

Pulses for zero hunger and zero malnutrition

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Pulses are indispensable for Indian agriculture and are grown across a range of farming systems, agro-ecologies and socio-economic profiles. The pulses are an excellent source of proteins, essential minerals, dietary fibres and vitamins, and their health benefits are multifaceted. With their miraculous nutrition profiles, pulses can definitely be an answer to eradicate global hunger and malnutrition, improve soil-health and promote environmental sustainability. With an active technological support, policy initiatives and farmer willingness, India is already at the doorsteps of self-sufficiency and ample quantities of pulses in affordable prices are now available to the masses for their advocated consumption. Nevertheless, measures for their sustenance, profitability and acceptability are needed to be adopted as a long-term goal to make them widely acceptable among farmers and consumers. Increasing public awareness of health and nutrition aspects of pulses, patronizing their cultivation and trade and protecting the rights of pulse growers will ensure zero hunger and malnutrition among the Indian populace.

Key words: Pulses, Malnutrition, Zero Hunger

INDIA, a predominantly vegetarian country, is the largest producer (24-25 million tonne), consumer (26-27 million tonne) and importer (2-3 million tonne) of pulses. With high protein content and 15 essential minerals, pulses are the indispensable constituents of the cereal-based vegetarian diets of Indian people and they grow pulses with cereals, oilseeds, sugarcane etc. traditionally since time immemorial. The role of pulses in promoting human health and management of non-communicable diseases such as obesity, diabetes, cardio-vascular problems and neuro-degenerative disease is amply appreciated not only in India but also by the global communities. Pulse seeds contain protein from 16 to 50% beside 15 essential minerals required by man and therefore, provide one of the best solutions to protein calorie malnutrition in combination with cereals. In India, over a dozen pulse

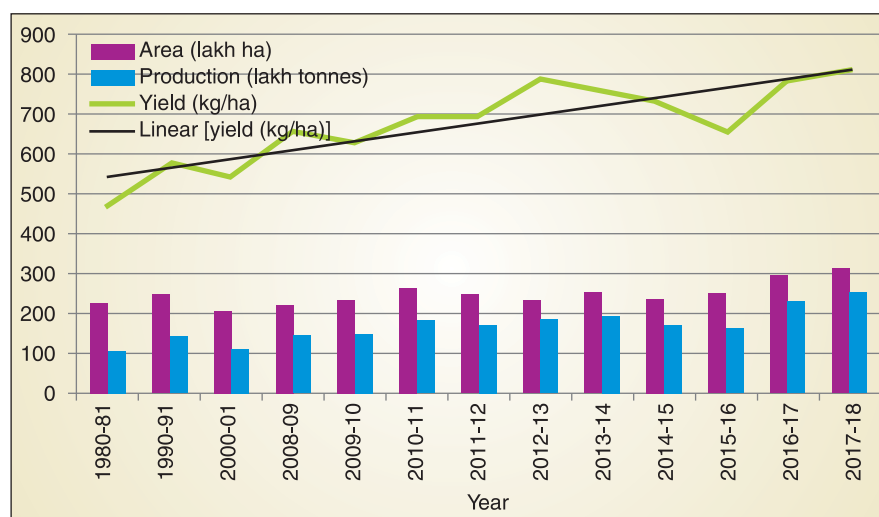


Fig. 1. Trends in area production and productivity of pulses in India

crops are grown and the most important pulses are chickpea (41%), pigeonpea (15%), urbean (10%), mungbean (9%), cowpea (7%), lentil (5%) and fieldpea (5%), followed by several minor pulses such as horsegram, common bean, mothbean, etc. Ushered by

technology revolution, policy initiatives and farmer-centric approach, a revolution was witnessed in indigenous pulse production in last 3-4 years and during 2017-18, 25.23 million tonne of pulses were produced from an area of

30.11 million ha. The average productivity also increased to 811 kg/ha (Fig. 1).

Nevertheless, at global level, the consumption of pulses was slow but steady decline. While the rising incomes, especially in the lower-and the upper-middle class, have led to shifts towards food derived from livestock, the availability of a wider choice of other products, especially the processed and ready to eat food has led people to abandon their traditional diets. The length of cooking time, flatulence causing properties of some of the pulses due to presence of oligosaccharides, and presence of high levels of 'anti-nutrients' such as phytate, tannin and phenol are the major reasons why the pulses are still underestimated in their nutritional potential. In higher income countries, a general lack of familiarity exists with different types of pulses and their health benefits. Strong research and policy support for cereals and comparatively higher financial returns from cereals further relegate pulses to poor farmers and marginal lands. Biotic and abiotic stresses, lack of access to quality inputs, and limited industrial development hamper improvements in productivity.

