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Studies on storage stability of apricot and date incorporated rice based extruded snack

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Abstract

Storage studies are an important parameter to analyse the quality characteristics and product behaviour during storage. A study was conducted at the *Division of Food Science and Technology, SKUAST- K, Shalimar* to investigate the effect of storage on quality characteristics of apricot + date incorporated rice based extruded product. The extrudate using broken rice flour + apricot powder: date powder in the proportion of 90:10 respectively was developed under optimized conditions of 15% moisture content, 450 rpm screw speed and 170°C barrel temperature and stored in high density polyethylene for three months at ambient temperature. Moisture content, water activity, free fatty acids, hardness, total plate count and sensory properties of extrudate were evaluated at an interval of one month for three months.

Keywords: Apricot powder, Broken rice flour, Date powder, Extrudate, Storage.

1. Introduction

Extrusion cooking is an important and popular food processing technique classified as a high temperature/short time process to produce fiber-rich products (Gaosong and Vasanthan, 2000; Vasanthan, *et al.*, 2002) ^[1, 2]. In the extruder, the food mix is thermo mechanically cooked to high temperature, pressure and shear stress which are generated in the screw-barrel assembly. The thermo mechanical action during extrusion brings about gelatinization of starch, denaturation of protein and inactivation of enzymes, microbes and many anti-nutritional factors; all this occurs in a shear environment, resulting in a plasticized continuous mass (Bhattacharya and Prakash, 1994) ^[3]. Nowadays, there is focus on foods with functional properties. The consumer's interest has been toward foods with more natural antioxidants, dietary fibers, natural colorants, minerals, vitamins and synthetic additives free.

Cereal grains are generally used as major raw material for development of extruded snack foods due to their good expansion characteristics because of high starch content. The broken rice is a byproduct of modern rice milling process. The rice portion can have varying percentages (5- 7%) of broken kernels which contain nutritive value similar to whole rice and are available readily at relatively lower cost. Rice flour has become an attractive ingredient in the extrusion industry due to its bland taste, attractive white color, hypoallergenicity and ease of digestion (Kadan *et al.*, 2003) ^[4]. Apricot (*Prunus armeniaca*) is the most important fruit crop in Ladakh division of Jammu and Kashmir. Nutritionally, it is a rich source of sugars, fibers, minerals, bioactive phytochemicals and vitamins like A, C, thiamine, riboflavin, niacin and pantothenic acid (Leccese *et al.*, 2007) ^[5]. Dates are one of the most popular fruits packed with essential nutrients, vitamins and minerals that are required for normal growth, development and overall well-being. Since antiquity, both fruits and pits of dates have been of use in various traditional and folk systems of medicines where date palms are found to be growing (Duke, 1992; Khare, 2007) ^[6, 7]. The chemical composition of the date shows that the flesh is an important source of sugar (81-88%, mainly fructose, glucose and sucrose), dietary fibre (5-8.5%) and small amounts of protein, fat, ash and polyphenol (Al-Farsi *et al.*, 2007; Al-hooti *et al.*, 1995; Al-Shahib and Marshall 2002) ^[8, 9, 10]. Thus, dates provide a good source of rapid energy (sugars) and a good nutritional value, based on their dietary fibre (DF) contents. DF has important therapeutic implications (e.g. for diabetes, obesity) and exhibits a protective effect (Goni, *et al.*, 2000; Guillon and Champ, 2000; Hill, 1998; Roehrig, 1988) ^[11, 12, 13, 14].

The loss of nutrients in fruits and vegetables depends on the type of food, processing time, processing temperature, and storage conditions. Some preservation methods are also believed to be responsible for depleting the naturally occurring antioxidants in the foods, with a subsequent decrease in their health-protecting capacity

(Kalt, 2005; Puupponen-Pimia *et al.*, 2003) ^[15, 16]. Extrusion being a high temperature short time process retains most of the bioactive components of raw materials.

Nowadays, consumers are increasingly demanding high food quality, and they have corresponding expectations that the quality of their food will be maintained at a high level during the period between purchase and consumption. Shelf life is an important attribute of all foods, including raw materials, ingredients, and manufactured products. It is defined as the time during which the food product will (1) remain safe; (2) be certain to retain desired sensory, chemical, physical, and microbiological characteristics; (3) comply with any label declaration of nutritional data; and (4) be acceptable to the consumer (Earle and Earle, 2008) ^[17].

2. Materials and Methods

Paddy was milled in Division of Food Science and Technology using Rubber roller based rice mill. Rice brokens were ground in a lab mill (model 3303 perten, Sweden) to a fineness that passes through 200 μ m sieve. Dried apricot and date were ground into powder using grinder (Black and Decker FG 550). The blend of rice + apricot: date was extruded at pre-optimized conditions i.e. 90% rice + apricot: 10% date, 15% moisture, 450 rpm screw speed and 170°C barrel temperature and stored in HDPE for three months. Extruded snacks were studied at an interval of one month for moisture, water activity, hardness, free fatty acids, total plate count and sensory quality.

