 2 (Eshak et al., 2010) by lowering the digestion and absorption of macronutrients and reducing the contact time between intestinal lumen and carcinogens (Raninen et al., 2011). The water soluble fibers enter in small intestine where they thicken the content of small intestine and modulate the digestive process by reducing the nutrients diffusion for absorption and interaction time of food and digestive enzymes.

Red kidney beans and neurodegenerative diseases

Neurological diseases are based on oxidative stress which have effects on brain tissues (Halliwell, 2001) and includes mild cognitive impairment, Alzheimer's and Parkinson's disease (Devore et al., 2010). Antioxidants can play a role in their prevention (Cantuti-Castelvetri et al., 2000). Many human studies show the polyphenols (flavanols) effects on cognitive function. The interaction between dietary
flavanols and cognitive impairment indicate that they can prevent from induces of neurodegenerative diseases (Patel et al., 2008). In several studies, it has been showed that flavonoids (plant foods) consumption has ability to enhance the cognitive performance (Spencer, 2010). The application of catechin based injection to mice brings up a positive change in memory impairment through cerebral ischemia (Matsuoka et al., 1995). The property of polyphenols to effects the neurological health are due to their ability to effects the peripheral, cerebrovascular blood flow and lower the neurological damage induced by neuro-inflammation and neurotoxins (Fraga and Oteiza, 2011).

CONCLUSION
Red kidney bean can be a potential ingredient to be utilized in a nutraceutical and functional foods. It may be helpful in ameliorating chronic diseases which have affected the masses worldwide.

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