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Studies on process standardization of sugarless amla (*Phyllanthus emblica*) candy

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Abstract
The present investigation focuses on standardization the process for preparation of Amla Candy using sorbitol. Further, sugar was completely replaced with sorbitol. It can be concluded that sorbitol syrup concentration treatments (45°Bx, 50°Bx and 70°Bx) along with 02% alum pretreatment was found to be suitable to improve the quality of candy. Moreover, cabinet tray drying (60°C) was selected on the basis of chemical composition and organoleptic evaluation for commercial feasibility. Eventually, the prepared candies can be properly stored in standing pouch up to 02 to 03 months without affecting their sensory quality attributes. This sorbitol based Amla Candy is nutraceutical rich product that have low calorific value & additional health benefits. Therefore, the developed Amla candies can be one of the upcoming value added food products. They may have a good commercial market and subject to catch attention of diabetic persons.

Keywords: Amla candy, *Phyllanthus emblica*, sorbitol based candy, Indian gooseberry, sugar free candy, diabetic candy

Introduction
Amla (*Phyllanthus Emblica*), the king of arid fruits, popularly known as Indian Gooseberry is a minor sub-tropical deciduous tree indigenous to Indian sub-continents. India ranks first in the world in Amla area and production volume. The tree belongs to the family of Euphorbiaceae botanically known as *Phyllanthus Emblica.* It is known by different names like Amla, Amalakki, Nelli, Indian Gooseberry etc. The main varieties of amla are Banarasi, Chakaiya, Hathijhool, Bansi Red, Pink-tinged, and NA-7. The Amla gets ready for harvesting during November – December. However, the fruit may be allowed to remain on the tree till February without much fruit drops. A fully mature Amla tree may yield 250-300kg of fruit annually.
Amla is one of the oldest Indian fruits and considered as "*Wonder fruit for health***"** because of its unique qualities**.** It has played an important therapeutic role from time immemorial and is frequently recommended for its synergistic effects in both the ayurvedic and unani systems of medicine. It is the highest source of vitamin C (478.56 mg/100 ml). In addition to Vitamin C, it also contains calcium, iron, protein and tannic acids, sugar, phosphorus, carbohydrates etc. Amla primarily contains tannins, alkaloids, phenolic compounds, amino acids and carbohydrates. The fruit also contains considerably higher concentration of most minerals and amino acids than apples. The fruit is highly perishable in nature. Its storage life in atmospheric conditions after harvesting is only 5–6 days. The fresh fruits are generally not consumed due to their high astringency but it has got great potential in processed forms. Hence attention has been focused on the preparation of different value added products from Amla.
Amla candies have the endurance for as long as about 09 months. Amla candy would be more attractive to consumers because it is more practical to live to eat. It contains a number of nutritive elements and shows superiority with regard to food values. Amla candy is made by immersing pre-treated amla in concentrated sugar solution i.e. syrup. The transfer of sugar from syrup to amla and migration of moisture from amla to the syrup is driven by osmotic pressure gradient setup between osmotic solution and the fruit. Osmotic concentration is a simultaneous moisture and solute diffusion process.
Keeping in view the disadvantages associated with excessive sugar consumption, considerable interest is being taken to explore the possibilities of replacing sugar with alternate artificial sweeteners. Sucrose has a high glycemic index and for this reason diabetic people should not consume large quantities of typical confectionery products. For this reason, the products suitable for diabetics contain sucrose substitutes. Sorbitol presents three potential advantages over sucrose as food ingredients. First, they do not promote the development of dental caries because dental bacteria are not able to ferment the sugar alcohols. Second, they produce a lower glycemic response than sucrose and are therefore suitable for diabetics. And third, most

