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RESEARCH ARTICLE

QUALITY CHANGES IN BROWN RICE AND MILLED RICE BASED SNACKS PRODUCT DURING STORAGE

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ABSTRACT

Changes in brown rice and milled rice based snacks product at ambient condition for three months storage where, high density polyethylene (HDPE) pouches were used for packaging of brown rice and milled rice snacks. Storage period had significant effect on the moisture content on brown rice snacks was high as compared with milled rice snacks. Free fatty acid content of brown rice snacks was remained in acceptable range. While milled rice snack showed low values for free fatty acids whereas brown rice extruded snack had higher values of free fatty acids. Hardness shows a non significant effect on brown rice and milled rice snacks. Maximum hardness was observed in brown rice extruded snack and minimum hardness shown by milled rice extrudates. Overall acceptability was reduced in both milled and brown rice snacks were observed upto 3 months of storage.

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INTRODUCTION

Today, dietary guidelines issued in all developing countries emphasizing on the need to include adequate amount of whole grains and enriched cereal products to increase complex carbohydrates and fiber in diet. Whole grains contain a wide variety of antioxidant compounds including vitamins, minerals. Ready-to-eat whole grains cereals have on average greater antioxidant potentials than many fruits and vegetables (Decker *et al.,* 2002). Brown rice grains contain more nutritional components, such as dietary fibers, E and B vitamins and gamma aminobutyric acid (GABA), than the ordinary milled rice grains. These bio-functional components exist mainly in the germ and bran layers that are removed by polishing or milling (Champagne *et al.,* 2004). Extrusion of snack foods demands close control of many variables such as feed moisture, feed composition, feed particle size, feed rate, barrel temperature, screw configuration, and die geometry. Most of the research made carried out on the extrusion cooking of rice is based on the rice grits obtained from white rice (Ding *et al.,* 2005; Hagenimana *et al.,* 2006 and Gonzalez *et al.,* 2000) there was no systematic study on the use of brown rice for extrusion cooking. The objective of this study was to evaluate the effects of ambient temperature and storage time on the qualities of snacks product, analyze the moisture content, free fatty acid, hardness and overall acceptability.

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MATERIALS AND METHODS

The present study was carried out in Department of Food Engineering and Technology, Sant Longowal Institute of Engineering and Technology, Sangrur, Punjab.

Materials

Raw materials used in investigation were paddy (variety PR 118) was procured from Directorate of Seed, PAU, Ludhiana.

Milling

Paddy was shelled to obtain brown rice (Satake, penirth, Australia). Part of brown rice was subjected to polishing in lab scale polisher to obtain polished rice. Grains were subsequently ground using lab scale super mill 3303 (Perten instrument AB, Sweden) to pass through 200 μm sieves.

Spice mix

Spice mix used in final product preparation was mixture of sugar (4 per cent), salt (2 per cent), ginger powder (1 per cent),

onion powder (1 per cent), cheese powder (1 per cent), garlic powder (0.75 per cent), chili powder (0.25 per cent) and citric acid (0.25 per cent).

Methods

Experimental design and data analysis by RSM

The central composite rotatable design (CCRD) for the three independent variables were moisture (A), screw speed (B) and die temperature (C) as showed in Table 1.

Table 1. Process variables used in the central composite design for three independent variables

Process Variable		Variable level code				
Sr.No.	Code	-1.682	-1	0	1	1.682
Moisture content (%)	A	12.64	14	16	18	19.38
Screw Speed (rpm)	B	348.37	400	475	550	601.13
Temperature(^{o}C)	C	116.36	130	150	170	183.64

Moisture content

Weighed samples (2 g) were dried in a hot air oven at 130 +/- 1°C for 1 hr. and moisture content in percent was calculated from loss of weight (AACC, 2000).

Hardness

Textural quality of the snack samples was examined for compression force (CF) by applying a TA-XT2i Texture Analyzer. P75 compression probe (75 mm. dia. cylinder aluminum) was applied to measure compression force required for samples breakage which indicates hardness. Testing condition was 1.0 mm/s pre-test speed, 2.0 mm/s test speed, 10.0 mm/s post test speed and Distance 5 mm.

Free Fatty Acids

Standard AOAC procedure (Anon, 1994) was followed with slight modification. Weighed 5 g of sample was taken in flask. Added 50 ml benzene and kept for 30 min. for extraction of free fatty acids. Took 5 ml. extract in flask, added 5 ml. benzene, 10 ml alcohol, phenolphthalein as indicator and titrated against 0.02N KOH till light pink colour disappeared.

Sensory evaluation

Extruded snacks were used for sensory attributes (appearance, colour, texture, stickiness, flavor, taste and Overall acceptability) through a panel of semi-trained judges using 9-point hedonic scale (Larmond, 1970). The following Performa was used for sensory evaluation.

