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Effect of Processing on Retention of Antioxidant Components in Value Added Amla Products

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Abstract

Amla (*Emblica officinalis*) is an important crop indigenous to Indian subcontinent which is used in alternative medicine, health foods and herbal products. It is also found to be a rich source of ascorbic acid and other bioactive substances as compared to any other fruits. The current research work was taken to study the effect of processing on retention of antioxidant components in value added amla products. Amla juice, amla ready to serve (RTS) beverage, amla squash and amla candy were prepared by following standard procedures as by the FPO specifications of Indian standards. Ascorbic acid content, total poly phenols, total flavonoids, tannins and total antioxidant activity were analysed in the prepared products immediately after the preparation and the results were taken for comparison with fresh amla towards finding out the retention of the antioxidant components during processing. Sensory qualities of the prepared products were evaluated. Among the processed amla products the antioxidant components were found maximum in juice followed by candy, squash and RTS. Amla squash scored highest for overall acceptability followed by RTS, candy and juice. Amla being rich in antioxidants should be minimally processed to retain its bioactive components.

Keywords: Amla, Ascorbic acid, Poly phenols, Flavonoids, Antioxidant Activity

1. Introduction

Amla or aonla (*Emblica officinalis*), popularly known as the Indian gooseberry, is a small sized, minor sub-tropical 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 chyavanprash 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. Amla is not only rich in poly phenols, tannins and minerals and also for vitamin C (200-900 mg per 100 g edible portion)[2]. The amla fruits are found to have 28 per cent of the total tannin content of the whole plant and contained two of its hydrolysable tannins known well as *Emblicanin* A and *Emblicanin* B. These have antioxidant properties and the former on hydrolysis yields gallic acid, ellagic acid and glucose and the subsequent yields ellagic acid and glucose[3].

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Though the fruit is rich in antioxidants and other nutrients, it is not consumed fresh because of high acidity and astringency. It is, therefore, processed into various value added products, viz. preserve (murabba), candy, juice, pickle, powder, segments-in-syrup, etc.[4]. However, processed fruits and vegetables have been considered to have a lower nutritional value than their respective fresh commodities due to the loss of vitamin C content during processing[5–6]. It is suggested that the processed fruits and vegetables would have retained their antioxidant activity inspite of the loss of vitamin C. hence the objective of the study is mainly to evaluate the effect of processing on retention of antioxidant components of value added amla products by assessing the ascorbic acid, total poly phenols, total flavonoids, tannins and total antioxidant activity of fresh amla fruit and value added amla products.

2. Material and Methods

Fresh and fully mature, good quality amla fruits were procured from Agricultural College Orchard, 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 amla using standard methods.

2.1 Physico-chemical Analysis

The physico chemical and nutritional characteristics of the fresh and processed amla products were analysed. The moisture content was determined by AOAC method[7]. The total soluble solid (TSS) content of the fresh and processed amla products were measured using a hand refractometer. Titratable acidity was determined by titration of aliquots against 0.1 N NaOH using phenolphthalein as indicator and was expressed in percentage of citric acid and the pH was estimated by digital pH meter[8]. The total and reducing sugars were estimated by Shaffer Somoyogi method[9]. The crude fibre content was determined by acid alkali method[10].

The colour of the samples was measured using a chromometer using the Hunter L*, a*, b* units, where L* indicates luminosity or brightness, a* corresponds to greenness (-)/ redness (+) and b* corresponds to blueness (-)/ yellowness (+).

2.2 Analysis of Antioxidant Components and Antioxidant Activity

Ascorbic acid content of amla products was estimated by volumetric method, total phenolic contents was determined by the spectrophotometric method and expressed as mg of Gallic Acid Equivalent (GAE) per 100 g on Fresh Weight Basis (FWB), tannin content was measured using Folin-Denis method and expressed as g of Tannic Acid Equivalent (TAE) per 100 g on FWB[11]. Total flavonoids were measured using aluminium chloride colorimetric assay[12] and expressed as mg of Quercetin Equivalent (QE) per 100 g on FWB. The analysis of total antioxidant activity was carried out using DPPH assay[13] and the results were reported as mg of Ascorbic Acid Equivalent of Antioxidant Activity (AAEAA) per 100 g on Fresh Weight Basis (FWB).

2.3 Sensory Acceptability

The sensory acceptability of amla products was determined using nine point hedonic rating scale by untrained judges. The parameters evaluated include appearance, colour, taste, flavour, consistency and overall acceptability.

3. Result and Discussion

3.1 Physico-chemical Analysis

Table 1 showed the results obtained for the physico chemical and nutritional characteristics of fresh and processed amla products. The results clearly indicated that there were significant differences between the processed amla products in terms of physico chemical and nutritional characters.

