



Review

Bioactive proteins and peptides in pulse crops: Pea, chickpea and lentil

F. Roy^a, J.I. Boye^{b,*}, B.K. Simpson^a^a Food Science & Agricultural Chemistry Department, McGill University, Macdonald Campus, 21,111 Lakeshore Road, Ste. Anne de Bellevue, Quebec, Canada H9X 3V9^b Agriculture and Agri-Food Canada, 3600 Casavant Boul, West Saint-Hyacinthe, Quebec, Canada J2S 8E3

ARTICLE INFO

Keywords:

Pulse crop
Lentil
Field pea
Chickpea
Trypsin inhibitor
Chymotrypsin inhibitor
Lectin
Angiotensin I-converting enzyme

ABSTRACT

Pulse crops are cool season, annually grown legume crops, which are harvested for their seeds. They are invaluable agricultural commodities which are produced and imported by many regions of the world. Pulse seeds are a valuable source of dietary protein, carbohydrates, fiber and an important source of essential vitamins and minerals. Their nutritional characteristics have been associated with a reduction in the incidence of various cancers, HDL cholesterol, type-2 diabetes and heart disease. Pulses also contain protein and non-protein antinutritional factors, which may cause deleterious effects on the host when the seeds or processed seeds are consumed raw. Conversely, recent studies have demonstrated that protein antinutritional compounds such as lectins, protease inhibitors and the non-antinutritional component, angiotensin I-converting enzyme (ACE) inhibitor may have beneficial properties. Lectins have been associated with reducing certain forms of cancer, activating innate defense mechanisms and managing obesity. Protease inhibitors such as trypsin and chymotrypsin inhibitors have been demonstrated to reduce the incidence of certain cancers and demonstrate potent anti-inflammatory properties. Angiotensin I-converting enzyme (ACE) inhibitor has been associated with a reduction in hypertension.

© 2009 Elsevier Ltd. All rights reserved.

Contents

1. Introduction	432
2. Pea, chickpea and lentil: world production and consumption.	433
2.1. Dry pea	433
2.2. Chickpea.	433
2.3. Lentil	434
3. Protein content of pulses	434
4. Antinutritional compounds of pulse crops	434
4.1. Lectin characteristics	435
4.2. Deleterious effects of lectins on human health	435
4.3. Nutraceutical potential of pulse lectins in human health	436
4.4. Protease inhibitors.	436
4.5. Deleterious effects of protease inhibitors on human health.	437
4.6. Methods for reducing protease inhibitory compounds in pulse seeds	438
4.7. Beneficial properties of denatured protease inhibitors on human health.	438
5. Angiotensin I-converting enzyme (ACE) inhibitory peptides	438
6. Conclusion.	440
References.	440

1. Introduction

Pulse crops belong to the family of cool season, annually grown leguminous crops (Maiti & Wesche-Ebeling, 2001). They are legume crops that are harvested for their seed only and do not include legumes which are grown for oil, such as soybean (Nwok-

* Corresponding author.

E-mail address: boyej@agr.gc.ca (J.I. Boye).

olo & Smartt, 1996). Consequently, pulse crops include dry pea, chickpea, lentil and lupin, along with various types of dry bean such as kidney and lima bean. These crops are produced on many continents worldwide. North America, specifically Canada, and areas within Asia and the Middle East are responsible for the majority of pulse crop production and exportation. Importation of pulses occurs most frequently in populated countries such as India and Egypt, where pulses are a staple of the diet.

Pulse crops are an excellent source of protein, carbohydrates, and fiber, and provide many essential vitamins and minerals. Their highly nutritional properties have been associated with many beneficial health-promoting properties, such as managing high cholesterol and type-2 diabetes and in the prevention of various forms of cancer. However, pulse crops and other leguminous crops also contain many antinutritional proteins, such as lectins, protease inhibitors and the non-antinutritional compound, angiotensin I-converting enzyme (ACE) inhibitor. Various deleterious effects may occur following the ingestion of raw pulse seeds or flours, such as hemagglutination, bloating, vomiting and pancreatic enlargement, due to the activity of the antinutritional compounds inside the host. Conversely, antinutritional compounds in pulses may have many beneficial properties in the treatment and/or prevention of disease when properly processed. This review will focus on the global production and exportation of dry pea, chickpea and lentil, and the deleterious and beneficial health effects of bioactive proteins and peptides present in pulse crops.

2. Pea, chickpea and lentil: world production and consumption

2.1. Dry pea

Dry pea is among the world's oldest crops, as records indicate it was grown in the Middle East approximately 9000 years ago. In addition, it has been harvested in Europe for several thousand years (Goodwin, 2003a,b), and has since been grown in 84 countries including Australia, Canada, China and the United States (Smith & Jimmerson, 2005a,b; McKay, Schatz, & Enders, 2003). Dry pea is adapted to brown, dark brown and black soil zones in semi-arid and non-irrigated areas of the world, and has been produced in the Canadian Prairies for over 100 years (Goodwin, 2003a,b). The five main types of pea grown worldwide are Austrian winter pea, green pea, maple pea, marrowfat pea and yellow pea. More than 60 varieties of pea have been developed for production in Canada. Canada primarily produces green and yellow pea, with only small quantities of maple, marrowfat and Austrian pea produced (Pulse Canada, 2008a,b). In 2004, 12 million metric tonnes of dry pea were produced worldwide. Canada was the leading country in pea production producing 28% of the total yield, followed by France and Russia at 14% and 10%, respectively (Smith & Jimmerson, 2005a,b). In Canada, Saskatchewan produces 68% of Canada's dry pea crop, while Alberta and Manitoba produce approximately 22% and 10%, respectively (Goodwin, 2003a,b).

