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Sumit Kumar
Centre of Food Science and Technology CCS Haryana Agricultural University, Hisar, Haryana, India

Rakesh Gehlot
Centre of Food Science and Technology CCS Haryana Agricultural University, Hisar, Haryana, India

Rattan Singh
Centre of Food Science and Technology CCS Haryana Agricultural University, Hisar, Haryana, India

Rekha
Centre of Food Science and Technology CCS Haryana Agricultural University, Hisar, Haryana, India

Ritu Sindhu
Centre of Food Science and Technology CCS Haryana Agricultural University, Hisar, Haryana, India

Simran Arora
Centre of Food Science and Technology CCS Haryana Agricultural University, Hisar, Haryana, India

Correspondence
Rattan Singh
Centre of Food Science and Technology CCS Haryana Agricultural University, Hisar, Haryana, India

Changes in chemical constituents and overall acceptability of Aonla-papaya cheese during storage

Sumit Kumar, Rakesh Gehlot, Rattan Singh, Rekha, Ritu Sindhu and Simran Arora

Abstract
The aonla-papaya cheese was evaluated for changes in its chemical constituents and overall acceptability at monthly intervals for three months storage period. Total sugars, reducing sugars and browning increased significantly, while ascorbic acid, total carotenoids and total phenols decreased significantly in aonla-papaya cheese during three months storage. A significant decrease in overall acceptability of aonla-papaya cheese was recorded during three months storage, however, the blended product was found acceptable even after three months storage.

Keywords: Aonla, papaya, cheese, chemical constituents, overall acceptability, storage

Introduction
Aonla (*Phyllanthus emblica* L. or *Emblica officinalis* Gaertn.) belongs to family Euphorbiaceae. It is grown in arid and semi-arid region of the country due to its hardy and drought tolerance nature. The fruit is acrid, cooling, refrigerant, diuretic and laxative. It is second richest source of natural vitamin C (600-900 mg/100 g) after Barbadose cherry and works well than synthetic ascorbic acid in curing of deficiency diseases. It is also used as a medicinal plant. Due to its astringent and acidic taste, aonla fruits are not consumed in fresh form; therefore, it is not popular as table fruit. The fruits are seasonal and perishable, so, there is a need to preserve it for use in off-season. Hence, it is necessary to process this fruit and develop innovative products with high nutritive value. Aonla fruits are already processed into a number of products like preserve, candy, juice, pickle, shreds, dried powder, chutney, etc. Dried fruits are also utilized in curing diabetes, fever, diarrhoea, dyspepsia, haemorrhages and cough (Bakshi *et al.*, 2015) [3]. Now-a-days, blended products are gaining more attention by researchers due to supplementation of lacking nutrients in these products.

Papaya (*Carica papaya* L.) is the most economically important fruit in family Caricaceae. Due to its high nutritive value and reasonable price, it is known as common man's fruit. The fruits are rich in nutrients especially β- carotene, which is converted into vitamin A in human body. Apart from β-carotene, it is a rich source of minerals like potassium and magnesium, and nutrients such as vitamins C, vitamin E, flavonoids, vitamins B, folate, pantothenic acid and fibre (Ramachandran & Nagarajan, 2014) [14]. Due to faster fruit softening, consequent to ripening and huge transportation losses upto 40%, the fruit requires conversion into processed products to ensure extended storage for transportation, trade and consumption. Various researchers utilize papaya fruits in developing ready-to-serve drink, nectar, squash, sherbets, jam and candy slices to avoid extra glut during peak season.

The consumers do not like the typical flavour of papaya pulp/juice after processing; however, its blending with other fruit pulp/juice may provide processed products of better nutrition and sensory quality. Papaya pulp could be blended with aonla pulp or juice, rich in nutrients but poor in acceptability due to high acidity, astringent taste and flavour. Blending of papaya pulp with aonla pulp can supplement its blended products with vitamins (especially vitamin A), minerals, besides improving its colour and appearance, taste, flavour and overall acceptability. Keeping this aspect in view, a study was conducted to standardize appropriate combination of aonla-papaya blends for preparation of cheese and to assess the changes in chemical constituents and overall acceptability of the blended products during storage.

Materials and Methods

The present investigation was carried out in Centre of Food Science and Technology, CCS Haryana Agricultural University, Hisar during 2016-17. Uniformly ripe aonla and papaya fruits were procured from local market, Hisar. Aonla and papaya fruits were washed thoroughly and the pulp was extracted (Fig. 1 and 2).

