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Quality performance, proximate composition and sensory evaluation of developed flavoured instant popcorn

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Abstract

Popcorn is a world famous snack food with significant commercial demand. Its market has been continuously growing in Sri Lanka. At the same time, different variety of instant popcorn products should be tested for sensory attributes, proximate composition and quality performance. The flavoured instant products were developed by adding 15%, 25% and 35% butter and butter oil as separately and 0.5g, 1.0g and 1.5g salt respectively for 20g of raw popcorn grains. 35% butter incorporated popcorn had significantly higher median score for appearance, taste and overall acceptability. There was no any effect of level of salt added. Proximate composition was determined for raw seed, raw popped flakes and flavoured popped flakes. Butter flavoured popped corn flakes were showed higher level for crude fat content and mineral content while lowest content for carbohydrate 16.71%, 2.4% and 64.2% respectively. Kernels were popped using a microwave oven and visually sorted into three different polymorphisms depending on whether the appendages were expanded unilaterally, bilaterally, or multilaterally. The expansion volume before sorting was comparatively lower and it was 10-11cm3/g. When popped, 37.37%, 14.02%, and 33.57% of kernels were expanded unilaterally, bilaterally, and multilaterally, respectively, while 14.2 % of kernels remained unpopped. Expansion volumes in respect to flake weight were shown significant differences for unilaterally, bilaterally, and multilaterally expanded polymorphisms of 9.34, 8.86 and 12.29cm3/g, respectively.

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*Keywords:*Popcorn; Expansion Volume; unpopped kernel; flakes morphology

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1.0. Introduction

Popcorn (*Zea mays Everta*) is one of the corn varieties which have the ability to pop when undergo heating process. Popcorn is a snack food with significant commercial popularity[1]. Popcorn was popped conventionally in oil and in a microwave oven without oil. The most studied and reported quality factors for popcorn have been expansion volume and the number of unpopped kernels[2]. High pop expansion volume is correlated with desirable consumer attributes including improved texture and consumer acceptability[3], while un-popped kernels are an undesirable nuisance to consumers and unrealized profit for producers. Previous researchers have studied the importance of various sensory attributes of popcorn Flakes using consumer response evaluations. The nutritional composition of popcorn showed that it contained 3.8–4.6% crude fat, 8.1– 10.5% crude protein, 0.07–0.23% reducing sugars and 61.0–67.9% starch, in which 27.0– 28.5% of the starch was amylase[4]. Popcorn hybrids contained on an average approximately 12.6% palmitic, 2.0% stearic, 25.5% oleic, 58.4% linoleic and 1.5% linolenic acids, respectively[4]. This research study's main objective is to develop flavoured instant popcorn product and increase the consumer interest as snack food. The secondary objective is to evaluate the quality performance of flakes and their morphology.

2.0. Materials and Methods

2.1. Selecting of flavour and salt level for instant popcorn development

New open pollinated popcorn seed were collected from Field Crop Research & Development Institute, Mahailluppallama. The butter (15%, 25% and 35%), butter oil (15%, 25% and 35%) and salt (0.5g, 1.0g and 1.5g) were added with different combinations into 20 g of popcorn grain. These combinations were mixed well and filled in to a paper bag which was developed locally. Then, the bags were kept one day in a refrigerator for seasoning before testing.

2.2. Determination of proximate composition of raw seed, raw (without any additives) popped flakes and flavoured popped flakes

Raw popcorn kernels, popped flakes and flavoured flakes were ground into powder by a home grinder (Bajaj, India). The compositional characteristics were evaluated using previously published methods according to the Association of the Official Analytical Chemists (AOAC) 2010 guidance. Total carbohydrate was measured by difference (100% - [(moisture% + protein% + lipid% + minerals %).

2.3 .Quality performances of popcorn

Unfolded bags were placed in the centre of microwave and popped on Medium high (800 W) power until the interval between pops slowed to 2-3 sec. The contents were poured into a white paper to remove unpopped kernels which were counted and weighed. Next, the popcorn flakes were visually inspected and sorted into three shapes based on whether the flake appendages were expanded unilaterally, bilaterally or multilaterally. The total popped volume and volume of each shape were measured in a 1L graduated cylinder by increment method of volume by using pearl millet and rounded to the nearest 5-mL graduation.

2.4. Sensory Evaluation

Flavoured instant popcorn product was evaluated for its sensory characters with ten untrained panellists. Sensory evaluation was done according to the 5 point hedonic scale. Panellist were advised to give ranks according to their preferences for sensory attributes (Rank 1= dislike very much, Rank 5= like very much). Drinking water was given to rinse their mouth before tasting the next sample.