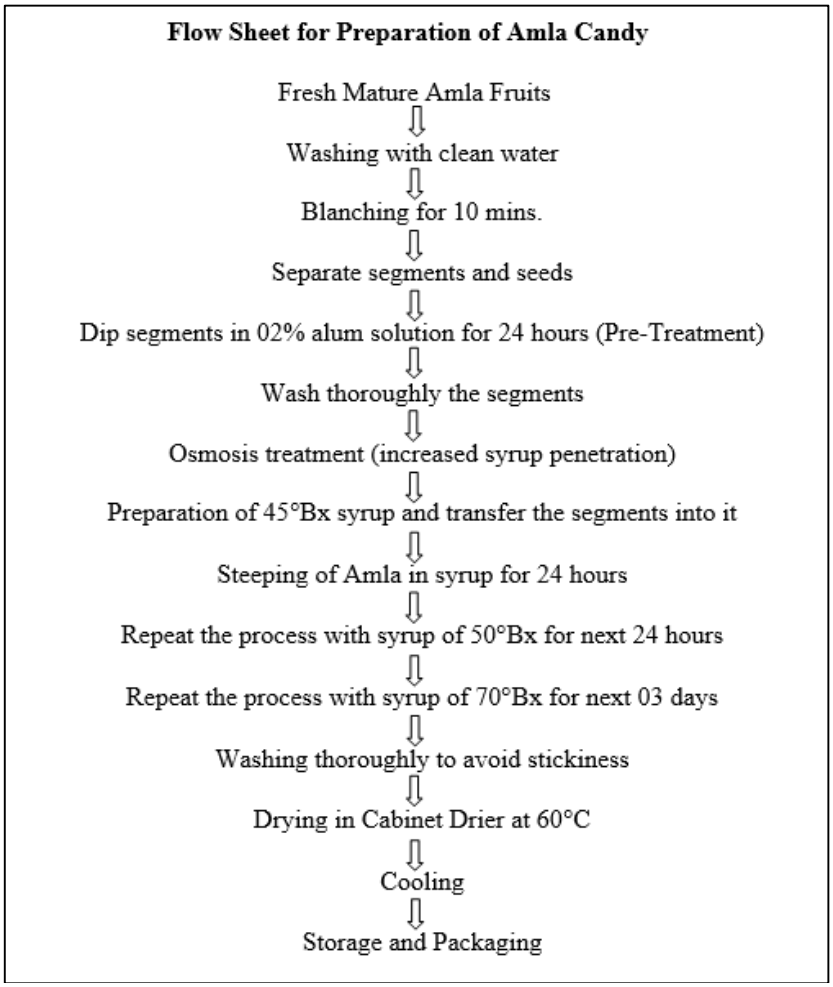
sorbitol are lower in calories (2.6 kcal/g) than sucrose (Kroger, Meister, & Kava, 2006) [12]. Sorbitol is produced industrially by hydrogenation of glucose derived from starch and from inverted sugar (Bornet, 1994) [3] and it presents about 60% of the sweetness of sucrose (Zumbé, Lee, & Storey, 2001). The use of sorbitol, which is of growing interest in drying processes for anti-browning (Labuza & Warren, 1976) and as a humectant (Zimmermann, 1989) [31], could give dried products with higher humidity but with the same water activity. Therefore, efforts were made to explore the possibility of utilizing sorbitol in place of sugar as sweetening material for production of amla candies.

Materials and Methods

Freshly harvested Amla fruits (Var. Krishna) were procured from local market. Krishna variety is moderate in keeping quality, hence selected for preparing candy (Pathak *et al*., 2003) [24]. Sorbitol, sugar and alum required for product preparation were purchased from local market. The suitable packaging materials i.e. standing pouch of 250 gauge for the purpose of study were obtained from local market.

Preparation of Amla Candy

Healthy, disease, pest and bruise-free Amla fruits were selected for the processing of Amla Candy. Fruits were then washed properly in running water to clean the fruit. Fruits were blanched in boiling water for 10 min. (Geetha *et al*., 2006) [6]. Then seeds were removed and segments were separated as suggested by (Kumar *et al*., 2001) [13]. The blanched segments were steeped in 02 % alum solution for one day. Proper washing was done to remove the traces of alum on the next day. The product was prepared by dipping the segments in successive increasing concentrations of sugar syrup at room temperature till equilibrium at 70°B was reached as per the method described by (Tandon *et al*., 2006) [25]. Firstly, 45°Bx sugar syrup was prepared to which pre-treated segments were transferred. After soaking for 24 hours, the segments were taken out and same syrup was boiled to the concentration of 70°Bx, which was cooled and transferred to the fruit segments. The product was kept for next 03 days. On the fourth day, the osmosed segment were separated out from syrup and washed thoroughly to remove surface syrup to avoid stickiness. The segments were spread on the aluminium trays with some spacing uniformly. And drying was carried out at 60±2 ^{0}C in a cross flow cabinet tray dryer with air velocity of 1.2±0.1 m/s. When the sufficiently dry and leathery texture was achieved, product was removed from dryer and cooled to ambient temperature. It was immediately packed, sealed and stored. The research project has been designed to study the consequence of replacing common cane sugar with natural sweetener sorbitol.



