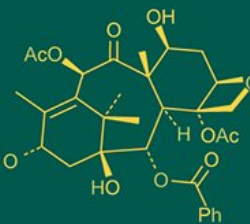
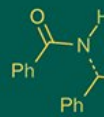
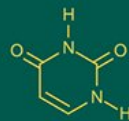
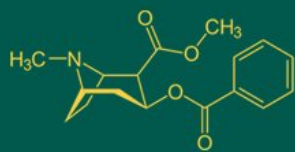


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Standardization of recipe and organoleptic evaluation of custard apple nectar fortified with aonla

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Abstract

The present investigation entitled "Standardization of recipe and organoleptic evaluation of custard apple nectar fortified with aonla" was carried out at the Horticulture Processing Laboratory, Department of Fruit Science, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, during the academic year 2025-26. The experiment was conducted using a Completely Randomized Design (CRD) consisting of eight treatment combinations, each replicated three times. The sensory quality of the fortified custard apple nectar was significantly affected by the different treatment combinations. Among all the treatments, the treatment T₆ [88% custard apple pulp and 12% aonla pulp] achieved the maximum organoleptic scores and was identified as the most acceptable recipe. This treatment demonstrated superior overall sensory characteristics, indicating its suitability for the preparation of fortified custard apple nectar.

Keywords: Standardization, fortified, nectar, organoleptic, custard apple and aonla

Introduction

Custard apple (*Annona squamosa* L.), commonly known as sugar apple or Sitaphal, is an important dryland fruit crop cultivated in tropical and subtropical regions because of its adaptability to arid and semi-arid conditions. It has been recognized as the "New Super Fruit of the 21st Century" due to its exceptional nutritional and medicinal properties (Gautam *et al.*, 2021). Among the edible species of the genus *Annona*, custard apple is the most commercially important fruit crop grown in tropical and subtropical regions worldwide. In India, it can be seen growing wild as well as cultivated in tropical and subtropical part of the country (Singh *et al.*, 2013). The fruit is highly valued for its aromatic, creamy-white pulp and is a rich source of vitamins A and C, carbohydrates, minerals and natural sugars making it a nutritious fruit with an energy value of about 105 kcal per 100 g of edible portion (Pillania *et al.*, 2010). Due to its high perishability nature, custard apple is difficult to store and transport, resulting in post-harvest losses. Despite its excellent nutritional and therapeutic qualities, there is a need to standardize suitable processing and preservation techniques (Parihar *et al.*, 2019). Processing the fruit into value-added products may reduce losses while offering a nutritious and healthier alternative to artificial beverages (Kumar *et al.*, 2015).

Aonla (*Emblica officinalis* Gaertn.), commonly known as Indian gooseberry, is an important indigenous fruit crop of India belonging to the family Euphorbiaceae (Pathak *et al.*, 2003). It is one of the richest natural sources of vitamin C and is also rich in polyphenols, dietary fibre, minerals and iron (Mehta *et al.*, 2002). Owing to its antioxidant, antiscorbutic, antimicrobial and therapeutic properties, aonla occupies an important place in the Ayurvedic and Unani systems of medicine. However, its sour and astringent taste and seasonal availability limit fresh consumption. Therefore, aonla is extensively processed into value-added products such as juice, nectar, candy, jam, murabba, beverages and chutney, enhancing its utilization and nutritional benefits (Goyal *et al.*, 2008).

Fruit beverages are becoming more popular in comparison to synthetic beverages or drinks since they are more nutritious. Nectar can be made by blending two or more fruit juices or pulp in various quantities, according to Attri *et al.*, (1998) and Langthasa (1999). Blending helps to balance the flavour, acidity, astringency, bitterness and enhances the nutritional value (De Carvalho *et al.*, 2007) [4, 16, 12, 9, 6, 10, 8, 5, 2, 7, 3].