3.2 Antioxidant Components

The antioxidant components in processed amla products were compared with the fresh amla were given in Table 2. Different factors such as processing techniques, clarification, osmotic dehydration and pasteurization can affect the antioxidant components of processed products. The ascorbic acid content of amla juice, amla RTS, amla squash and candy had 456.2 mg/100g, 131.25 mg/100g, 182.47 mg/100g and 206.34 mg/100g

Table 1. Physico chemical and nutritional characteristics of fresh and processed amla products

Parameters		Amla	Amla Juice	Amla RTS	Amla Squash	Amla Candy
Moisture Content (%)		81.80 ± 0.20	-	-	-	17.15 ± 0.49
TSS (˚brix)		11.3 ± 0.08	11.0 ± 0.47	15.0 ± 0.06	45.0 ± 2.02	75.0 ± 0.88
Acidity (%)		2.50 ± 0.02	2.35 ± 0.05	0.32 ± 0.008	1.00 ± 0.01	0.52 ± 0.01
pH		2.10 ± 0.02	2.25 ± 0.04	3.52 ± 0.13	2.70 ± 0.03	3.31 ± 0.12
Colour	L*	82.00 ± 1.62	18.66 ± 0.01	29.80 ± 0.02	95.84 ± 1.03	105.34 ± 2.94
	a*	-19.51 ± 0.79	-0.51 ± 0.02	-1.45 ± 0.01	-6.92 ± 0.30	8.97 ± 0.17
	b*	36.86 ± 0.66	-0.80 ± 0.02	-4.42 ± 0.04	20.48 ± 0.35	42.9 ± 1.50
Reducing sugar (g/100g)		4.82 ± 0.13	5.15 ± 0.20	6.21 ± 0.12	23.54 ± 0.89	37.20 ± 1.40
Total sugar (g/100g)		9.45 ± 0.41	9.13 ± 0.28	14.10 ± 0.41	43.20 ± 1.32	66.50 ± 2.69
Crude fibre (g/100g)		3.40 ± 0.07	-	-	-	2.03 ± 0.06

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

Table 2. Antioxidant components in fresh and processed amla products

Parameters	Amla	Amla Juice	Amla RTS	Amla Squash	Amla Candy
Ascorbic acid (mg/100g)	526.80 ± 4.93	456.17 ± 6.59 (86.59)	131.25 ± 5.11 (24.91)	182.47 ± 4.11 (34.63)	206.34 ± 5.69 (39.16)
Total Poly phenols (mg GAE/100g)	2904.00 ± 9.22	2207.04 ± 8.18 (76.00)	1597.20 ± 8.40 (55.00)	1675.86 ± 5.58 (57.70)	1861.60 ± 8.76 (64.10)
Total Flavonoids (mg QE/100g)	369.46 ± 6.55	268.41 ± 6.77 (72.64)	192.12 ± 6.06 (52.00)	198.48 ± 2.32 (53.72)	212.76 ± 5.36 (57.58)
Tannins (g TAE/100g)	2.14 ± 0.04	1.81 ± 0.06 (84.67)	0.35 ± 0.01 (16.54)	0.49 ± 0.01 (22.89)	0.52 ± 0.01 (24.29)
AAEAA (mg/100g)	2763.95 ± 16.87	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; Values in parenthesis are percentage retention of components

respectively. Different techniques of measuring and squeezing process may also affect the vitamin C contents of fruit juices[14]. Klopotek et al.[15] 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 amla products were found to be less when compared with the fruits 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[16]. Hertog et al.[17] and Shadidi and Nazck[18] had shown that flavonoid content could be affected by different processing techniques.

Mehta[19] stated that the total tannins were found to be reduced in the dried amla would have happened as the action of enzyme polyphenoloxidase converting tannin into other products. Oboh et al.[20] reported that cooking or wet heating could increase the tannin content. Poiana et al.[21] reported that the jam prepared from frozen fruits (strawberries, sweet cherries and sour cherries) using heat source showed a notable loss of antioxidant capacity (30–41%), phenolics compounds (25–43%), vitamin C content (54–78%). Extensive loss of monomeric anthocyanins were (found approximate 90%) at the time of thermal processing.

3.3 Total Antioxidant Activity

Total antioxidant activity in fresh fruit was 2763.95 mg AAEAA /100g and amla juice, amla RTS, amla squash and candy had 2239.37 mg/100g, 1151.67 mg/100g, 1385.45mg/100g and 1663.70 mg/100g respectively. The heat processing of fruits showed a decrease in antioxidant activity due to decrease in vitamin C, total poly phenols and total flavonoids content. The maximum retention of antioxidant components and antioxidant activity in amla juice could be due to its minimum heat processing.

