

Pulses and Human Nutrition: A Review

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ABSTRACT

Ironically, India – one of the major consumers of pulses is facing its biggest supply crunch and pricing crisis where pulses are concerned.

Prices of dals (pulses) have shot through the roof and the common man is struggling to put a square meal on the table. India is likely to import about 5 million tonnes of pulses during April-December period of this fiscal, largely by private traders, to boost domestic supply and cool retail prices that have reached up to Rs 200 per kg. India, the world's largest producer of pulses, had imported about 4.5 million tonnes in the corresponding period of the previous year. The country had imported 5.78 million tonnes in the entire 2015-16 fiscal to meet domestic demand.

Imports are happening. About 1.2-1.3 million tonnes of pulses have already been imported. Moreover, private traders have contracted for 3 million tonnes of pulses to be shipped between September and December.

1. Introduction

Pulses belong to the family leguminosae (COPR, 1981). The family leguminosae is made up of many species which are cultivated all over the world (Rubatzky and Yamaguchi, 1997). Legumes have a wide range of usage, some are used as fodder or green manure, some are used as silage, while others are extracted for their oil, notably soya bean and groundnut (COPR, 1981). Such oil contributes a great deal to the energy intake of people all over the world. Majority of legumes are grown for their green pods, green seeds, or dried seeds (COPR, 1981). The term pulses cover all those grown for their

dried seeds (COPR, 1981). Pulses have a variety of functions. The use of pulses ranges from their forming a staple diet to their being used as condiments, milk, cheese and snacks (Reddy et al., 1986; Uzogara and Ofuya, 1992). They play a very important role in human nutrition. The present paper reviews the work that has been done on the nutritional value of pulses.

Production: Pulses are grown all over the world (Reddy et al., 1986). Production as per continent is shown in the table below.

Table 1 Production of Pulses by Continent in 10³ Mt*

PLS	SCIENTIFIC NAME	N & C AMERICA	S. AMERICA	AFRICA	EUROPE	ASIA	USSR
1Dry Beans	Phaseolus vulgaris	2627	2839	1911	830	6366	170
Broad beans	Vicia faba	88	109	1124	551	2408	-
Peas (dry)	Pisum sativum	435	98	334	2727	2377	7800
Chickpeas	Ciser arietinum	180	26	290	90	7257	-
Lentils	Lens culinaris	288	-	136	74	1714	-
Cowpea	Vigna unguiculata	57	-	1003	6	27	-

¹Haricot bean (alsocommonbean)

*MT – Metric Tonnes, Data obtained from FAO Year Book (1975 & 1986)

Asia is the largest producer of the pulses listed above, followed by the USSR, where most of the pulses produced are in the form of dry Peas (*Pisumsativum*). The next largest producing continent for all pulses is Africa and the types of beans majorly produced are dry beans (*Phaseolusvulgaris*), broad beans (*Viciafaba*) and cowpeas (*Vignaanguiculata*). The continent that produces next to Africa is Europe, where most of the pulses produced are dry Peas (*Pisumsativum*). The least producing continents are North America, Central and South America. In these continents the dry beans (*Phaseolusvulgaris*) constitutes the pulse produced most.

Consumption of Pulses: Pulses are consumed all over the world. Consumption is higher in those parts of the world,

where animal proteins are scarce and expensive for example, South East Asia and Africa (COPR, 1981). In this part of the world, they provide a large proportion of the protein required for adults and children. About 20% of the protein presently available to man, come from pulses in the developing countries (Reddy et al., 1986).

The nutritional value of pulses:

The nutritional importance of pulses is numerous; they can be a valuable source of energy. The energy content of most pulses have been 100g (Table 2). Energy is required for all metabolic processes. The energy of Pulses come from the nutrient supply of protein, fat and carbohydrate.

