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Jasia Nissar

Division of Food Science and Technology, Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir, Shalimar, Jammu and Kashmir, India

Tehmeena Ahad

Division of Food Science and Technology, Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir, Shalimar, Jammu and Kashmir, India

HR Naik

Division of Food Science and Technology, Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir, Shalimar, Jammu and Kashmir, India

Syed Zameer Hussain

Division of Food Science and Technology, Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir, Shalimar, Jammu and Kashmir, India

AH Rather

Division of Food Science and Technology, Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir, Shalimar, Jammu and Kashmir, India

Correspondence**Jasia Nissar**

Division of Food Science and Technology, Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir, Shalimar, Jammu and Kashmir, India

Studies on storage stability of corn based apple incorporated breakfast snacks

Jasia Nissar, Tehmeena Ahad, HR Naik, Syed Zameer Hussain and AH Rather

Abstract

Shelf life studies of food products are important, keeping in view the consumers awareness towards the quality and safety of food products. Experiments were conducted to assess the storage studies of corn based apple incorporated breakfast snacks extruded at pre-optimized conditions (10% apple powder, 15% moisture, 250 rpm screw speed and 1700C barrel temperature). The developed snacks were packed in high density polyethylene (HDPE) bags and kept under ambient conditions for the period of three months. The stored samples were evaluated for moisture content (MC), water activity(WA), free fatty acids (FFA), breaking strength(BS), total plate count(TPC) and sensory evaluation at regular intervals for three months. Gradual increase in moisture content and gradual decrease in breaking strength was observed during three months of storage. Storage had non-significant effects on FFA, AW, and TPC. In the present study it was observed that corn based apple incorporated snacks did not developed any potential health risk and can be stored up to three months when packed in HDPE bags.

Keywords: storage, breakfast snacks, extruded, HDPE

1. Introduction

Breakfast snacks have become an integral part of daily diet in majority of the countries and are gaining momentum due to busy schedule of people and need for convenience food. Extrusion cooking, a versatile food processing technique being the high temperature short time process has become the method of choice for the development of snacks owing to nutrient retention and favorable economics of the process [9]. Cereals are the main raw materials used for the development of extruded snacks [9, 10]. Corn, one of the major cereal grain of India, is an attractive ingredient for extrusion process because of its superior characteristics attributed to its starch content, typical corn flavor and appealing yellow color. Incorporation of fruits has shown to cause positive impact on the nutritional value of snacks. Apple being the main horticultural produce of Jammu and Kashmir (India) undergoes much of post harvest losses. One viable method for its proper utilization could be incorporation of apple into extruded snacks. Apple on the average contains 2% vit. C, 1% of each b-complex vitamin, 2% of P, 2% of K and 1% of Ca, Mg, Zn and 58 mg/l of phenolic compounds. Incorporation of apple in to corn based extrudates can pave the way for the snack which is rich in vitamins, minerals and antioxidants.

2. Material and methods

2.1 Preparation of raw material

The present investigation was carried out in the Division of Post Harvest Technology, Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir (SKUAST-Kashmir), Shalimar, Kashmir. The corn (C-6) variety obtained from division of plant breeding and genetics, SKUAST-K was milled in lab mill 3030 (Perten, Sweden) to fineness that passes through 200mm sieve. Culled apple (CV: Red delicious variety) was procured from local market, dried in cabinet dryer and powdered in knife grinder to obtain the required fineness. The blends of corn flour and apple powder were extruded at pre-optimized conditions i.e 10% apple powder, 15% moisture, 250 rpm screw speed and 1700C barrel temperature and were stored in HDPE for three months. Extruded snacks were studied at an interval of one month for moisture content, water activity, free fatty acids, breaking strength, total plate count and sensory evaluation.

2.2 Extruder cooking.

The extrusion was performed on co-rotating intermeshing twin screw extruder model BC 21 (Clextral, Firminy, France). The barrel diameter and its length to diameter ratio (L/D) were 2.5 mm and 16:1, respectively. The extruder had four barrel zones, temperature of the 1st, 2nd, and 3rd was maintained at 20, 30 and 40°C, respectively, throughout the study period; while the temperature in last zone (compression and die section) was varied according to experimental design. The extruder was equipped with torque indicator which showed percent of torque in proportion the current drawn by drive motor. Raw material was metered into extruder with a single screw volumetric feeder.

