EXCELLENT PUBLISHERS

International Journal of Current Research and Academic Review

ISSN: 2347-3215 Volume 2 Number 1 (January, 2014) pp. 164-170

www.ijcrar.com

Process development for puffing of Sorghum

Vinita Sharma, P.S.Champawat and V.D.Mudgal*

Department of Processing of Food Engineering, CTAE, MPUAT, Udaipur-313001, India

***Corresponding author**

KEYWORDS

Sorghum;
Moisture content;
Puffing quality;
Expansion ratio;
Nutritional quality

A B S T R A C T

Popped sorghum is one of the ready to eat snacks which is popularly consumed by local growers. A number of process are used in the preparation of ready-to-eat cereals including puffing, flaking and shredding of wheat, corn and rice but none for sorghum. The quality of sorghum puffed by conventional and microwave was evaluated. The effects of moisture content, microwave power and time on the puffing qualities of sorghum were investigated. Sorghum was adjusted at three moisture levels 18, 21 and 24% (wb) and puffed with conventional and microwave method. In conventional method sorghum at 21% moisture content for 3 min produced a higher puffing yield (83%), expansion ratio (4.44) and flake size (0.18ml/grain). Similarly in microwave method sorghum at 21% moisture content, 100 percent power level for 3 min produced highest puffing yield (89%), expansion volume (8.67) and flake size (0.28). Puffed sorghum at low moisture content (18%) produced high puffing yield but lowest expansion ratio and flake size in both conventional and microwave method. Puffing at low moisture content and high microwave power decreased the lightness of the puffed sorghum. The maximum value of protein, fat and ash obtained in conventional method were 7.90, 3.19, and 2.36%, similarly in microwave method value obtained were 7.91, 3.16 and 2.37% respectively.

Introduction

Sorghum (*Sorghum bicolor*) popularly called as jowar, is the “king of millets” and is the fifth in importance among the world’s cereals, after wheat, rice, maize and barley. It is a staple food grain in many Indian states. It is grown especially in the arid and semi-arid regions. The major sorghum production areas today include the great plain of North America, sub-Saharan Africa, north eastern China and the deccan plateau of central India, Argentina, Nigeria, Egypt and Mexico. India has the largest share (32.3%) of the world’s area under sorghum and ranks second in production after the US. The production of sorghum in 2011 is 7003100 tonnes from an area of 7381700 hectares with a mean yield of 948.7 kg/ha (www.*faostat.fao.org)*.The nutrient composition of sorghum grain indicates that it is a good source of energy, protein, vitamins, and minerals including trace elements. Sorghum has 11.9 per cent of moisture and about 10.4 per cent of protein and a lower fat content of 1.9 per cent. The fibre and mineral content of grain sorghum is 1.6 per cent. It is a good source of energy and provides about 349 k cal and gives 72.6 per cent of carbohydrates.

Over the years, the popping have been applied to many cereals including, rice, wheat, corn, amaranth seed (Mariotti *et al.* 2005), wheat (Yengi *et al.* 2004 and Pardesi *et al.*, 2009), rice (Srinivas and Desikachar, 1973, Madhuri, 2002, Maisont and Narkrugsa, 2009 and Murthy *et al.* 2006), corn (Heymann *et al.* 2000, Gokmen 2004, Karaba 2004 and Korian and Mikhali 2012), amaranth seed (Bhuvaneshwari, 1995, Zapotoczny *et al.*, 2006, Kambale, 2011).

A few reports available on popping of sorghum revealed that, sorghum expands very well when subjected to high temperature and short time (HTST) treatment. Popping imparts acceptable taste and desirable aroma to pop sorghum. Popping being a dry heat process may inactivate the lipase and improve the shelf life of popped products. Popped sorghum being a pre-cooked ready to eat material can be used in snack foods, specialty foods as a base for development of supplementary foods. However, detailed investigations are needed to determine the quality of popped sorghum and its suitability for different food uses. Hence the present study was undertaken to develop a process for puffing of sorghum.

