REVIEW ARTICLE

Nutritional composition of Chickpea (Cicerarietinum-L) and value added products

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Abstract

Chickpea (Cicer arietinum L.) is an important pulse crop grown and consumed all over the world, especially in the Afro-Asian countries. It is a good source of carbohydrates and protein, and the protein quality is considered to be better than other pulses. Chickpea has significant amounts of all the essential amino acids. Starch is the major storage carbohydrate followed by dietary fibre, lipids are present in low amounts but chickpea is rich in nutritionally important unsaturated fatty acids like linoleic and oleic acid.

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Key Words

Chickpea; nutritional composition; value added products; lifestyle diseases

Introduction

Chickpea (Cicerarietinum L.) is an important pulse crop grown and consumed all over the world, especially in the Afro-Asian countries. It is a good source of carbohydrates and protein, and the protein quality is considered to be better than other pulses. Chickpea has significant amounts of all the essential amino acids. Starch is the major storage carbohydrate followed by dietary fibre, lipids are present in low amounts but chickpea is rich in nutritionally important unsaturated fatty acids like linoleic and oleic acid.

It can be utilized to develop nutritious value added products and hence products can also be used as nutritious food for low income group in developing countries and for patients suffering with life style diseases. Chickpea (CicerarietinumL.), also called garbanzo bean or Bengal gram, is an Old World pulse and one of the seven Neolithic founder crops in the Fertile Crescent of the Near East. (1) Currently, chickpea is grown in over 50 countries across the Indian subcontinent, North Africa, the Middle East, southern Europe, the Americas and Australia. Globally, chickpea is the third most important pulse crop in production, next to dry beans and field pea. During 2006-09, the global chickpea production area was about 11.3 million ha, with production of 9.6 million metric tonnes (mmt) and average yield of 849 kg. India is the largest chickpea producing country with an average production of 6.38 million MT during 2006-09, accounting for 66% of global chickpea production. (2) The other major chickpea producing countries include Pakistan, Turkey, Australia, Myanmar, Ethiopia, Iran, Mexico, Canada and USA. (1, 2)

Globally, chickpea is mostly consumed as a seed food in several different forms and preparations are determined by ethnic and regional factors. (3,4) In the Indian subcontinent, chickpea is split (cotyledons) as dhal and ground to make flour (besan) that is used to prepare different snacks. 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. These different forms of consumption provide consumers with valuable nutrition and potential health benefits. (5, 6)

There are two major types of chickpea distinguished by seed-size, shape and color. One, desi-type is characterized by relatively smaller seeds of angular shape with dark seed coat, whereas other kabuli-type is characterized by large owl/ram-head-shaped seeds with beige-colored seed coat. Kabuli-type chickpea is considered more economically important as it receives higher market price than desi-type. (7)

Nutrient Composition Chickpea is a good source of carbohydrates and proteins, which together constitute about 80% of the total dry seed mass. The starch content of chickpea cultivars have been reported to vary from 41% to 50%. The kabuli type contains more soluble sugars (8). The unavailable carbohydrate content is higher in chickpea than other legumes (9), and chickpea carbohydrate has a lower digestibility than that of other pulses (10)

The crude protein content of chickpea varies from 12.4 to 31.5%. Chickpeas contain about 6% fat that is important in the vegetarian diets of resource-poor consumers. The fiber components of kabuli and desi varieties differ quantitatively and qualitatively (11).

The protein quality is considered to be better than other pulses. Chickpea has significant amounts of all the essential amino acids except sulphur-containing amino acids, which can be complemented by adding cereals to the daily diet. Starch is the major storage carbohydrate followed by dietary fibre, oligosaccharides and simple sugars such as glucose and sucrose. Although lipids are present in low amounts, chickpea is rich in nutritionally important unsaturated fatty acids such as linoleic and oleic acids. β-Sitosterol, campesterol and stigmasterol are important sterols present in chickpea oil. Ca, Mg, P and, especially, K are also present in chickpea seeds. Chickpea is a good source of important vitamins such as riboflavin, niacin, thiamine, folate and the vitamin A precursor β-carotene. As with other pulses, chickpea seeds also contain anti-nutritional factors which can be reduced or eliminated by different cooking techniques. Chickpea has several potential health benefits, and, in combination with other pulses and cereals, it could have beneficial effects on some of the important human diseases such as CVD, Type 2 diabetes, digestive diseases and some cancers. (12)

