Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2019; 8(3): 3454-3456
Received: 28-03-2019
Accepted: 30-04-2019

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Development and evaluation of aonla-papaya toffee

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Abstract
Aonla-Papaya toffee was developed and evaluated for changes in chemical and sensory parameters at monthly intervals for three months storage period. Total soluble solids (TSS) increased significantly, while acidity, ascorbic acid, total carotenoids and total phenols decreased significantly in aonla-papaya toffee with the advancement in three months storage duration. Colour and appearance, flavour, taste, mouthfeel and overall acceptability of aonla-papaya toffee decreased significantly during three months storage, however, the products acceptable even after three months storage. Toffee prepared with 80 aonla:20 papaya pulp ratio was found most acceptable.

Keywords: Aonla, papaya, blends, toffee, chemical, sensory, parameters, storage

Introduction
Fruit toffee is an important product of commerce in all fruit growing areas of India (Gowda *et al*., 1995) [7]. Toffees are chewable confectionery items containing sugar, milk solids and butter or vegetable fat as major ingredients (Bhokre *et al*., 2010) [4]. Fruit toffee is a dried pulp with proper amount of sugar and acid mixture. The product shall have 20% moisture, 75% TSS and 25% fruit content.

Aonla (*Phyllanthus emblica* L.) is a member of family Euphorbiaceae and sub family Phyllanthiodae. Aonla fruit is highly nutritious and known as *Kaya Kalp* according to *Hindu* mythology as it restores health and vitality. Aonla is a rare example of an edible material that is rich in tannins as well as ascorbic acid. The vitamin C content in aonla varies from 200 to 950 mg/100 g depending upon the variety and size of fruit (Barthakur & Arnold, 1991) [3]. It is claimed to be the second richest source of natural vitamin C (600-900 mg/100 g) after Barbadose cherry (Pokharkar, 2005) [10].

Aonla is also a source of carbohydrates, carotene, thiamine, riboflavin, and minerals like iron, calcium and phosphorus. It contains a considerable higher concentration of minerals and amino acids than apple. It is valued for its antiscorbutic, diuretic, laxative, antibiotic, acidic, hypoglycaemic, hypolipidemic and cooling properties. The fruits are generally not consumed fresh due to highly acidic and astringent taste; therefore, it is not popular as a table fruit, but it has a great potential in processed forms. Several value added products have been developed from aonla such as pickles, preserve (murrabba), candy, sauce, chutney, jam, spread and ladoo.

Papaya (*Carica papaya* L.) is the most economically important fruit in family Caricaceae. It is grown in every tropical and subtropical country, and is available throughout the year in India. It is a good 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) [11]. The extract of various parts of papaya has antioxidant, anti-hypersensitive, anti-inflammatory, anti-tumour, anti-fungal, anti-microbial, antisickling and anti-ulcer activity (Vij & Prashar, 2015) [14]. Due to faster fruit softening consequent to ripening and huge transportation losses up to 40%, the fruit requires conversion into processed products to ensure extended storage for transportation, trade and consumption. Papaya fruit is utilized by various researchers 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 fruit pulp or juice of aonla, rich in nutrients but poor in acceptability due to high acidity, astringent taste or 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 the above aspects in view, the present research work was planned to standardize appropriate combination of aonla-papaya blends for preparation of toffee and to evaluate the storage quality of the blended product.

Materials and Methods

The present investigation was conducted in Centre of Food Science and Technology, CCS Haryana Agricultural University, Hisar during 2016-17. Aonla and papaya fruits were procured from local market of Hisar. Aonla fruits cv. Chakaiya were thoroughly washed under running water to remove dirt and other foreign materials attached on the surface of fruits. The fruits were blanched in water containing 2% brine + 2% alum + 0.2% potassium metabisulphite for 4 to 5 minutes. The segments were separated from its stone and grated in a food processor to obtain aonla pulp. Sodium benzoate (1000 ppm/ kg pulp) was dissolved in small quantity of water and mixed with aonla pulp, packed in polypropylene jars and stored in deep freezer (-20^{0}C) for preparing toffee from aonla-papaya blends (Fig. 1).

Aonla fruits
↓
Blanching in water containing 2% brine + 2% alum + 0.2% KMS
↓
Separating aonla segments from stone
↓
Grating aonla segments in food processor
↓
Collecting grated pulp
↓
Mixing sodium benzoate
(1000ppm/kg pulp)
↓
Packing in polypropylene jars
↓
Storing in deep freezer

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

Papaya fruits were thoroughly washed under running water, peeled off, seeds and inner white portion removed and cut into thin slices. Fine pulp was obtained by blending fruit slices in a mixer. Sodium benzoate (1000 ppm/ kg pulp) was dissolved in small quantity of water and mixed with papaya pulp. Papaya pulp was packed in polypropylene jars and stored in deep freezer (-20^{0}C) for developing aonla-papaya toffee (Fig. 2).

Ripe papaya fruits
↓
Washing
↓
Peeling off and removal of seeds
↓
Slicing
↓
Blending slices in a mixer
↓
Mixing sodium benzoate
(1000ppm/kg pulp)
↓
Packing in polypropylene jars
↓
Storing in deep freezer

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

Aonla-Papaya toffee 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 was cooked with 600 g sugar, 100 g glucose, 100 g butter and 160 g skimmed milk powder. Initially, the pulp was cooked until its contents remained one third of its original volume. At this stage, sugar, butter and glucose were mixed with the pulp and the contents were again cooked until desired consistency when it started leaving sides of the vessel. Skimmed milk powder dissolved in lukewarm water was mixed with the cooking mass. It was then cooked up to attainment of 75% TSS. Cooked mass was removed from fire and poured on butter-smeared tray. After cooling slightly, toffees were prepared by hands. Toffees were wrapped in butter paper and packed into LDPE bags. Aonla-Papaya toffees (100:0, 80:20, 0:100) were selected based on sensory evaluation of all products for evaluating changes in chemical and sensory parameters at monthly intervals during three months storage period.