Moisture was studied as per AOAC 1995 method. Water activity was measured using water activity meter (AQUA LAB, SN: PRE-000197). Hardness was estimated using Texture analyser. Standard AOAC procedure was followed with slight modification for free fatty acid determination.

Sensory evaluation of snacks was done by a panel of semi-trained judges using 5- point scale. Total plate count was studied by standard serial dilution plate count method using nutrient agar (Anonymous, 1957) ^[19], Martin's lose Bengal agar (Martin and James, 1995) ^[20]

2.1 Extrusion processing

The extrusion was performed using a co-rotating intermeshing twin screw extruder model BC 21 (Cletral, Firminy, France). The barrel consisted of four zones heated electrically. The temperature distribution inside barrel varied from low at the zone next to the feeding to high at zone next to die. Temperature of the 1st, 2nd, and 3rd was maintained at 20, 30 and 40°C, respectively, throughout the study; while the temperature in last zone (compression and die section) was varied. The extruder was equipped with torque indicator which showed percent of torque in proportion the current drawn by drive motor. The raw material was fed into the extruder with a single-screw volumetric feeder. A cutter with bladed knives and a die made of stainless steel were used for shaping the extrudates.

3. Results and discussion

The rice + apricot: date extrudate was extruded at pre-optimized condition (Composition – 90% rice + apricot: 10% date powder, moisture content – 15%, screw speed – 450 rpm and Barrel temperature – 170°C). The extrudate was stored in high density polyethylene for three months under ambient conditions and analysed at one month's interval for moisture, hardness, free fatty acids, water activity and overall acceptability.

Table 1: Effect of storage period on moisture content, free fatty acids, water activity, breaking strength, total plate count and overall acceptability

Storage period (month)	Moisture content (%)	Free fatty acids (%)	Breaking strength (N)	Water activity	Total plate count (CFU/g)	Overall acceptability
0	4.31	0.007	85.02	0.42	0.00	4.50
1	4.43	0.007	81.57	0.45	0.00	4.16
2	4.73	0.008	78.00	0.46	6.00	4.03
3	5.07	0.010	75.95	0.50	9.00	3.83
CD (p \leq 0.05)	0.015	0.001	0.248	0.012	0.591	0.162

3.1 Moisture content

The moisture content of extruded snacks increased during storage period of 90 days. The moisture content of product ranged from 4.31-5.07 per cent. Increase in moisture content of extrudates was due to absorption of moisture from the storage environment owing to their hygroscopic nature. Similar results for extruded snacks were reported by Kocherla *et al.* (2012) ^[21]. Sumathi *et al.* (2007) ^[22] also reported that increase in the moisture content was considerable for pearl millet based extruded samples packed in HDPE. Results obtained in the present investigation are well in agreement with the above-mentioned researchers. Charunuch *et al.* (2008) ^[23] reported an increase in moisture content in Thai rice extruded snack supplemented with mulberry during storage of 4 months.

3.2 Free fatty acids

During the storage period of three months the free fatty acids increased. The free fatty acids of product ranged between 0.007-0.010 per cent. The increase in free fatty acids was within permissible limits. The increase in free fatty acids

during storage might be due to the breakdown of long fatty acid chain into individual fatty acid moieties and increased lipid hydrolysis at elevated temperature (Khan *et al.*, 2011) ^[24]. Similar results were also reported by Bindu and Srinivas (2007) ^[25]; Aubourg and Medina (1997) ^[26].

3.3 Breaking strength

The hardness of the extrudates showed a decreasing trend during a storage period of three months. The hardness of the product decreased from 85.02-75.95 N. The decrease in hardness might be related to gain in moisture of extrudates and thereby increased starch bonding (Dar *et al.*, 2014) ^[27]. These results are in alignment with those of Hussain *et al.* (2015) ^[28].

3.4 Water activity

The water activity of extruded products increased during storage from 0.42-0.50. Water activity is an indicator of quality and stability of extruded food products. The increase in water activity of extrudates might be attributed to the

humid environmental conditions. These results are in alignment with those of Hussain *et al.* (2015) [28].

3.5 Total plate count

The microbiological change as measured by TPC in the extruded snacks stored at ambient temperature condition was within permissible limits. This indicates the extrudates were microbiologically safe during the storage period. Similar findings were reported by Hussain *et al.* (2015) [28].

3.6 Overall acceptability

The extrudates were organoleptic evaluation every month during storage period of three months. Overall acceptability score showed a slight decrease during the storage period of 90 days. The evaluated organoleptic parameters were within acceptable range during storage period of three months.

4. Conclusion

Storage studies revealed that rice + apricot: date extruded products showed no significant changes in quality and overall acceptability during three months of storage. All the quality parameters were within acceptable limits. There was a slight decrease in acceptability owing to the texture degradation due to moisture absorption by extrudates. It can be concluded that rice based apricot and date powder incorporated extruded products are fit for consumption when stored in high density polyethylene for three months of storage.

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