Top 10 reasons to eat more pulses

1. Excellent source of vegetable protein
2. Excellent source of iron (Fe), folate and potassium (K)
3. Excellent supplier of soluble fibre
4. Gluten-free - suitable for celiac people
5. Cholesterol-free
6. Low-fat
7. Low-sodium (Na)
8. Low glycemic index for lower glucose and insulin levels
9. Good source of antioxidants
10. Good source of phytoestrogens

Nutritional composition of pulses

Legumes, with about twice the protein content of cereal grains, are among a superior plant-based source of dietary proteins to human beings and animals. They are the only plants that have an ability to fix atmospheric nitrogen through the action of specialized bacteria in their root

Table 1. Indicative nutritional profile of pulse grains (per 100 g)

Pulses		Energy (Kcal)	Protein (g)	Fat (g)	Carbohydrate (g) fiber (%)	Total dietary
English name	Scientific name					
Chickpea	<i>Cicer arietinum</i>	368	21.0	5.7	61	22.7
Pigeonpea	<i>Cajanus canjan</i>	342	21.7	1.49	62	15.5
Lentil	<i>Lens culinaris</i> Medik	346	27.2	1.0	60	11.5
Mungbean	<i>Vigna radiata</i>	345	25.0	1.1	62.6	16.3
Urdbean	<i>Vigna mungo</i>	347	24.0	1.6	63.4	17.2
Fielpea	<i>Pisum sativum</i>	345	25.1	0.8	61.8	13.4
Rajmash	<i>Phaseolus vulgaris</i>	345	23.0	1.3	62.7	17.7
Cowpea	<i>Vigna unguiculata</i>	346	28.0	0.3	63.4	18.2
Horsegram	<i>Macrotyloma uniflorum</i>	321	23.6	2.3	59.1	15.0
Mothbean	<i>Vigna aconitifolia</i>	330	24.0	1.5	61.9	

Source: Singh, N.P. and Pratap, A. 2016. Food legumes for nutritional security and health benefits. (In:) U. Singh et al., *Biofortification of Food Crops*. Springer, pp. 41-50

nodules. The plant uses this nitrogen to make protein (26.5 to 57% in soybean, 15.8 to 32.1 % in pea, 16 to 28% in chickpea, 21 to 31% in mungbean, and 16 to 24% in pigeon pea) which is available to human beings in the form of its seeds. Legumes also provide a range of essential nutrients viz., low glycaemic index carbohydrates, minerals and vitamins besides dietary fibre (5% to 37% dry weight of different pulses).

Pulses provide most of the energy (1,040 to 1,430 kJ/100 g) in the form of carbohydrates rather than fat. The carbohydrate content in pulses is about 60% while fats are only 1-6 % most of which is provided by polyunsaturated and monounsaturated fatty acids. Pulses are also fairly good sources of thiamin and niacin, supply adequate vitamins and minerals (iron, zinc, magnesium, phosphorus and calcium) and also little amount of manganese, copper and potassium. Recently the first bio-fortified variety of lentil, L 220, with increased concentrations of iron and zinc was released by Indian Institute of Pulses Research, Kanpur which will be tremendously beneficial for the people from low income groups who can not afford exogenous iron and zinc. For iron, beans have the highest folate content followed by mungbean, lentil and pea. Folate content in raw chickpea and pea are 149.7 and 101.5 µg/100 g, respectively and 78.8 and 45.7 µg/100 g in boiled chickpea and pea, respectively. Their grains are good source of B-vitamins, especially thiamine, riboflavin, niacin, pyridoxal and pyridoxine. The embryo of pulses

contains vitamin E, a strong antioxidant. The nutritional profile of major pulses is described in Table 1.

Dietary fibers

Pulses are eaten as a whole grain as well as dehulled slit 'dal'. The whole grain pulses (with seed coat) including fieldpea, *kabuli* chickpea, mungbean and common bean are much higher in dietary fiber than the dehulled *dal* (*arhar*, red lentil etc.). Pulses typically contain more dietary fiber (15-32 TDF) than cereals and of this approximately one-third to three-quarters are insoluble. The insoluble fiber has high water holding capacity and leads to fecal bulking whereas the soluble fiber ferments positively affecting colon health through production of SCFA, lowered pH and helps to slow gastric emptying rate.

