INNSPUB

Journal of Biodiversity and Environmental Sciences (JBES)
ISSN: 2220-6663 (Print) 2222-3045 (Online)
Vol. 16, No. 3, p. 112-117, 2020
http://www.innspub.net

REVIEW PAPER OPEN ACCESS

Nutritional importance of Chickpea

Haroon Rashid[1], Muhammad Kamran Taj*[1], Majid Rafeeq[1], Farooq Shahzad[1], Saqiba Jogezai[2], Imran Taj[1], Sakina Khan[1], Saima Azam[1], Lalbibi1, Bibi Sazain[1], Syeda Ayesha Ali[1], Ashiq Hussain[3], Zohra Samreen[4]

[1]*Center for Advanced Studies in Vaccinology and Biotechnology, University of Balochistan, Quetta, Pakistan*

[2]*Department of Microbiology, University of Balochistan, Quetta, Pakistan*

[3]*Bolan University of Medical and Health Science, Quetta, Balochistan, Pakistan*

[4]*Trauma Center Sandeman Provincial Teaching Hospital Quetta, Balochistan, Pakistan*

Article published on March 30, 2020

Key words: Carbohydrates, Proteins, Mineral, Vitamins, Fat.

Abstract

Chickpea is an appreciated crop and provides nutritious food for a growing world population. The Chickpea adjust itself according to with climate change. The nutritional importance of chickpea has been explained by nutritionist in health and food area in many countries around the world. Chickpea form a well-balanced source of carbohydrates, proteins, vitamins and minerals essential to combat malnourishment in human populations. The Chickpea with a high protein content combined with high digestibility is preferred in diets where food is inadequate. In diets of affluent cultures, chickpeas with good vitamin, fatty acid and mineral balance combined with low digestibility would have a preference. Chickpea main types are Desi and Kabuli. The Desi type is characterized by relatively small angular seeds with different coloring and sometimes spotted. The Kabuli type is characterized by larger seed sizes that are smoother and generally light colored.

***Corresponding Author:** Muhammad Kamran Taj ✉ kamrancasvab@yahoo.com

Introduction

Chickpea is the main source of business of the rural people in Pakistan. Its production completely depends upon the concentration of rainfall. There are two major types of chickpea, well-known by size, shape and color of seed. The first comparatively small seeds is called Desi and with large seed called Kabuli. The Desi chickpea is cultivated mostly in the Indo-Pakistan subcontinent. In the period 2005-06, Pakistan had a total area of 1028.90 thousand hectares annually under chickpea (4.3% of the total cultivated area), comprise 6% of the total area under pulses in the country. The chickpea produced 479.5 thousand tones with an average yield of 466kg/ha. Overtime productivity of chickpeas decreased from 617 to 466kg/ha during 1996-2006. On an average, Punjab province give about 80% of this production and the Sindh, Khyber Paktonkhawa and Balochistan provinces produced the remaining 20% (ICRISAT, 2005). The Chickpea helps to managed the soil fertility, particularly in dry land, by deriving a major part of its nitrogen from symbiotic N2 fixation. The Chickpea meets 80% of its nitrogen requirement from symbiotic nitrogen fixation and can fix up to 140kg N ha-1 from air. It leaves substantial amount of residual nitrogen behind for subsequent crops and adds much needed organic matter to maintain and improve soil health, long-term fertility and sustainability of the ecosystems (ICRISAT, 2005; Mahmood *et al.*, 1991).

