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Quality evaluation of value added products from Aonla

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Abstract
Aonla (*Emblica officinalis*) belongs to the family *Euphorbiaceae* and is assigned for various properties in the Ayurveda - an Indian indigenous system of medicine. It is a rich source of ascorbic acid and various other bioactive components when compared to other fruits. The present study involves the quality evaluation of value added products from Aonla. Aonla juice, Aonla ready to serve (RTS) beverage, Aonla squash and Aonla candy were prepared by standard procedures. The formulated product was evaluated for various physico-chemical characteristics; bioactive compounds and total antioxidant activity using DPPH assay. Sensory evaluation was also carried out for the value added Aonla products. Among the products the antioxidant components were found maximum in juice followed by candy, squash and RTS. Aonla squash scored highest for overall acceptability followed by RTS, candy and juice. This fruit products with immense health benefits could be easily adopted for large scale production by the industry.

Keywords: Aonla, quality evaluation, bio active components, antioxidant activity

Introduction
Fruits are rich sources of nutritional and bioactive compounds which confer immense health benefits. Aonla or amla (*Emblica officinalis*), popularly known as the Indian gooseberry, is a small sized, minor subtropical fruit and grows widely along the hillsides and sub mountainous areas of North India. This fruit is extensively used in the preparation of Ayurvedic and Unani medicines like chyawanprash and is regarded as rejuvenating herb [1]. Owing to its nutritive and miraculous medicinal properties, this fruit has acquired wide popularity. It is well known for its nutritional qualities. It is rich in polyphenols, minerals and is regarded as one of the richest source of vitamin C (200-900 mg per 100g of edible portion) [2]. The fruits of aonla are also excellent source of tannins. The fruits have 28 per cent of the total tannins distributed in the whole plant. The fresh fruits are generally not consumed as it is highly acidic and astringent; therefore it is not a popular table fruit [3]. But excellent nutritive value and therapeutic values of the fruit have great potential of processing into various quality products which can get positioned in national and international market [4]. The present study is aimed to evaluate the quality characteristics and antioxidant potential of value added Aonla products.

Material and Methods
Fresh and fully mature, good quality Aonla fruits were procured from local market of Madurai, Tamil Nadu and used in the study. The procured fruits were inspected to discard the spoiled, bruised and immature ones. The products such as pasteurized juice, RTS beverage, squash and candy were processed from Aonla using standard methods.

Physico-chemical analysis
The value added products were analysed for various physico-chemical parameters. The moisture content was determined by AOAC method [5]. The total soluble solids of the products were determined using a hand refractometer (0 to 32º brix). Titratable acidity was determined by titration method [6]. The pH of the products was estimated by the method described by Saini [7]. The total and reducing sugars were estimated by Shaffer Somoyogi method [8]. The crude fibre content was determined by acid alkali method [9].
Colour values of the products was measured using a chromometer using the Hunter L*, a*, b* values. L*-value indicate the intensity of colour towards lightness. The - a* shows the greenness while + a* shows trend towards redness. The positive b* -value indicating tendency toward yellowness of beverage while negative value indicate blue colour.

Analysis of bioactive compounds and antioxidant activity
Ascorbic acid content of aonla products were estimated by titration method and total polyphenols were determined by the spectrophotometric method [10]. Total flavonoids were measured using aluminium chloride colorimetric assay [11]. The analysis of antioxidant activity was carried out using DPPH assay [12].

Sensory acceptability
The sensory acceptability of aonla products were determined using nine point hedonic rating scale. The parameters evaluated include appearance, colour, taste, flavour, consistency and overall acceptability [13].

Statistical analysis
The values reported are mean ± standard deviation of three evaluations. Factorial Completely Randomized Design (FCRD) [14] were employed for analysis of data at 0.05 level of significance.

Result and Discussion
Physico-Chemical Analysis
Table 1 showed the results obtained for the physico

chemical and nutritional characteristics of value added Aonla products. The results clearly indicated that there were significant differences between the Aonla products in terms of physico chemical and nutritional characters.