Aonla-Papaya blends
↓
Concentrating pulp up to 1/3 of original volume
↓
Mixing sugar, butter and glucose
↓
Cooking until desired consistency
↓
Mixing skimmed milk powder dissolved in lukewarm water
↓
Cooking
(Up to 75% TSS)
↓
Pouring cooked mass on butter-smeared trays
↓
Preparing toffee with hand and wrapping in butter paper
↓
Packing in LDPE bags
↓
Storing at room temperature (18.6-38.6^{0}C)

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

Aonla-Papaya toffees were analyzed for changes in chemical and sensory parameters at monthly intervals for three months storage. Total soluble solids (TSS) were estimated at ambient temperature by hand refractometer (58-92%) for aonla-papaya toffee. Acidity and ascorbic acid contents were analyzed by the methods of Ranganna (2014) [12]. Total carotenoids were analyzed by Rodriguez-Amaya method (1999) [13] and total phenols were estimated by the method of Amorium (1977) [1]. The overall acceptability of aonla-papaya toffee was based on mean scores obtained for all the sensory characters *i.e.*, colour and appearance, flavour, taste and mouthfeel. The characters with mean scores of 6 and above out of 9 were considered acceptable (Ranganna, 2014) [12]. The treatments were replicated thrice and the data were analyzed statistically using completely randomized design. The critical difference value at 5 per cent level was used for making comparison among different treatments during storage.

Results and Discussion

The perusal of data presented in Table 1 show an increasing trend in total soluble solids of aonla-papaya toffee during three months storage. The increase in total soluble solids might be due to acid hydrolysis of insoluble polysaccharides especially gums and pectin, and its conversion into soluble sugars. Similar increase in TSS was observed by Attri *et al*. (2014) [2] in papaya toffee and Chavan *et al*. (2016) [5] in guava toffee. The acidity of aonla-papaya toffee decreased significantly during three months storage. Similar results of decrease in acidity were found by Attri *et al*. (2014) [2] in papaya toffee and leather.

The ascorbic acid content decreased significantly in aonla-papaya toffee 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 also be due to oxidation of ascorbic acid into dehydroascorbic acid. The differences in ascorbic acid content among different treatments might be due to differences in composition of raw materials in the recipes. Results are in confirmity with the findings of Mewada *et al*. (2013) [9] in guava-papaya toffee.

Table 1: Changes in chemical and sensory parameters of aonla-papaya toffee during storage

Treatments* Aonla: Papaya	Storage period (months)	Total soluble solids (%)	Acidity (%)	Ascorbic acid (mg/100 g)	Total carotenoids (mg/100 g)	Total phenols (mg/100 g)	Colour and appearance (score out of 9)	Flavour (score out of 9)	Taste (score out of 9)	Mouthfeel (score out of 9)	Overall acceptability (score out of 9)
100:0	0	75.0	1.06	186	0.11	92	7.6	8.5	8.1	7.8	7.9
	1	75.0	1.02	162	0.09	91	7.5	8.1	8.0	7.7	7.7
	2	76.0	0.93	153	0.08	88	7.5	7.8	7.6	7.2	7.4
	3	77.2	0.72	129	0.05	87	7.2	7.6	7.4	6.8	7.1
80:20	0	75.0	0.85	170	0.60	87	7.9	8.1	8.2	8.4	8.1
	1	75.3	0.80	158	0.54	84	7.8	8.0	8.1	8.2	8.0
	2	76.6	0.76	139	0.52	83	7.6	7.6	7.8	7.6	7.8
	3	78.0	0.68	127	0.48	81	7.6	7.4	7.6	7.0	7.4
0:100	0	75.0	0.20	32	1.67	76	8.4	8.0	8.4	8.6	8.4
	1	76.0	0.16	24	1.61	75	8.1	7.9	7.8	7.8	7.9
	2	77.0	0.12	17	1.55	72	7.8	7.5	7.7	7.6	7.7
	3	77.5	0.12	12	1.54	70	7.5	7.3	7.5	7.5	7.5
CD at 5%	Treatment	NS	0.05	1.74	0.07	1.81	0.18	0.13	NS	0.12	0.15
	Storage	0.56	0.05	2.01	NS	1.57	0.21	0.16	0.20	0.14	0.18
Treatment x Storage		NS	0.10	3.48	NS	NS	NS	NS	NS	0.25	NS

*Recipe- 1 kg blended pulp, 600 g sugar, 100 g glucose, 100 g butter and 160 g skimmed milk powder; NS - Non-significant

There was significant decrease in total carotenoids of aonla-papaya toffee during three months storage. It might be due to thermo-labile, thermo-sensitive and epoxide forming nature of carotene compounds. The results are in accordance with those of Attri *et al*. (2014) [2] in papaya toffee.

Decrease in total phenols of aonla-papaya toffee was also recorded during three months storage period. According to Kopjar *et al*. (2009) [8], 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. Similar results were observed by Deepika *et al*. (2016) [6] in aonla based fruit bars.

There was a significant decrease in colour and appearance, taste, flavour, mouthfeel and overall acceptability of aonla-papaya toffee during three months storage period. This might be due to changes in chemical constituents or certain enzymatic and non-enzymatic changes in the products. However, organoleptic score of the blended fruit products remained above the acceptable level even after three months storage. The decrease in sensory scores during storage was also observed by Chavan *et al*. (2016) [5] in guava toffee.

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