The Bioscan 12(2): 771-774, 2017
AN INTERNATIONAL QUARTERLY JOURNAL OF LIFE SCIENCES
www.thebioscan.com

EFFECT OF SOAKING AND ROASTING ON NUTRITIONAL AND ANTI-NUTRITIONAL COMPONENTS OF CHICKPEA (*PRATAP-14*)

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KEYWORDS
Chickpeas
Anti-nutrients
Nutritional components
Soaking and roasting
In-vitro protein digestibility

Received on :
10.03.2017

Accepted on :
17.05.2017

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ABSTRACT
Chickpea was soaked for 8 hours, sundried and roasted in hot air oven at 175 ± 5°C for 20 minutes. Application of soaking and roasting significantly decreased the moisture (7.48 to 5.49 %), fiber (9.67 to 9.25%), ash (2.70 to 1.44%) and total iron content (5.53 to 5.18 mg/100gm). Soaking and roasting increased the protein (23.48 to 24.38 %), fat (6.50 to 6.76%), carbohydrate (50.15 to 52.66%), energy (354 to 370kcal/100g), *in-vitro* protein digestibility (65.43 to 71.54%), total calcium (143.29 to 168.49 mg/100g), *in-vitro* calcium bioavailability (104.45 to 128.27 mg/100g) and *in-vitro* iron bioavailability (0.80 to 1.05 mg/100g). Soaking and roasting also significantly reduced the anti-nutrients like phytic acid (1.56 to 0.68 mg/g) and tannin (4.02 to 1.72 mg/g). Results of investigation revealed that the soaking and roasting of chickpeas found to be advantageous in terms of their nutritional compositions.

INTRODUCTION

Legumes are necessary part of ancient diets around the world. Legumes are cheap, nutrient rich sources of protein that will be substituted for dietary animal protein (Anderson *et al*., 1999). Legumes are not only excellent sources of essential minerals, but also they are rich in dietary fiber and other phytochemicals . Chickpea (*Cicer arietinum* L.) seed is a low cost source of legume protein which might be used as a substitute for animal protein as a result of their supply is limited and expensive (Pelletier, 1994). The protein content of chickpea seed is highly variable and depends on geographical conditions. Chickpea seed contains crude protein ranges between 14.9 to 30.6 per cent (Chavan *et al.,* 1986). Chickpea is also a good source of calories, certain minerals and vitamins (Deshpande, 1992). Particularly in tropical and subtropical areas chickpea is one of the oldest and most widely consumed legumes. In many countries chickpea and its flour (besan) are being used extensively in food processing industry because of its versatile flour functionality, ideal cell wall polysaccharide composition and relatively high content of oil. In many Indian sweets, desserts and savory products chickpea flour is the main ingredient (Alajaji and El-Adawy, 2006).

Like other legume chickpea seed is processed and cooked in a variety of forms before consumption. Different traditional processing methods such as soaking, sprouting, boiling, roasting, frying, steaming etc were used to remove anti-nutritional factors and increase digestibility of chickpea seed (Attia *et al.*, 1994). Anti-nutrients are almost present in all food sources in different forms. Legumes serve as dietary sources of minerals but due to the presence of anti-nutrients bioavailability of these is considered to be low (Sandberg, 2002). Khapre et al. (2016) studied the effect of roasting on nutritional and anti-nutritional components of foxtail millet. They reported that the application of roasting treatment significantly decreased the moisture (8.9 to 3.7 %) and slightly reduced the fiber (5.66 to 5.49 %) and fat (1.93 to 1.86 %). Roasting increased the calcium (41 to 42.1 mg/100g) and also significantly reduced the anti-nutrients like tannins (221.1 to 92.4 mg CAE/100g) and phytic acid (306 to 180.5 mg/100g). Bindiya et al. (2015) studied the effect of germination on the chemical composition and nutritive value of maize grain. They reported that that germination significantly (p d" 0.05) increased the protein content from 10.34% to 11.78% where as fiber content was found to decrease from 2.12 % to 1.91 %. However Ishanullah et al. (2008) studied the nutritional quality of roasted and pressure cooked chickpea compared to raw seeds and found that roasting significantly decreased the moisture 7.70 % to 5.52 %, fiber 9.89% to 9.13%, ash 3.53% to 3.24% , iron content 2.93 to 2.71 mg/100gm and increased the fat 6.29% to 6.75%. Whereas pressure cooking also significantly decreased the moisture 7.70 % to 2.49 %, fiber 9.89% to 8.53%, ash 3.53% to 2.97% , iron content 2.93 to 2.36 mg/100gm and increased the fat 6.29% to 6.99%.

