ISSN:2319-2607 IISUniv.J.Sc.Tech. Vol.2(1),66-70 (2013)
RESEARCH ARTICLE

Effect of Fermentation and Dehulling on Nutritional Composition of Chickpea (*Cicer arietinum*)

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Abstract

Legumes are important in human nutrition due to their high protein content. In the present study, two promising (high yield) cultivars of *desi* chickpea (*Cicer arietinium*) were quantitatively analysed for nutritional constituents and effect of various processes on their content was studied. The processing techniques used were fermentation and dehulling. Raw chickpea seeds were presoaked and then subjected to these two methods of processing. The various biochemical constituents, i.e. moisture, protein, fat, ash, crude fibre, carbohydrate and minerals (calcium, iron and phosphorus) were analyzed using standard AOAC methods. To find out the change in biochemical composition of chickpea after processing, statistical test unpaired t - test was applied. No significant change was observed in the nutrients of chickpea cultivars subjected to both fermentation and dehulling.

Keywords

Chickpea, Dehulling , Fermentation, Legumes, Nutritional Composition

Introduction

Food legumes offer a reasonably cheaper source of protein as compared to animal protein, hence making it valuable for developing countries (Singh and Singh, 1992). Legume protein is complementary to protein of cereal and contains more than adequate levels of the essential amino acid (lysine) which is deficient in most of the cereals. Contrary to this, legume proteins are deficient in sulphur containing amino acids (methionine and cystine), adequate amounts of which are present in cereal grains (Ali, 2003). Among the world's grain food legumes, chickpea is the third most important legume crop. Chickpea has been and is being consumed by humans since ancient times owing to its good nutritional properties (Hulse, 1991). India is the largest chickpea producing nation and accounts for 75% of global chickpea production (FAOSTAT, 2009).

The high fibre content, low fat content (excluding oilseeds) and high concentration of polyunsaturated fatty acids (particularily essential fatty acids), make legumes extremely desirable from health point of view. Chickpea contains highest carbohydrate and lowest protein of all legume seeds. It is also rich in fibre, minerals and vitamins (El adawy 2002; Iqbal *et al*, 2006). Chickpea is relatively a good source of nutritionally important poly unsaturated fatty acids (PUFA). Chickpea consumption is reported to have some physiologic benefits that may reduce the risk of chronic diseases and optimize health (Soni, 1982; Zulet and Martinez, 1995; Kushi *et al*, 1999). Increased dietary intake of whole grain foods and legumes has been shown to improve glycemic controls (Venn and Mann, 2004).

Materials and Method

For the present study, samples of two promising (high yield) cultivars of *desi* chickpea (*Cicer arietinium*) *viz*. RSG823 and RSG931 were procured from Chickpea Research Centre, Agriculture Research Station, Durgapura, Jaipur. The seeds were cleaned manually to remove dirt, grit, broken grains and foreign matter (stones, hull etc.) and were coded as C1 and C2, respectively. They were analysed for various proximate components *viz*. moisture, protein, fat, ash, crude fibre and carbohydrate and minerals (calcium, iron and phosphorus). The effect of processing on the various nutrients was studied by subjecting the chickpea cultivars to two processing methods - fermentation and dehulling. Raw chickpea seeds were first cleaned and then soaked in distilled water at the room temperature for a period of 12 hours, before subjecting them to the two methods of processing.

The presoaked chickpea seeds were washed, weighed and ground in an electric grinder to form a smooth paste by adding distilled water. The paste was then collected in a clean glass container and was diluted with distilled water to form a batter like consistency. It was then covered with lid and incubated at 35°C±2°C for 24 hours to ferment naturally (Salunkhe and Reddy, 1989). The fermented batter was then weighed and transferred in a clean stainless steel plate/tray on which it was spread in as thin layer as possible and was kept for drying in a hot air

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oven at 70°C±2°C till constant weight was obtained. The dried fermented chickpea paste was ground to a powder coded as F1 and F2 obtained from cultivars C1 and C2.

Similarily, the presoaked chickpea seeds were washed in running water and kept for drying at 50°C for 6 to 8 hours in a hot air oven. The dried chickpea seeds were hand pounded. The dehulled chickpea seeds were separated from hulls by winnowing and sieving (Singh, 1988). The dehulled chickpea seeds thus obtained as *dhal*, were ground in an electric grinder to obtain powder coded as D1 and D2, obtained from cultivars C1 and C2. The nutrients in the raw and processed chickpea samples were analysed by using the standard AOAC methods, 2005.