Table 2. The Energy Content of Some Pulses Commonly Consumed By Man

Pulses	Scientific Name	Energy (kcal/100g)
Cowpeas	<u>Vigna unguiculata</u>	340
Chickpeas	<u>Cicer arietinum</u>	347
Broad bean	<u>Vicia faba</u>	320
Cluster bean		307
Lentil	<u>Lens culinaris</u>	302
Mung bean	<u>Vigna radiata</u>	310
Peanut	<u>Arachis hypogea</u>	570
Pigeon pea	<u>Cajamis cajan</u>	301
Soya bean	Glycine max	403

Source: Woleung et al (1968); Gopalan et al (1980)

The carbohydrate supplies: The carbohydrate content of pulses is high (Table 3) (Reddy et al., 1985; Okeet et al., 1995). The high carbohydrate content contributes a great deal to the energy supply of pulses. A large percentage of pulses occurs as starch (Table 3), about 1.8 - 18% occurs as oligosaccharide while 4.3 - 25% occurs as dietary fibre (Table 4). Although the oligosaccharides, which are made up of raffinose, stachyose, verbascose, cause gas production in man, they are presently believed to have some beneficial effects. They can shorten transit time and promote the growth of bifid bacteria in man. Infect researchers in Japan have actually suggested that oligosaccharides from soya beans could be used as substitute for common table sugar. They are also hypothesized to improve longevity and reduce colon cancer risk (Hayakawa et al., 1990; Koo and Rao, 1991). The high dietary fibre content of pulses (Table 4), are postulated to have some important physiological effects, such as reducing the transit time in the mammalian gut (Sathe et al., 1984). This would help to relieve gastrointestinal conditions such as constipation and diverticular disease. It is also capable of lowering the blood cholesterol level due to its ability to bind with cholesterol in the human gut (Burkitt and Trowell, 1985). This feature is being suspected as being

capable of reducing colonic cancer in man (Davis and Stewart, 1987; Hangen and Bennink, 2002). Pulses also have low glycaemic indices (Hatford, 1985; Björk et al., 2000), which makes them valuable foods for diabetics. The cotyledon of legumes like locust bean and guar (guar gum) reduces postprandial glucose and insulin concentrations in man (Fairchild et al., 1996; Gatenby, 1991; Feldman et al., 1995).

2. Protein Supply

Pulses have a high protein content (Table 5), the value is about twice that in cereal and several times that in root tuber (FAO, 1968), so they can help to improve the protein intake of meals in which cereals and root tubers in combination with pulses are eaten (Kushwah et al., 2002). Pulse when eaten with cereals, can also help to increase the protein quality of the meal (Table 6). In man, protein helps in the repair of body tissue, synthesis of enzymes and hormones and also in the supply of energy. In children, the consumption of pulses should be encouraged, particularly where animal protein is scarce and expensive, as this would help to furnish the child with the necessary amino acids required for growth.

Table 3. Starch and Total Carbohydrate Content of Pulses

Common name	Scientific name	Total carbohydrates %	Starch %	Amylose content of starch %
Winged bean	<u>Psophocarpus tatragnobulus</u>	24.0 – 42.2	–	–
Smooth peas	<u>Pisum sativum</u>	56.6	36.9 – 48.6	23.5 – 33.1
Wrinkled pea	<u>Pisum sativum</u>	–	24.0 – 36.6	62.8 – 65.8
Great Northern beans		61.2 – 61.5	44.0	10.2 – 30.3
California small white beans		–	57.8	29.1 – 32.6
Broad beans	<u>Vicia faba</u>	57.3	41.2 – 52.7	20.7 – 45.5
Lentil	<u>Lens culinaris</u>	59.7	34.7 – 52.8	20.7 – 45.5
Cowpea	<u>Vigna unguiculata</u>	56.0 – 68.0	31.5 – 48.0	–
Lupine seed	<u>Lupinus spp</u>	–	0.3 – 3.5	–
Black gram	<u>Vigna mungo</u>	56.5 – 63.7	32.2 – 47.9	43.9
Bengal gram	<u>Cicer arietinum</u>	60.1 – 61.2	37.0 – 50.	31.8 – 45.8
Mung gram	<u>Vugna radiata</u>	53.3 – 61.2	37.0 – 53.6	13.8 – 35.0
Red gram	<u>Caianus cajan</u>	57.3 – 58.7	40.4 – 48.2	39.6
Red kidney bean	<u>Phaseolus vulgaris</u>	56.3 – 60.5	31.9 – 47.0	17.5 – 37.2
Navy bean	<u>Phaseolus vulgaris</u>	58.4	27.0 – 52.7	22.1 – 36.0
Pinto beans	<u>Phaseolus vulgaris</u>	54.6 – 63.7	51.0 – 56.5	25.8

Pink beans	<i>Phaseolus vulgaris</i>	–	42.3	14.9 – 35.3
Black eye beans	<i>Vigna unguiculata</i>	–	41.2	15.8 – 38.3
African yam bean	<i>Strepnostylis stenocarpa</i>	40.8	–	–

Source: Reddy *et al.* (1985); Frank-Peterside, Dosumu, and Njoku (2002); Ofuya (2002); Oke, Tewe, and Fetuga (1995).

