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Phytochemicals and bioactive compounds of pulses and their impact on health

Khedidja Benouis

Condensed Matter and sustainable development Laboratory (LMCDD), Djillali Liabes University,
 BP. 89, Sidi-BelAbbes, 22000, Algeria

*Corresponding author's E. mail: benouiskhadidja@yahoo.fr

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ABSTRACT

At Sixty-eighth session, the United Nations General Assembly (20 December, 2013) announced that 2016 is the International Year of Pulses (IYP) and The Food and Agriculture Organization (FAO) of the United Nations was nominated for implementation of the International Year in collaboration with governments and different organizations. Pulses constitute an important source of several substances needed for good health, as phytochemicals and natural bioactive compounds. These grains are very high in nutrients; rich with protein, complex carbohydrates, soluble dietary fiber, and can be stored for months without losing their high nutritional value. Also, pulses are characterized by their nitrogen fixing properties contribute to increased soil fertility and have beneficial effects on the environment, but their benefits are often underestimated. In this mini-review, the health benefits of phytochemicals and bioactive components in pulses briefly we described.

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Capsule Summary: The health benefits of phytochemicals and bioactive components in pulses are overviewed. Pulses are densely packed with beneficial substances as phytochemicals and natural bioactive compounds. They can be a healthiest food choice for a healthy lifestyle.

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INTRODUCTION

Throughout the history of humanity, and for thousands of years, Pulses have constitute an important food categories for humans that have been incorporated in various forms into most traditional diets and used as staple foods to cover basic protein and energy needs. "Pulse" is a term deriving from the Latin "puls" meaning pottage (Sardana et al., 2010). The Food and Agriculture Organization of the United Nations (FAO) defines pulses as "annual leguminous crops yielding from one to twelve grains or seeds of variable size, shape and colour within a pod" (FAO, 1994). The definition covers 11 primary pulses (dry beans, dry broad beans, dry peas,

chickpeas, dry cow peas, pigeon peas, lentils, bambara beans, vetches, lupins and pulses nes) but excludes legumes harvested green for food (ex. green beans). The most consumed are lentils, peas, chickpeas and beans; Pules are incorporated into a healthy, balanced diet, to fight against obesity but also to prevent and treat chronic diseases such as diabetes, cardiovascular diseases. A number of organizations recommend consumption of dietary pulses to reduce risk of cancer; these include the World Cancer Research Fund International, the American Institute of Cancer Research and the Federal Department of Health Canada (WCRFI and AICR, 2011; HC, 2011). As a result of their nutrition facts and interesting properties, the United

Nations declared 2016 as "International Year of Pulses (IYP 2016)" (UN, 2013).

The first intent of the IYP 2016 aims to heighten public awareness of the nutritional benefits of pulses as part of sustainable food production for a food security and nutrition.

In this paper, the essential phytochemicals and bioactive compounds of pulses and their impact on health to heighten public awareness their benefits are briefly highlighted (Table 1).

DISCRIPTION

Pulses are a good source of nutritional components (Tharanathan and Mahadevamma, 2003), they are low in fat and rich in complex carbohydrates, vegetable protein and minerals phosphate. They are an excellent source of dietary fiber (USDA, 2005; USDHHS, 2015); researchers have found a positive correlation between the anticarcinogenic effects and various components present in pulses, including dietary fiber (Mathers, 2002; Champ, 2002; Howe, 1992) and folate (Rampersaud, 2002).

Pulse grains also represent a source of several natural bioactive substances such as lectins, enzyme inhibitors, oxalates, oligosaccharides, phytic acid and phenolic compounds, these substances play important metabolic roles in humans or animals that frequently consume these sensational seeds (Champ, 2002).

Scientific studies have shown that consumption of pulses (three or four times per week) can contribute to the prevention of coronary heart disease (CHD) and improve well-being of human (Flight and Clifton, 2006; Bazzano et al., 2001). The mechanisms responsible for this apparently protective role can have a favorable influence on glucose and blood lipids. Also, pulses are a good source of minerals, especially beans and lentils which are very rich on iron (Vadivel and Janardhanan, 2000; MH, 1999; Mataix and Mañas, 1998; Elhardallon and Walker, 1992) and zinc (Vadivel and Janardhanan, 2000; Vadivel et al., 2000; Jimenez et al., 1998; Terrés et al., 2001).

The major polyphenolic compounds of pulses are tannins, flavonoids and phenolic acids. The dark grains such as black gram, lentil and red kidney beans are highly rich with the phenolic content. They are organic molecules characterized by the presence of at least two phenolic groups, associated in complex structures, generally of high molecular weight. These compounds are the products of secondary metabolism of plants; they have a good antioxidant activity assessed by 2,2-diphenyl-1-picrylhydrazyl (DPPH) free radical scavenging (Amarowicz and al., 2004; Awika and al., 2003; Xu and Chang, 2007). Some phenolic compounds can decrease protein digestibility (Chung and al., 1998), mineral bioavailability (Sandberg, 2002) and diminish development of various degenerative diseases (Harman, 1956).