Health benefits

The health benefits of pulses are amply appreciated by the global health researchers. Pulses besides playing a vital role for nutritional security, also have proved role in improving cardiovascular health, celiac disease, diabetes management and weight loss.

Cardiovascular health: Consumption of pulses has been demonstrated to decrease serum LDL-Cholesterol and triglycerides (two major risk factors for CHD) as well as other risk factors, such as hypertension, diabetes, and obesity. It is estimated that eating >100 g pulses everyday can reduce 'bad' or LDL cholesterol by 5%, lowering the risk



Fig. 2. First bio-fortified variety of lentil, IPL 220, rich in iron and zinc (left), and the whole grain pulses (with seed coat) are higher in dietary fiber than the dehusked dal (right)

of heart disease. Eating around 160 g of pulses every day leads to a feeling of 31% more satiated than otherwise. This leads to reduced food consumption by an individual and avoiding snacks too often which are mostly unhealthy eatables ultimately leading to weight loss. Chickpea is the most hypocholesteremic agent among pulses.

Diabetes management: Epidemiological studies strongly suggested that high intakes of whole-grain foods protect against the development of Type II diabetes mellitus. Pulses have a low glycemic index (GI) with GI values ranging from 28 to 52. The complex carbohydrates in pulses lead to a slower digestion and hence low GI as compared to other carbohydrate-containing foods. This results in a slower release of glucose following a pulse-inclusive meal leading to minimal fluctuations in blood glucose levels and a more stable insulin response. Therefore, people who consume 3 or more servings of whole-grain foods per day are less likely to develop Type II diabetes mellitus as compared to low consumers with a 20–30% risk reduction. Pulses showed improvement of blood lipid levels as overall metabolic control.

Weight management: Pulses are high in fiber and protein, moderate in calories and low in fat. Whole pulses eaten with the seed coat (e.g. green lentils, *kabuli* chickpea), are higher in dietary fibre than those are dehusked before consumption (e.g. split peas, and red lentils). While the

insoluble fibre in pulses is important for bowel health, the soluble fibre lowers blood cholesterol. About 100 g of cooked lentils or dry peas contains about half of the daily fiber recommendation for adults. Therefore, a combination of pulses with cereals help people feel satisfied for a long time leading to reduced intake of food and therefore may help with weight management.

Celiac diseases: Celiac disease is an autoimmune disease in which the absorptive surface of the small intestine is damaged by gluten which is found in wheat, oat, barley and rye. This causes discomfort or pain and can even result in malnutrition because of poor nutrient absorption. Pulses are gluten free and an excellent source of dietary proteins, minerals, vitamins and fibres as compared with other gluten-free alternative. Pulses being rich in iron also supplement the celiac patients who otherwise suffer with iron and vitamin B deficiencies. Pulse flours provide an excellent alternative to gluten-containing flour of cereals and ensure balanced nutrition and fibers in the form of baked foods. Legume flours (chickpea, faba bean, lentil, peas) are now being routinely used to manufacture healthier products for celiac people. Pulses are also being used in several *pasta* products, canned and dried soups.

Pulses and cancer risk

While the *World Cancer Research Report 2006* concluded that there was limited evidence on legume consumption and reduced risk of cancer, a number of studies

conducted after that suggested ample association of legumes with a reduced risk of bowel cancer. Evidences are also there to suggest that pulses provide protection against prostate cancer, lung cancer, breast and colorectal cancers, although much of the evidence is limited to the effect of soy-intake. Many phytochemicals and bioactive components in pulses viz., dietary fiber, oligosaccharides, folate, selenium, protease inhibitors, phytic acid, lignans, phenolics, saponins and isoflavones are reported associated with anti-carcinogenic activity. Phenolic compounds, including tannins found mainly in the seed coat of pulses have antioxidant activity. Phytoestrogens in pulses may play a role in the prevention of hormone-related cancers e.g breast and prostate cancer.

Anti-nutritional effects of pulses

Pulses contain a number of phytochemicals which may have health effects for human beings, if not consumed properly. These include the polyphenolic compounds, phytates, lectins, trypsin inhibitors etc. Among the sugars, raffinose, stachyose, verbascose, ajugose and pentosans are predominant which escape digestion in the gut and are fermented, in the large bowel and may lead to abdominal discomfort and flatulence, if pulses are consumed in abundance. Soaking pulses overnight in plenty of freshwater helps to reduce the content of these sugars.