Fortification of custard apple nectar with aonla offers a promising approach for developing a nutritionally enriched beverage with improved functional value and consumer acceptability. Therefore, the present study was undertaken to standardize the recipe for fortified custard apple nectar with aonla and to evaluate its organoleptic properties in order to identify the most acceptable formulation for the development of a nutritious and consumer-acceptable beverage.

Methods and Materials

For the preparation of fortified custard apple nectar, uniformly matured, healthy and diseases free Custard apple and Aonla fruits were procured from the local market. The flow chart for the preparation of custard apple nectar fortified with aonla is illustrated in Fig.1. The fruits were washed thoroughly with water and then were crushed in mixer grinder for the extraction of pulp. After extraction of pulp from the

selected fruits, the total soluble solids and acidity present in the fruit pulp were first recorded and then accordingly sugar and citric acid was added to maintain 15% TSS and 0.3% acidity in custard apple based fortified nectar. Further, sugar syrup was prepared and when the sugar completely dissolved in the water, citric acid was added. This sugar syrup was strained using muslin cloth, followed by addition of fruit pulp. This mixture was cooked until it reaches the TSS of 15 °Brix. The processed nectar was filled hot in the sterilized glass bottles leaving head space of 1.5-2 cm. The bottles were then sealed using corking machine and were stored in ambient condition. The resulting custard apple based fortified nectar were tasted by the panel of judges and were evaluated for various sensory parameters i.e. colour / appearance, taste, flavour, aroma & overall acceptability using 9-point Hedonic scale.

