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Effect of Popping on Nutritional Composition of Sorghum

Dhadke S.G.*, Pawar V.S. and Wanole P.D.
Department of Food Process Technology, College of Food Technology, VNMKV, Parbhani (Maharashtra), India.

(Corresponding author: Dhadke S.G.)*
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ABSTRACT: Sorghum is a nutritionally dense millet in the grain family that plays a significant part in our daily diet. Sorghum is gluten free and is rich in fiber and minerals. Sorghum may be used in different food items if adequate processing processes are used. Sorghum may also be made into a nutritious food by a popping approach. Popping is a traditional process that improves the shelf-life of grains as well as helps to preserve their nutritional value. It enhances the flavour of the grains, so their acceptability. This study investigates the influence of popping on proximate composition and minerals of *Dagdi* variety (local variety) of sorghum. The results revealed that the moisture varied from 8.31±0.2 to 5.28±0.7%, protein 11.30±0.2 to 12.45±0.01%, fat 1.56±0.02 to 1.07±0.01%, ash 1.40±0.1 to 1.88±0.01%, crude fiber 1.45±0.02 to 1.72±0.01 and carbohydrate from 75.45±0.5 to 76.98±0.1%. The mineral content was well preserved. The zinc content ranges from 1.172 to 1.431, iron ranges from 5.589 to 6.276, manganese ranges from 0.698 to 0.936 and copper ranges from 0.164 to 0.256 mg/100g.

Keywords: Sorghum, Popping, Nutrients, chemical composition, Mineral content.

INTRODUCTION

Sorghum (*Sorghum bicolor* [L.] *Moench*) is the world's fifth most important crop in terms of productivity (Wrigley *et al.*, 2004). Sorghum supplies nutrition to nearly 700 million people as it includes calories, protein, and minerals. Sorghum is characterised as coarse grain because of its outer fibrous bran. Sorghum offers 349 Kcal calories, 10.4 g protein, 1.9 g fat, 72.6 g carbohydrates, 25 mg calcium, 4.1 mg iron, 0.37 mg thiamine, and 0.13 mg riboflavin per 100 g grain (Chavan and Salunkhe 1984). Sorghum protein exceeds wheat protein in terms of biological value. Sorghum contains no gluten and is strong in fiber and minerals. When digested slowly, sorghum is a healthy meal for diabetics (Klopfenstein and Hoseney 1955).

The nutritional composition of the variety Parbhani jyoti was 8.2% moisture, 1.8% fat, 10.39% protein, 71.1% carbohydrate, 2.10% crude fibre, and 1.4% ash, while the nutritional composition of the variety Maldandi was 8.2% moisture, 1.68% fat, 10.49% protein, 72.30% carbohydrate, 2.90% crude fibre, and 1.21% ash. Calcium 27.50mg, phosphorus 371mg, iron 3.91mg, zinc 3.14mg per 100 gm for variety Parbhani jyoti (Patekar *et al*., 2017).

Popping sorghum is a low-cost method for producing flour with better starch properties, and it provides an untapped possibility for developing unique and healthier cereal-based food items (Baskaran *et al*., 1999). One of the important sectors of the food business is snack food. Designing snack foods nowadays may be a difficult process due to shifting customer tastes and expectations, as well as the illusive hunt for something distinctive that appeals to a wide range of individuals. Popping and puffing have been used for hundreds of years as a simple, economical, and rapid traditional method of dry heat application for the manufacturing of weaning meal formulas and ready-to-eat snacking items (Sullivan and Craig 1984).

Popping is a simultaneous starch gelatinization and expansion technique that exposes grains to high temperatures for short period of time. During this procedure, superheated vapour created inside the grains by immediate heating cooks the grain and rapidly swells the endosperm, causing the outer skin to rupture. There are several techniques of popping/puffing employed, including dry heat, sand and salt treatment, hot air popping, gun puffing, popping in hot oil, and microwave heating. Though several grains and millets, including rice, wheat, corn, sorghum, ragi, and foxtail millet, are used for popping/puffing, just a handful of them pop properly. This might be due to the elements that determine cereal popping properties, such as season, varietal difference, grain characteristics such as moisture level, grain composition, physical features, endosperm kinds, and popping method (Mishra *et al*., 2015).