Materials and Methods

The material (Sorghum, *var*. CSV-15) was procured from AICRP on Sorghum, Rajasthan College of Agriculture, MPUAT, Udaipur for conducting investigation on puffing.

Nutritional Quality of Sorghum

Proximate composition *viz*. moisture, protein, ash and fat contents were determined according to standard procedure of AOAC, 1990. Moisture content was determined by the difference between the accurately weighed samples before and after drying in a hot oven at 105°C. Protein content was estimated as per the method described by Lowry *et al.*, 1951. Fat content was estimated by refluxing with petroleum ether (60°C) in soxhlet apparatus for 12 h. Sample weighing five gram were put in a dry crucible and ignited in a muffle furnace for three hours at 600°C. The burned sample was cooled at room temperature and weighed for calculating the ash content.

Puffing Methods

The sorghum samples of moisture content of 18, 21 and 24% were puffed for 2, 2.5 and 3 min of puffing time by conventional as well as microwave oven method. The puffing trails with microwave oven were conducted at 60, 80 and100% power level.

Conventional method

The cooking pan was heated by using LPG burner. Gas control knob of the burner was set at the same level during popping and it was covered. The heating was continued until complete popping took place.

Microwave oven method

Microwave oven was used as a modern method of popping. The grains samples with 18, 21 and 24% moisture content were put in glass bowl and covered with lid. The covered bowl was kept inside for puffing of grains for popping periods of 2, 2.5 and 3 min. Three power levels (60, 80 and100%) were selected for puffing the samples.

Quality parameters of puffed sorghum in terms of popping yield, expansion ratio and flake size were evaluated by using following equations.

Popping yield (%)

Popping yield is the ratio of total weight of popped sorghum to the sum of total weight of popped and unpopped grains (%).

$$\text{Popping yield}(\%) = \frac{\text{Total weight of popped grains}}{\text{Total weight of popped grains} + \text{unpopped grains}} \times 100$$

Expansion ratio

Expansion ratio is the ratio of total popped volume (ml) to that of volume of raw kernels (ml) and expressed as ml.

$$\text{Expansion ratio} = \frac{\text{Total popped volume (ml)}}{\text{Volume of raw kernels (ml)}}$$

Flake size (ml/grain)

The flake size is the ratio of volume of the popped sorghum to that of number of popped kernels.

$$\text{Flake size (ml/grains)} = \frac{\text{Volume of popped sorghum}}{\text{Number of popped kernels}}$$

Result and Discussion

Conventional method of popping

Effect of moisture content and time on quality parameters *viz.* popping yield, expansion ratio and flake size of sorghum puffed using conventional method has been presented in Fig.1. Popping yield varied from 68.52 to 83.87 percent at different moisture levels and time. The popping yield increased as the moisture content increased from 18 to 21% moisture level, and then decreased with further increase of moisture to 24%. The expansion ratio increased as the moisture content and time increased then these parameters decreased with further increase of moisture. These results agreed with findings of Metzger *et al*. (1989), for the optimum moisture content for maximum expansion volume was 21%. Expansion ratio varied from 2.98 to 5.05 at different moisture levels and time. The maximum popping was obtained from moisture content of 21%, because it had the highest flake size. The highest expansion ratio at 21% moisture content was 5.05 and lowest expansion ratio at 18% moisture content was 2.98 for 3 min popping. The total mean of flake size of pop sorghum was 0.138 ml/grain. Song *et al*. (1991) reported that smallest-sized fraction (4.36–4.76 mm kernels) had the greatest number of unpopped kernels. Similarly, Dofing *et al*. (1990) reported that large kernel samples had larger flake size than small kernel samples, and high expansion volume was negatively associated with number of unpopped kernels.

Microwave method of popping

Effect of power, moisture content and time on quality parameters *viz.* popping yield, expansion ratio and flake size of sorghum puffed using microwave oven has been presented in Fig.1.