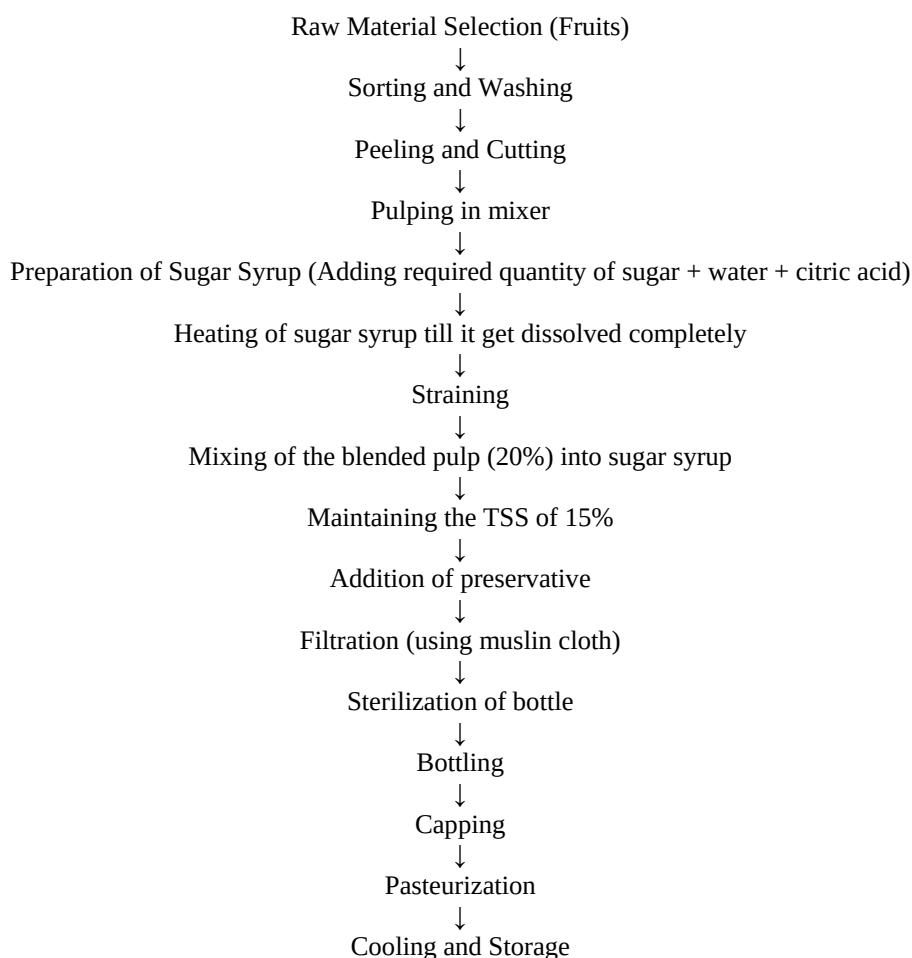


Fig 1: Flow chart for preparation of Nectar

Table 1: Treatment details of nectar

S.No.	Treatments	Notations used
1	Custard Apple pulp 100% (control)	T ₀
2	Custard Apple pulp: Aonla pulp (98:2)	T ₁
3	Custard Apple pulp: Aonla pulp (96:4)	T ₂
4	Custard Apple pulp: Aonla pulp (94:6)	T ₃
5	Custard Apple pulp: Aonla pulp (92:8)	T ₄
6	Custard Apple pulp: Aonla pulp (90:10)	T ₅
7	Custard Apple pulp: Aonla pulp (88:12)	T ₆
8	Custard Apple pulp: Aonla pulp (86:14)	T ₇

Results and Discussion

Sensory evaluation of custard apple nectar fortified with aonla

The organoleptic evaluation of custard apple nectar fortified with aonla were recorded for the following variables i.e. colour and appearance, taste, flavour, aroma and overall acceptability, which has been presented in Table 2 and 3.

Colour and appearance

The present experiment recorded the maximum mean score (8.20) of colour and appearance at the time of preparation under the treatment T₆ [Custard apple pulp: Aonla pulp (88:12)], while the minimum score (6.40) of colour and appearance was recorded under the treatment T₀ (100 per cent Custard apple pulp) at 0 day (time of preparation). The maximum colour and appearance observed under the treatment T₆ [Custard apple pulp: Aonla pulp (88:12)] was due to the less non-enzymatic reaction of organic acid with sugar or oxidation of phenols which leads to degradation of colour and appearance. Similar findings were noted by Gautam *et al.* (2021) in custard apple based nectar and Sharma (2023) in aonla based nectar. During the storage period the maximum (8.20) colour and appearance score of fortified nectar was examined during 0 day of storage (D0). However, the minimum (6.85) colour and appearance score was observed during 90 days of storage (D6). This decline may be attributed to non-enzymatic reactions between organic acids and sugars, as well as the oxidation of phenolic compounds, leading to colour degradation. It may also be associated with the decline in ascorbic acid content during the storage period. Similar results were reported by Thakre and Jain (2013) in papaya-banana nectar, Aswathy and Nirmala (2016) in annonaceous fruit nectar, Gautam *et al.* (2021) in custard apple based nectar and Sharma (2023) in aonla based nectar [4, 14, 17, 1, 4, 14].

Taste

It is evident from result obtained at the time of preparation under the present trial the maximum value of taste (8.30) was verified under the treatment T₆ [Custard apple pulp: Aonla pulp (88:12)], while the minimum score of taste (6.30) was demonstrated under T₀ (100 per cent Custard apple pulp). Treatment T₆ exhibited the maximum taste acceptability, which may be attributed to the desirable balance between sweetness and acidity achieved through the blending of custard apple and aonla pulp. The results of the present study are corroborated with the findings of Gautam *et al.* (2021) in custard apple based nectar. During the storage period the maximum taste score (8.30) was seen during 0 day of storage (D0). However, the minimum taste score (7.00) was noted during 90 days of storage (D6). This reduction in taste may be attributed to various extrinsic factors affecting the storage stability of the product, with storage temperature playing a significant role. Biochemical changes occurring under higher storage temperatures and pH conditions may have led to the formation of brown pigments, thereby reducing the taste quality of the nectar during storage. These results are substantiated with the finding observed by Thakre and Jain (2013) in papaya-banana nectar, Aswathy and Nirmala (2016) in annonaceous fruit nectar, Gautam *et al.* (2021) in custard apple based nectar and Sharma *et al.* (2023) in aonla blended nectar [4, 14, 17, 1, 4, 14].