Table 4. Dietary Fibre Content of Pulses (Per 100g of Whole Mature Seeds)

Legume	Dietary fibre	References
Chickpea	25.6	1
Groundnut	6.1	2
Kidney bean	25.4	2
Mung bean	15.2	1
Pea	16.7	1
Soya bean	11.9	2
Cluster bean	4.3	2
Lentils	11.7	2
Pigeonpea	15	2

Kamath and Belvady (1980) By Paul and Southgate(1978)

Table 5. Protein Content of Pulses

Common name	Scientific name	Protein content g/100gDM	
		Mean	Range
Broad bean	<i>Vicia faba</i>	24	22.0 – 38.2
Chick pea	<i>Cicer arietinum</i>	22.2	19.1 – 31.2
Common bean	<i>Phaseolus vulgaris</i>	23.9	15.2 – 36.0
Common pea	<i>Pistum sativum</i>	23.1	14.2 – 36.1
Cowpea	<i>Vigna unguiculata</i>	24	20 – 34.2
Pigeon pea	<i>Cajanus cajan</i>	21	17.9 – 31.0
Groundnut	<i>Arachis hypogaea</i>	26.2	17.1 – 31.0
Soya bean	<i>Glycine max</i>	40.3	28.7 – 50.1
African yam bean	<i>Streptostylis stenocarpa</i>	18.4	18 – 22

Source: FAO (1981); Ofuya (2002); Frank-Peterside, Dosumu and Njoku (2002); Oke, Tewe and Fetuga (2002); Amartiefo *et al.* (2002)

Table 6 Protein Quality of Cereal Grain and of Cereal Grain / Bean Diets Fed at Equal Levels of Dietary Protein

Protein source	Average weight gain (g)	PER
100% rice	43	2.15
90% rice + 10% beans	56	2.32
100% maize	13	0.87
90% maize + 10% beans	32	1.4
100% sorghum	12	0.88
90% sorghum + 10% beans	30	1.39
100% wheat	19	1.05
90% wheat + 10% beans	41	1.73
100% oats	34	1.6
90% oats + 10% beans	75	2.37
Casein	75	2.71

Source: Bressani (1972)

3. Fat Supply

The fat content of pulse varies in different species. Most species contain about 1% fat, while groundnut and soya bean, have very high fat content, about 30% for soyabean and 49%

for peanut (FAO, 1968). The fat content besides contributing to the energy needs, provides the needed essential fatty acids for man. A pulse like soyabean, contains linoleic acid, which is an

omega-3-fatty acid. This fatty acid is currently being studied for its ability to reduce the risk of heart disease and cancer.

4. Micronutrient Supply

VITAMIN SUPPLY: The vitamins present in appreciably quantities in pulses are thiamin, riboflavin, pyridoxine and folic acid; vitamin E and K are also found in pulses. The B-vitamins act as co-enzymes in biological processes. Vitamin E is known to play a role as an antioxidant inhibiting the oxidation of vitamin A in the GIT and of polyunsaturated in the tissues. It is also believed to maintain the stability of cell membranes (Davies and Stewart, 1987). Vitamin K functions primarily in the liver where it is necessary for the formation of blood clotting factors.

5. Conclusion

Thus far, the many important functions of pulses have been highlighted. Their consumption should be encouraged in both adults and children. Because of their high dietary fibre content, I will advice more usage among the affluent who can afford lots of animal protein. Their use should also be encouraged among malnourished children because of their high protein content. The use of pulses as components of weaning foods in combination with cereals is also recommended, as this would give cheaper cereals with more complete protein. Finally, the use of oil from pulses should be encouraged because of the high polyunsaturated fatty acid content. Polyunsaturated fatty acids are suspected of being capable of reducing the risk of heart diseases.

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