Formulation of Recipe of Amla Candy

Method comprised of first syruping treatment at 45°Bx for 24 hours, followed by second syruping treatment at 50°Bx for next 24 hours and eventually third syruping treatment at 70°Bx steeped for 72 hours.

Table 1: Standardized Syrup Concentration

Syruping Treatment	° Brix	Steeping Period
1st	45	24 hours
2nd	50	24 hours
3rd	70	72 hours

Results and Discussion

Physico-chemical & Nutritional parameters of Amla fruit

During present investigation, Amla fruit of Krishna variety was selected for the development of Amla Candy. It is because var. Krishna is most suitable for the preparation of quality product candy as reported by Nayak *et al.* (2009) [16] on the basis of the observations recorded on various biochemical characters and organoleptic quality. The physical characteristics of fresh fruits are depicted in Table 2.

Table 2: Physical characteristics of Amla fruit

Parameters	Observations
Colour	Light Greenish Yellow
Diameter (cm)	3.78
Height (cm)	3.50
Fruit weight (g)	15.58
Seed weight (g)	1.40
Pulp weight	90% of the fruit weight

Each value is an average of three determinations

The colour of selected Amla fruit is observed of light greenish yellow which will be highly reflected in the final prepared candies. The Amla fruit had weight of 15.58g whereas the weight of pulp was found to be 90%.

Data reported in Table 2. is in well agreement with the data obtained by Indian Medicinal Plants (1997) [10] elaborated as the *Phyllanthus Emblica* fruit is light greenish yellow, spherical and appear to be much hard and the taste of fruit is sour. Fruits are fleshy, pale yellow with six obscure vertical furrows enclosing six trigonous seeds.

Table 3: Proximate Chemical & Nutritional composition of Amla fruit

Parameters	Observations
Moisture (%)	83.0
Total Soluble Solids (°Brix)	8.9
Acidity (%)	1.5
Protein (%)	0.65
Fat (%)	0.12
Mineral Matter (%)	0.80
Fiber (%)	3.50
Carbohydrate (%)	14.65
Calcium (%)	0.045
Phosphorous (%)	0.025
Iron (mg/100g)	1.5
Ascorbic Acid (mg/100g)	423.65
Polyphenol (%)	3.2

Each value is an average of three determinations

The nutritional composition of Amla fruit (var. Krishna) was estimated and presented in Table 3. Data in table revealed that Krishna variety amla fruit contain 83 % moisture content. The highest mineral content especially in calcium, phosphorous, iron along with highest vitamin C content in selected Amla variety fulfills the nutritional enrichment in the final processed product viz. Amla candies. The total mineral matter in fruit is 0.80 %, which is composed of majorly iron (1.5 mg/100g fruit), calcium (0.045 %) and phosphorous (0.025 %). Moreover Amla fruit contain 3.2 % polyphenol and 423.65 mg/100g ascorbic acid was occurred. The results obtained were found more or less similar to those reported by Dachiya *et al.* (2001) [4]. It can be seen from the table that the total soluble solids and acidity was found to be 8.9° Bx and 1.5 % respectively in the selected amla fruits. Similar results regarding nutritional composition of Amla fruits are reported by Bharthakur *et al.,* 1991 [2]; Singh *et al.,* 1993 [24] and Jain *et al.,* 2002 [11].