Table 1: Physico Chemical and Nutritional Characteristics of value added Aonla Products

Parameters		Aonla Juice	Aonla RTS	Aonla Squash	Aonla Candy
Moisture Content (%)		-	-	-	17.15 ± 0.49
TSS (˚brix)		11.0 ± 0.47	15.0 ± 0.06	45.0 ± 2.02	75.0 ± 0.88
Acidity (%)		2.35 ± 0.05	0.32 ± 0.008	1.00 ± 0.01	0.52 ± 0.01
pH		2.25 ± 0.04	3.52 ± 0.13	2.70 ± 0.03	3.31 ± 0.12
Colour	L*	18.66 ± 0.01	29.80 ± 0.02	95.84 ± 1.03	105.34 ± 2.94
	a*	-0.51 ± 0.02	-1.45 ± 0.01	-6.92 ± 0.30	8.97 ± 0.17
	b*	-0.80 ± 0.02	-4.42 ± 0.04	20.48 ± 0.35	42.9 ± 1.50
Reducing sugar (g/100g)		5.15 ± 0.20	6.21 ± 0.12	23.54 ± 0.89	37.20 ± 1.40
Total sugar (g/100g)		9.13 ± 0.28	14.10 ± 0.41	43.20 ± 1.32	66.50 ± 2.69
Crude fibre (g/100g)		-	-	-	2.03 ± 0.06

All data are the Mean ± S.D of three replicates

Bioactive Components

The bioactive components in value added Aonla products were given in Table 2. Different factors such as processing techniques, clarification, osmotic dehydration and pasteurization can affect the bioactive components of processed products. The ascorbic acid content of Aonla juice, Aonla RTS, Aonla squash and candy were 456.2 mg/100g, 131.25 mg/100g, 182.47 mg/100g and 206.34 mg/100g respectively. Different techniques of measuring and squeezing process may also affect the vitamin C contents of fruit juices [15]. Klopotek [16] showed that the vitamin C contents of strawberry juices decrease 35 per cent by pasteurization.

The total poly phenols, flavonoids and tannin contents were also found high in the juice compared to RTS, squash and candy. The poly phenol contents in Aonla products were low due to loss of phenolics during juice extraction, pasteurization and osmotic dehydration process. Another reason may be that polyphenols are involved in specific physicochemical interactions with the solid part of the fruits, especially the cell wall material [17]. Hertog [18] and Shadidi and Nazck [19] had shown that flavonoid content could be affected by different processing techniques.

Mehta [20] stated that the decrease in total tannins in dried Aonla might have been due to the action of the enzyme polyphenoloxidase which might have converted tannins into other products. Oboh [21] reported that cooking or wet heating could increase the tannin content. Poiana [22] reported that the thermal processing of frozen fruits (strawberries, sweet cherries and sour cherries) into jam form resulted in significant losses of antioxidant capacity (30-41%), phenolics compounds (25-43%), vitamin C content (54-78%). Monomeric anthocyanins were extensively degraded (approximate 90%) during thermal processing.

Total Antioxidant Activity

Total antioxidant activity Aonla juice, Aonla RTS, Aonla squash and candy were 2239.37 mg/100g, 1151.67 mg/100g, 1385.45mg/100g and 1663.70 mg/100g respectively. The decrease in vitamin C, total poly phenols and total flavonoids content led to a decrease of antioxidant activity as a response of thermal processing of fruits. The maximum retention of antioxidant components and antioxidant activity in Aonla juice could be due to its minimum heat processing.

Kaur and Kapoor [23] reported more than 70 per cent antioxidant activities as percentage inhibition of oxidation in Aonla fruits which was correlated positively with total phenols. Bonsi and Padilla-Zakour [24] reported that the antioxidant capacity is reduced during processing of apple products. Apple sauce retained the most antioxidant capacity (>40%) among the three products. Cider and juice retained approximately 23 and 26 per cent of antioxidant capacity. Among the 3 apple sauce samples, sauce made from unpeeled blanched apples retained 73 per cent antioxidant capacity. The decrease in DPPH % scavenging activity during heat processing of amla bar, candy and toffee was directly correlated to total poly phenols content [25].