Chickpea contains nutritionally important minerals, notably calcium and iron, and the availability of iron is reported to be good (13). Immature green chickpea seeds are reported to contain 2.2mg thiamine (100 g)-1 and .7 mg riboflavin (100 g)-1(14). Fermentation improves the protein quality of chickpea in such products as dhokla, by increasing the levels of limiting amino acids (15), and thiamine and riboflavin, the important B-vitamins which usually are not consumed in adequate amounts to meet daily requirements in India (16)

The antioxidant capacity, and antimutagenic , apoptosis-related and antipro-liferative effects of chickpea are associated with the presence of phenolic compounds in the seeds.

Overall, chickpea is an important pulse crop with a diverse array of potential nutritional and health benefits. (17)

Value added products Food-based strategies aims to improve the quality of the overall diet by increasing the availability and consumption of a wider range of foods, they address multiple nutrient deficiencies simultaneously. Chickpea being a rich source of nutrients and micronutrients has been incorporated in a variety of products and has shown beneficial results.

Biscuits were developed using blends of chickpea flours each with concentrations of 0, 10, 20, 30 and 40% along with of refined wheat flour. The flours were evaluated for their chemical and functional properties. The chickpea flour showed highest foaming capacity and stability. The thickness and diameter of biscuits did not differ significantly. The spread ratio and percent spread decreased with the addition chickpea flours each up to a concentration of 30%. The fracture strength of biscuits increased significantly with addition of chickpea flours and was highest at 40% concentration. The protein and crude fibre content of biscuits increased significantly from 7.1 to 9.2% and with increasing extent of chickpea flour in the blends. The sensory properties of biscuits prepared by replacing refined wheat flour up to 20% each with chickpea flour were more or less similar to those of control biscuits. (18)

Experimental bread made of wheat flour complemented with 5, 10 and 15% chick-pea flour was studied, using wheat bread as control. Samples were analyzed for their proximal chemical composition and amino acids content. Crude fibre and protein increased from 0.36% to 0.55%, and from 14% to 17.6%, respectively, when 15% chick-pea flour was added. The lysine content increased as the level of supplementation was raised. Biological quality of proteins was measured in rats as protein efficiency ratio (PER) as well as apparent digestibility resulting in an increase of PER values from 0.90 to 1.34. The nutritive value of the bread was significantly improved by adding chick-pea flour. (19)

The improvement in the nutritional quality of wheat crackers was improved by incorporation of chickpea flour. Chickpea flour was characterised with higher protein, fat and ash content in comparison to fine wheat flour. On the other hand, wheat flour contained higher starch level than that in chickpea flour. Chickpea flour was also characterised with good water holding and emulsifying capacities, but the lower water retention capacity and emulsifying stability. Furthermore, fine wheat flour was substituted with different levels of chickpea flour (0, 10, 20 and 30 % w/w) to produce crackers. The addition of chickpea flour at level more than 10 % showed adverse effect to physical properties of crackers embodied in reduced volume index, width and spread ratio. Sensory evaluation of crackers revealed that enhancing level of chickpea flour in crackers caused higher intensity of leguminous taste and odour and cracker had slightly bitter taste. Incorporation of chickpea flour also modified structure of crackers by increasing hardness and reduction porosity of final products. (20)

Pasta was prepared with of durum wheat flour mixed with chickpea flour at two different levels and its chemical composition, in vitro starch digestibility and predicted glycemic index were assessed. Protein, ash, lipid, and dietary fibre content increased while total starch decreased with the chickpea flour level in the composite pasta, all in accordance to the composition of the legume flour. Potentially available starch decreased and resistant starch (RS) increased by adding chickpea flour to the pasta. The main indigestible starch component in composite spaghetti was the fibre-associated RS, representing up to 50 % of total RS levels. The starch hydrolysis index (HI) decreased as chickpea flour in the pasta increased, reflecting the slow and low digestion of the starch in the leguminous ingredient. Predicted glycemic index was lower in spaghetti added with chickpea flour than in durum wheatcontrol pasta. Pasta added with chickpea flour might be a dietetic alternative for people with low-calorie requirements. (21)