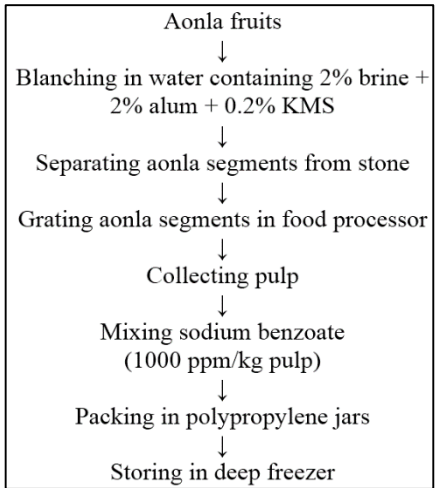

Fig 1: Flow sheet for extraction of pulp from aonla fruits

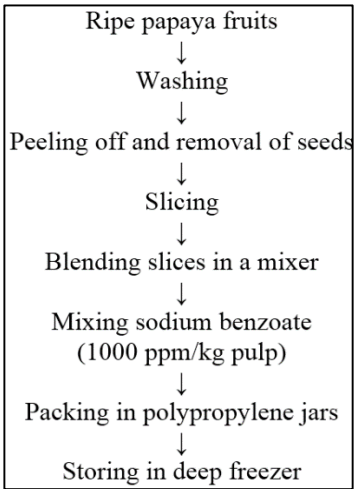

Fig 2: Flow sheet for collection of pulp from papaya fruits

Aonla-Papaya cheese was prepared from aonla-papaya blends (100:0, 80:20, 60:40, 40:60, 20:80 and 0:100) as per standard procedure (Fig. 3). One kg blended pulp, 900 to 1000 g sugar, 0.6 to 3.0 g citric acid, 70 g butter, 5 g salt and 20 g pectin were used for preparation of aonla-papaya cheese. The mixture of blended pulp, sugar, butter and citric acid was cooked with constant stirring with a ladle to obtain desired consistency. Pectin dissolved in lukewarm water was added to the cooking mass. Finally, salt was mixed with the cooked mass, when it started leaving sides of the vessel. The end point was judged by sheet test and total soluble solids (68%) were measured using hand refractometer (58-92%). The product was finally spread on butter smeared trays and left for cooling and setting. After setting, suitable size pieces of cheese were cut, wrapped in butter paper and packed in LDPE bags. Aonla-Papaya cheese (100:0, 60:40, 0:100) were selected based on sensory evaluation of all the blended products for further analysis for changes in chemical constituents and sensory quality at monthly intervals during three months storage period.

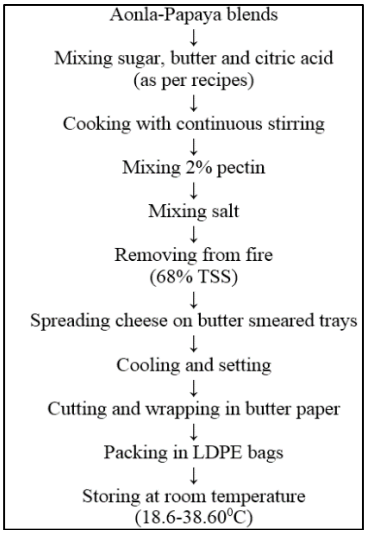

Fig 3: Flow sheet for preparation of aonla-papaya cheese

Cheese was analyzed at monthly intervals for changes in chemical constituents and overall acceptability during three months storage. Total and reducing sugars were estimated by the method of Hulme & Narain (1931). Ascorbic acid and browning were analyzed by the methods of Ranganna (2014) [15]. Total carotenoids were analyzed by Rodriguez-Amaya method (1999) [16] and total phenols were estimated as per the method given by Amorium *et al*. (1997). The overall acceptability of cheese was based on mean scores obtained from sensory parameters *i.e.*, colour and appearance, flavour, texture, taste. The treatments were replicated thrice. The data were analyzed according to two factorial completely randomized designs and were subjected to analysis of variance (ANOVA) technique. The critical difference value at 5% level was used for making comparison among different treatments during storage period.