Storage studies

Snacks prepared from brown and milled rice were packed in HDPE (200 guage) bags. Samples were stored under ambient conditions for shelf life estimation over a period of 3 months and the product was evaluated for moisture content, water activity, hardness, free fatty acids and overall acceptability, at the interval of 1 month, during the storage period.

Statistical analysis of data

Data collected from the aforesaid experiments was subjected to statistical analysis with the help of factorial design in CRD using CPCS1computer programme package to find out the effect of storage on stored snacks (Singh *et al.,* 1998).

RESULTS AND DISCUSSION

Effect of storage period on snacks

Moisture content

(Table 2, Fig. 1) represents the effect of storage on the moisture content of snacks. Storage had a significant effect on the moisture content of snacks. The moisture content of brown rice snacks was high as compared with milled rice snacks. Maximum percent moisture gain with storage period was observed in brown rice extruded (3.41 to 5.39) and compared to milled rice extruded (3.21 to 4.57).

Table 2. Effect of storage period on Moisture content per cent of snacks (n=3)

Store period (Months)	Brown Rice snacks	Milled rice snacks	Storage Mean
0	3.14	3.21	3.31
1	3.49	3.32	3.40
2	4.11	3.78	3.94
3	4.11	3.78	3.94
Mean	4.1	3.72	

* Each value was an average of three determinations

Maximum moisture content after three months of storage were observed in brown and milled rice snack sample was 5.39 per cent and 4.57 per cent. Increase in moisture content was due to hygroscopic nature of snacks and snacks absorb the water to attain equilibrium with the surrounding. (Charunuch *et. al.,* 2008) concluded that there was increased in moisture content observed in Thai rice extruded snack supplemented with mulberry from 3.5 to 5 per cent during storage of 4 months.

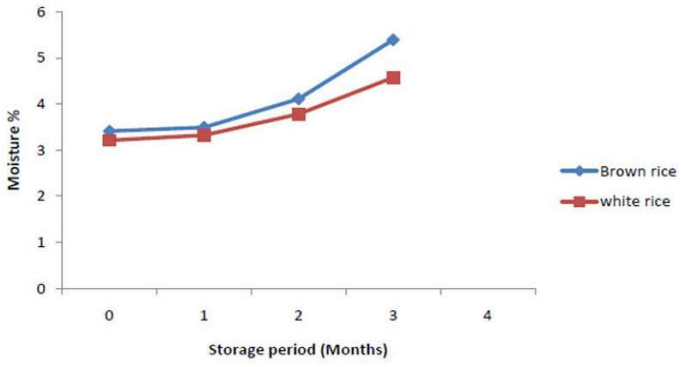

Fig.1. Effect of storage period on Moisture content per cent of snacks

Hardness

(Table 3, Fig. 2) depicted the effect of storage on the hardness of both milled and brown rice snacks. Storage had a non significant effect on the hardness of snacks were found. Maximum hardness was observed in brown rice extruded snack (24.68 N) and minimum hardness shown by milled rice extrudates (23.32 N). At the end of 3rd month of storage hardness of brown rice extrudate decrease by 14.14 per cent upto hardness value of 21.19 N, while in case of Milled rice extrudates hardness decrease by14.8 per cent upto hardness value of 19.85 N. (Charunuch *et. al.,* 2008) resulted that during

4 month of storage there was decrease in hardness from 21.38 to 19.44 N for thia rice snacks.

Table 3. Effect of storage studies on Hardness (N) of snacks (n=3)

Store period (Months)	Brown Rice snacks	Milled rice snacks	Storage Mean
0	24.68	23.32	24.00
1	24.03	22.72	23.37
2	22.33	20.07	21.20
3	21.19	19.85	20.52
Mean	23.06	21.49	

* Each value was an average of three determinations

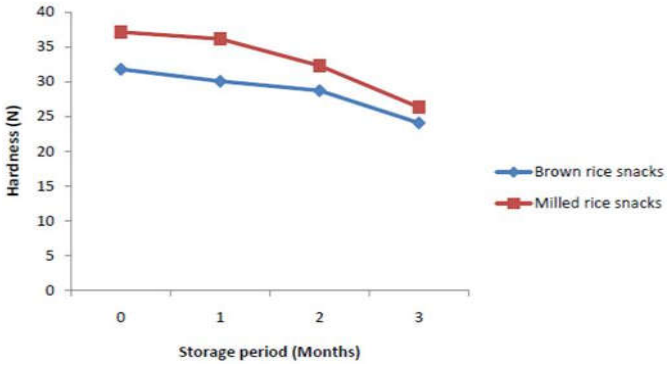

Fig. 2. Effect of storage period on Hardness of snacks

Free Fatty Acid (FFA)

Storage period affected FFA content of snacks (Table 4, Fig. 3). Per cent free fatty acids for all sample increased with storage period, but the values remained in the acceptable range because of which, the taste, flavour and acceptability of snacks were not much affected at the 3rd month of storage.