Flavour

It is apparent from the result gained under the present investigation that the maximum value of flavour (8.20) was recognized under the treatment T₆ [Custard apple pulp: Aonla pulp (88:12)], while the minimum flavour score (6.20) was seen under T₀ (100 per cent Custard apple pulp). The improved flavour may be attributed to the complementary flavour characteristics of custard apple and aonla at an optimum blending proportion. The result of present study was verified with the findings testified by Patil *et al.* (2011) in rose apple -aonla nectar and Sharma *et al.* (2023) in aonla based nectar. As per data acquired under the present analysis during the storage, the maximum score of flavour (8.20) was viewed during 0 days (D0), however the minimum score (6.90) was contemplated during 90 days of storage (D6). The decline in flavour during storage may be attributed to several extrinsic factors affecting the storage stability of the processed product, among which temperature plays a crucial role. Biochemical changes occurring under higher storage temperatures and pH conditions may have promoted the development of off-flavours. Similar findings were in close agreement with earlier finding reported by Aswathy & Nirmala (2016) in annonaceous fruit nectar and Sharma (2023) in aonla based Nectar [11, 1, 14, 4].

Aroma

It is apparent from the result found under the present experiment that the maximum value of aroma (8.00) was confirmed under the treatment T₆ [Custard apple pulp: Aonla pulp (88:12)], while the minimum score of aroma (6.10) was recorded under T₀ (100 per cent Custard apple pulp) at 0 day (time of preparation). The maximum aroma score in T₆ might be due to the favourable combination of the characteristic aroma of custard apple and aonla. Similar observations were also enrolled by Gautam *et al.* (2021) in custard apple based nectar and Sharma *et al.* (2023) in aonla blended nectar. During the storage period of fortified nectar, the maximum score of aroma (8.00) was seen during 0 day of storage (D0), however the minimum score (6.70) was noted during 90 day of storage (D6). The decrease in aroma acceptability may be attributed to various extrinsic factors influencing the storage stability of the product, with temperature being one of the most important. Furthermore, the loss of volatile aromatic compounds responsible for the characteristic aroma of the nectar during ambient storage may have contributed to the reduction in aroma acceptability. The present results are similar with the finding by Thakre and Jain (2013) in papaya-banana nectar, Gautam *et al.* (2021) in custard apple based nectar and Sharma (2023) in aonla based Nectar.

Overall acceptability

It is obvious from the result gained under the present investigation that the maximum value of overall acceptability (8.17) was recognized under the treatment T₆ [Custard apple pulp: Aonla pulp (88:12)], while the minimum overall acceptability score (6.37) was seen under T₀ (100 per cent Custard apple pulp) at 0 day (time of preparation). The superior overall acceptability of T₆ could be attributed to its better balance of colour and appearance, taste, flavour and aroma. The results are in accordance with the findings reported by Gautam *et al.* (2021) in custard apple based nectar. During the storage period, the maximum score of overall acceptability (8.17) was noted during 0 day of storage (D0), however the minimum score (6.86) was observed

during 90 days of storage (D6). The overall acceptability of the fortified nectar gradually declined during the 90-day storage period under ambient conditions. This reduction in sensory quality may be attributed to several extrinsic factors affecting storage stability, with temperature playing a major role. Biochemical changes occurring at higher storage temperatures and pH levels may have promoted the formation of brown pigments and the development of off-flavours. In addition, the loss of volatile aromatic compounds responsible

for the characteristic flavour and taste of the nectar likely contributed to the gradual decline in overall acceptability during storage. The present results are parallel with the findings recorded by Thakre and Jain (2013) in papaya-banana nectar, Aswathy & Nirmala (2016) in annonaceous fruit nectar, Gautam *et al.* (2021) in custard apple based nectar and Raj & Mistry (2024) in custard apple and banana blended nectar ^[17, 4, 14, 1, 13].