Table 2: Bioactive compounds and antioxidant activity of value added Aonla Products

Parameters	Aonla Juice	Aonla RTS	Aonla Squash	Aonla Candy
Ascorbic acid (mg/100g)	456.17 ± 6.59	131.25 ± 5.11	182.47 ± 4.11	206.34 ± 5.69
Total Poly phenols (mg GAE/100g)	2207.04± 8.18	1597.20 ± 8.40	1675.86 ± 5.58	1861.60 ± 8.76
Total Flavonoids (mg QE/100g)	268.41 ± 6.77	192.12 ± 6.06	198.48 ± 2.32	212.76 ± 5.36
Tannins (g TAE/100g)	1.81 ± 0.06	0.35 ± 0.01	0.49 ± 0.01	0.52 ± 0.01
AAEAA (mg/100g)	2239.37± 8.02	1151.67 ± 9.83	1385.45 ± 10.45	1663.70 ± 14.55

AAEAA – Ascorbic acid equivalent antioxidant activity All data are the Mean ± S.D of three replicates

Sensory Analysis

The processed Aonla products were evaluated for sensory evaluation on nine point hedonic rating for consumer acceptance and the data was given in Fig 1. The results of overall acceptability showed that squash scored highest (8.65) followed by RTS (8.51) candy (8.07) and juice (7.31). The highest value of overall acceptability for squash and RTS may be due to it sweet and sour taste.

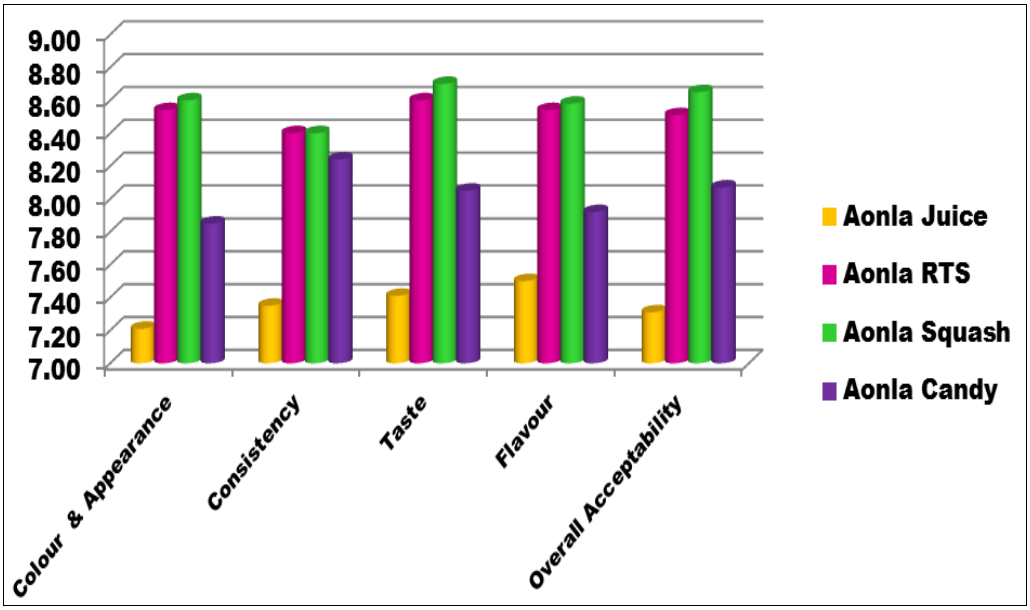

Fig 1: Sensory Scores of value added Aonla Products

Conclusion

Aonla fruit, because of its high acidity and astringent taste, is not palatable for direct consumption. Hence it is consumed mainly in processed form. The value added products retain bioactive components even after processing. It could be concluded from the results of the present investigation that thermal processing of fruits lead to significant alterations in retention of antioxidant components. The processed products are not only good source of antioxidants but also have consumer acceptance.

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