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Nutrient composition of raw chickpea (*Cicer arietinum*), chickpea *dhal* and flour

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Abstract

Chickpea (*Cicer arietinum)* is an important source of protein in several developing countries. The chickpea was evaluated for the proximate composition i.e. moisture, protein, fat, ash, crude fiber and carbohydrates. The contents were found to decrease after dehulling and milling of the chickpea. The decrease was 12% in chickpea and 24% in chickpea flour, respectively. Similarly 69.5% and 55.7% decrease was found in cystine content of the chickpea *dhal* and chickpea flour respectively. The methionine, cystine and protein digestibility was also found to decrease whereas starch digestibility was found to be increased. The antinutrients like phytate, polyphenol, tannins and trypsin inhibitor and minerals viz. calcium, iron and zinc were also found to be decreased. While total solubility was found to be increased after these domestic processing.

Introduction

Grain legumes or pulses occupy an important place in the world food and nutrition economy. Present world production is estimated to be 50 million metric tons and, at an average price of $400 per metric ton, its total value would amount to $2 billion. They are important constituents in the diets of a very large number of people, especially in the developing countries, and are good sources of protein which help to supplement cereal diets, improving their protein quality (http:/www.unu.edu). Chickpea is the third most important food legume grown globally. The chickpea is widely grown in Indian sub-continent which accounts for almost 90% of the world's crop. (http://www .vvsat.org).Chickpea is used as whole seed or split seed (*dhal*), flour in preparing variety of snacks, raw or roasted fresh green chickpeas.

Pulses or legumes are poor man's meat due to their high protein content ranging from 20 to 40% (Mahajan and Chattopadhyay, 2000). These are the cheaper source of the protein than milk, cheese, almonds, cashew nuts, meat, fish etc., hence is valuable food. Pulses have about the same calorific value per unit weight as cereals. Pulses protein usually contain adequate level of the nutritionally important amino acid such as lysine which is deficient in cereals. The combination of cereals and pulses can provide a good balance of amino acids since cereals usually supply adequate methionine (Srivastava and Srivastava , 2003)

The pulses are subjected to various processing techniques like dehulling, milling, soaking, germination, fermentation and cooking. The methods improve the nutritional value and lower the toxic compounds (Gopalan *et al.*1991). Keeping in view the effect of dehulling, splitting and milling processes on the nutrient composition of the chickpea the present study was carried out with following objectives:

1. To determine the proximate composition of Chickpea, dehulled chickpea and chickpea flour.
2. To study the antinutritional factors present in the chickpea, dehulled chickpea and chickpea flour.
3. To determine the availability of selected nutrients using *in vitro* methods.

Material and Methods

Procurement of sample

The chickpea variety PDG-3 was procured from the Department of Plant Breeding, Punjab Agricultural University, Ludhiana (India). The chickpea were cleaned and freed of extraneous matter. Then the sample was divided into two parts. One part was split by using pulse pearler to prepare *dhal* and another to *besan* (flour) by using Willy mill. Whole

chickpea, chickpea *dhal* and chickpea flour samples were stored in the air tight container for the use of further analysis.

Chemical analysis

The proximate composition like moisture, protein, fat, ash, crude fiber were determined by AOAC (1985) method. Carbohydrate and energy content (carbohydrate was calculated by adding moisture, protein, fat, ash, crude fiber and subtracted from 100. For calculating energy protein and carbohydrate content were multiplied by factor 4 and fat content was multiplied by factor 9 the sum of these was added. The methionine was analyzed by Horn *et al.* (1946) and cystine by Liddel and Saville (1959) method. In *vitro* starch digestibility was determined by the Singh *et al.* (1982) method and protein digestibility was determined by Akeson and Stachmann (1964) method as modified by Singh and Jambunathan (1981)

Mineral contents

Mineral contents of the samples were digested by wet digestion. For the estimation of soluble iron, calcium and zinc, the soluble iron content extracted at pH 7.5 was determined by atomic absorption spectrophotometer for which the filtrate was wet digested by the method of Piper (1950). Different mineral concentrations in unknown samples were estimated from the calibration curves drawn with the reading of standard solutions. Mineral contents in the samples were then calculated as

$$\frac{A \times b}{C} \times \mu g \text{ of iron/g of sample}$$

Where,

A = µg of iron in the test solution calculated from standard

b = dilution factor

C = Weight of sample (g) taken for digestion.