The pressure on our economy to feed more people has increased the importance of utilizing the potential rain fed regions of Pakistan to improve food security (Mahmood *et al.*, 1991). The Chickpea is drought tolerant cash crop and thus is the major wealth for the people of Balochistan. There was a wide gap potential and actual yield, which may be attributed to various constraints, viz., crop management, labour management, and infrastructural constraints (Malik, 1990). Chickpea is the most important pulse crops mainly grown in the irrigated and rain fed areas of Balochistan by resource poor farmers in drought prone areas specifically. Considerable progress has been achieved in developing improved varieties of chickpea that fit specific niches in the cropping pattern. Fallow areas were brought under chickpea cultivation as the crop could now escape terminal drought. However, large-scale adoption could not be sustained due to several socioeconomic and technological constraints. Low productivity growth of chickpea has resulted in declining or stagnant per capita availability of this crop in the major producing regions. An important policy question is whether the decline in per capita availability of pulses is a supply or demand constraint. In the short to medium term, supply would be more constrained than demand for chickpea. Population and income growth and positive income elasticity of demand would ensure present levels of consumption. In the long run demand would be more constrained due to changes in tastes, preferences, and urbanization. Their overall benefits extend much beyond generating income to resource poor farmers. For the long run sustainability of the system, improvement in production through improved varieties resistant to pests and diseases and better agronomic management should continue in the future. The focus of research should be on developing production technologies appropriate for diverse environments. The survey describes the existing production practices, identifies technical and socioeconomic constraints of low productivity, and determines average cost of chickpea's production and returns at farm level.

Nutritional value of chickpea

Chickpea is a valued crop and provides nutritious food for an expanding world population and will become increasingly important with climate change.

The nutritional value of chickpea in terms of nutrition and body health has been recently emphasized frequently by nutrition is tin health and food area in many countries around the world. Production ranks third after beans with a mean annual production of over 11.5 million tons with most of the production centered in India. Land are devoted to chickpea has increased in recent years and now stands tan estimated 14.56 million hectares. Production per unit area has slowly but steadily increased since 1961 at about t6kg/ha per annum. Over 2.3 million tons of chickpea enter world markets annually to supplement the needs of countries unable to meet demand through domestic production. Australia, Canada, and Argentina are leading exporters of Chickpea (Malik, 1990).

Chickpea is a good source of Carbohydrates

The main energy provided by chickpeas in human diet and animal feed is derived from carbohydrates, which constitute 51%-65% of Desi and 54%-71% of Kabuli seed weight. Some of the carbohydrate energy is provided by the water soluble sugars varying from 2.2%-10.7% in Desi, and 5.5%-10.85% in Kabuli types. The oval to spherical starch granules (9-10 µm wide, 14-30µm wide) represent the major energy source of chickpeas and comprise 30-57% of seed weight (Pankaj *et al.*, 2001; Sharif, 2004). Two large glucan polymers, amylose and amylopectin, combined with minute amounts of proteins and minerals make up the granules. The amylose molecules are linear α(1,4)-linked glucan polymers that are sparsely branched through α(1,6) linkages. Amylopectin polymers, in contrast, are heavily branched as a result of α(1,6) linkages positioned at every 20-30 glucose residue on the α(1,4) glucan backbone. For Desi and Kabuli chickpeas, the amylose concentration varies from 20-42% and 20.7%-46.5%, respectively; thus, many chickpea genotypes have considerable higher amylose concentration than cereal starches, which are in the 25%-28% range (Sharif, 2004; Zuberi, 1989). The seed coat consists mainly of non-starch complex polysaccharides such as cellulose, pectic polysaccharides and hemicellulose giving rigidity to cell walls. These structural polysaccharides can be loosely grouped as dietary fiber and constitutes 15%-22% of seed carbohydrate content in chickpea. This is a relatively high concentration of dietary fiber when compared to cereals such as wheat (12%), rice (2-4%) and other pulse crops such as peas (5.1%) and beans (2.7%) (Zuberi, 1989; Asare *et al.*, 2011).

Chickpea is a good source of Carbohydrates

The main energy provided by chickpeas in human diet and animal feed is derived from carbohydrates, which constitute 51%-65% of Desi and 54%-71% of Kabuli seed weight. Some of the carbohydrate energy is provided by the water soluble sugars varying from 2.2%-10.7% in Desi, and 5.5%-10.85% in Kabuli types. The oval to spherical starch granules (9-10 µm wide, 14-30µm wide) represent the major energy source of chickpeas and comprise 30-57% of seed weight (Pankaj *et al.*, 2001; Sharif, 2004). Two large glucan polymers, amylose and amylopectin, combined with minute amounts of proteins and minerals make up the granules. The amylose molecules are linear α(1,4)-linked glucan polymers that are sparsely branched through α(1,6) linkages. Amylopectin polymers, in contrast, are heavily branched as a result of α(1,6) linkages positioned at every 20-30 glucose residue on the α(1,4) glucan backbone. For Desi and Kabuli chickpeas, the amylose concentration varies from 20-42% and 20.7%-46.5%, respectively; thus, many chickpea genotypes have considerable higher amylose concentration than cereal starches, which are in the 25%-28% range (Sharif, 2004; Zuberi, 1989). The seed coat consists mainly of non-starch complex polysaccharides such as cellulose, pectic polysaccharides and hemicellulose giving rigidity to cell walls. These structural polysaccharides can be loosely grouped as dietary fiber and constitutes 15%-22% of seed carbohydrate content in chickpea. This is a relatively high concentration of dietary fiber when compared to cereals such as wheat (12%), rice (2-4%) and other pulse crops such as peas (5.1%) and beans (2.7%) (Zuberi, 1989; Asare *et al.*, 2011).

