

NUTRITIONAL AND BIOCHEMICAL IMPORTANCE OF CHICKPEA IN RESPECT TO HUMAN HEALTH A REVIEW

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Abstract: Pulses are an important source of dietary protein, energy, minerals and vitamins for the mankind. Chickpea is a good source of carbohydrates and protein, together constituting about 80% of the total dry seed mass in comparison to other pulses. They are a good source of many nutritionally important substances, especially the high-quality proteins with typically high content of lysine and a lower content of sulphur containing amino acids. Hence, it is appropriate legumes with cereals to balance the resulting amino acid composition of the food. The content of total dietary fiber in dry matter reaches about 30% and the resistant starch in legumes also behaves like a fiber. Chickpea is being consumed by humans since ancient times owing to its good nutritional properties. Furthermore, chickpea is fulfilling the need as functional food with potential beneficial effects on human health.

Keywords: Chickpea, Human health, Legumes Nutritional significance

INTRODUCTION

Chickpea (*Cicer arietinum* L.) is one of the oldest most widely consumed and grown legume in the world, also called garbanzo bean or Bengal gram. According to the size, shape and color of the seeds, two types of chickpea are usually acknowledged that is Kabuli and Desi Chickpea. Kabuli chickpea is large seeded with salmon white testa, is grown mainly in the Mediterranean area, central Asia and America and Desi chickpea is small seeded with a light brown testa, is cultivated mostly in India and east Africa(1). It is generally accepted that the kabuli type was derived from desi type through mutation followed by conscious selection (2). Polymorphism has been also reported between *Cicer arietinum* and its wild genotype *Cicer reticulatum* (3). Chickpea is a good source of carbohydrates and protein, together constituting about 80% of the total dry seed mass(4,5) in comparison to other pulses. It is cholesterol free and is a good source of dietary fibre, vitamins and minerals (6,7). Poor nutritive value of this legume, due to the presence of certain antinutritional factors such as tannins, phytates and trypsin inhibitors has been also reported by some authors earlier (8). Trypsin inhibitors and tannins inhibit the digestibility of protein and starch, whereas, Phytic acid reduces the bioavailability of some essential minerals viz. iron and zinc etc. (9). Globally, chickpea is mostly consumed as a seed food in several different forms and preparations are determined by ethnic and regional factors (10,11). In the Indian subcontinent, chickpea is split (cotyledons) as dhal and ground to make flour (besan) that is used to prepare different snacks (12,13). In other parts of the world, especially in Asia and Africa chickpea is used in stews, soups/salads and consumed in roasted, boiled, salted and fermented forms. (14). These different forms of

consumption provide consumers with valuable nutrition and potential health benefits. Chickpea is considered to have medicinal and used for blood purification. Chickpea has been and is being consumed by humans since ancient times owing to its good nutritional properties. Furthermore, chickpea is being act as a functional food with potential beneficial effects on human health.

Biochemical quality of chickpea

Pulses are important source of protein in predominantly vegetarian diet of vast section of the population of the developing countries. Biochemical quality, Chickpeas is good source of protein and carbohydrate, its protein quality is better than other legumes such as pigeon pea, black gram and green gram (15). Chickpea contains 21.1% protein, 61.5% carbohydrate and 4.5% fat. It is also rich in calcium, iron, and niacin (16). As a grain legume it has added benefit of improving soil nitrogen status and contributing to the yield and protein content of the succeeding cereal crop in the rotation. The pulse proteins are mainly deficient in sulphur containing amino acids (Methionine and tryptophan) but are rich in lysine in which cereals are relatively deficient. In general, pulse proteins exhibit a wide range of variation in their essential amino acids composition. Cotyledons, being the major component of seed accounts for 93 per cent of methionine and tryptophan of the whole seed, while the seed coat is usually very poor in these amino acids. The embryo is rich in methionine and tryptophan, but it contributes only about 2.5 per cent of their total quantity in seed. Environmental factors under which the pulse crops are grown influenced their amino acid composition (17).