Antinutritional factors

The phytic acid content of prepared recipes was estimated by Haug and Lantzsch (1983) method. Polyphenol content was estimated by AOAC (1985). Trypsin inhibitor content was estimated by Roy and Rao (1971).

Trypsin Inhibitor Units (TIU): One unit of trypsin was defined as the amount of enzyme which converts 1mg of casein to TCA solution components at 37°C for 20 minutes at pH 7.6. One unit of inhibitor activity is that which reduces the activity of trypsin by one unit under assay conditions.

Calculations:

0.5 ml contains 10mg of casein.

$$\text{TIU per mg protein} = \frac{\text{OD of test}}{\text{OD of Std.}} \times \text{Con of Std.} \times \text{dilution factor} \times \frac{100}{\text{wt. of samples}} \times \frac{1}{10}$$

Results and Discussion

The data on proximate composition of whole chickpea, chickpea *dhal* and flour have been presented in the Table 1. The moisture content of the samples was found to be 8.43 ± 0.45, 7.32±0.42 and 8.09±0.01g/100g in whole chickpea, chickpea *dhal* and flour respectively. Aggrawal and Singh (2003) also reported the moisture content 6.13 to 12.9% in chickpea varieties. The total ash content of the samples ranged between 2.39 ± 0.23 to 4.27± 0.12 g/100g, minimum in chickpea flour and maximum in whole chickpea. The value reported by Gopalan et al (1991) was 3.0 and 2.7% for whole chickpea and chickpea *dhal*. The crude protein content was found to be 24.24±0.30, 22.65±0.01 and 21.85±0.65 g/100g in whole chickpea, chickpea *dhal* and flour respectively. Protein content was found significantly decreased. The decrease in the protein content might be due to the splitting and dehulling process of the chickpea. The fat content and the crude fiber content of the samples were also found to be decreased during the splitting and dehulling process. The carbohydrates content was found minimum (53g) in whole chickpea and maximum (62g) in chickpea flour. The calorific value was found minimum (362 Kcal) in whole chickpea and maximum (382 Kcal) in chickpea *dhal*. Since the carbohydrate content was calculated by difference method, the variation in carbohydrate was attributed to the differences in the content of other constituents. The methionine content of the chickpea was also found to be decreased after dehulling and milling process. The decrease was 12% in chickpea and 24% in chickpea flour. Similarly 69.5% and 55.7% decrease was found in cystine content of the chickpea *dhal* and chickpea flour, respectively.

Table 1. Proximate composition of whole chickpea, chickpea *dhal* and flour (g/100g)

Nutrients	Whole Chickpea	Chickpea *dhal*	Chickpea flour
Moisture	8.43 ± 0.45	7.32 ± 0.42	8.09 ± 0.01
Ash	4.72 ± 0.12	3.52 ± 0.14	2.39 ± 0.23
Protein	24.24 ± 0.30	22.65 ± 0.01	21.85 ± 0.65
Fat	6.89 ± 0.18	6.25 ± 0.25	4.59 ± 0.10
Crude fiber	3.87 ± 0.21	1.21 ± 0.21	1.10 ± 0.01
Carbohydrates	53	59	62
Energy (KCal)	362	383	377
Methionine (g/16gN)	1.779 ± 0.30	1.550 ± 0.00	1.340 ± 0.09
Cystine (g/16gN)	0.203 ± 0.00	0.062 ± 0.02	0.090 ± 0.012
Protein digestibility (%)	83.25 ± 0.27	82.87 ± 0.27	80.25 ± 0.05
Starch digestibility (%)	72.32 ± 047	75.92 ± 0.47	73.73 ± 0.03