In humans, carbohydrates when consumed are acted on by enzymes which degrade the complex molecules in to progressively smaller molecules and finally into glucose to be absorbed by the blood stream. The ease by which food carbohydrates are broken down and delivered into blood stream is of great importance for human health (Chibbar *et al.*, 2010; FAO, 2004). For starches, the ratio of amylose to amylopectin concentration in grains and seeds affects digestibility, where the less branched amylose molecules are more resistant to degradation in the digestive tract than the heavily branched amylopectin. Based on in vitro enzymatic hydrolysis assays, starch can be classified as readily digestible starch (RDS), slowly digestible starch (SDS) and resistant starch (RS). The RDS fraction is broken down to constituent glucose molecules within 20 minutes, whereas it takes 100 min to break down the SDS and the amylose-rich RS fraction remains undigested after 120 minutes. In the human body, RDS and SDS are completely digested within the small intestine by enzymatic digestion, whereas RS need to reach the large intestine before degradation is initiated by bacterial fermentation. Similar to RS, dietary fibers of the cell wall are largely resistant to digestion in the small intestine, but undergo fermentation in the large intestine. Insoluble dietary fiber (e.g. cellulose and hemicelluloses) is important for the overall health of the digestive system as it supports gastrointestinal movement (FAO, 2012).

Chickpea is good source of Protein

The protein concentration in chickpeas ranges from 16.7%-30.6% and 12.6%-29% for Desi and Kabuli types, respectively, and are 2-3-fold higher than in cereal grains (8%-16%). Chickpea proteins have a relatively high content of the essential amino acid lysine (4.9g 100g-1-6.9g 100g-1) as compared to cereal grains (2.8g 100g-1). However, sulphur-containing amino acids methionine and cysteine are in lower concentration in chickpea as compared to cereals. Protein digestibility, very important for human nutrition, is affected by various factors such as inhibitors of enzymatic breakdown of proteins.

The enzyme inhibitors can be in activated during processing or cooking but chickpea type and genotype also affect protein digestibility and in chickpea it varies from 34%-79.4% (Hoddinott *et al.*, 2012).

Chickpea is good source of Fatty acids

The fat concentration in chickpeas varies from 2.9-7.4% in Desi and 3.4-8.8% for Kabuli types and can be considered high when compared to other pulse crops. Polyunsaturated, monounsaturated and saturated fatty acids share about 66, 19 and 15% of the total fat content in chickpea seeds. The polyunsaturated linoleic acid is the most prevalent fatty acid in chickpea seed (46-62/16-56% in Desi/Kabuli types) followed by oleic acid (18-23/19-32%) and palmitic acid (9.1/9.4%). Linoleic acid is considered as hypocholesterolemic agent; thus it reduces the risk of atherosclerosis and coronary heart disease (Jukanti *et al.*, 2012).

Chickpea is good source of Minerals

On average, 100 g of raw chickpea seeds contains 4.6–6.7, 3.7–7.4, 93–197, 125–159, 732–1126, 0.7-1.1 mg of iron (Fe,) zinc (Zn), calcium (Ca), magnesium (Mg), potassium (K) and copper (Cu), respectively. A 100g serving of chickpea can meet significant requirement of daily allowances of Fe (75/33% in males/females), Zn (48/66%), Ca (13/13%), Mg (34/45%), K (21/21%) Cu (90/90%) and P (48/48%) (Asare *et al.*, 2011). However, the mineral concentration can show large variations depending on genotype and growth conditions, and in particular soil environment. For example, chickpea grown in North America have a high selenium concentration (15.3-56.3µg 100g-1) that is adequate to fulfill 61% of the recommended daily allowance in humans (Knights, 2004).

