

Passion for pulses: health benefits of pulses and why Australians should eat more of them

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Summary

Since ancient times people have recognised the special nutritional qualities of pulses. Pulses are members of the legume plant family which are grown for human and animal consumption and include various varieties of beans, chickpeas, lentils, peas and lupins. In Charlemagne's empire in the Middle Ages, legume rotations were introduced to the farming system and society was reported to respond by becoming 'more forceful', probably because of increased protein in the diet (1).

In modern times pulses are still an important protein source in many parts of the world and are also credited with other health benefits in societies, such as Australia, where a deficit in protein intake is rarely a problem. Pulses are high in fibre and carbohydrate, and low in fat (except for soybean). They have high amounts of macro-nutrients such as iron, calcium, magnesium and potassium, trace elements such as copper, zinc, selenium and manganese, vitamins such as the B group vitamins, thiamine, niacin and folate, and phytonutrients including antioxidants and compounds with oestrogenic activity. The latter are thought to help in prevention of hormone-related cancers, like breast and prostate cancer, and to reduce problems related to menopause such as osteoporosis. Some of the health benefits of pulses are supported by clinical or epidemiological data, but many are anecdotal or extrapolated from other observations.

This paper outlines observations about pulses (excluding soybeans) relating to their health benefits, and issues concerned with the low consumption rate of pulses in Australia and how consumers might be encouraged to include more pulses in their diets.

Protein

Pulse seeds are high in protein because of the special symbiotic relationship between the plant and the rhizobia bacteria which live in nodules on their roots. Rhizobia biochemically transform nitrogen from air into nitrogen which can be used by plants to make protein, giving pulses a distinct competitive advantage over many other plants. The benefit to humans is a seed which is particularly high in protein. Pulse seeds have as much protein as milk, eggs or meat.

The amino acid complement of pulses is not as well balanced as animal protein; pulses have low methionine and cysteine but high lysine levels and thus provide a good balance with cereal proteins which are high in methionine and cysteine but low in lysine (2). Examples of well balanced pulse-cereal couplings from cuisines around the world include hommos and pitta bread, chickpeas and pasta, dahl and naan bread, tempeh and rice, and beans and tortillas.

Gluten-free

While pulses are high in protein, they do not contain gluten – a protein found in wheat, oats, rye, triticale and barley. Because of the binding properties of gluten, it is present in most breads, other baked goods and most processed foods. This makes life difficult for people with coeliac disease in which gluten damages the absorptive surface of the small intestine for whom the only treatment is a gluten-free diet. Pulses provide variety and economy to their diet.

High complex carbohydrates

Pulses store carbohydrate as starch and are thus high in complex carbohydrates, offering a slow-release of sugar into the blood-stream. An exception to this generalisation is soybean which stores carbohydrate as oil. Because of their low glycaemic index, pulses are useful for diabetics and others who need to watch their blood sugar level. As mentioned below, the soluble fibre content of pulses will also delay sugar entry.

High fibre

Pulses are high in fibre with one serving of baked beans providing about 6 g. Pulses contain high levels of both soluble and insoluble fibre. The soluble fibre forms a gel in the digestive system and is associated with delaying sugar entry into the intestine and possibly reducing cholesterol levels. Insoluble fibres help prevent digestive disorders, decrease risk of colon and rectal cancer and play a role in weight management.

By extrapolation, pulses have a role to play in improving bowel health and decreasing incidence of obesity, heart disease and adult-onset diabetes. While it is generally thought that pulse consumption will reduce these diseases, there is little direct evidence for these benefits.

Quantifying some of the health effects of elevated chickpea consumption is the aim of research currently being undertaken at the Centre for Legumes in Mediterranean Agriculture, the Baker Medical Research Institute and Deakin University, funded by the Grains Research and Development Corporation.

Low fat

Pulses are free of cholesterol and with the exceptions of soybeans are low in fat. The majority of pulse fatty acids are unsaturated, containing both monounsaturated and essential polyunsaturated fatty acids. Pulse consumption is associated with lower blood cholesterol levels (see also section on phytochemicals).

There is a postulated hypocholesterolaemic effect which means that pulses are thought to decrease total and low-density protein lipoprotein (LDL) blood cholesterol in healthy people but especially in individuals with abnormally high LDL cholesterol levels for genetic or dietary reasons. This was first observed in a study which found that the blood cholesterol levels of Trappist monks who ate large amounts of pulses (100 to 150 g per day) was lower than that of Benedictine monks who consumed a 'Western-style' diet (3). Blood cholesterol will be examined in relation to chickpea consumption in the current research project mentioned above.

Nutrients

Pulses are high in iron, calcium, magnesium, potassium and trace elements such as copper, zinc, selenium and manganese (4). Part of the anecdotal benefit of decreased risk of osteoporosis associated with pulse consumption is due to the high level of calcium and the high level of potassium and plant protein which may increase calcium retention. (See also the section below on phytochemicals.) The high levels of some nutrients does not necessarily equate to high bioavailability and some other compounds found in legumes (eg tannins) are thought to decrease absorption of multivalent cations.