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Chickpea grain composition

Carbohydrate

The total carbohydrate includes mono and oligosaccharides, starch and other polysaccharides. Starch is the most abundant pulse carbohydrate and varied from 31.5 to 53.6% (18). Among the sugars, oligosaccharides of the raffinose family predominated in most pulses and account for a significant value (31.1 to 76.0%) of the total soluble sugars (18). Cellulose is the major component of crude fibre in chickpea. Pulses contain appreciable amount of crude fiber (1.2 to 13.5%). Crude fibre was relatively higher in green seeded chickpea followed by desi and kabuli types (19).

Dietary Fiber

Dietary fiber (DF) is the indigestible part of plant food in the human small intestine. DF is composed of poly/oligosaccharides, lignin and other plant-based substances (20). Soluble and insoluble DFC is about 4-8 and 10-18 g per 100-g of raw chickpea seed respectively (21, 22). The fiber content of chickpea hulls on a dry weight basis is lower (75%) as compared to lentils (87%) and peas (89%) (22). The desi types have higher total DFC and insoluble DFC in comparison to the kabuli types. This could be due to thicker hulls/ seed coat in desi (11.5 % of total seed weight) compared to the kabuli types (only 4.3-4.4 % of total seed weight) (21). Usually no significant differences are found in soluble DFC between kabuli and desi types due to similar proportion of hemicelluloses which constitute large part (~ 55%) of the total seed dietary fibre in kabuli and desi (23).

Protein

Protein calorie malnutrition is observed in infants and young children in developing countries and includes a range of pathological conditions arising due to lack of protein and calories in the diet (24). Malnutrition affects about 170 million people especially preschool children and nursing mothers of developing countries in Asia and Africa (25). Pulses provide a major share of protein and calories in Afro-Asian diet. Among the different pulses, chickpea is reported to have higher protein bio availability (26,27). Chickpea protein quality is better than some pulse crops such as black gram [*Vigna mungo* L.], green gram [*Vigna radiata* L.] and red gram [*Cajanus cajan* L.] (28).

Minerals

About 100g of chickpea seed can meet daily dietary requirements of iron (1.05 mg/day in males and 1.46 mg/day in females) and zinc (4.2mg/day and 3.0 mg/day) and 200g can meet that of magnesium (260 mg/day and 220 mg/day) (29). There were no significant differences between the Kabuli and desi genotypes except for calcium, with desi types having a higher content than Kabuli types (30). The amount

of total iron present in chickpea is lower (5.45 mg 100-g) as compared to other pulse crops like lentils (8.60 mg 100-g) and beans (7.48 mg 100-g) (31).

Vitamins

Vitamins are required in tiny quantities; this requirement is met through a well-balanced daily diet of cereals, pulses, vegetable, fruits, and meat and dairy products. Chickpea can complement the vitamin requirement of an individual when consumed with other foods.

Carotenoids

β -carotene is the most important and widely distributed carotenoid in plants and is converted to vitamin A more efficiently than the other carotenoids (32). On a dry seed weight basis chickpea has higher amount of β -carotene than "golden rice" endosperm or red colored wheats (33). Chickpea contains several phenolic compounds in the seed, two important phenolic compounds found in the chickpea are the isoflavones, biochanin A [5, 7-dihydroxy-4'-methoxyisoflavone] and formononetin [7-hydroxy-4'-methoxyisoflavone] (34). The other phenolics detected in chickpea oil are daidzein, genistein, matiresinol, and secoisolariciresinol (35).