Fig.1 Effect of moisture content and time of popping on popping yield, expansion ratio and flake size

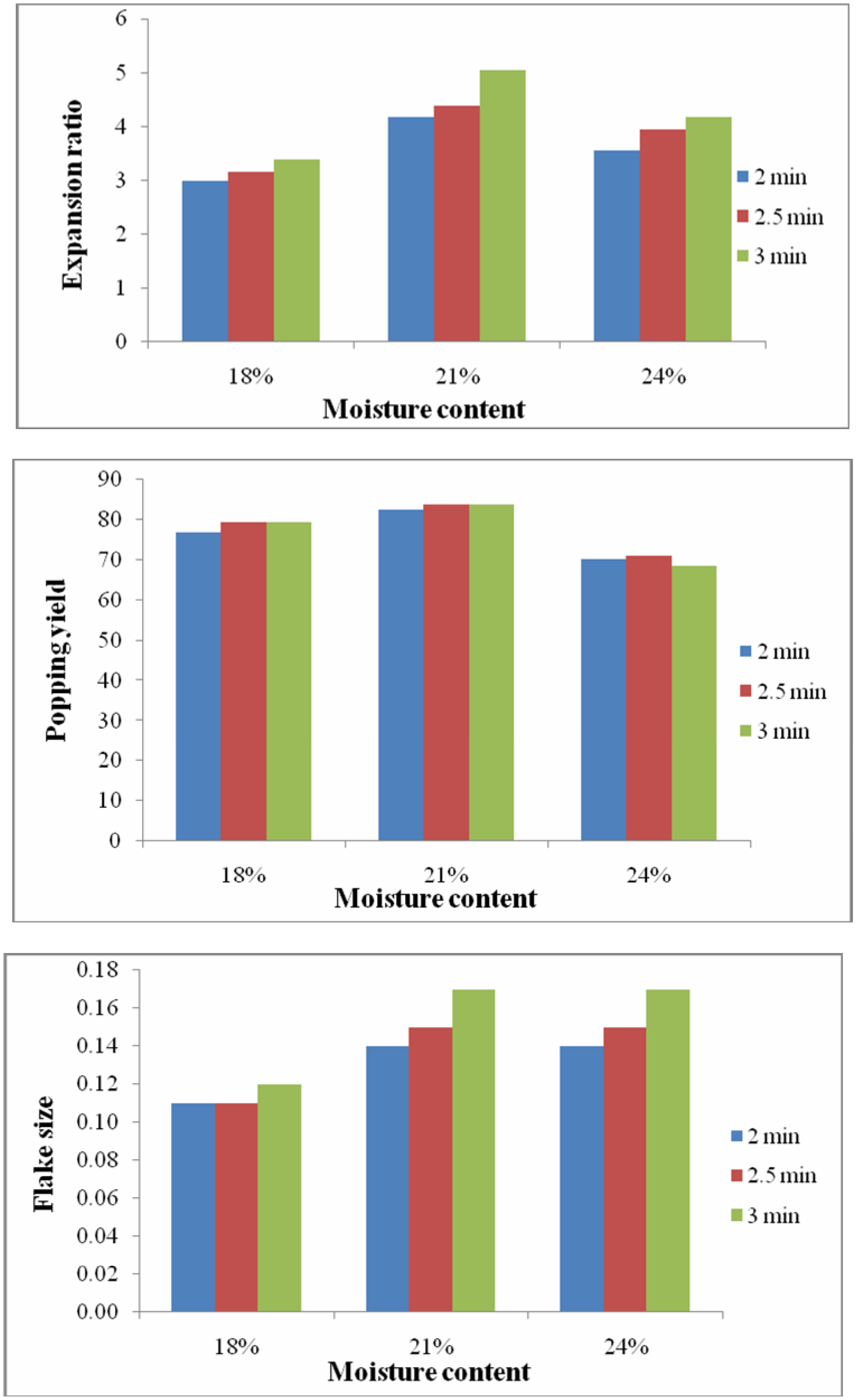
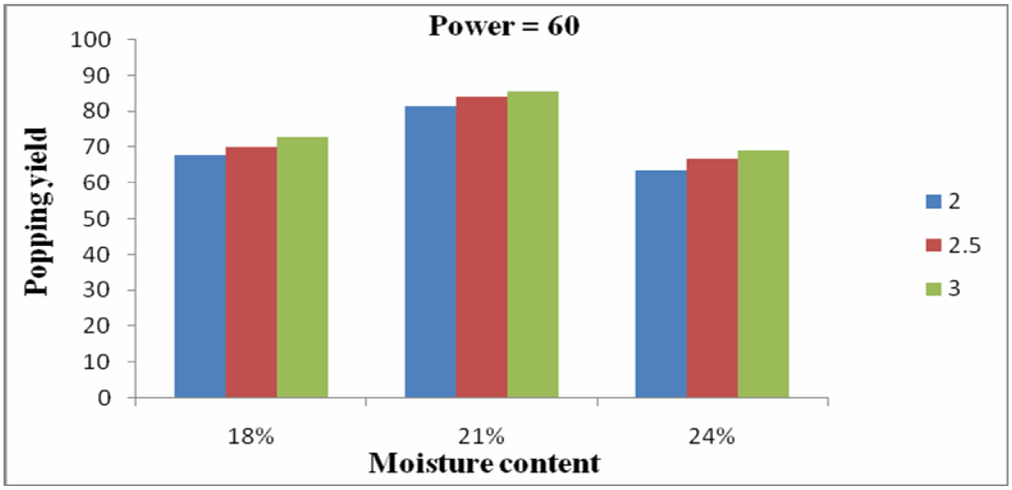
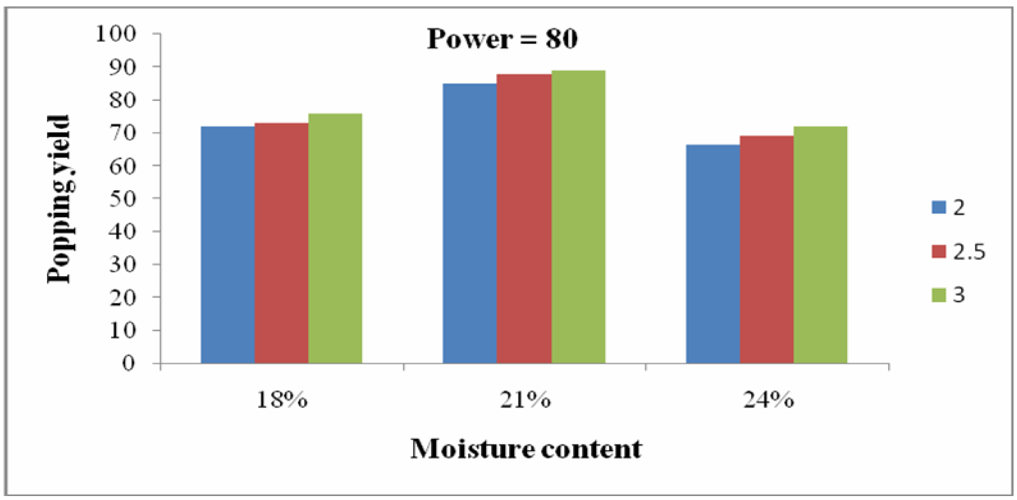