Table 4. Effect of storage studies on free fatty acids per cent of snacks (n=3)

Store period (Months)	Brown Rice snacks	Milled rice snacks	Storage Mean
0	0.012	0.011	0.0115
1	0.012	0.011	0.0115
2	0.013	0.012	0.0125
3	0.014	0.013	0.0135
Mean	0.013	0.012	

* Each value was an average of three determinations

Milled rice snack showed low values for free fatty acids (0.013) whereas brown rice extruded snack had higher values of free fatty acids (0.014). This is probably due to more fat content of brown rice as compared to milled rice. (Manthey *et. al.,* 2008) analysed the FFA content increased from 1.90 to 2.36 per cent during refrigerated storage. The free fatty acid content ranged from 1.2 to 1.8 and 1.48 to 2.31 in treated and control *Sev* and 1.28 to 1.59 and 1.32 to 1.64 in treated and control *Boondi*, from 0 to 3.5 months storage (Waghray and Gulla, 2010).

Sensory evaluation (overall acceptability, 9 Points Hedonic scale)

Storage period slightly affected overall acceptability of snacks (Table 5, Fig. 4). Reduction in the overall acceptability of both milled and brown rice snacks were observed upto 3 months of storage.

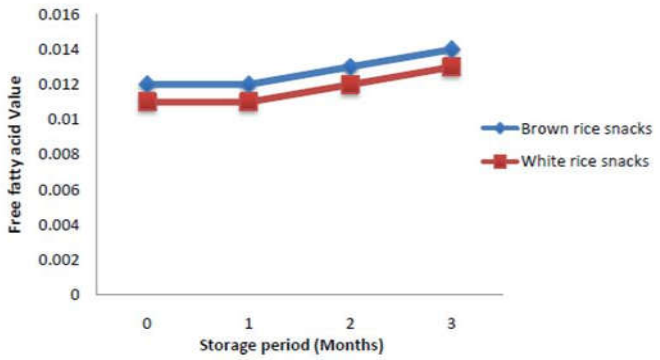

Fig. 3. Effect of storage period on free fatty acid value of snacks

Table 5. Effect of storage studies on Sensory evaluation of snacks (n=3)

Store period (Months)	Brown Rice snacks	Milled rice snacks	Storage Mean
0	8.41	8.30	8.35
1	8.26	8.09	8.18
2	7.89	7.80	7.85
3	7.60	7.51	7.55
Mean	8.04	7.92	

* Each value was an average of three determinations

During the entire 3 months of storage, overall acceptability of snacks was within acceptable range. There was non significant effect of storage periods on the overall acceptability of brown and milled rice snack was observed. In the first month of storage overall acceptability score for brown rice was higher (8.41) than milled rice snacks (8.30). Changes in texture/appearance of snacks were particularly noticed on storage, while mouthfeel and flavor score were not much varied during the storage studies. But in sensory score brown rice snack was found lower score than milled rice snacks. A brown rice snack was remained most acceptable after three months of storage (7.60), while that for milled rice extrudates (7.51) was found.

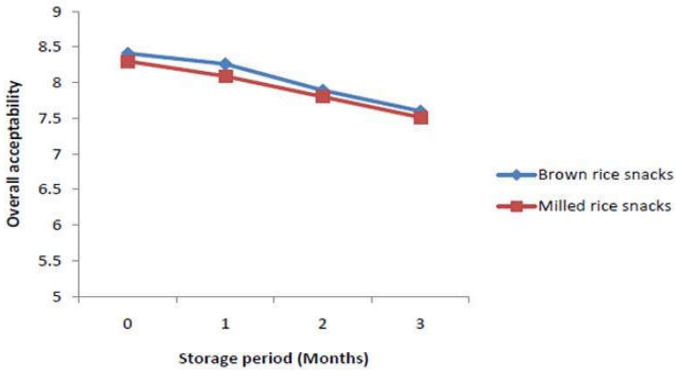

Fig. 4. Effect of storage period on overall acceptability of snacks

Conclusion

High Density Polyethylene (HDPE) pouches were used for packaging of brown rice and milled rice snacks and storage was carried out under ambient conditions for three months. Storage period had significant effect on the moisture of the snacks. However, free fatty acid content of brown rice snacks was remained in acceptable range during 3 months of storage period. Storage period had slightly a non significant effect on the hardness of brown rice and milled rice snacks however

reduction in the overall acceptability of both milled and brown rice snacks were observed.

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