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## Sensory stability of *Annona* species pulp: Influence of storage conditions and duration

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### Abstract

The Annonaceous fruits are gaining popularity due to higher productivity under adverse eco-physiological conditions and high nutraceutical values. However, its highly perishable nature, shorter season of availability and limitations in storage and processing through conventional methods are the challenging key hurdles for the growers and processing sector. Keeping this view in context, a storability study was carried out for the *Annona* species pulp at Department of Fruit Science, Faculty of Horticulture, Dr. PDKV Akola, where the pulp was preserved under  $-20^{\circ}\text{C}$  temperature for period of eight months. As the acceptance of any preserved product in the market mainly depends on the sensory qualities hence, organoleptic evaluation was conducted for various sensory attributes throughout the storage. The stored pulp of *Annona* species was fairly acceptable till the completion of storage.

**Keywords:** *Annona* species, organoleptic characteristics, freezing technology, second-grade fruits, off-flavour and off-colour

### Introduction

The fruits from the genus *Annona* (Annonaceae family Juss.) are evolving as dryland fruit crops, due to tremendous potential higher quality yield even with limited resources and expenses, moreover, they have high nutritional and pharmaceutical properties also (Pinto *et al.*, 2005) [11]. However, despite the vast potential, shortcomings like short season availability and resulting glut situations, high postharvest losses and incapability of conventional preservation methods in the successful storage are the main downsides for the *Annona* species. During the peak season the second-grade fruits are bound to be dispatch for lesser prices or even discarded. The preservation methods which involves thermal treatments are not appropriate for the *Annona* species as it leads to the development of off-colour and off-flavour development (Kamble and Soni, 2010) [7]. These all limitations setback the *Annona* species from getting eclectic acceptance in the market and commercialization at the global level, and still not acknowledged as significant fruit crops. Hence, there is an imperative need of a solution in this direction.

It is a known fact that the quality of the stored food products such as colour, taste, flavour and the nutritive value generally declines storage period progresses. Hence, the foremost objective of any preservation and storage technique is to minimize these losses as much as possible. The freezing technology can be a beneficial alternative in this aspect for retaining the sensory and nutritive properties up to a significant level, as it slows down the deteriorative biochemical reactions by restricting the functionality of enzymes. The evaluation of sensory qualities of a food product is an essential tool for deciding its acceptability, which facilitated in translating the qualitative information into quantitative data and allowed the more accurate monitoring of changes (Lim, 2011) [8]. The human element plays a vital role in the evaluation of organoleptic characters of a product. The sensory evaluation can be product-oriented or consumer-oriented (Shewfelt, 1999) [13]. However, for envisaging the success of any new product or technology at the market level, the consumer acceptability is requisite.

### Materials and Methods

The present storage experiment was laid out in Factorial Randomized Block Design (FRBD) with two factors, *Annona* species *viz.* *Annona squamosa* L. ( $S_1$ ) and *Annona atemoya*( $S_2$ ) and

storage duration of eight months ( $P_0$  to  $P_8$ ). The second-grade fruits of the *Annona* species having a small size, not much appealing as per skin appearance, although with good quality pulp were procured from the orchard of Fruit Science department, Faculty of Horticulture, Dr. PDKV Akola, Maharashtra during the peak season, *i.e.* November. The extracted pulp of both species after addition of 0.1 per cent potassium metabisulphite (KMS) preservative, immediately packed in the airtight plastic containers as per the treatment details and stored at  $-20\text{ }^\circ\text{C}$  for eight months.

For evaluating the changes occurred in the sensory acceptance of pulp, the squash was prepared from both species pulp every month and evaluated by a semi-trained panel of 10 judges on the basis of various sensory attributes. For the scoring purpose, the nine-point Hedonic rating test with a 0-9 scale (1 = dislike extremely and 9 = like extremely) was adopted (Amerine *et al.*, 1965) [2]. The scores for the sensory attributes *viz.* appearance, colour, flavour, taste and overall acceptability were expressed on the 0-9 scale and averaged. The proforma was as follows