2.3 Quality parameters

Physico-chemical characteristics i.e. Moisture was studied using AOAC 2000 methods. Water activity was estimated using water activity meter (Rotronic, UK). Standard AOAC procedure was followed with slight modification for free fatty acid determination. Break strength was estimated using Texture analyzer and total plate count was studied by standard serial dilution plate count method using nutrient agar ^[1], Martin's lose Bengal agar ^[8]. Extruded snacks were studied for the period of three months at regular intervals.

2.4 Sensory analysis

Sensory quality of extrudates sample was determined with the help of 10 semi trained panelist using a 5-point Hedonic scale (5-excellent to 1-poor). The aspects considered were color, appearance, texture, flavor, mouth feel and *overall acceptability*. overall acceptability was evaluated as an average of color, appearance, texture, flavor and mouth feel. The average scores of all the 10 panelists were computed for different characteristics.

3. Results and discussion

3.1 Storage stability of snacks

The blends of corn and apple extrudates, extruded at optimized conditions were packed in HDPE bags, stored for 3 months at ambient temperature and were analyzed at an interval of one month for the moisture content, water activity, free fatty acids, breaking strength, total plate count and sensory evaluation.

3.2 Moisture content

With the advancement of storage period, an increase in moisture content was observed in extruded samples. Effect of storage period was found to be significant on the moisture content of the snacks. The moisture content of the product ranged from 3.36-4.68 per cent (table 1) at 90th day of storage. The increase in moisture content was due to hygroscopic nature of extrudates ^[3]. Increase in the moisture content from 3.5-5% was reported in Thai rice ^[4]. Due to the hygroscopic nature of the snacks and in efficient barrier properties,

breakfast snacks absorbed moisture from environment ^[3].

3.3 Water activity

During the storage period of three months, the water activity of snacks increased slightly. The mean water activity at zero months of extrude was 0.42 which increased to 0.53 (table 1) after three months of storage. The slightly increase of water activity in extrudates was possibly due to the change in humidity of the surrounding environment.

3.4 Free –fatty acids

Storage had significant effect on the development of FFA over the period of three months. The FFA content increased only slightly from 0.061 to 0.077 per cent (table 1) in three months. This is presumably due to the typically low levels of fat in corn flour, furthermore it is reported that extrusion denatures enzymes responsible for oxidation of lipids, lipids embedded within starch are less susceptible to oxidation and Millard's reaction products produced upon extrusion processing possess antioxidant properties ^[2].

3.5 Total plate count

Storage had a non-significant effect on the total plate count. Owing to low water activity of the snacks, high temperature thermal processing, TPC was too few to count (TFTC <25 colonies /plate) upto three months of storage.

3.6 Breaking - strength

The effect of storage period had no significant effect on the breaking strength of extrudates. Break strength is associated with the expansion and cell structure of the product. During the three months of storage period, a decrease in the break strength of extrudates was observed. Change in break strength was observed from maximum of 98.3 to minimum of 80N (table 1) over the period of three months. Moisture gain by extrudates during the storage period cause decrease in hardness and eventually decrease in the force required to break the product. Dar et al 2014, reported decrease in hardness of extrudates might be related to moisture gain and increased starch bonding in extrudates.

3.7 Sensory analysis

Organoleptic properties are important for estimating eating quality and acceptability of the product in terms of texture, flavor and mouth feel. Storage period had non-significant effect on the organoleptic properties of the snacks. During storage period of three months, the organoleptic properties of snacks were within the acceptable range. The overall score decreased from 4.3 to 3.9 on a 5 point scale (table 1). Pradeep *et al*, 2013 reported that overall acceptability of RTE nutritious snacks packed in LDPE was with the acceptable range over the period of 90 days. Overall acceptability of rice based snack was with the accepted range over the 90 days of storage ^[11].

Table 1: Effect of Storage Period on Moisture, water activity, Free Fatty Acids, breaking strength, Total Plate Count and sensory analysis.

Storage period (3 months)	Moisture content (%)	Water activity	Free fatty acids (%)	Breaking strength (N)	Total plate count (cfu/g)	Overall acceptability
0	3.36	0.42	0.061	50	0.00	4.30
1	3.62	0.44	0.068	48	0.00	4.20
2	4.21	0.47	0.072	46	TFTC	4.00
3	4.68	0.53	0.077	41	TFTC	3.80
CD (p<0.05)	0.123	0.019	0.002	NS	NS	0.19

TFTC = Too few to count, NS = Non significant

4. Conclusion

It can be concluded from the present study that the product was acceptable after three months of storage. Product retained most of its nutritional and sensory attributes under three months of storage. However the snacks turned soft with the passage of storage time, therefore there is scope to conduct further studies regarding the efficiency of packing material and packaging methods.

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