Fig.2 Effect of microwave power, moisture content and time of popping on popping yield





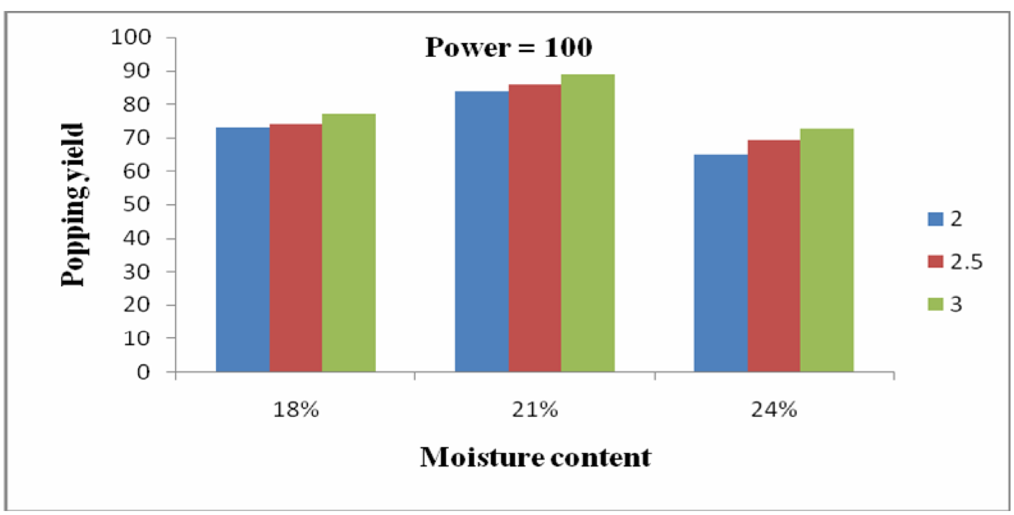


