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ORIGINAL ARTICLE

Comparative Study of Chickpea and Green Pea Flour Based on Chemical Composition, Functional and Pasting Properties

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Abstract

The objective of this work was to investigate the chemical composition, pasting properties and selected functional properties of chickpea and dried green pea flour. The proximate analysis showed that there was a non significant difference in chickpea flour and dried green pea flour composition, except that of crude fat and fiber. The crude fat of chickpea flour shows a significant ($p<0.05$) increase from that of dried green pea flour and crude fiber of dried green pea flour shows significant ($p<0.05$) increase than chickpea. The result of functional properties viz. water absorption capacity and oil absorption capacity, foaming capacity and stability showed a non significant difference of both the selected legumes. Pasting properties of both the flour of legumes were significantly different ($P<0.05$). Chickpea flour had a lower pasting temperatures and the peak, final, and setback viscosities than dried green pea flour. These characteristics seem to be related to the increased fat content of chickpea flour than green pea flour.

Keywords: Chickpea, green pea, proximate, functional and pasting.

Introduction

The seeds of legumes are dicotyledonous; the plant with approximately 17,600 species in about 690 genera belongs to the family Leguminosae. The production of pulses in the world in tonnes was 71354787 (FAOSTAT, 2012). Because of the nutritional quality legumes are one of the important crops in the world (Arab *et al.*, 2010). Legume grains are the valuable sources of protein (18-25 %, dry basis) and carbohydrates (50-60 %, dry basis), with starch (22-45 %, dry basis) and non-starch polysaccharides (dietary fibre) as predominant fractions and finally a small but significant amount of oligosaccharides are present in them (Hemeda and Mohamed, 2010) as well as vitamins and minerals (B-vitamins, folates, and iron), antioxidants and polyphenols (Han *et al.*, 2010). Legumes having beneficial physiological effects in controlling and preventing various metabolic diseases like that of diabetes mellitus, colon cancer and coronary heart disease, so their intake should be on regular basis (Siddiq *et al.*, 2010). Variety of food preparations of legumes are made, either as such or in combination with cereals. Because of the high cost of proteins of animal origin and there in accessibility by the poorer part of the population, use of legumes is option to this, and is important as an inexpensive root of proteins (Tharanathan and Mahadevamma, 2003).

Chickpea (*Cicer arietinum L.*) is a legume that is grown in tropical and subtropical areas. Chickpea presents high potential as a functional ingredient for the food process industry, this is because of their good balance of amino acid, relatively low levels of anti-nutritional factors and bioavailability of proteins, the seed of chickpea have been considered a suitable source of dietary proteins. The size of chickpea is large, salmon-white in color, and contains higher levels of protein and carbohydrate. Major carbohydrate portion of chickpea is starch that representing near about 83.9 % of the total carbohydrate (El-Adawy, 2002). Chickpea seed has a high protein digestibility, mostly contains high levels of complex carbohydrates (low glycaemic index), is rich in vitamins and minerals and is relatively free from anti-nutritional factors (Muzquiz and Wood, 2007; Wood and Grusak, 2007).

Botanically, pea plant is an herbaceous vine. It belongs to the family of Fabaceae or leguminosae of the genus, *Pisum.* Scientific name: *Pisum sativum***.** Short stalked green pods appear during late winter or spring. Peas (*Pisum sativum L.*) are cheaper and highly nutritious crop and processed seeds can be utilized in specific food formulations for pre-school children to

improve their protein intake. In addition, they are rich in lysine which are mostly deficient in cereals so can complement cereals complying with the FAO reference pattern (FAO, 2007). Peas (*Pisum sativum*) are widely available in many parts of the world. These legumes are important protein sources in both human and animal nutrition (Nalle *et al.*, 2010) However, their use in poultry feed industry remains limited because of the presence of anti-nutritional factors which interfere with nutrient utilization resulting in poor animal performance. Legumes represent an interesting source of proteins, minerals, vitamins and fibres.

In view of the increasing utilization of legumes in composite flours for the formulation in various food products, their functional properties including oil absorption, water absorption, foaming capacity and foaming stability, emulsion capacity, emulsion stability etc. are assuming a great significance. The functional properties constitute the major basis of criteria for the adoption and acceptability of proteins in food systems (Kaur and Singh, 2005). Functionality has been defined as any property of a food ingredient, except that of its nutritional values, that has a great impact on its utilization (Mahajan and Dua, 2002). The application of legume flours as functional ingredients in some foods like that of cakes, breads, pasta, biscuits, doughnuts, tortillas, and snacks have been reported by large number of authors (Han *et al.*, 2010; Anton *et al.*, 2008).

The functional, pasting properties of commonly used plant materials like soybean, cowpea and pigeon pea are studied extensively by many scientists (Narayana and Rao, 1982). However, there is little information about the comparative study of chickpea and dried green pea. Hence, the purpose of this study was to determine the chemical composition, functional properties and pasting properties of the chickpea and dried green pea flour and then utilizes them in the development of extruded products.