Levels of 5, 10 and 15% of legume flours i.e. soybeans, lupins and chick peas were used to supplement cookies. The effect of this supplementation on the rheological properties of the resulting dough was investigated. It was found that, there was an increase in water absorption capacity, dough stability, arrival time, dough development time and mix tolerance index. Extensograph results indicated that dough resistance to extension; dough energy and proportional number were reduced with increasing the lupin flour in the formula, while dough extensibility was not changed. However, soy flour increased resistance to extension, proportional number and energy and lowered dough extensibility. At the same time supplementing wheat flour with chick peas lowered both dough resistance to extension and proportional number, while it increased dough extensibility and energy. By organoleptic evaluation, it was found that using either 5% soybeans or 10% chick peas or 15% lupin flour could replace wheat flour in cookies formula without adversely affecting baking performance or altering the physical characteristics of the end product. (22)

A medical formula was developed from a chick-pea (Cicerarietinum) protein concentrate obtained by ultrafiltration (67.8% of protein). Additionally sucrose, methionine, milk flavor, and mixtures of corn and coconut oils, vitamins and minerals were used, to perform FAO/WHO standards. All ingredients were blended in water to 500C, and the mixture was spray-dried. The nutritive value of the formula was evaluated with the Net Protein Ratio (NPR), Nitrogen Utilization (NU) and both relatives values to casein ANRC (R-NPR and RNU). The proximal analysis of the infant formula was: protein 16.0% (with 4.9 g/16 g N of reactive lysine), fat 25.8%, moisture 4.0%, ash 3.2% and carbohydrates 51.0%. The values of NPR, R-NPR, NU and R-NU were 3.95, 83.6, 3.55 and 82.5 respectively. These results showed the chick-pea protein concentrate, is potentially utilizable as an ingredient in the formulas for medical purposes. (23)

Four bread recipes were prepared with chickpea flour, pea isolate, carob germ flour or soya flour to see the characteristics of the four gluten-free bread formulations and the possibility of substituting soya protein with other legume proteins. Carob germ flour batter structure was thicker compared with the other batters, probably due to the different protein behaviour and the residual gums present in carob germ flour. Chickpea bread also showed the softest crumb.

Confocal scanning-laser microscopy results showed a more compact microstructure in carob germ flour bread compared with soya and chickpea formulations. Chickpea bread exhibited the best physico-chemical characteristics and, in general, good sensory behaviour, indicating that it could be a promising alternative to soya protein. (24)

The effects of the addition of chickpea (Cicerarietinum), emulsifier and altered amount of water on the functional properties (bread volume, colour of crust, crumb texture and crumb porosity) of white and whole wheat bread were investigated applying a screening three factorial design. Addition of chickpea increased crumb firmness and slightly decreased bread volume in both bread types. Addition of emulsifier increased bread volume and decreased bread firmness. Altering the amount of water addition had no significant effects on white bread, but decreased crumb firmness and increased bread volume in whole wheat bread. None of the investigated parameter had an effect of whole wheat bread colour, while in white bread chickpea addition increased darkness and yellowness of the bread. Optimum addition for breads of highest quality would be 56.9–58% water, 1.0% emulsifier and 10.0–16.0% chickpea in white bread and 58% water, 1.0% emulsifier and 11.8% chickpea in whole wheat bread. (25)

Conclusion

Encouraging the introduction of chickpea based foods can be done in places where this legume is part of the local staple food. Resultant products can also be used as nutritious food for low income group in developing countries and for patients suffering with life style diseases.

Thus it can be concluded that chickpea as a common source of carbohydrate and protein can be utilized to develop more value added products hence making it more economical and affordable for the developing countries without compromising the nutrition quality. Also encouraging the introduction of chickpea based foods can be done in places where this legume is part of the local staple food. Resultant products can also be used as nutritious food for low income group in developing countries and for patients suffering with life style diseases.

Recommendation

Chickpea as a common source of carbohydrate and protein can be utilized to develop more value added products hence making it more economical and affordable for the developing countries without compromising the nutrition quality

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