Effect of syrup concentration on Sugar based Amla Candy (C_1) & Sorbitol based Amla Candy (S_1)

Table 4. revealed that after first syrup treatment, highest water loss (43.40 %) and highest solid gain (39.55 %) in S_1 sample after 3rd day syrup treatment. This is because of sorbitol having a lower molecular weight than other osmotic agents. The use of low molecular weight osmotic agent, such as sorbitol, increased the osmotic pressure gradient and thereby increased the water loss (Phisut *et al*., 2013) [20]. Low molecular weight solutes markedly penetrated the fruits, whereas those of higher molecular weight only showed a slight and slow inward motion. This effect could be interpreted in terms of respective solute diffusivities (Torreggiani *et al*., 1993) [26]. The use of sorbitol for candy preparation plays a key role in osmosis process for partial removal of water from fruit tissue and addition of solute by immersion in hypertonic solution. This is affected mainly by solute type, solute concentration and osmosis duration. Tortoe, (2010) [27] stated that the specific effect of osmotic solution is of great importance when choosing the solution, which was observed in present study. This is actually based upon molecular weight and size of solute of alternate osmotic agent.

Table 4: Effect of Syrup Concentration on Sugar based Amla Candy

Sample	After 1st Syrup Treatment			After 2nd Syrup Treatment			After 3rd (day) Syrup Treatment		
	Syrup Conc. (°B)	WL* (%)	SG** (%)	Syrup Conc. (°B)	WL* (%)	SG** (%)	Syrup Conc. (°B)	WL * (%)	SG** (%)
C_1	45	19.85	16.20	50	26.65	22.35	70	40.45	36.50
S_1	45	23.70	18.20	50	30.95	25.10	70	43.40	39.55

WL*: Water Loss, SG**: Solid Gain

Organoleptic quality of prepared Amla Candy

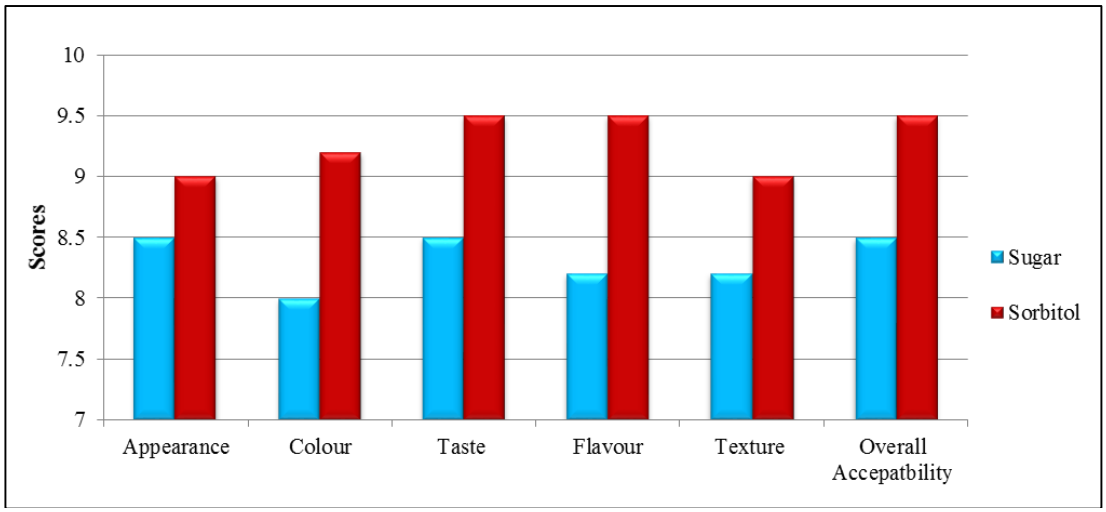
Organoleptic evaluation was done by 9 point hedonic scale for various quality attributes which decides the suitability of syrup concentration for preparation of Amla Candy. The average scores of organoleptic evaluation are depicted in Table 5.

The results of sensory assessment showed that the perception of the quality of product varied significantly with the osmotic agent as well as syrup concentration (by varying °Bx). Sensory scores for S_1 sample were found to be highest for all parameters than sugar based candy samples. Highest score obtained in overall acceptability (9.5) showed that it as highly accepted by judges.