Materials and Methods

The seeds of chickpea (*Cicer arietinum L.*) and peas (*Pisum sativum L.*) were brought from the local market of Sangrur, Punjab, India. Seeds were cleaned manually from the dirt, foreign material etc. and stored until further use at 20°C. All the reagents used in the study were of analytical grade. Seeds were ground and then sieved through 60-mesh screen and stored in polythene bags at room temperature until used.

Proximate composition

Moisture (925.10), protein (920.87), fat (920.85), crude fibre (978.10) and ash (923.03) contents were determined according to standard methods of AOAC (1990).

Functional properties

Water and oil absorption capacity

To determine water and oil absorption capacity 1 g (db) of sample was weighed into 25 ml pre-weighed centrifuge tubes and then stirred into 10 mL of double distilled water or refined oil for 1 min. The samples were allowed to stand for 30 min and then centrifuged at 2200×g for 30 min. The water or oil released on centrifugation was drained. Water or oil absorption capacity was expressed as kg of water or oil held per kg of flour sample.

Foaming properties

Foaming properties were determined according to the method of Okaka and Potter (1979). One gram of flour was dispersed in 50 ml of distilled water, in a capped test tube, by shaking vigorously for 5 min followed by immediate pouring into a graduated cylinder of volume 250 ml. The volume of the foam formed was then recorded as the foam capacity (ml/100 ml). A final observation was made after 60 min for recording the foam stability (ml/100 ml).

Bulk density

Bulk density was measured as a ratio of mass to volume. A graduated cylinder, previously tarred, was gently filled up to 10 ml mark with flour sample. This was then packed by gently tapping the cylinder on the bench top until there was no further diminution of the sample level and noted the volume. The weight of the filled cylinder was taken and the bulk density was calculated as the weight of sample per unit volume (g/ml).

Pasting properties

Pasting properties were studied by using Rapid Visco Analyzer (Perten). Viscosity profiles of flours were recorded using flour suspensions (3.5 g/25 g). The sample was heated from 50 to 95 °C at 6 °C per min after equilibrium time of 1 min at 50 °C and a holding time of 5 min at 95 °C. The cooling was carried out from 95 to 50 °C at 6 °C per min with a holding for 2 min at 50 °C. Parameters recorded were pasting temperature, peak viscosity, trough viscosity (minimum viscosity at 95 °C), final viscosity (viscosity at 50 °C), breakdown viscosity (peak viscosity -trough viscosity) and setback viscosity (final viscosity - trough viscosity).

Statistical analysis

The data reported in all of the tables are the averages of triplicate observations. Statistical analysis of the results was done with Microsoft Excel 2007 (Microsoft Inc., USA) and Duncan's test was applied to determine the differences between means.

Result and discussion

Proximate composition

The proximate composition of chickpea flour and dried green pea flour is given in Table 1. The result given is the average of three replicas. There was a non significant difference of ash content of both chickpea and dried green pea flour. Similar results were determined by Kaur and Singh (2005) (2.72-2.88 %) and Boye *et al.* (2010) (2.76-3.04 %) in the chickpea flour from different cultivars and in the whole flour from various legume seeds. The crude protein content of both the legumes is 22.96 for dried green pea and 24.61 for chickpea. There was a significant difference ($p<0.05$) of fat content and fiber content of both the legumes. Finally the carbohydrate content of both the legumes was 57.78 for chickpea and 57.94 for dried green pea. The variation in chemical composition among both the kinds of legume flours can be attributed to the differences in their genetics, varieties, and growth environments (e.g., geographical location and growing season) (Kaur *et al.*, 2007).

Functional properties

The functional properties of flours play important role in the manufacturing of different types of products. The chickpea flour and dried green pea flour were analyzed for their functional properties. Table 2 shows the various functional properties of flours.

Water absorption capacity

The Water absorption capacity (WAC) of flour has an important role in the food product preparation process, as it influences other functional and sensory properties. The WAC for chickpea was found to be 1.36g/g and that of dried green pea flour is 1.95g/g. The WAC of legume flours is directly correlated to their cooking properties and affects their food processing properties. Water absorption of legume flours greatly influences the type of food made from cereal legume mixed flours; addition of some types of legume flour to cereal flour could help maintain the soft texture of the resulting food product (Wall, 1979). Kaur and Singh (2005) reported that legume flour containing several water-loving components, such as polysaccharides, generally have high WAC. The protein quality of legume flours also affects their WAC. WAC of both the legumes i.e. dried green pea flour and chickpea flour was high, which could be attributed to the presence of greater amount of hydrophilic constituents like soluble fiber and lower amount of fat content (Akubor and Badifu, 2004).

Oil absorption capacity

The oil absorption capacity (OAC) of flour is important as it improves the mouth feel and retains the flavour. The OAC of chickpea flour was found to be 1.19g/g and that of dried green pea flour is 1.79g/g as shown in Table 2. A non significant increased value of OAC in case of dried green pea could be attributed to the presence of a little large proportion of hydrophobic groups as compared with the hydrophilic groups on the surface of protein molecules (Subagio, 2006). Hydrophobic proteins play the main role in oil absorption. The OACs of different legume flours are influenced by particle sizes, starch and protein contents, protein types (Sathe *et al.*, 1982), and non-polar amino acid side chain ratios on the protein molecule surface (Chau *et al.*, 1997). According to Kinsella (1976), more hydrophobic proteins show superior binding of lipids, indicating that non-polar amino acid side chains bind the paraffin chains of fats. Based on this suggestion, legume flour that shows higher OAC likely contains a higher amount of available non-polar side chains in its protein molecules.