Results and Discussion

There was a gradual increase in total sugars of aonla-papaya cheese during three months storage (Table 1). This might be due to hydrolysis of polysaccharides like pectin, starch, etc. into simple sugars. Similar observations we re recorded by Rai *et al*. (2005) [13] in guava cheese. Reducing sugars of aonla-papaya cheese also increased significantly with the advancement in storage duration. The increase in reducing sugars might be due to inversion of non-reducing into reducing sugars and hydrolysis of polysaccharides. Similar results were recorded by Khan *et al*. (2014) [7] in guava bar, Kohinkar *et al.* (2014) [8] in fig-guava toffee and Chavan *et al*. (2016) [4] in guava toffee.

The ascorbic acid content decreased significantly in aonla-papaya cheese during three months storage. The factors for decrease in ascorbic acid content of the products include temperature, presence of oxygen in the package and light. It might be also due to oxidation of ascorbic acid into dehydroascorbic acid. The differences in the products might be due to differences in the composition of raw materials in the recipes. Results are well matched with the findings of Rai *et al*. (2005) [13] in guava cheese and Khan *et al*. (2014) [7] Khan in guava bar.

Furthermore, there was significant decrease in total carotenoids of aonla-papaya cheese during three months storage. It might be due to thermo-labile, thermo-sensitive and epoxide forming nature of carotene compounds. The results are in conformity with those of Deepika *et al*. (2016) [5] in aonla based fruit bars.

Decrease in total phenols of aonla-papaya cheese was also found significant during three months storage. According to Kopjar *et al*. (2009) [9], total phenols decreased in the samples regardless of exposure to light or darkness because it was easily volatile and got oxidized. Moreover, cell structure disrupted during processing and the materials became prone to non-enzymatic oxidation, which could be one of the major causes for loss in total phenols of the products (Patras *et al*., 2011) [12]. Similar results were observed by Deepika *et al*. (2016) [5] in aonla based fruit bars.

The increase in non-enzymatic browning of aonla-papaya cheese was noticed due to differences in composition of raw materials in the recipes. Kuchi *et al*. (2014) reported bar that degradation of ascorbic acid during storage, followed by its further degradation to 2, 3-diketogulonic acid and finally to maillard compounds such as furfural and 2-furonic acid eventually form brown pigments in guava jelly. The results are confirmed with the findings of Rai *et al*. (2005) [13] in guava cheese and Deepika *et al*. (2016) [5] in aonla based fruit bars.

Aonla-Papaya cheese showed a significant decrease in overall acceptability of aonla-papaya cheese during three months storage period. However, organoleptic score of the blended fruit product remained above the acceptable level even after three months storage. This might be due to changes in chemical constituents or certain enzymatic and non-enzymatic changes in the products. The decrease in sensory scores during storage was also observed by Adhau and Salvi (2014) [1] in guava cheese and Patel *et al*. (2016) [11] in guava cheese.

Table 1: Changes in chemical constituents and overall acceptability of aonla-papaya cheese during storage

Treatments Aonla: Papaya	Storage period (months)	Total sugars (%)	Reducing sugars (%)	Ascorbic acid (mg/100 g)	Total carotenoids (mg/100 g)	Total phenols (mg/100 g)	Browning (O.D. at 440 nm)	Overall acceptability (9 point hedonic scale)
100:0	0	54.07	30.64	122	0.13	97	0.106	8.1
	1	55.52	32.98	114	0.12	95	0.164	7.8
	2	56.60	33.52	72	0.10	94	0.189	7.5
	3	57.68	34.61	66	0.09	92	0.233	7.3
60:40	0	56.24	31.54	84	0.81	91	0.087	8.2
	1	57.32	32.80	78	0.75	89	0.135	8.0
	2	59.84	34.24	70	0.72	88	0.150	7.9
	3	61.28	35.69	52	0.71	86	0.182	7.8
0:100	0	58.76	32.44	25	1.80	80	0.090	8.4
	1	60.92	33.88	20	1.79	78	0.110	8.2
	2	62.73	34.42	17	1.77	75	0.144	8.1
	3	63.81	36.23	14	1.72	74	0.190	7.9
CD at 5%	Treatment	0.48	0.57	4.10	0.07	2.43	0.003	0.07
	Storage	0.55	0.66	4.73	NS	2.81	0.003	0.08
Treatment x Storage		NS	NS	8.20	NS	NS	0.006	0.14

NS-Non-significant

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