Statistical Analysis

Mean values and the standard deviations for estimated nutrients were analysed and unpaired t-test was applied to find out the change in biochemical compositon of chickpea after processing.

Results and Discussion

The results of proximate analysis showed that there existed a significant difference ($p < 0.05$) in the content of fat, ash and minerals of the two chickpea cultivars (Table 1). The analysis revealed moisture content, of various chickpea cultivars, to range from 7.050 to 7.18 g/100g, with a mean value of 7.12± 0.10 g/100g, which is almost similar to that reported by Costa *et al*, 2006 and Shah *et al*, 2011. However, higher values for moisture content of chickpea (8-10%) have been reported by Khalil *et al*, 2007; Ozer *et al*, 2010; Uppal and Bains, 2012.

The protein content of the selected chickpea cultivars ranged from 22.862 to 23.340 g/100g of chickpea, with a mean value of 23.10± 0.34 g/100g (Table 1). Similar values have been reported by Singh and Pundir, 1991; El- adawy *et al*, 2002; Saxena *et al*, 2002; Iqbal *et al*, 2006; Khalil *et al*, 2007; Khattak *et al*, 2008; Maheri - sis *et al*, 2008; Ozer *et al*, 2010. On the other hand, lower values (18-21%) have been reported in earlier studies conducted by Jambunathan and Singh, 1989; Costa *et al*, 2006. It has been documented that protein content of chickpea seeds is highly variable (Ozer *et al*, 2010) and that differences among studies may be attributed to genetic variations in cultivars under examination. Soil type and agronomic practices may also contribute to difference in the protein content (Nikolopoulou *et al*, 2006; Zia ul haq *et al*, 2007).

The fat content of the various chickpea cultivars was found to range from 4.25 to 4.86g/100g, with a mean value of 4.56±0.43 g/100g. Also, it was found that cultivar C2 had significantly higher fat content than C1. Fat content obtained was in line to that documented by Jambunathan and Singh, 1989. While some earlier studies have pointed higher fat content (5-7%) in chickpea in comparison to present investigation (El- adawy, 2002; Costa *et al*, 2006; Iqbal *et al*, 2006; Ozer *et al*, 2010). The ash content of various chickpea cultivars in the present study was found to range from 2.50 to 3.02 g/100g, with a mean value of 2.76±0.37 g/100g (Table 1). C1 showed significantly lower ash content than C2. The results for ash content obtained in the present study are in agreement to the values earlier documented by El-adawy, 2002; Agarwal and Singh, 2003; Costa *et al*, 2006; Khalil *et al*, 2007; Ozer *et al*, 2010, however, have reported higher value (5%) for ash in *desi* chickpea in comparison to *kabuli* chickpea. Fibre content in various chickpea cultivars was shown to range from 7.82 to 7.90 g/100g, with a mean value of 7.86±0.06 g/100g. When the present data was compared with the earlier findings, a lower values (3.4-4%) for fibre content in chickpea in comparison to present investigation were found to be reported by El-adawy, 2002; Agarwal and Singh, 2003; Ozer *et al*, 2010, while, higher fibre content (9-10 %) in chickpea has been documented by Saxena *et al*, 2002; Costa *et al*, 2006; Maheri - sis *et al*, 2008.The results obtained showed that carbohydrate content in various chickpea

Table 1. Mean nutrient content of raw chickpea cultivars

Selected Chickpea Cultivars			
Nutrients	**C1**	**C2**	**Mean±SD**
Moisture (g/100g)	7.05±0.25	7.18±0.26	7.12±0.10
Protein (g/100g)	23.34±1.07	22.86±1.05	23.10±0.34
Fat (g/100g)	4.25±0.19	4.86±0.22*	4.56±0.43
Ash (g/100g)	2.50±0.0	3.02±0.06*	2.76±0.37
Fibre (g/100g)	7.82±0.08	7.90±0.79	7.86±0.06
Carbohydrate (g/100g)	62.86±1.53	62.07±1.55	62.47±0.56
Calcium (mg/100g)	370.00±10.50	407.00±11.59*	388.5±26.16
Phosphorus (mg/100g)	447.00±24.50	483.00±12.53*	465.5±24.75
Iron (mg/100g)	2.43±0.23	5.25±0.29*	3.84±1.99

Mean ± Standard Deviation

Mean values having stearic superscript within same row are significantly different (P<0.05)

cultivars in the present study to range from 62.07 to 62.860 g/100g, with a mean value of 62.42±0.56 g/100g.