Nutritional quality of chickpea

Besides, their nutritional value, Chickpea is an important *Rabi* pulse grown in India and the mature seed may be used as whole or split into '*dal*' vegetable and its flour for various preparations for human consumption as well as for feeding animals. It is eaten as both whole, sprouted, fried or boiled and salted or more generally in the form of the split pulse (*dhal*), which is cooked and eaten. Green foliage and green grains are also used as vegetables. Straw of gram is an excellent fodder for cattle. Pulses are also an important component grown under moisture stress conditions coupled with their low nitrogen (N) requirement. Pulses can complement with cereals in the cropping system because it utilized the available limited moisture than many other crops and are endowed with unique properties of maintaining and restoring soil fertility status through their capacity to fix atmospheric nitrogen (N) with the help of *Rhizobium* harbored in nodules on the roots as well as of conserving and improving physical properties of soil by virtue of their deep penetrating tap root system. Like other grain legumes, chickpea is a good source of mineral and vitamins. Calcium and iron are important but are usually deficient in the diets of low income people particularly infants, pre-school children, pregnant and lactating women. Consumption of whole seed of chickpea is desirable since its seed coat contributes about 70 per cent of the total seed calcium (36). So, the diet of pulses and cereals can complement each other and has greater biological value than that of either component alone.

Aspect of human health benefit

Although pulses have been consumed for thousands of years for their nutritional qualities, the emphasis has been given to last two to three decades to improve the potential impact of pulses as food on human health been revived. Chickpea consumption is reported to have some physiologic benefits that may reduced the risk of chronic diseases and optimize health. Chickpea is a relatively inexpensive source of different vitamins, minerals and several bioactive compounds viz- phytates, phenolic compounds, oligosaccharides, enzyme inhibitors etc. that could help us to add in potentially lowering the risk of chronic diseases. Due to its potential nutritional value chickpea is gaining consumer acceptance as a functional food in the diet of human beings. Recent reports on the importance of chickpea consumption were related to well being and improvement of sound health.

Diabetes

Pulses like chickpea have a higher amount of resistant starch and amylase (37). Amylose has a higher degree of polymerization (1667 glucose vs. 540) rendering the starch in chickpea more resistant to digestion in the small intestine ultimately resulting in less availability of glucose (37,38). The lower bioavailability of glucose resulted in slower entry of glucose into the blood stream thus reducing the demand of insulin, resulted in decrease the glycemic index (GI) and insulinemic postprandial response (39,40). Lowering GI is an important aspect in reducing both the incidence and severity of type II diabetes (41). Further, increased consumption of resistant starch is related to improve glucose tolerance and insulin sensitivity (42). The Dietary Guidelines for Americans recommended consumption of 21-25 grams of fiber per day for women and 30-38 grams per day for men to maintain the GI index properly.

Blood pressure

Maintaining a low-sodium intake is essential to lowering blood pressure, however increasing potassium intake may be just as important because of its vasodilation effects. According to the National Health and Nutrition Examination Survey, fewer than 2% of US adults met the daily 4700 mg recommendation. Linoleic acid, a PUFA is biologically important due to its involvement in production of prostaglandins. Prostaglandins are involved in lowering of blood pressure and smooth muscle constriction (43). Also, linoleic and linolenic acids are required for growth and performing different physiological functions (44). Additionally, phytosterols like β -sitosterol, is helpful in reducing blood pressure (45). Linoleic acid and β -sitosterol are the major PUFA and phytosterol in chickpea seeds respectively, therefore chickpea seeds could be

incorporated as a part of regular diet that may help to reduce blood pressure.

Bone health

The iron, phosphate, calcium, magnesium, manganese, zinc and vitamin K content are present in chickpeas, which all contributed to building and maintaining bone structure and strength. Though phosphate and calcium are both important in bone structure, the careful balance of the two minerals is necessary for proper bone mineralization - consumption of too much phosphorus with too little calcium intake can result in bone loss. Bone matrix formation requires the minerals manganese, iron and zinc play crucial roles in the production and maturation of collagen. Low intakes of vitamin K have been associated with a higher risk for bone fracture. Adequate vitamin K consumption is important for good health, as it acts as a modifier of bone matrix proteins, improves calcium absorption and may reduce urinary excretion of calcium.

