

Research note

Physicochemical, cooking, textural and roasting characteristics
of chickpea (*Cicer arietinum* L.) cultivars

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Abstract

Seeds of five desi (PBG-1, PDG-4, PDG-3, GL-769, and GPF-2) and one kabuli type (L-550) chickpea cultivars were evaluated for their physicochemical (seed weight, seed volume, hydration capacity, hydration index, swelling capacity and swelling index), cooking, instrumental textural (hardness, cohesiveness, gumminess, springiness, chewiness and fracturability) and roasting (puffing capacity, puffing index, and expansion index) characteristics and related to each other. Significant variation in physicochemical, cooking, textural and roasting properties was observed among different chickpea cultivars. The results showed that cultivars having higher seed weight and volume had higher cooking time, swelling capacity and hydration capacity. The interrelationships between roasting characteristics of seeds from different chickpea cultivars showed a significant negative correlation of puffing capacity, puffing index and expansion index with seed weight, volume, swelling and hydration capacity. The kabuli type chickpea cultivar was observed to have poor roasting and textural properties. Swelling and hydration capacity correlated well with cooking time, springiness and hardness of soaked chickpea seeds. Cooking time had a positive correlation with hardness and gumminess and a negative correlation with springiness. It was also observed that cultivars with high fat and carbohydrate and low fiber content had high soaked-seed hardness.

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1. Introduction

Chickpea is one of the most important legume crops in the Indian sub-continent. Australia, Iran, Mexico, Myanmar, Tanzania and Turkey are the other countries where chickpea is grown (Williams & Singh, 1987). It is also a staple food crop in many tropical and subtropical countries. Chickpeas are a good source of protein and carbohydrate and its protein quality is better than other legumes such as pigeon pea, black gram and green gram. They also supply some minerals (Ca, Mg, Zn, K, Fe, P) and vitamins like thiamine and niacin (Williams & Singh, 1987). The shape, size, and color of chickpea seed

vary according to the cultivars. Based on seed color and geographic distribution, chickpea is grouped into two types—desi (Indian origin) and kabuli (Mediterranean and Middle Eastern origin). The seeds of kabuli cultivars are large with white to cream colored seed coat. The seeds of desi cultivars are small, wrinkled with brown, black or green color. The bold seeded cultivars of desi type are often used for roasting. Significant differences in these two groups have been observed with regard to their seed coat %, crude fiber content, mineral and trace element composition, polyphenolic content and in vitro digestibility by several workers (Chavan, Kadam, & Salunkhe, 1986; Jambunathan & Singh, 1981; Singh & Jambunathan, 1981).

The Instron has been adapted to perform a modified texture profile analysis. Textural characteristics of

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legumes may be dependent upon seed microstructure, chemical and physical changes occurring during processing. Cooking time is a highly significant aspect of cooking quality. Cooking time is a heritable characteristic that differs widely among genotypes. One of the main drawbacks that limit the utilization of legumes is their long cooking time (Williams, Nakoul, & Singh, 1983). Chickpea has been observed to be the most difficult to cook among the commonly consumed legumes in India due to its larger seed size and chemical composition (Singh, 1999). Softening of beans during cooking is accompanied by structural changes in the seed (Rockland & Jones, 1974; Sefa-Dedah, Stanley, & Voisey, 1978). Differences in gelatinization pattern of the starch and the susceptibility of the cell constituents, notably the protein matrix, to softening may contribute to the overall textural characteristics of the legume (Sefa-Dedah & Stanley, 1979). Roasting process renders the grain digestible, without the loss of nutritious components and hence such grains are consumed throughout the world. Srivastav, Das, and Prasad (1994) studied the effect of sand temperature and time of roasting on the hardness of roasted bengal gram, maize and soybean. The present investigation was, therefore undertaken to study physicochemical, cooking, textural and roasting properties of different chickpea cultivars and to establish possible interrelationships between them.

2. Materials and methods

2.1. Materials

Representative samples of six improved commercial chickpea cultivars viz. PBG-1, PDG-4, PDG-3, GL-769, GPF-2, and L-550 from 2002 harvest were obtained from Punjab Agricultural University, Ludhiana, India. The cultivars PBG-1, PDG-4, PDG-3, GL-769, GPF-2 were of desi type while L-550 cultivar was of kabuli type.

2.2. Proximate composition

Chickpea samples were tested for their ash, fat, fiber and protein content by employing the standard methods of analysis (AOAC, 1984). The carbohydrate content was calculated by difference. All the results were reported on dry weight basis (dwb).

2.3. Physical characteristics of chickpea seeds

Seed weight, seed volume, seed density, hydration capacity, hydration index, swelling capacity and swelling index were evaluated using the methods of Williams et al. (1983).

2.4. Cooking time of chickpea seeds

Seeds (100 g) of chickpea from different cultivars were taken in beakers fitted with condensers to avoid evaporation losses during boiling. Distilled water was added in the ratio of 1:4 (w/v) to the beakers. Cooking time was determined by the method of Williams et al. (1983).

2.5. Color measurement

The surface color of chickpea samples was measured using a Hunter colorimeter Model D 25 optical Sensor (Hunter Associates Laboratory, Reston, Va., USA). A glass petri dish containing chickpea grit of uniformly size was placed above the light source, covered with a white plate and Hunter *L* (lightness), *a* (redness and greenness) and *b* (yellowness and blueness) color values were recorded and compared with a red standard possessing the following values: $L_s = 25.54$, $a_s = 28.89$, $b_s = 12.03$. Total color difference (ΔE) was calculated applying the equation

$$\Delta E = [(L_s - L)^2 + (a_s - a)^2 + (b_s - b)^2]^{1/2}$$

2.6. Roasting characteristics of chickpea seeds

Chickpea seeds (100 g), uniformly mixed with a calculated amount of water to bring the moisture content of seed to $12.5 \pm 0.3\%$ was rested for 10 min. Thereafter, it was roasted in hot sand for 20 s at 190°C . Then the sample was taken out and rested for a period of 5 min and again roasted for 20 s in hot sand (190°C). The roasted seeds were separated from hot sand using sieve (35 mesh size). The moisture content of roasted samples was $2.9 \pm 0.3\%$. Seed volume, puffing capacity and puffing index were determined after roasting using the method of Singh, Sekhon, Bajwa, and Goyal (1992). Percent unpuffed (hard shelled) grains were calculated by counting. Bulk density of roasted chickpea seeds was calculated as mass per unit volume. Expansion index of roasted seeds was determined using expression:

$$\text{Expansion index} = \frac{\text{Volume after roasting (ml)}}{\text{Volume before roasting (ml)}}$$

For the measurement of hardness, the roasted seeds were cooled to room temperature in a dessicator, transferred to airtight containers and hardness was measured within 2–3 days. The seeds were placed horizontally on the base plate of Instron Universal Testing Machine (Model 4464, Instron, Buckinghamshire, England), which was operated at a crosshead speed of 60 mm/min using 50 kg load cell. The hardness was noted as maximum force (kg), required breaking the sample. Eight measurements were performed for each sample.

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