Popped sorghum is a common traditional snack food in central India. It is also suitable for use in weaning meal formulas and ready-to-eat products (Thorat *et al*., 1988). During festival times, popped sorghum was widely used; typically, laddus are made from popped sorghum grains. When sorghum starch was popped, structural changes occurred, and the act of popping

transformed the starch granules into thin lattices of interconnecting sheets. Protein bodies, on the other hand, remained intact, while protein around individual starch granules was disturbed (Harbers, 1975).

The popping process retains the true nutritional profile of grains while dramatically boosting iron bioavailability, protein digestibility, and dietary fibre content. Some of the anti-nutrients that popping reduces include phytate, phosphate, and tannin. Popped sorghum may provide health benefits because to its high fibre and antioxidant content, such as a lower risk of heart disease and numerous cancers (Reddy *et al.*, 1991). There are different popping methods including dry heat application, moist heat application, sand/salt/oil as heating media, and microwave popping. The popping quality of sorghum produced using different procedures differed greatly (Yenagi *et al.*, 2005).

Popped sorghum included 10.50g of protein, 2.36g of fat, 1.97g of crude fibre, 80.94g of total carbohydrate, and 387 Kcal per 100g, total dietary fibre 14.30%, insoluble dietary fibre 12.30%, and soluble dietary fibre 2.00% (Shaheen, 2010).

MATERIAL AND METHODS

Raw material. Good quality of sorghum of local variety named *Dagdi* was procured from the local market of Parbhani, Maharashtra.

Chemicals. Chemicals used in this research are of analytical grade and they were obtained from the Department of Food Process Technology, College of Food Technology, VNMKV, Parbhani.

Processing equipment's. Electronic balance, soxlet apparatus, autoclave was used from Department of Food Process Technology, College of Food Technology, VNMKV, Parbhani and Popping cum puffing machine for popping of sorghum was used from Department of Agricultural Process Engineering, College of Agricultural Engineering and Technology, VNMKV, Parbhani.

Popping method. Sorghum grains are first washed to remove all debris and other objects. These grains were then soaked for 4 minutes in hot water (90°C). Then, for eight hours, these grains were tied in a cloth. Then, these grains were fed to a machine for popping. When the grains were mix with salt, which was used as a heating medium at 180°C. The grains pops when heated vapours form inside them.

Physical properties of raw sorghum

Thousand kernel weight. A digital weighing balance was used to weigh one thousand grains in three replications. The mean value was then recorded.

Thousand kernel volume. Volume was determined by measuring the cylinder and multiplying the displayed amount of hexane by 1000 kernels (Dutta *et al.*, 1988).

Bulk density. The measuring cylinder was filled with 25 grains, and the volume they took up was measured. It was computed using the formula below and shown in g/ml (Rooney and Murty 1982).

True density. Twenty-five gram of sound grains were weighed using a digital scale before being added to the measuring cylinder, which had already been filled with a hexane reference solution. After adding the grains, the rise in liquid level was gauged. Bulk density is shown in g/L (Dutta *et al.*, 1988)

$$\text{Trye density} = \frac{\text{weight of grains}}{\text{volume displyed}}$$

Angle of repose. The angle of repose is the angle produced between the cone's base and slope during a free vertical fall of grains to the horizontal plane. It was determined using the method given by Sunil *et al.*, (2016). It was discovered by applying the phrase to calculate the height (h, mm) and radius (r, mm) of grains stacked in natural heaps.

Angle of repose (°) = tan-1{h/r}

Where, h = Height of heap and r = Radius of base of heap

Proximate analysis. Proximate analysis of raw and popped sorghum were analysed including moisture, fat, protein, carbohydrate, crude fiber, ash and mineral by the method given by AOAC (2005).

Mineral analysis. A defatted sample weighing two gram was kept at 550°C. On a heated plate, strong hydrochloric acid (HCL) was then used to digest the resulting ash. The digested material was then filtered using Whatman No. 42 filter paper, and the final volume was made to 100 ml with distilled water. This volume was then utilised for analysis of Fe, Cu, Zn and Mn using automic absorption spectroscopy.

RESULT AND DISCUSSION

Physical property of raw sorghum. The design of machinery and equipment used in harvesting, post-harvesting, milling operations, and food processing depends heavily on physical characteristics. Operations like separation, sorting, and transfer are made easier by these characteristics. Table 1 summarises the results of tests conducted on several physical characteristics of sorghum (*dagdi* variety), including bulk density, true density, thousand kernel weight, thousand kernel volume, and angle of repose.