Kaur and Kapoor[22] reported more than 70 per cent antioxidant activities were correlated positively with total phenols. Bonsi and Padilla-Zakour[23] reported that apple products showed a reduction in antioxidant capacity at the time of processing. 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 reduction of DPPH % scavenging activity is positively correlated to the total poly phenols content during thermal processing of amla bar, candy and toffee[24].

The intensity of the radical scavenging effect is measured by the calculated half-Inhibition Concentration (IC_{50}), the efficient concentration required for decreasing initial DPPH concentration by 50 per cent. The antioxidant potential is inversely proportional to IC_{50} value, which was calculated from the linear regression of the percentage antioxidant activity versus extracts concentration, a lower IC_{50} value would reflect greater antioxidant activity of the sample.

From Figure1 the IC_{50} values of methanolic extracts of amla products was found to be highest in amla RTS (284 µg/ml) followed by amla squash (273 µg/ml), amla candy (267.5 µg/ml), amla juice (208 µg/ml) and lowest in amla fruit (170 µg/ml). Liu et al.[25] stated that the aqueous fraction of amla showed the highest DPPH radical scavenging activity (IC_{50} 142.6 µg/ml). Khomdram and Shantibaladevi[26] reported that the amla fruit has very high amount of vitamin C (379.7 mg/100g).

3.4 Sensory Analysis

The processed amla products were evaluated for various sensory attributes by semi trained judges using nine point hedonic rating scale and the scores obtained was presented in Table 3. 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 sensory score value for the overall acceptability of squash and RTS might be high because of its sweet and sour taste.

4. Conclusion

Amla fruit is found to have more vitamin C and bioactive components. Though because of its high acid content and astringent taste made the amla fruits not more palatable for direct consumption or as table fruits. Then it has to be

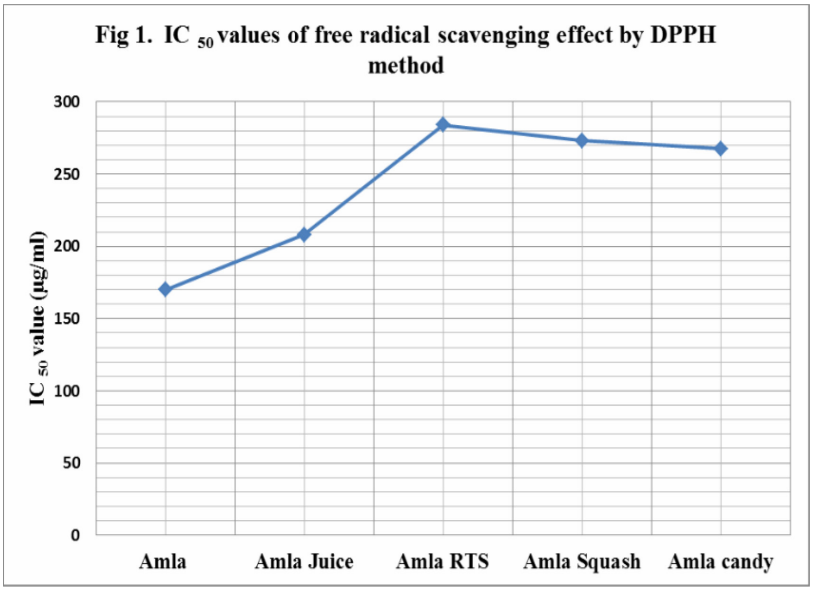

Figure 1. C_{50} values of free radical scavenging effect by DPPH method.

Table 3. Sensory scores of processed amla products

Products	Colour and Appearance	Consistency	Taste	Flavour	Overall Acceptability
Amla Juice	7.21 ± 0.25	7.35 ± 1.08	7.41 ± 0.12	7.50 ± 0.25	7.31 ± 0.24
Amla RTS	8.54 ± 0.15	8.40 ± 0.15	8.60± 0.16	8.54 ± 0.11	8.51 ± 0.01
Amla Squash	8.60 ± 0.05	8.40 ± 0.35	8.70± 0.30	8.58 ± 0.11	8.65 ± 0.10
Amla Candy	7.85 ± 0.18	8.24 ± 0.07	8.05 ± 0.29	7.92 ± 0.30	8.07 ± 0.29

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

processed into various value added products. The bioactive components of amla were found to be retained even after converting them into value added products under thermal processing. Based on the research work it is concluded that thermal processing of fruits lead to significant alterations in retention of antioxidant components.

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