The lectins or haemagglutinins in some pulses can lead to diarrhoea, vomiting, nausea and bloating. The enzyme inhibitors and lectins can reduce protein digestibility and nutrient absorption, respectively. Likewise, phytic acid can diminish mineral bioavailability and saponins, common in chickpea, lentil and faba bean may interfere with nutrient absorption as they are not absorbed properly. The lathyrus toxin in grasspea and certain drought-resistant chickpeas can cause lathyrism, a neurological disorder leading to paralysis of lower limbs, when consumed in large amounts. On the other hand, the same compounds may have protective effects against



Fig. 3. Pulse cultivation brings prosperity in farm families, improves soil nutrition and ensures nutritional security

cancer. However, ample evidences are available which suggest that most of the above anti-nutritional properties can be mitigated effectively by interventions like soaking for 6-8 hr, boiling, roasting and cooking.

Some good practices to eat pulses

Soaking for added health and nutrition: Soaking ensures that pulses can be more easily digested and their nutrients are better absorbed by the body. When dried pulses are soaked in water at room temperature for a few hours their enzymes are activated which brings them back to life. Pulses when soaked in water for 6-8 hr significantly reduce their phytate content and cooking time. This also significantly reduces their tendency to cause flatulence. Soaked seeds of pulses germinate more quickly than the unsoaked ones.

Sprouting to breakdown anti-nutrients: Sprouting leads to germination of pulse seeds and development of small tender plantlets. The procedure of sprouting involves soaking the pulses for 4-8 hr followed by draining and then keeping them moist and properly aerated for 36 to 72 hr. Sprouting makes pulses edible in a raw form. This also renders them more easily digestible as their protein, carbohydrates and fats begin to break down into a pre-digested form. There is significant increase in nutrients in sprouted pulses when compared to their dried seeds. In the process of sprouting, the vitamins, minerals and available protein increase

substantially. The vitamin C content rises from negligible levels to 12 mg/100 g after 18 hr of germination. Surprisingly, sprouted pulses are also reported to have low polyphenols and tannins.

Pulses with grains: a win-win situation: In the entire Indian subcontinent pulses are eaten with cereals which is a

medically-proven good practice. Pulses are high in lysine and low in sulphur-containing amino acids whereas the protein of the grains is low in lysine but high in sulphur-containing amino acids. Therefore, a combination of cereals and pulses ensures a perfect balance of proteins and ensures that the body requirement of proteins are met in the same quantity of food intake, especially in low-income communities, where the affordability of other sources of protein such as animal protein are limited.

Pulse flour: a tasty choice: Food prepared from pulse flours taste more and is easy to digest. Pulse flour can be used in a variety of recipes. It can be a great and easy ingredient to prepare gluten-free food and to boost levels of fibre. Pulse flours can be easily blended and incorporated into a range of vegetarian and non-vegetarian recipes and high protein, high fibre snacks can be prepared using pulse and wheat flour blends. These can enhance moisture content in baked foods, and crispiness in meat preparations and breadings. Pulses can extend or substitute a portion of meat in a recipe, which may also increase juiciness. Chickpea flour, field pea flour bean flour are most commonly used pulse flours.

SUMMARY

Pulses are grown across a range of farming systems, agro-ecologies and socio-economic strata. Nutritional and health benefits of pulses are many and their major inclusion in

predominantly vegetarian diets will lead the world towards zero hunger and zero malnutrition. Nevertheless, as also stated in Morocco declaration on 'Pulses: solutions to food and nutrition security, agricultural sustainability and climate change adaptation', their role in global health including the reduction of non-communicable disease such as obesity, diabetes, heart and neuro-degenerative diseases is understated. Community-level nutrition education programmes and trainings to broaden and diversify the use of pulses at household-level need attention. Simultaneously, commercial production of pulse-based complimentary foods and economic usage of pulses byproducts for preparation of fortified diets need impetus. Remarkable growth has been achieved in indigenous pulses production in India in recent years and measures for its sustenance, profitability and acceptability are required to be adopted. Rapid mixing and instant fixing' approach needs to be adopted through speed breeding concept in pulses to for continual development of new, higher yielding, multiple pests- and disease resistant and climate resilient crop varieties that meet both farmer needs and consumer preferences. Adoption of improved varieties, timely availability of quality seed coupled with recommended package of practices can significantly enhance the productivity of small holder farmers in India. Enhanced pulse production creates a host of opportunities for local value added processing, stimulates domestic demands and provides off-farm employment and sources of income to rural poor. While pulses directly benefit the farm families by eradicating protein energy malnutrition, indirectly they contribute more to the socio-economic upliftment of such families. Therefore, there is a strong need to patronize pulses cultivation and trade and promote their consumption to make India a hunger and malnutrition free nation.

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