The high levels of iron, calcium, folate and fibre makes pulses an excellent food for pregnant women. This is just as well since chickpeas have a reputation as a sexual stimulant. In the sixteenth century, they were added to the diets of stallions before their services were required and Culpepper's herbal of 1652 reports that chickpeas are 'under the dominion of Venus, they are less windy than beans but nourish more; they ... are thought to increase sperm.'

Vitamins

The B vitamins, folate, thiamine, niacin are high in pulses (5,6). Carotene is very high in green split peas (6). Both prolonged storage and long cooking times can decrease vitamin contents (6). Sprouting seeds dramatically increases levels of vitamins A and C (7).

Phytochemicals

Pulses contain isoflavones and other phytochemicals which may have various health benefits. Two isoflavones found in chickpea (biochanin and formononetin) may reduce the concentration of blood cholesterol (8). The soy isoflavones genistein and daidzein have oestrogenic activity and may be related to decreased risk of hormone-related cancers such as breast and prostate (9). Most readers will know that high consumption of soy products in China and Japan correlate to relatively low rates of breast, colon and prostate cancers in those countries and cause and effect have been postulated (10). With the exception of soybean, there are few studies on pulse consumption and health benefits. One study found that people who ate more legumes had decreased risk of colon cancer (11).

Evidence is beginning to accumulate to support the hypothesis that pulse consumption may decrease risks of some cancers. *Vicia faba* agglutinin, the lectin present in faba or broad beans can stimulate differentiation of colon cancer cells (12), suggesting that this lectin added to the diet may slow the progression of colon cancer. There is great interest in effects of diet on cancer risk and there will undoubtedly be more research of this kind coming to light in the near future.

The dark side

While the health benefits of pulses are many and varied, they are not without their dark side. Pulses contain oligosaccharides like stachyose and raffinose which are not digested by humans and thus provide a food source for bacteria which reside in the gut. This give rise to the famed flatulence effect of pulses (13). This effect can be minimised by throwing out the soaking water which removes many of the soluble sugars and by increasing the fibre content of the diet slowly

and then keeping it high. Some herbs are also thought to counteract the flatulence effect, including cumin seed, epazote, asafoetida and winter savoury.

Pulses can also contain other 'antinutrients' such as lectins, protease inhibitors (trypsin and chymotrypsin), tannins, saponins and alkaloids (4). Because plant breeders have made concerted efforts to reduce some of these offending compounds and preparation methods have evolved to detoxify others, these are generally not a problem. When certain pulses with high levels of a toxin form the bulk of a diet (such as *Lathyrus sativa* in drought stricken areas), there can be dire consequences. But when pulses are prepared properly (usually by soaking and cooking) and form part of a balanced diet, they present no health risk and provide the benefits outlined above.

Australia's domestic consumption

While Australian farmers produce some of the highest quality pulses in the world and Australia is one of the top pulse exporters, Australian pulse consumption is one of the lowest in the world. Australians eat about 2 kg pulses per person per year compared to 4 kg in the USA, 5 kg in the UK, 6 kg in Italy and 18 kg in Brasil (14).

In a survey of Australian consumers, the Bread Research Institute found that one of the main reasons given for this low pulse consumption was that many Australians do not know how to cook pulses and/ or are put off by perceived long preparation times. This is in spite of the fact that very nutritious meals with red lentils can be prepared in less time than it takes to get a take-away pizza delivered to the door. Most Australians are also unaware of the many health benefits associated with eating pulses, giving them little incentive to include them in their diet.

Passion for Pulses

In response to the perceived need for more information about the health benefits of pulses and how to prepare them, the Centre for Legumes in Mediterranean Agriculture embarked on a bold adventure for a plant research organisation - preparing a pulse cookbook. The result is *Passion for Pulses: A Feast of Beans, Peas and Lentils from around the World* (15) which was published by UWA Press. It is hoped that the cookbook will assist with an industry objective of doubling domestic pulse consumption by the year 2005.

Passion for Pulses includes over 150 recipes which have all been tested by professional chefs and in ordinary kitchens. The recipes have all been photographed by award-winning photographer Brad Rimmer and the result is a beautifully-presented display of the diversity of uses of pulses.

The inclusion of recipes such as the unlikely but delicious lentil cheesecake has precluded the marketing of the cookbook as a health food cookbook per se. We consciously decided to target mainstream Australia rather than preach to the converted vegetarian or health food market. While most of the recipes are indeed healthy and vegetarian, there are recipes such as Cassoulet which contain meat and others which would not pass as health food by anyone's criteria. Two of my favourites are Chickpea Flour Shortbread and Lentil Brownies. These are marked with an 'indulgence' icon to prevent confusion.

Conclusions

Pulses taste good, are versatile and economical and as outlined in this paper have many associated health benefits. Some of the health benefits of pulse consumption are associated with decreased risk of obesity, heart disease and prostate, colon and breast cancers - diseases which affect all Australians directly or indirectly. It is logical that we should join forces in promoting pulse consumption across the country.

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