Table 1: Physical properties of raw sorghum (*Dagdi*).

Physical parameter	Mean value
Thousand kernel weight (g)	33.12±0.2
Thousand kernel volume (ml)	24.25±0.5
Bulk Density (g/ml)	0.76±0.01
True Density (g/ml)	1.12±0.05
Angle of Repose	31º17'

*Each value represents the average of three determinations

The data depicted in the Table 1 shows that the thousand kernel weight of sorghum was observed 33.12±0.2g, thousand kernel volume was 24.25±0.5 ml, bulk density was noticed 0.76±0.01 g/ml, true density was 1.12±0.05 g/ml, angle of repose was observed 31º17'. The same results were reported for the physical characteristics of grains by the (Patekar *et al.*, 2017).

Effect of popping on the proximate composition of raw sorghum. Different biochemical characteristics such as moisture, fat, protein, ash, crude protein and carbohydrate of raw and popped sorghum were determined and data summarized in Table 2.

Table 2: Preoximate composition of raw and popped sorghum.

Parameter (%)	Raw sorghum	Popped sorghum
Moisture	8.31±0.2	5.28±0.07
Fat	1.56±0.02	1.07±0.01
Protein	11.30±0.2	12.45±0.01
Ash	1.40±0.1	1.88±0.01
Crude fiber	1.45±0.02	1.72±0.01
carbohydrate	75.45±0.5	76.98±0.1

*Each value represents the average of three determinations

The moisture, protein, fat, carbohydrate, ash and crude fiber of raw sorghum was determined to be 8.31±0.2, 11.30±2, 1.56±02, 75.45±5%, 1.40±0.1 and 1.45±0.02 respectively. The similar results were obtained by Paterkar *et al.* (2017), with protein, fat, and carbs of 10.39, 1.80, and 71.01%, respectively, and crude fibre of 2.10%. The following table's data are consistent with Gajmal's (2021) moisture of sorghum (Parbhani moti) of 8.12%, ash 1.49%, protein 7.50%, crude fiber 2.24%, crude fat 1.72%, and carbohydrate 78.49%. The moisture of popped sorghum was observed 5.28±0.07%, the fat was 1.07±0.01%, protein 12.45±0.01%, ash 1.88±0.01%, crude fiber 1.72±0.01 and carbohydrate was observed 76.98±0.1. As sorghum grains were exposed to high temperatures, moisture was reduced. The fat content of popped sorghum remained unchanged. The protein content of popped sorghum has doubled due to phytic acid reduction, which also helps to increase protein digestion. To some extent, crude fibre increased. Similar type of research were reported by Anjitha *et al*. (2021).

Effect of popping on mineral composition of raw sorghum. Change in the minerals of raw and popped sorghum were determine and summarized in the Table 3.

Table 3: Mineral composition of raw and popped sorghum.

Minerals (mg/100g)	Raw sorghum	Popped sorghum
Zinc	1.172	1.431
Iron	5.589	6.276
Magnesium	0.698	0.936
Copper	0.164	0.256

The result shows that the mineral content of popped sorghum was slightly increased as zinc increased from 1.172 to 1.431 mg/100g, iron increased from 5.589 to 6.276 mg/100, magnesium was changed from 0.698 to 0.936 and copper was increased from 0.164 to 0.256. Ajintha *et al.* (2021) reported that the mineral content was slightly reduced as temperature was increased, the zinc content was changed to 3.46 mg/100g from 3.57 mg/100g when the temperature was changed from 300°C to 200°C, similarly magnesium content was changed from 117 to 116 mg/100g.

CONCLUSION

This study shows that the chemical composition of raw sorghum is improved after popping as there is increase in the protein and carbohydrate content. It is also found that the mineral content of raw sorghum is retained. Popped sorghum can be considered as a healthy snack food.

FUTURE SCOPE

Sorghum is a major staple food in semi-arid tropics. However the demand for sorghum as a staple food is declining day by day as there are no alternative uses and value added products similar to rice and wheat. Popped sorghum is one of the ready-to-eat snack which is popularly consumed only by local growers. It has got potential to develop value added products as a convenient ready-to-use food. There is a need to study the grain quality characteristics of sorghum cultivars grown for popping to develop value added products to meet the needs of present day consumers. Hence, the study was undertaken to study nutritional and processing qualities of pop sorghum cultivars grown in different seasons and value addition.

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