Fig.3 Effect of microwave power, moisture content and time of popping on expansion ratio

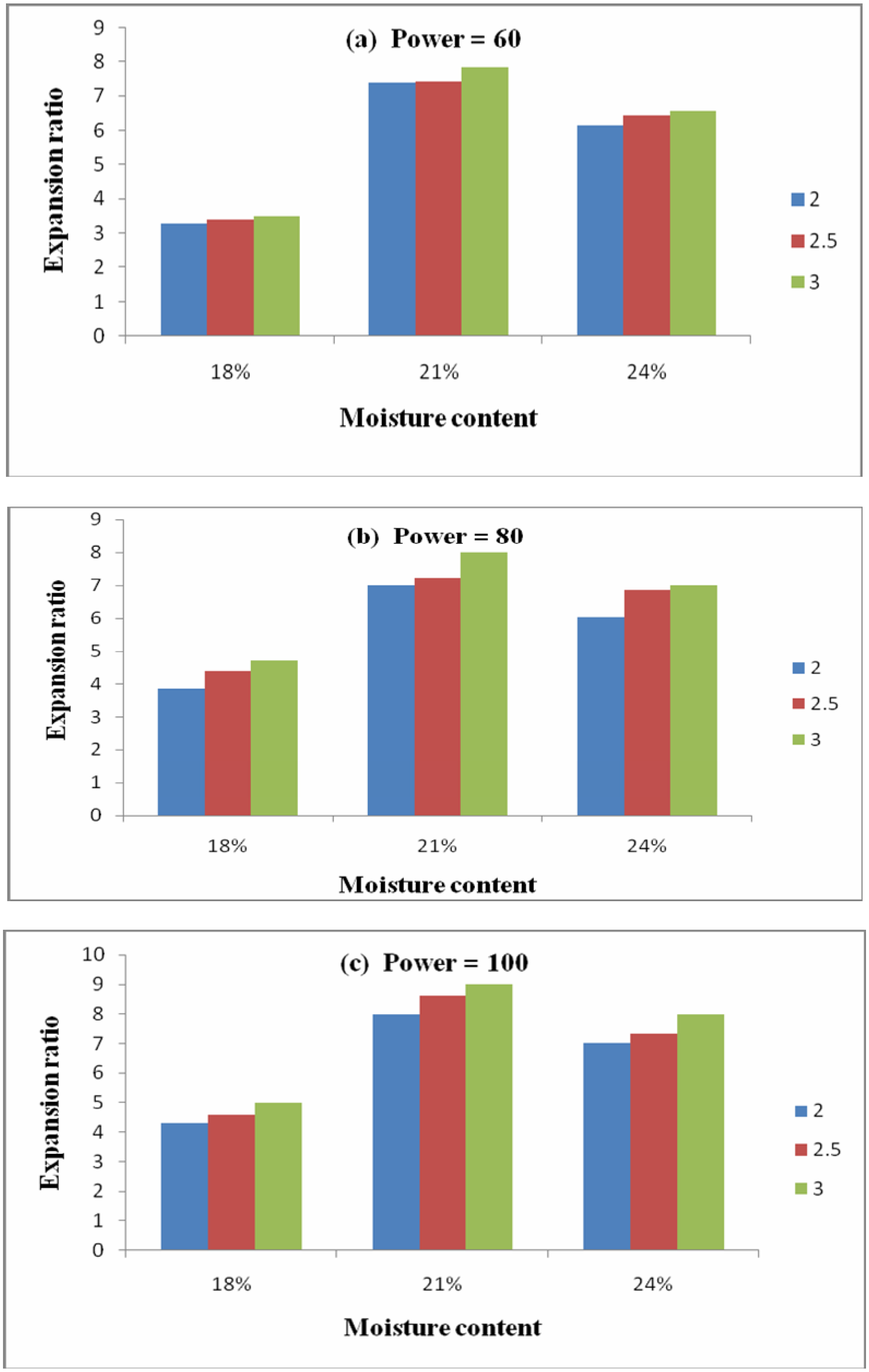
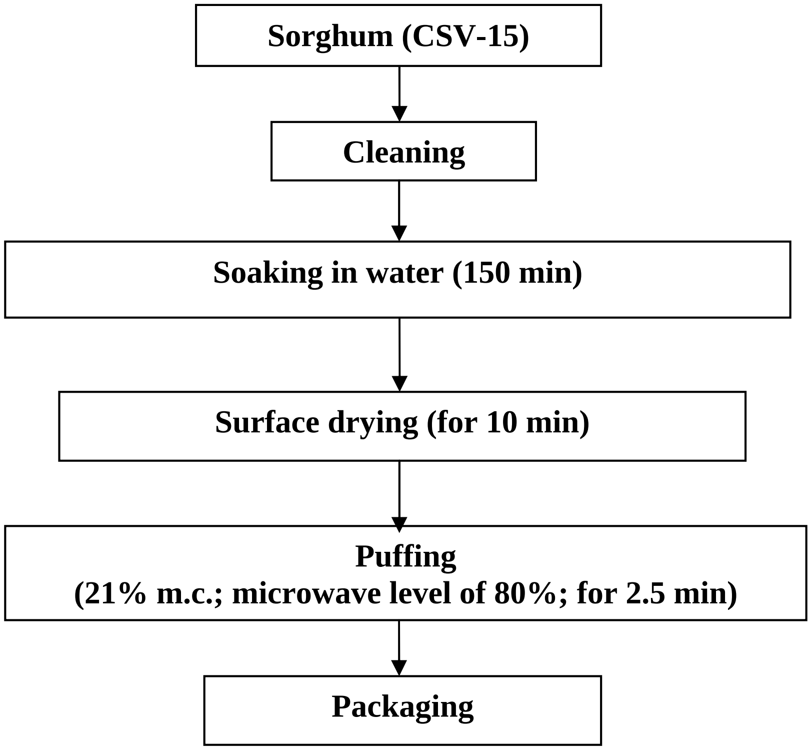