Chickpea is good source of Vitamins and other bioactive compounds

Chickpea has a good complement of vitamins; the predominant being folic acid (~300mg 100g-1) and tocopherol (~13mg 100g-1). Chickpea seeds also contain antioxidants/pigments such as carotenoids, which give bright colors to plant tissues. The important carotenoids in chickpea are β- carotene, lutein, zeaxanthin, beta-cryptoxanthin, lycopene and alpha-carotene. With the exception of lycopene, wild accessions of chickpea contain higher concentrations of carotenoids than cultivated varieties. In the plants, the most prevalent carotenoid is β-carotene, which can easily be converted in to vitamin A. Chickpea seeds are rich in β-carotene and on a dry weight basis contain more than Golden rice or red-colored wheats (Thavarajah and Thavarajah, 2012).

Chickpea is good source of Anti-nutritional compounds the acceptability of chickpea in daily diets is often impeded by the presence of certain anti-nutritional factors in the seeds. Raffinose family oligosaccharides (RFO), phytic acid, saponins and enzyme inhibitors are generally included in this group of undesirable seed components.

RFO play an important role for seed desiccation, germination, photosynthate translocation and stress tolerance in plants and are particularly prevalent in pulse seeds. For chickpea, the RFO content varies from 2 to 8%, and if consumed in large quantities, causes flatulence in humans. The stomach discomfort is a result of RFO fermentation in large intestine releasing carbon dioxide, hydrogen and in smaller quantities, methane gases. Phytic acid constitutes about 0.4 to 1.1% of chickpeas and has an important cellular function for plant and seed development.

The component has a negative effect on nutrition by chelating mineral nutrients, thereby lowering their bioavailability. Thus, about 60%-90% of all phosphorous present in legume seeds is unavailable for uptake and high presence of phytic acid in the western diet is thought to exacerbate iron, calcium and zinc malnutrition in developing countries. The saponins (56kg-1) and inhibitors of trypsin (1mg g-1- 16mg g-1), chymotrypsin (2mg g-1 - 13mg g-1) and α-amylase (5 unit g-1 - 11 unit g-1) have been reported to reduce the bioavailability of other nutrients in chickpea seeds (Wood and Grusak, 2007).

Use of chickpeas to combat nutritional deficiencies in diets

One step towards combating malnourishment in both developed and undeveloped countries could be an increased utilization of pulses such as chickpeas in the daily diet. As chickpeas have a large variation in carbohydrate and protein composition and functionality, the strategy would involve selection of genotypes with suitable digestion profile and nutrition value for each end-user group. In developed countries with excess food supply, the focus is on optimizing vitamin, mineral and fatty acid content and simultaneously reducing digestibility and calorie uptake. For this purpose, chickpeas with a high amylose concentration and producing high content of RS or SDS upon cooking would be preferred. As RS behaves like dietary fiber in the digestive tract, it will release less calories than normal starch and the high-amylose diet would also have beneficial effects on the health of the digestive tract. Upon fermentation of RS and other dietary fibers, growth of remedial microflora, viz. lactic acid bacteria and bifidobacterium, is stimulated and production of short chain fatty acids like propionic and butyric acids is increased. Propionates can inhibit cholesterol and fatty acid biosynthesis and thereby lower the risk of coronary heart diseases, whereas butyrate can prevent colorectal cancer by reducing cell proliferation and inducing apoptosis. In diets of food deprived regions, high-protein food products rich in essential amino acids and high energy content are needed to meet the daily nutritional requirements. Preferably, the pulse diet would be consumed with cereals to combine the high protein and lysine content with sulphur-rich amino acids of cereals. Chickpea genotypes with a starch structure promoting RDS, e.g. low amylose, would be preferred for complete digestion and thus full utilization of the calorific value of the food product (Government of Pakistan, 2006).