2.5 .Statistical analysis

The sensory data were analyzed using SPSS (Statistical Package for Social Scientist) version 16.1. The analysis of variance (ANOVA) was performed by SAS windows 9.1 portable versions to determine the level of significant differences between the means of formulated food samples using least significant different Test at $P < 0.05$.

3.0. Results & Discussion

3.1 Selecting the best flavour for popped corn

According to the sensory evaluation results, it revealed that, butter is preferred by the panellists than the butter oil. Butter gives the distinct flavour, aroma and colour to the product. 35% butter incorporation was significantly higher for appearance, taste and overall acceptability. There was no significant difference for amount of salt added.

Table 1 Median ranks for different sensory attributes of developed flavoured instant popcorn according to Freidman test.

Treatments	Appearance	Taste	Crispness	Saltiness	Overall Acceptability
Treatment1(15% Butter,0.5g salt)	1.0 d	2.8 c	3.8 b	3.2a	2.5 b
Treatment 2 (25% Butter, 1g salt)	3.5 cb	4.1 b	2.6 c	3.9a	3.8 b
Treatment 3 (35% Butter, 1.5g salt)	5.5 a*	5.6 a*	4.1 a	4.0a	5.5 a*
Treatment 4 (15% Butter oil, 0.5g salt)	2.5 c	2.3 c	2.6 c	3.5a	1.9 c
Treatment 5 (25% Butter oil, 1g salt)	4.0 b	3.2 bc	3.8 b	3.2a	3.4 b
Treatment 6 (35% Butter oil,1.5g salt)	4.0 b	3.0 c	4.1 a	3.3a	4.0 b
Probability	0.000	0.000	0.019	0.747	0.000

3.2 Proximate composition variation of raw seed, raw popped flakes and flavoured popped flakes samples

Moisture content of the raw seed corn sample is significantly higher than the raw popped flakes and flavoured popped flakes; it revealed that there was a moisture loss during the popping action.

Table 2 Proximate composition of raw seed, raw popped flakes and flavoured popped flakes

	Moisture content %	Mineral content %	Crude Protein %	Crude Fat%	Carbohydrate content %
Raw seed	9.87a*	1.08c	13.46a	2.79b	72.79b
Raw popped Flakes	3.40c	1.97b	13.41a	3.56b	77.63a*
Flavoured popped flakes	4.81b	2.40a*	11.86b	16.71*a	64.20c
CV	5.37	7.02	2.46	6.31	1.13
R^2	0.99	0.96	0.89	0.99	0.98

Mineral content of the raw seed was lower than the flakes. The flavoured popcorn was contained significantly higher amount of mineral percentage which had come from the added butter and the salt. Crude fat content showed significantly higher amount from butter flavoured popped corn flakes than the raw seed and raw popped flakes. The reason was added butter level proportional to the crude fat content of the product. Significantly lower amount of carbohydrate can be observed in flavoured popcorn flakes, because of added butter level contributed more proportion to crude fat content of the product and reduced the proportion of carbohydrate.

3.3 Popping performance based on the flakes morphology

The total average expansion volume before sorting was 10-11 cm^3/g. According to flakes morphology, most

of the corns were unilaterally expanded and it was significantly higher compared to the other two shapes.

Table 3 Quality performance of different flakes morphology

	Mean values of 20 g popcorn samples					
	Unilaterally expanded	Bilaterally expanded	Multilaterally expanded	Un-popped	CV	R2
Counts	52.33a*	19.66c	47.00b	20.00	6.11	0.98
Shape types or un-popped %	37.37	14.04	33.57	14.20		
Mass (g)	6.60a	2.82b	6.78a	3.76	6.22	0.97
Pop volume (ml)	61.66b	25.00c	83.33a*		6.57	0.98
Expansion volume (cm3/g)	9.34b	8.86b	12.29a*		3.62	0.96

Unpopped kernels were remained 14.20% from total corn grains. This suggests that most unpopped kernels are not inherently unviable, but rather that not all kernels achieve the minimum thermodynamic requirements for popping during microwave heating. The multilaterally expanded shape had the significantly highest expansion volume, in this study, there were less bilaterally expanded kernels, but same study revealed that significantly higher amount of bilaterally expanded kernels were observed (Sweley, 2011.). This study was showed higher expansion volume represented by the multilaterally expanded flakes; this was agreed with the earlier studies (Sweley, 2011.).

4.0 .Conclusions

This experiment has shown that butter as a good additive which can be enhanced the taste and appetite of the consumers. Proximate composition showed significant differences among the treatments and crude fat level was higher in butter flavoured popcorn flakes. Multilaterally expanded flakes had higher volume compared to other two shapes. Finally, this popcorn line could be used to fulfil the consumer requirement at this level and reduced the importation as well.

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