Phenolic acids are aromatic secondary plant metabolites, they are the main polyphenols made by plants.

Flavonoids are a family of polyphenolic; they are phytochemicals compounds found in almost pulses. They have been assayed in various diseases affecting the heart, brain, and other disorders, including those leading to cancer. Flavonoids and phenolic acids have antioxidant and good physiological and biological properties (Murphy and Hendrich, 2002; Pieta, 2000; Yeh and Yen, 2003; Wei and Wang, 2015).

Phytic acid (myo-inositol hexaphosphate) is a naturally occurring molecule found in pulses, it can diminish mineral bioavailability (Sandberg, 2002) and exhibit antioxidant activity and protects DNA damage by creating complexes with Fe (Midorikawa et al., 2001; Phillippy, 2003; Graf et al., 1987; Vucenic and Shamsuddin, 2006).

Pulses are also rich in Protein inhibitors of hydrolases active against proteases, amylases, glycosidases, lipases and phosphatases (Belitz and Weder, 1990; Campos-Vega and al., 2010). They are the main sources of lectins in ordinary human food. This small protein that can bind to cell membranes is one of the major proteins found in lentil (Zhang, 2009). Plant lectins present in pulses are important tools in cell biology and immunology (Grant, 1995); a number of studies have suggested an important correlation between certain lectin-binding patterns and their biological behavior in diverse tumors (Jordinson, 1999; Sames, 2001; Wang, 2000; Lorea, 1997; Rimmelink, 1999).

On the other hand, some enzyme inhibitors and lectins have an antinutritional effects, they can diminish protein digestibility and nutrient absorption, but their effect is effectively remove after cooking (Habiba, 2002; Lajolo and Genovese, 2002).

Another important natural compounds found in the seeds and underground organs of pulses (beans, chickpeas, lentils etc), these are short chains of galactose molecules called the Galactooligosaccharides (GOS). Clinical trials have examined the laxative effects of galactooligosaccharides, they have shown that the use of GOS may reduce the severity of constipation in older adults with low defecation frequency (Hamilton-Miller, 2004; Narimiya, 1996; Teuri and Korpela, 1998; Sairanen, 2007; Niittynen, 2007), but in adults with normal bowel function, the effects of GOS was limited (Niittynen, 2007; Deguchi et al., 1997; Teuri et al., 1998) and may cause flatulence (Teuri and Korpela, 1998; Muzquiz et al., 1999). On the other hand, these same molecules can elicit prebiotic activity (De Boever et al., 2000; Rycroft et al., 2001; Macfarlane et al., 2008; Ito, et al., 1993; Gibson et al., 1995) and have protective effects against cancer (Lajolo and Genovese, 2002; Mathers, 2002).

CONCLUSIONS

Through history, in many locations of the world, pulses played an important role in the human nutrition. Yet today, their secrets constitute a one of the interesting Human subjects research. Recent clinical trials provide information about their significant role in metabolic and physiological functions of the human body, studies show that pulses are a

Table 1: Reported phytochemicals and bioactive compounds in pulses

S. No	Pulse name	Phytochemicals/ bioactive compounds	References
1	Common beans Soybeans Chickpeas	Protease inhibitors	(Gonzalez and Prisecaru, 2005) (Champ, 2002) (Clemente and Domoney, 2001)
2	Dry beans Common beans Runner beans	Amylase inhibitors	(Lajolo et al., 1984)
3	Kidney beans Common beans	Lectins	(John et al., 2007) (Grant et al., 1995a)
4	Lentils Red kidney beans Black beans	Phenolic acid, Flavonoids, Isoflavones	(Xu and Chang, 2007)
5	Lentils Red kidney beans Black beans Field beans Pea seeds	Condensed Tannins	(Xu and Chang, 2007) (Smulikowska et al., 2001) (Gdala et al., 1992) (Savage, 1989)
6	Broad beans Lentils Lupins	Tannin-Free	(Smulikowska et al., 2001)
7	Soybeans Red kidney beans Peas Lentils	Phytates	(Sandberg, 2002) (Reddy et al., 1989)
8	Beans	Oxalates	(Weiwen and Michael, 2005) (Hônow and Hesse, 2002) (Sandberg, 2002) (Massey et al., 2001)

good source of nutritional, phytochemicals and natural bioactive compounds and pulses are better food choice and can help to protect good health.

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