Conclusion

Grain legumes are important as it is a source of income and nutrition to billions of small holder farmers and consumers around the world. Another matter of concern in chickpea production is the yield gap between developing countries and developed countries. This is evident from the fact that production in developed countries has increased due to yield improvements whereas in developing countries it has been primarily due to area expansion. Shifting chickpea cultivation to limited-irrigation zones and improving input usage can have a huge impact on boosting yields. The demand for chickpea pulses spurred by the population and income growth in the developing countries has resulted in some developed countries increasing their domestic production to capture these markets. Therefore, it is high time the developed and developing countries to realize the huge potential of pulses in increasing the soil fertility and nutrition and take steps in increasing the productivity and thus, the production of chickpea. The chickpea is a very versatile pulse crop with large seed size, rich in dietary fiber, protein and a starch component with diversity in concentration and digestibility.

Chickpea has the potential to be an integral part of human diet around the world by full utilization of its diversity. For developed world, it has potential to reduce obesity and related metabolic disorders as it can be used in calorie-reduced foods. However, for its full acceptance in developed countries, the concentration of antinutritional factors needs to be reduced to overcome stomach disorders associated with consumption of chickpea based foods.

Acknowledgements

The author acknowledged Director and staff of the CASVAB, university of Balochistan, Quetta who help in this article.

References

Asare EK, Jaiswal S, Maley J, Båga M, Sammynaiken R, Rossnagel BG, Chibbar RN. 2011. Barley grain constituents, starch composition and structure affect starch in vitro enzymatic hydrolysis. J Agric Food Chem **59,** 4743-4754.

Chibbar RN, Priyatharini A, Hoover R. 2010. Molecular diversity in pulse seed starch and complex carbohydrates and their role in human nutrition and health. Cereal Chem **87,** 342-352.

Government of Pakistan. 2006. "Agricultural Statistics of Pakistan (district-wise)". Economic Wing, Ministry of Food, Agriculture and Livestock, Islamabad.

Hoddinott J, Rosegrant M, Torero M. 2012. Hunger and malnutrition. Challenge Paper 2012 Global Copenhagen Consensus **68,** 332-367. DOI: 10.1017/CBO9781139600484008.

ICRISAT. 2005. "Chickpea" International Crops Research Institute for the Semi-Arid Tropics webmaster-icrisat@cgiar.org.

Jukanti AK, Gaur PM, Gowda CLL, Chibbar RN. 2012. Nutritional quality and health benefits of chickpea (*Cicer arietinum* L.): a review. Br J Nutr 108, 11-26.

Knights EJ. 2004. Chickpea. In: Wrigley C, Corke H, Walker CE (Eds) Encyclopedia of Grain Science 1. Elsevier Ltd. Oxford, UK 280-287.

Mahmood K, Munir M, Rafique S. 1991. Rainfed Farming Systems and Socio-economic Aspects in Kalat Division (Highland Balochistan). Pak J Agri Soc Sci 5, 15-20.

Malik SJ. 1990. "Agricultural Credit Markets for Sustained Growth and Development of Agriculture in Pakistan. Agricultural Strategies in the 1990's" Issues and Policies 183-195.

Pankaj K, Deshmukh PS, Kushwaha SR, Sunita K. 2001. Indian Society of Agricultural Science. Annals of Agricultural Research. Division of Plant Physiology. Indian Agricultural Research Institute, New Delhi pp. 110-112, India.

Sharif M. 2004. Wheat yield Gap Analysis: Future Options for Pakistan: A Report submitted in partial fulfillment of the requirement for intership programme in Agricultural Economics B.Sc. (Hons.) Agriculture.

Thavarajah D, Thavarajah P. 2012. Evaluation of chickpea (*Cicer arietinum* L.) micronutrient composition: Biofortification opportunities to combat global micronutrient malnutrition. Food Res Int **49,** 99-104.

Wood JA, Grusak MA. 2007. Nutritional value of chickpea. In: Yadav SS, Redden R, Chen W, Sharma B (Eds) Chickpea Breeding and Management. CAB International, Wallingford, UK 101-142.

Zuberi HA. 1989. Production Function, Institutional Credit and Agricultural Development in Pakistan. Pak Dev Rev **28(1),** 43-56.