Foaming capacity and foaming stability

Foaming capacity is assumed to be dependent on the configuration of protein molecules. It has been found that flexible proteins have good foaming capacity but highly ordered globular molecule gives low foam ability (Graham and Philips, 1976). Foaming capacity and stability generally depend on the interfacial film formed by proteins, which maintains the air bubbles in suspension and slows down the rate of coalescence. Foaming properties are dependent on the proteins and some other components, such as carbohydrates, that are present in the flours (Sreerama *et al.*, 2012). The foaming capacity and foaming stability of both the legume flours show a non significant difference. The foaming capacity and stability of chickpea flour was 36% and 90% where as foaming capacity and stability of dried green pea flour was 39% and 84%. Stability of the foam is ensured by the ability of the foam film formed around the air bubbles to remain intact without leakage; therefore, stable foams can be formed only by agents with a high surface activity (Cherry and McWatters, 1981). The good stability of the foam resulted from both the legume flours suggesting that the globular proteins have good surface properties.

Table 1: Chemical composition of chickpea flour and dried green pea flour

Parameters	Chickpea flour	Dried green pea flour
Moisture	8.40±0.50[b]	9.44±0.31[a]
Ash	2.79±0.19[a]	2.74±0.13[a]
Crude protein	24.61±1.37[a]	22.96±1.40[a]
Crude fat	4.64±0.36[a]	1.94±0.53[b]
Crude fibre	1.75±0.36[b]	4.96±0.32[a]
Total carbohydrate	57.78±1.08[a]	57.94±1.78[a]

Values are means ± SD of 3 replications. Means figu res in a row followed by different superscripts indicate that they are significantly (p < 0.05) different with each other determined by Duncan's tests.

Table 2: Functional properties of chickpea flour and dried green pea flour

Parameters	Chickpea flour	Dried green pea flour
Water absorption capacity (g/g)	1.36±0.23[a]	1.95±0.80[a]
Oil absorption capacity (g/g)	1.19±0.15[a]	1.79±0.63[a]
Foaming capacity (%)	36± 0.03[a]	39±1[a]
Foaming stability (%)	90±0.05[a]	84±0.01[a]
Bulk density (g/ml)	0.79±0.07[a]	0.9±0.01[a]

Values are means ± SD of 3 replications. Means figures in a row followed by different superscripts indicate that they are significantly (p < 0.05) different with each other determined by Duncan's tests.

Table 3: Pasting properties of chickpea flour and dried green pea flour

Parameters	Pasting temperature (°C)	Peak viscosity (cp)	Trough viscosity (cp)	Breakdown (cp)	Final viscosity (cp)	Setback (cp)
Dried green pea	77.65±0.63	729±8.54	690.34±13.11	38.67±5.03	935±10.14	244.67±11
Chickpea	75.85±2.01	704±32	621±6	83±2	819±45	198±11

Values are means ± SD of 3 replications.

Bulk density

Non significant differences were observed among the bulk densities of the both the flours from different legumes as shown in Table 2. The bulk density for chickpea flours was found to be 0.79 g/mL and 0.9 g/mL for dried green pea flour. Akubor and Obiegbuna (1999) reported that bulk density of a sample could be used in determining its packaging requirements as this relates to the load the sample can carry if allowed to rest directly on one another.

Pasting properties

The pasting properties of dried green pea flour including pasting temperature 77.65°C, peak viscosity (729 cp), trough (690.34 cp), final viscosity (935 cp), and setback (244.67 cp) were higher than chickpea flour. Chickpea flour had a low pasting temperature (75.85°C), lower peak viscosity (704 cp), trough (621 cp), final viscosity (816 cp), and setback (198 cp) as shown below in Table 3. It indicated that chickpea flour can easily be used as a paste, poor resistant to shearing and also difficult to retrograde. All these characteristics are related to its high fat content (Table 1). Higher fat content has been shown to restrict starch from swelling as it absorbs water and inhibits interactions among the starch molecules, as well as between starch and its stirring paddles, as a result affecting pasting viscosity. Higher fat content can also inhibit the directional arrangement of dispersed molecular chains of starch, which induces the difficulty to retrograde. The ability to be lowering retrograde is an advantage in various food products such as soups and sauces that undergo loss of viscosity and precipitation as a result of retro gradation (Adebowale and Lawal, 2003).

Conclusion

It can be concluded that both the legumes have little difference in chemical composition, except that of fiber and fat which showed significant difference. A non significant difference of functional properties was observed between the flours of dried green pea and

chickpea. Pasting properties of both the flour of legumes were significantly different. Chickpea showed lower pasting properties as compared to dried green pea. These characteristics seem to be related to the increased fat content of chickpea flour than green pea flour. That is related to starch swelling and water absorption. These properties can influence food processing properties of both the legumes.

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