Table 2: Sensory evaluation of freshly prepared custard apple nectar fortified with aonla

Notations	Treatments	Colour and appearance	Taste	Flavour	Aroma	Overall acceptability
T ₀	Custard apple pulp 100% (control)	6.40 ^f	6.30 ^f	6.20 ^f	6.10 ^e	6.37 ^f
T ₁	Custard apple pulp: Aonla pulp (98:2)	6.80 ^e	6.90 ^e	6.80 ^e	6.70 ^d	6.89 ^e
T ₂	Custard apple pulp: Aonla pulp (96:4)	6.90 ^{de}	6.80 ^e	6.70 ^e	6.60 ^d	6.87 ^e
T ₃	Custard apple pulp: Aonla pulp (94:6)	7.20 ^d	7.30 ^d	7.20 ^d	7.10 ^c	7.20 ^d
T ₄	Custard apple pulp: Aonla pulp (92:8)	7.80 ^b	7.70 ^c	7.60 ^{bc}	7.50 ^{bc}	7.77 ^{bc}
T ₅	Custard apple pulp: Aonla pulp (90:10)	7.50 ^c	7.60 ^{cd}	7.50 ^{cd}	7.40 ^{bc}	7.53 ^c
T ₆	Custard apple pulp: Aonla pulp (88:12)	8.20 ^a	8.30 ^a	8.20 ^a	8.00 ^a	8.17 ^a
T ₇	Custard apple pulp: Aonla pulp (86:14)	7.90 ^{ab}	8.00 ^b	7.90 ^{ab}	7.70 ^{ab}	7.90 ^{ab}
	SE (m) ±	0.10	0.11	0.11	0.13	0.11
	C.D. at 5%	0.29	0.32	0.33	0.39	0.32

Note: The superscript letters signifies that the treatment means with similar letters are at par at 5% level significance, while the means with different letters are significantly

different at 5% level of significance. These letters have been affixed based on CD-value comparison of treatment means.

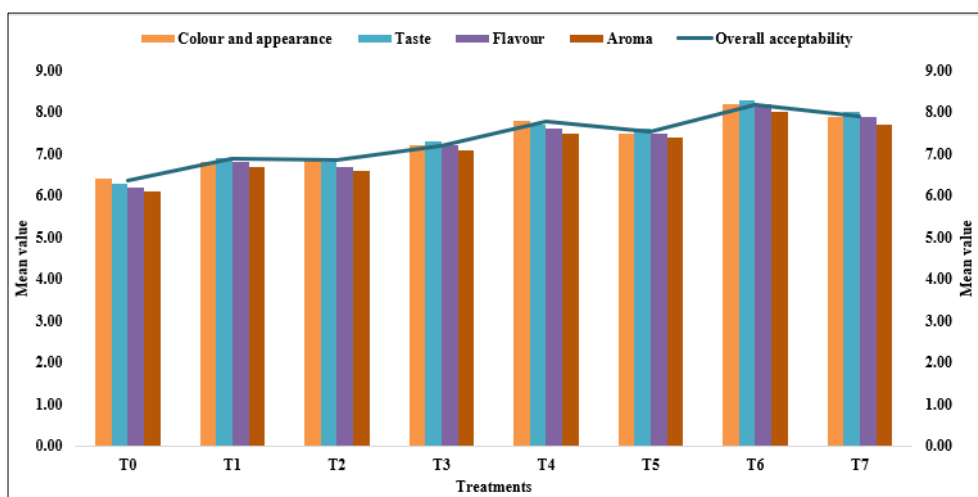


Fig 2: Sensory evaluation of freshly prepared custard apple nectar fortified with aonla

Table 3: Sensory evaluation of custard apple nectar fortified with aonla during storage period at ambient condition