Fig.4 Process Developed for Puffing of Sorghum



Puffed yield was used to compare the puffing ability of the sorghum under different processing conditions. In microwave popping, popping yield ranged between 63.67 to 88.88% with the mean of 73.48. The highest popping yield recorded was 88.88 at 21% moisture, 100% power level for 3 min. At 24% moisture content, total puffed yield from both methods decreased significantly. This may have been due to the higher moisture in the grains loosening the interlocking in the husk, which resulted in insufficient internal steam pressure being maintained to cause During microwave-puffing of sorghum, not only the moisture content, but also the microwave power and time are important in determining the expansion volume of the puffed sorghum. At different power, moisture content and time the flake size ranged between 0.13 to 0.27 m*l*/grain with the mean of 0.20 m*l*/grain.

puffing (Maisont and Narkrugsa, 2009). The lowest popping yield was 63.67 at 24% moisture content, 60% power level for 2 min as shown in Fig. 2. In case of microwave popping, expansion ratio of popped grains varied significantly, it ranged from 3.28 to 8.89 ml with the overall mean of 6.30 ml. Pop sorghum showed the highest expansion ratio of 8.89 ml as shown in Fig. 3. The moisture present in the sorghum is converted to superheated vapour, providing the driving force for expansion (Chinnaswamy and Bhattacharya, 1983).