Table 5: Organoleptic quality of prepared Amla Candy

Samples	Appearance	Colour	Taste	Flavour	Texture	Overall Acceptability
C_1	8.5	8.0	8.5	8.2	8.2	8.5
S_1	9.0	9.2	9.5	9.5	9.0	9.5
SE ±	0.126	0.128	0.128	0.115	0.113	0.115
CD at 5%	0.35	0.35	0.35	0.32	0.312	0.32

Each value is an average of ten determinations



Physico-chemical & Nutritional parameters of Amla Candy

Amla Candy can be categorized under intermediate moisture food. Generally, intermediate moisture food (IMF) contains moderate levels of moisture of the order of 20 to 50 % (Vora *et al.*, 2003) [17]. The IM foods have an acceptable eating quality and reasonable storage stability under ambient conditions (Iman *et al.*, 2011) [9]. The data pertaining to the results of physico-chemical and nutritional analysis of selected Amla candies (sugar based & sorbitol based) is presented in the Table 6.

Table 6: Physico-chemical & Nutritional parameters of Amla Candy

Parameters	Sugar based Amla Candy (C_1)	Sorbitol based Amla Candy (S_1)
Moisture (%)	24.30	23.80
T.S.S (°Bx)	74	73
pH	3.50	4.10
Acidity (%)	0.50	0.48
Protein (%)	0.35	0.39
Fat (%)	0.10	0.12
Crude Fiber (%)	3.1	3.3
Carbohydrate (%)	70.50	78.20
Total sugar (%)	65.35	72.82
Ascorbic Acid (mg/100g)	242.75	231.25
Iron (mg/100g)	0.60	0.65
Calcium (mg/100g)	43.87	36.15
Magnesium (mg/100g)	18.63	15.60
Phosphorous (mg/100g)	7.16	8.35
Potassium (mg/100g)	189.75	192.35
Sodium (mg/100g)	8.1	11.2
Energy Value (kcal/100g)	284.44	230.95

Each value is an average of three determinations

The present investigation showed the moisture content present is within acceptable range (23-25 %). The total sugar content was found to be highest in the case of sorbitol based candy (72.82 %) as compared to other candies, may be attributed to its high solid gain during osmosis. On the contrary, ascorbic acid estimated is found to present in the lowest amount in candy (231.25 mg/100g). Highest pH and lower acidity indicates comparatively its basic nature. In addition, sorbitol treatment as osmotic agent caused drastic increase in all minerals. Similar findings related to increment of mineral content was also reported by Hanan and Rasha (2012) [7] during the nutritional assessment of Baladi rose petal jam by addition of sorbitol in replacement of sugar. It was observed that sorbitol retained considerable amount of iron in candy (0.65 mg/100g). Further, Loria *et al.* (1962) [15] observed that sorbitol increases intestinal absorption of iron in man, therefore Amla candy prepared with sorbitol may increase the iron bioavailability.

(Ca – 36.15 mg/100g, Mg – 15.60 mg/100g and K – 192.35 mg/100g) represents good source of mineral content. Further, the highest amount of sodium (8.5 mg/100g) & highest amount of phosphorus (8.35 mg/100g) is also observed. However, sorbitol based Amla candy found to have lowest energy value (230.95 kcal). It is because sorbitol has fewer calories per unit mass compared to sucrose (Ziesenitz & Siebert, 1987) [30]. Therefore, sorbitol is best known for its use in diabetic foods. Hence, this product is an attempt to cater the customers who are concerned about weight management and blood glucose level.

Sorbitol offer some important health benefits, which include the maintenance of good oral health (Hayes, 2001) [8], weight control and reduction of dietary glycemic load (Wolever, 2002) [29]. Besides, these low digestible carbohydrates may play a role in the maintenance of human digestive health.

Conclusion

The present investigation focuses on standardization the process for preparation of Amla Candy using sorbitol. Further, sugar was completely replaced with sorbitol. It can be concluded that sorbitol syrup concentration treatments (45°Bx, 50°Bx and 70°Bx) along with 02% alum pretreatment was found to be suitable to improve the quality of candy. Moreover, cabinet tray drying (60 °C) was selected on the basis of chemical composition and organoleptic evaluation for commercial feasibility. Eventually, the prepared candies can

be properly stored in standing pouch up to 02-03 months without affecting their sensory quality attributes. This sorbitol based Amla Candy is nutraceutical rich product & provides low calories combined with an additional health benefits as a result of appreciable amount of mineral content. Therefore, the developed Amla candies can be one of the upcoming value added food products. They may have a good commercial market and subject to catch attention of customers of every age group.

Hence it is finally concluded that developed processing technology for preparation of Amla Candy is techno economically viable and therefore can be commercially exploited.

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