Heart

The Chickpea contained high fiber, potassium, vitamin C and vitamin B-6 content, coupled with the lack of cholesterol which, all support and boost up to heart health. Chickpeas contain significant amounts of fiber, which helped to lower the total amount of cholesterol in the blood, thereby decreasing the risk of heart disease.

Cancer

Selenium is a mineral that is not present in most fruits and vegetables, but can be found in chickpeas. It plays a role in liver enzyme function, and helps detoxify some cancer-causing compounds in the body. Additionally, selenium prevents inflammation and also decreases tumor growth rates. Chickpeas also contain folate, which played a role in DNA synthesis and repair, thus preventing the formation of cancerous cells from mutations in the DNA. Saponins, which are phytochemicals and antioxidant in nature are present in chickpeas, prevent cancer cells from multiplying and spreading throughout the body. Butyrate is reported to suppress cell proliferation (46) and induce apoptosis, which may reduce the risk of colorectal cancer (47). Lycopene, an oxygenated carotenoid present in chickpea seeds, may reduce the risk of prostate cancer (48).

Weight Loss

Intake of foods which are rich in dietary fibre is associated with lower body mass index [BMI]. Eating of foods with high fibre content helps in reaching satiety faster (fullness post-meal) and this satiating effect lasts longer since fibre-rich foods require longer time to chew and digest in the intestinal system (49).

Inflammation

Choline is a very important and versatile nutrient in chickpeas that help with sleep, muscle movement, learning and memory. Choline also helps to maintain the structure of cellular membranes, aids in the transmission of nerve impulses, assists in the absorption of fat and reduces chronic inflammation

Digestion and regularity

Because of their high-fiber content, chickpeas helped to prevent constipation and promote regularity for a healthy digestive tract. Lindsey Lee, RD, clinical dietitian with Eat Right by UAB Weight Management Services, states:

"Most of the fiber in chickpeas is insoluble fiber, which is great for digestive health. Individuals who eat them typically have better blood sugar regulation since chickpeas are so high in fiber and protein"

Other health benefits

Chickpea seed oil contains different sterols, tocopherols and tocotrienols. These phyto sterols are reported to exhibit anti-ulcerative, anti-bacterial, anti-fungal, antitumor and anti-inflammatory properties coupled with a lowering effect on cholesterol levels (50). Chickpea seeds have been used in traditional medicine as tonics, stimulants and aphrodisiacs (51). Further, they are used to expel parasitic worms from the body (anthelmintic property), as appetizers, for thirst quenching and reducing burning sensation in the stomach. In the Ayurvedic system of medicine chickpea preparations are used to treat a variety of ailments like throat problems, blood disorders, bronchitis, skin diseases and liver or gall bladder related problems [biliousness] (52). In addition to these applications, the chickpea seeds are also used for blood enrichment, treating skin ailments, ear infections, and liver and spleen disorders (53).

CONCLUSION

The information presented here shows the potential nutritional importance of chickpea and its role in improved nutrition and health. It is an affordable source of protein, carbohydrates, minerals and vitamins, dietary fibre, folate, β -carotene and health promoting fatty acids. Scientific studies provide some evidence to support the potential beneficial effects of chickpea components in lowering the risk for various chronic diseases, although information pertaining to the role of individual chickpea components in disease prevention and the mechanisms of action are limited to date. This is due to the complex nature of disease etiology and various factors impacting their occurrence. It is imperative the scientific community continues to unravel the mechanisms involved in disease prevention and determine how food bio-actives from such foods as chickpea can influence human health.

Further research, especially well conducted RCTs, and needs to be performed to provide compelling evidence for the direct health benefits of chickpea consumption. Scurvy patients are advised by the doctors to take germinated Gram seed to get rid-off. Malic and oxalic acid collected from green, leaves of gram are prescribed to get rid of intestinal disorders. (Wealth of India, 1950).

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