Anti-nutritional factors present in the legumes grains limit the increased use of legumes in food. Keeping this in view processing is adapted to improve the nutritional components, digestibility of nutrients and limit their anti-nutritional activity. Hence the objectives of the research are to access effect of

soaking and roasting on nutritional and anti-nutritional components of chickpea.

MATERIALS AND METHODS

Processing of legume

Commercially released variety (*Pratap-14*) of the selected chickpea (*Cicer arietinum*) was procured from Rajasthan State Seeds Corporation Ltd. (RSSCL), Udaipur. Chickpea flour was prepared by using the method given by International Soyabean Programme, 2009. Chickpea were cleaned by sorting out contaminants such as sand, sticks and leaves and were washed and covered with several times their volume of water and soaked for 8 hours separately. After draining water, chickpeas were dried in sunlight and after sun-drying chickpeas were spread in a single layer on a aluminum sheet and were roasted at 175 ± 5°C for 10 minutes in oven. After turning, them they were again roasted for 10 minutes. After roasting the chickpea seeds were cooled to room temperature. Roasted grains were ground to fine powder using laboratory mini grain mill and the flour was passed through a sieve of mesh size 80-200. The prepared flours were packed in air tight plastic containers and stored under ambient storage conditions (temperature ranging between 23°C to 44°C in month of June to August) until used for analysis.

Nutritional analysis

The raw and processed chickpea samples were analyzed for moisture, protein, fat, ash, fiber, energy, carbohydrate, calcium and iron by the standard NIN (2003) procedures. *In-vitro* protein digestibility (IVPD) was determined by the methods of Mertz *et al*. (1984). *In-vitro* calcium and iron bioavailability was estimated by the methods of Lock and Bender (1980).

Anti-nutritional factors analysis

Tannin content of the samples was estimated by using the method of Atanassova and Christova (2009). Phytic acid content of the samples was determined by the method of Peach and Tracy (1955).

Statistical analysis

Statistical analysis was performed by using software SPSS (Statistical Package for the Social Sciences) version 15 for PC windows. Data were presented as mean ± SD. One way Analysis of (ANOVA) was used to assess the nutritional composition and anti-nutritional factors of raw and processed chickpea flours. The level of significance used was 5% ($p < 0.05$).

RESULTS AND DISCUSSION

Nutritional compositions of raw chickpea

The data pertaining to nutritional component of raw chickpea is tabulated in Table 1.

The results regarding nutritional composition of chickpea indicated that the moisture content of raw chickpea was 7.48 per cent. Protein content was found to be 23.48 per cent. Fat content was depicted to be 6.50 per cent. The value of crude fiber and ash content was noted to be 9.67 per cent and 2.70 per cent .It was also observed that the carbohydrate content of the raw chickpea was discerned to be 50.15 per cent. The energy content was found to be 354 kcal per 100 g. The values observed for *In-vitro* protein digestibility content of raw chickpea was noted to be 65.43 per cent. The values observed for minerals viz. calcium and iron content of raw chickpea was found to be 143.2 mg/100 g and 5.53 mg/100 g. Similar results were reported by Dejene (2010), Muhammad *et al*.(2009), Saleh *et al*. (2006), Yadahally *et al*. (2012), Ritika *et al*. (2012) and Esmat *et al*. (2010). The *In-vitro* calcium bioavailability and *In-vitro* iron bioavailability of raw chickpea was observed to be 104.4 mg/100g and 0.80 mg/100g. Similar results were reported by Uma (1994), Reihaneh and Jamuna (2007), Davies and Nightingale (1975) Rao and Prabhavathi