Notations	Days of Storage	Colour and appearance	Taste	Flavor	Aroma	Overall acceptability
D ₀	0 DAS	8.20 ^a	8.30 ^a	8.20 ^a	8.00 ^a	8.17 ^a
D ₁	15 DAS	8.05 ^{ab}	8.15 ^{ab}	8.05 ^{ab}	7.85 ^{ab}	7.98 ^{ab}
D ₂	30 DAS	7.90 ^{ab}	8.00 ^{bc}	7.90 ^{ab}	7.70 ^{ab}	7.85 ^{ab}
D ₃	45 DAS	7.70 ^{bc}	7.80 ^{cd}	7.70 ^{bc}	7.50 ^{bc}	7.68 ^{bc}
D ₄	60 DAS	7.45 ^{cd}	7.55 ^{de}	7.45 ^{cd}	7.25 ^{cd}	7.43 ^{cd}
D ₅	75 DAS	7.15 ^{de}	7.30 ^e	7.20 ^{de}	7.00 ^{de}	7.16 ^{de}
D ₆	90 DAS	6.85 ^e	7.00 ^f	6.90 ^e	6.70 ^e	6.86 ^e
	SE(m) ±	0.12	0.08	0.11	0.12	0.10
	C.D. at 5%	0.36	0.25	0.33	0.36	0.31

DAS: Days After Storage

Note: The superscript letters signifies that the treatment means with similar letters are at par at 5% level significance, while the means with different letters are significantly

different at 5% level of significance. These letters have been affixed based on CD-value comparison of treatment means.

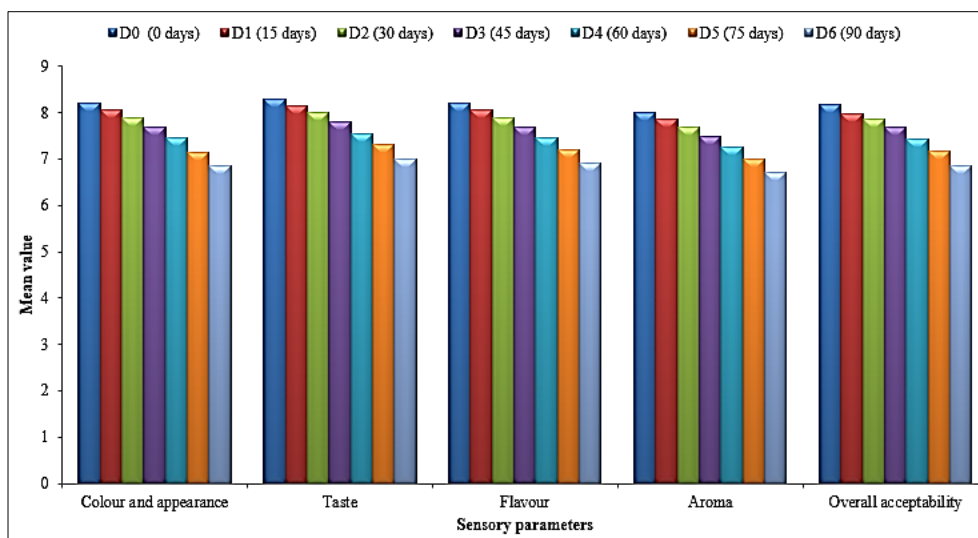


Fig 3: Sensory evaluation of custard apple nectar fortified with aonla during storage period at ambient condition

Conclusion: The study revealed that fortification of custard apple nectar with aonla had a significant effect on its sensory quality. Among all the 8 treatments, T₆ [Custard apple pulp: Aonla pulp (88:12)] recorded the maximum scores for colour and appearance, taste, flavour, aroma and overall acceptability, whereas the minimum sensory scores were observed under T₀ (100% custard apple pulp). With the advancement of storage under ambient storage, all sensory attributes gradually declined with the minimum scores observed during 90 days after storage (D₆).

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