In addition to being the world's largest producer of dry pea, Canada is also the leading exporter of dry pea. In 2007, Canada exported over 2 million metric tonnes of dry pea, followed by the United States and France with 469 thousand and 350 thousand metric tonnes, respectively. Conversely, in 2006, India was the largest importer of dry pea as it imported over 1.1 million metric tonnes, followed by Spain and Belgium with 663 thousand and 334 thousand metric tonnes imported, respectively. Presently, Canada and the United States are the 8th and 11th largest dry pea importing countries, importing 77 thousand and 58 thousand metric tonnes, respectively (Agriculture & Agri-Food Canada, 2008).

Pea, similar to other pulse and grain commodities, is relatively inexpensive and highly nutritious. It is high in fiber (soluble and insoluble) and protein (especially rich in the essential amino acids tryptophan and lysine), low in sodium and fat, and is an excellent source of complex carbohydrates, B vitamins, folate, and minerals such as calcium, iron, and potassium. In addition, a diet high in dry pea has been demonstrated to be effective in lowering the incidence of colon cancer, type-2 diabetes, LDL-cholesterol and heart disease (Agriculture & Agri-Food Canada, 2008). Due to the nutritional value described above, pea is considered to be an important agricultural commodity. As such, it is commonly used in soups, or processed into pea flour, pea starch, or pea protein concentrates. The processed pea products can be used in baked goods, soup mixes, breakfast cereals, processed meats, health foods, pastas and purees. Commercially, dry pea is available canned or dried in either whole or split pea varieties (Agriculture & Agri-Food Canada, 2008; Slinkard, Bhatti, Drew, & Morrall, 1990). In addition, pea is one of the most commonly utilized pulse crops in animal feed for poultry, sheep, cattle and swine feed rations, and is used as a feed additive in the aquaculture industry (Schatz, 2002). Finally, dry pea varieties such as AC Trapper can be seeded as a green manure crop as an alternative to summer-fallow in organic farming practices (Lawley & Shirliffe, 2004).

2.2. Chickpea

The chickpea is a member of the cool season *Fabaceae* (Leguminosae) family of legumes (Nwokolo & Smartt, 1996). Similar to dry pea, chickpea is one of the earliest cultivated vegetables, as it is believed to have originated in the Middle East approximately 7450 years ago (Maiti & Wesche-Ebeling, 2001). Chickpea has since been grown in temperate and semi-arid regions of the world such as Asia, Europe, Australia and North America. In 2004, 45 countries were actively producing chickpea, and together produced a total of 8.6 million metric tonnes. India was the leading producer of chickpea accounting for approximately 66% of the world's production. Turkey was the second largest producer, producing approximately 7% of the world supply, followed by Pakistan and Iran at approximately 6% and 4%, respectively. In contrast, Canada and the United States contribute very little to the total quantity of chickpea produced worldwide, as they account for approximately 1% and less than 1% of the world production, respectively (Smith & Jimmerson, 2005a,b). The majority of the Canadian production comes from the Prairie Provinces with Saskatchewan producing approximately 81% of Canada's chickpeas, while Alberta produces the rest.

Chickpea is the third most important pulse crop commodity in the world based on total production (Yust et al., 2003). In 2003, India was both the leading producer and importer of chickpea, with approximately 259 thousand metric tonnes imported (30% of the total amount imported worldwide). Pakistan and Bangladesh were the second and third largest importers of chickpea worldwide, with approximately 123 thousand (14%) and 84 thousand metric tonnes (10%), respectively. Similar to chickpea production, the United States and Canada only marginally contributed to the total quantity of chickpea imported worldwide. In 2003–2004, the United States imported approximately 17 thousand metric tonnes (1%) (Smith & Jimmerson, 2005a,b), while Canada imported only 2 thousand metric tonnes (Agriculture & Agri-Food Canada, 2006a,b).

There are two main commercially available types of chickpea grown worldwide: the desi and the kabuli chickpea. Desi chickpea seed is small with a dark irregular-shaped seed coat and is grown on semi-arid land. Kabuli chickpea (Garbanzo beans) is larger than desi chickpea, has a thin light-colored seed coat and is normally grown in temperate regions of the world (Agriculture & Agri-Food Canada, 2008). A variety of desi and kabuli chickpeas have been

Download English Version:

<https://daneshyari.com/en/article/4562726>

Download Persian Version:

<https://daneshyari.com/article/4562726>

[Daneshyari.com](https://daneshyari.com)