Table 1: Nutritional composition of Chickpea

Sr. No.	Nutritional component	Value(Raw Chickpea)	Value(Soaked and Roasted Chickpea)
1	Moisture (%)	7.48 ± 0.17	5.49 ± 0.01
2	Protein (%)	23.48 ± 0.49	24.38 ± 0.76
3	Fat (%)	6.50 ± 0.05	6.76 ± 0.06
4	Fiber (%)	9.67 ± 0.19	9.25 ± 0.02
5	Ash (%)	2.70 ± 0.23	1.44 ± 0.03
6	Carbohydrate (%)	50.15 ± 0.61	52.66 ± 0.74
7	Energy (kcal)	354 ± 0.95	370 ± 0.54
8	*In-vitro* protein digestibility (%)	65.43 ± 0.43	71.54 ± 0.38
9	Calcium (Ca) (mg/100g)	143.29 ± 0.00	168.46 ± 0.01
10	Iron (Fe) (mg/100g)	5.53 ± 0.01	5.18 ± 0.01
11	*In-vitro* Calcium bioavailability (mg/100g)	104.45 ± 0.03	128.27 ± 0.00
12	*In-vitro* Iron bioavailability (mg/100g)	0.80 ± 0.01	1.05 ± 0.01

Values are expressed as mean ± standard deviation. Values are expressed on 100g dry weight basis

Table 2: Anti-nutritional factors content of chickpea

Sr. No.	Anti-nutritional factors	Value (Raw Chickpea)	Value (Soaked and Roasted Chickpea)	Per cent Reduction(%)
1	Phytate (mg/g)	1.56 ± 0.022	0.68 ± 0.00	56.41
2	Tannin (mg/g)	4.02 ± 0.08	1.72 ± 0.02	57.21

(1982) and Hussein and Ghanem (1999).

Nutritional composition of processed (soaked and roasted) Chickpea

The processed (soaked and roasted) chickpea was subjected to chemical analysis and the data pertaining to the present investigation is given in Table 1.

The moisture content of processed chickpea was observed to be 5.49 per cent. Due to combined processing method moisture content was found to be reduced. Protein content was found to be 24.38 per cent. In current findings after processing protein content increases due to the decrease in anti-nutritional factors. The value of crude fiber and ash content was noted to be 9.25 per cent and 1.44 per cent. Fat content was found to be 6.76 per cent. It was also observed that the carbohydrate content of the processed chickpea was discerned to be 52.66 per cent. The energy content was noted to be 370 kcal per 100 g. The values observed for *In-vitro* protein digestibility content of processed chickpea was found to be 71.54 per cent. Heat treatment enhance digestibility of protein by inactivating anti-digestive factors and by denaturing protein. The values observed for minerals viz. calcium and iron content of processed chickpea was found to be 168.4 mg/100 g, and 5.18 mg/100 g. Similar results were reported by Dejene (2010), Muhammad *et al*. (2009), Saleh *et al*. (2006), Yadahally *et al*. (2012), Ritika *et al*. (2012) and Esmat *et al*. (2010). The *In-vitro* calcium and *In-vitro* iron bioavailability of processed chickpea was reported to be 128.2 mg/100g and 1.05 mg/ 100g. Increase bioavailability of chickpea after processing could be contributed to simultaneous reduction of phytic acid, tannin and dietary fiber. Similar results were reported by Uma (1994), Reihaneh and Jamuna (2007), Davies and Nightingale (1975) Rao and Prabhavathi (1982) and Hussein and Ghanem (1999).

Anti-nutritional factors of raw and processed (soaked and roasted) chickpea

The chickpea was subjected to soaking and roasting and then undergone chemical analysis and the data pertaining to the anti-nutritional factors content is tabulated in Table 2.

The phytic acid content of raw and processed chickpea flour was found to be 1.56 mg/g and 0.68 mg/g notable changes was observed maximum decrease in phytic acid content was noted *i.e.,* a decrease of 0.88 mg/ g which accounts to be about 56.41 per cent reduction .However the tannin content of raw and processed chickpea flour was noted to be 4.02 mg/g and 1.72 mg/g respectively. Maximum decrease in tannin content was observed *i.e.,* a decrease of 2.3 mg/g which accounts to be about 57.21 per cent reduction. Similar results were reported by Pramod *et al*. (2014), Saleh *et al*.(2006) and Reihaneh and Jamuna (2007) for reduction of anti-nutrients in chickpea by processing. After the nutritional and anti-nutritional evaluation of processed chickpea it was concluded that soaking and roasting treatment resulted in significant effect on nutritional quality with effective anti-nutritional factors reduction. Hence the use of combined food processing technologies such as soaking and roasting can be used as a strategy to overcome problem of anti-nutritional factors in chickpea.

ACKNOWLEDGEMENT

The authors are highly thankful to Department of Foods and Nutrition, College of Home Science, MPUAT, Udaipur, Rajasthan for providing facilities to carry out the investigation and thanks to University Grant Commission (UGC), New Delhi, India for financial support.

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