Nutritional quality of popped sorghum

There was a significant variation in moisture content of conventionally popped sorghum. It ranged from 8.73 to 8.93 per cent. Protein, fat and ash content have been ranged from 7.10 to 7.90, 2.75 to 3.19 and

1.65 to 2.14%. The mean moisture, fat and ash contents puffed sorghum processed from conventional method were lower than sorghum puffed from microwave method. However, popping did not affect the protein (7.09-7.91%) or fat (2.23-3.26) and moisture contents (8.86 to 9.01) but a slight reduction in total ash (1.25-2.36%) was observed. The process developed for puffing of sorghum has been depicted in Fig. 4.

Conclusion

Moisture content significantly affects the popping yield, expansion ratio and flake size. The expansion ratio and flake size increased with an increase in moisture content from 18 to 21%, and then decreased with moisture to 24%. Performances of popping quality were poor in terms of expansion volume and flake size in the conventional method than microwave method. The moisture content, microwave power and time affected the puffing quality of sorghum. The nutritional value did not affected by different processing method of popping. The lowest puffing yield was obtained at 24% moisture content. A moisture content of 18% gave the lowest expansion ratio and flake size. The popping yield, expansion ratio and flake size increases with an increase in moisture content up to 21% and decreased with additional moisture. Using 100% power gave the highest expansion ratio, while 60% power gave the lowest expansion ratio.

References

AOAC. 1990. Official Methods of Analysis. AOAC. 1990. Official Methods of Analysis. 15th ed. The Association of Official Analytical Chemists. Arlington, Virginia. pp 1298.

Chinnaswamy R and Bhattacharya K R. 1983. Studies on expanded rice. Optimum condition processing conditions. J. Food Sci., 48:1605-1608.

Dofing S M, Thomas-Compton M A and Buck J S. 1990. Genotype popping method interaction for expansion volume in popcorn. Crop Science, 30:62–65.

Gokmen S. 2004. Effects of moisture content and popping method on popping characteristics of popcorn. J. of Food Eng., 65:357–362.

Heymann H. 2000. Effect of Process Conditions on the Physical and Sensory Properties of Extruded Oat-Corn Puff. J. of Food Sci., 65:1253–1259.

Karababa E. 2004. Physical properties of popcorn kernels. J. of Food Eng, 72:100–107.

Korian M. 2012. Hot-air popcorn machine especially with a seasoning coater. United States Patent 8276504.

Lowry O H, Rosebrough N J, Farr A L and Randall R J. 1951. Protein Measurement with the Folin Phenol Reagent. J. Biol. Chem. 193:265-275

Maisont S and Narkrugsa W. 2009. Effects of some physicochemical properties of paddy rice varieties on puffing qualities by microwave. Kasetsart J. (Nat. Sci.), 43(3):566-575

Mariotti M, Alamprese C, Pagani M A and Lucisano M. 2005. Effect of puffing on ultrastructure and physical characteristics of cereal grains and flours. J.of Cereal Sci., 43:47–56.

Metzger D D, Hsu K H, Ziegler K E and Bern C J. 1989. Effect of moisture content on popcorn popping volume for oil and hot-air popping. Cereal Chemistry, 66:247–248.

Murthy K Das V, Kumar A and Raghavarao K S M S. 2006. Department of Food Engineering, Central Food Technology Research Instiitute, Mysore.

Pardeshi I L. 2009. Development of cereal based ready-to-eat snack foods, Unpublished Ph.D. Thesis, Post Harvest Technology Centre, IIT, Kharagpur (WB), India– 721 302.

Song A, Eckhoff S R, Paulsen M and Litchfield J B. 1991. Effects of kernel size and genotype on popcorn popping volume and number of unpopped kernels. Cereal Chemistry: 68:464–466.

Srinivas T and Desikachar H S. 1973. Factors affecting the puffing quality of paddy. J. of Sci, Food and Agri, 24:883-891.

Yenagi N B and Bhuvaneswari G. 2004. Cooking and popping qualities of raw and bulgurised wheat varieties. Research Highlights, JADU, 14:82-186.