The calcium of the selected chickpea cultivars was shown to range from 370 to 407 mg/100g, with a mean value of 388.5±26.16 mg/100g (Table 1). Statistical analysis further revealed, calcium content to significantly ($P<0.05$) vary among the two chickpea cultivars. It was found that cultivar C2 had significantly higher calcium content in comparison to C1. Jambunathan *et al*, 1981; Sharma *et al*,1996; Agarwal and Singh, 2003; Iqbal *et al*, 2006, on the other hand, have reported lower values (160- 220 mg/ 100g) for calcium in comparison to the present study. While, higher calcium content (470 mg/100g) in chickpea *dhal*, in comparison to present results, has been reported by Chitra *et al*, 1996.

The phosphorus content of various chickpea cultivars in the present study were estimated by standard method (Fiske and Subbarao, 1925). Table 1 shows that phosphorus content in the two chickpea cultivars ranged from 447 to 483 mg/100g, with a mean value of 465±24.75 (g/100g). Phosphorus content was found to be significantly lower in cultivar C2 than C1. Jambunathan *et al*, 1981, have reported the phosphorus content of chickpea to be in close proximity to the present investigation, but lower value (215- 230mg/100g) for phosphorus has been reported by Agarwal and Singh, 2003; Iqbal *et al*, 2006.

The iron content of the selected chickpea cultivars was estimated by standard method (AOAC, 2005). The results showed that iron content in various chickpea cultivars ranged from 2.43 to 5.25 mg/100g, with a mean value of 3.84±1.99 mg/100g. Iron content, like calcium and phosphorus was found to be significantly higher in cultivar C1 as compared to C2 (Table1). When compared with the findings of earlier researchers, Jambunathan *et al*, 1981; Chitra *et al*, 1997; Iqbal *et al*, 2006, documented iron content in the range similar to the present investigation, whereas, higher values (12 – 16mg/100g) for iron in chickpea have been reported by Sharma *et al*, 1996.

No change was found in the nutrients after subjecting the chickpea cultivars to fermentation, viz. moisture, protein, fibre, fat, ash, carbohydrate, iron phosphorus and calcium content, (Table 2). Whereas, Moreno *et al*, 2004 reported a significant decrease in lipid content in chickpea due to fermentation. Sugar contents have been found to increase during fermentation of cowpea and ground bean by Egounlety and Aworh, 2003. A similar result has also been documented by Khetarpaul and Chauhan, 1990 in pearl millet.

The nutritional analysis of the dehulled chickpea cultivars showed moisture, fat, ash, fibre, calcium, iron and phosphorus content to remain unchanged. On the other hand, results pertaining to significant reduction in fibre and ash and an increase in fat content have been reported by Singh *et al*, 1991; Attia *et al*, 1994. Protein content of the selected cultivars did not change which is similar to the findings reported by Attia *et al*, 1994. Deosthole, 2006, though found iron content in chickpea to decrease by dehulling and a significant reduction in iron and calcium content due to dehulling have been reported by Singh *et al*, 1991.

Conclusion

It was concluded that the chickpea cultivar C2 had higher moisture, fat, ash, fibre and mineral contents than cultivar C1, while C1 had higher protein and carbohydrate content than C2. Also, it was found that the two cultivars varied significantly in terms of ash, fat, calcium, phosphorus and iron contents. On subjecting the chickpea cultivars to fermentation and dehulling, no change in nutrients was found by either process.

Table 2. Impact of the processing on nutrient content of chickpea

Nutrients	Raw Chickpeas	Fermented Chickpeas	Dehulled Chickpeas
Moisture (g/100g)	7.12±0.10	7.78±0.14	6.51±0.38
Protein (g/100g)	23.10±0.34	23.69±0.53	24.44±0.93
Fat (g/100g)	4.56±0.43	4.02±0.14	4.63±0.45
Ash (g/100g)	2.76±0.37	2.59±0.55	2.57±0.32
Fibre (g/100g)	7.86±0.06	9.06±0.41	4.46±0.19
Carbohydrate (g/100g)	62.47±0.56	61.88±0.25	61.83±0.21
Calcium (mg/100g)	388.5±26.16	368.50±24.75	296±22.63
Phosphorus (mg/100g)	465.5±24.75	484.33±23.10	391.5±26.16
Iron (mg/100g)	3.84±1.99	3.26±2.41	2.53±1.82

Mean±Standard Deviation

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