The protein digestibility of the whole chickpea, chickpea *dhal* and chickpea flour was found to decrease after dehulling, splitting and milling. The decrease was 0.46% and 3.68% in chickpea *dhal* and chickpea flour respectively. Saharan *et al.* (2002) reported 58.4%protein digestibility in whole ricebean seeds. While the starch digestibility was found to increase by 5.0% and 1.9% in chickpea and chickpea flour respectively, after dehulling, splitting and milling.

Table 2 represents the mineral content of whole chickpea, chickpea *dhal* and flour (mg/100g). The results revealed that the total calcium content of the whole chickpea, chickpea *dhal* and flour was 60.2, 55.5 and 50.2 mg/100g, respectively. Sood *et al.* (2000) reported the higher content of calcium (250.38 mg/100g) in the chickpea variety (HPG-17). The soluble calcium content was found be 10.6, 8.3 and 8.0 mg/100g and Total iron content was found to be 5.19, 5.16 and 4.57 mg/100g in whole chickpea, chickpea *dhal* and flour respectively. Sood and Malhotra (2001) reported 10.34 mg/100g of iron content in the C-235 one of the chickpea varieties. It was observed that after splitting and milling of chickpea the iron content was decreased. Similar result was found in the total zinc content of the chickpea in the present study too.

Table 3 represents the antinutritional content of whole chickpea, chickpea dhal and flour. The phytic acid content was found to decrease after dehulling and milling. The decrease was 11% in chickpea *dhal* and 23.5% in chickpea flour. Phytic acid is not only present in the outer layer of the seeds, but is also evenly distributed in the endosperm. The polyphenols content

Table 2. Mineral content of whole chickpea, chickpea *dhal* and flour (mg/100g)

	Whole Chickpea	Chickpea *dhal*	Chickpea flour
Total calcium	60.2	55.3	50.2
Soluble calcium	10.6	8.3	8.0
Total iron	5.19	5.16	4.57
Soluble iron	2.68	2.89	3.69
Total zinc	3.26	3.16	2.88
Soluble zinc	0.61	0.68	0.47

Table 3. Antinutritional content of whole chickpea, chickpea *dhal* and flour(mg/100g)

	Whole Chickpea	Chickpea *dhal*	Chickpea flour
Phytic acid	136	121	104
Polyphenols	520	432	382
Tannins	199	127	107
Trypsin Inhibitor (TIU/ Protein)	105	99	87

of the chickpea was also found to decrease after dehulling and milling. Preet and Punia (2000) reported that removal of seed coat (dehulling) of soaked cowpeas reduced the polyphenols by 70-71%. Soaking (12h) brought about an improvement in protein and starch digestibility, which further increased after dehulling. In the present study the tannin content was found as 199, 127, and 107 mg/100g in whole chickpea, chickpea *dhal* and flour respectively. In another study the tannin content in chickpea was reported to be 175-591 mg/100g in whole seed of chickpea and 28 mg/100g in cotyledon. Dehulling eliminated about 68-99% of tannins in pulses and improved *in- vitro* protein digestibility and iron absorption (Srivastava and Srivastava, 2003). The trypsin inhibitor (TI) content was decreased and the decrease was 5.7 % after dehulling and 17.1% after milling. Bishnoi and Khetrapaul (1994) have also reported a decrease in the TI content after domestic processing.

Conclusions

The chickpea contains good amount of the nutrients and some of the antinutrients such as phytic acid, tannins and trypsin inhibitor. The dehusking, splitting and milling of the chickpea helps in lowering the concentration of antinutrients significantly, which improve the digestibility of the chickpea.

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