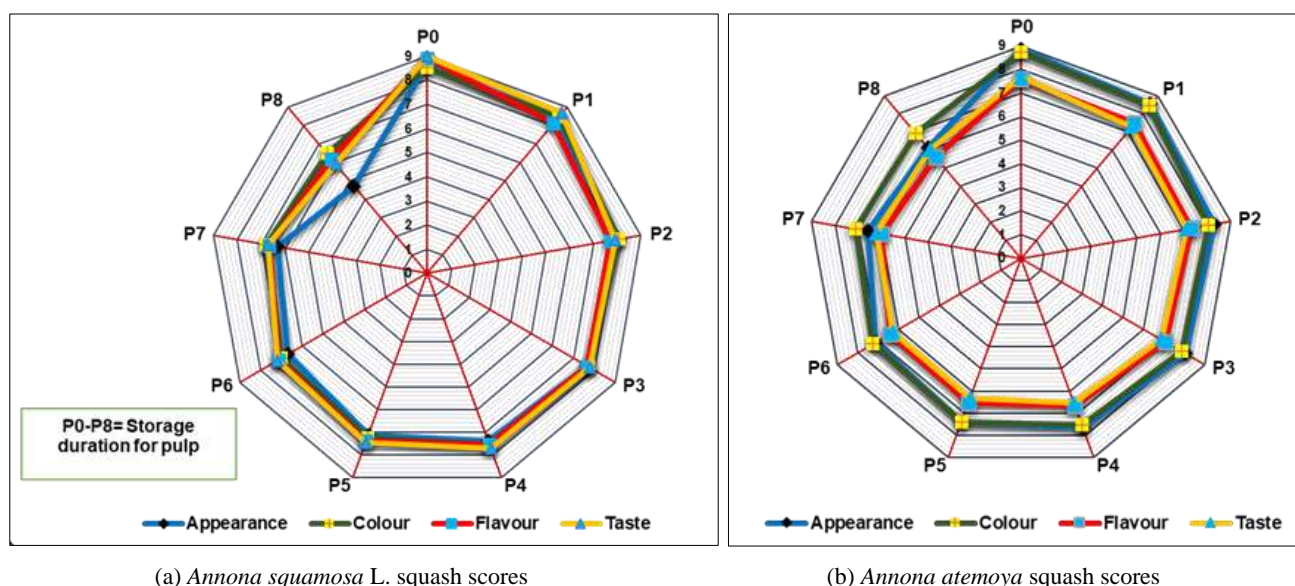
Like extremely – 9; Like very much – 8; Like moderately – 7; Like slightly – 6; Neither like nor dislike – 5; Dislike slightly

– 4; Dislike moderately – 3; Dislike very much – 2; Dislike extremely – 1.

## Results and discussion

The sensory evaluation scores were given by the panel of ten members for squash as per the nine-point hedonic scale for different attributes *viz.* appearance, colour, flavour, taste and overall acceptability. Then the result was generated by using the pooled mean of two years' data for eight months.

The fig. 1 (a and b) graphically presented the scores obtained by the squash prepared from both species stored pulp with the proceeding months. The squash of *Annona atemoya* ( $S_2$ ) species scored higher in each month for appearance with 8.87 scores at initial ( $P_0$ ) to 6.13 score in the last month ( $P_8$ ), graded in range of like extremely to like slightly. While in the case of *Annona squamosa* L. ( $S_1$ ) squash, the scores reduced from 8.67 scores in the initial month ( $P_0$ ) to a score of 4.73 during eight months ( $P_8$ ) of storage. The higher colour values as achieved by *Annona atemoya* ( $S_2$ ) squash was 8.73 at initial preparation ( $P_0$ ) to 6.93 scores in the last month prepared sample ( $P_8$ ) over the *Annona squamosa* L. ( $S_1$ ) squash value of 8.53 ( $P_0$ ) to 6.47 ( $P_8$ ).



**Fig 1:** (a) Effect of the stored pulp of (a) *Annona squamosa* L. species and (b) *Annona atemoya* on the organoleptic characters of squash prepared from the stored pulp

The scoring for these attributes declined in the squash samples made from the frozen stored pulp with the advancement of storage period. The primary cause for the decline in the present study is possibly the ice crystallization and volume expansion caused by the freezing process, which might have led to the exposure of carotenoids and phenolic substances to enzymatic degradation (Ranveer *et al.*, 2010) [12]. However, the rate of reduction was low, and scores maintained above average was perhaps due to the restricted activity of PPO enzyme during storage which is responsible for the enzymatic browning under low-temperature ( $-20\text{ }^\circ\text{C}$ ) as an effect of reduced water activity and limited availability of oxygen (Zielinski *et al.*, 2014) [18]. Along with this, the addition of KMS (Potassium metabisulphite) preservative controlled the browning by either reducing o-quinones to colourless diphenol (Grothier *et al.*, 2008) [5] or by reacting irreversibly with o-quinones to form stable colourless products (Marshall *et al.*, 2000) [9]. Similar effect of KMS and temperature was observed by Sravanthi *et al.* (2014) [15] in custard apple; Eissa *et al.* (2014) [4] in fruit drinks.

The *Annona squamosa* L. squash secured higher scores for flavour attribute throughout the storage period of eight months ( $P_0$ - 8.93 to  $P_8$ - 6.20) as compared to the *Annona atemoya* squash (7.60 scores in the initial to a score of 5.60 in the eighth month). The squash prepared from the stored pulp of *Annona squamosa* L. ( $S_1$ ) species achieved a perfect score of 9 for its taste (graded as like extremely) in the initial stage and maintained up to 5.93 score in the last month ( $P_8$ ). The *Annona atemoya* ( $S_2$ ) squash scores achieved in 7.67 scores in the initial month (like very much) and maintained a score of 6 till the last month. The type and concentration of compounds in the final product are intimately related to storage conditions and processing techniques (Kaewtathip and Charoenrein, 2012) [6]. The phenolic compounds are known to affect the sensory characteristics of food by imparting colour, flavour and taste to foods. The decline in the flavour and taste might be due to the fluctuations in the TSS-acidity ratio, degradation of phenolic compounds (Yadav *et al.*, 2013) [16] or the degradation of ascorbic acid and furfural production (Perez and Sanz, 2001) [10]. However, under the low-temperature ( $-20$

<sup>0</sup>C), the scores were above average even after eight months of storage for the pulp. This slight decline in scores can be ascribed to the low rate of all deteriorative chemical reactions and restricted enzyme activities. These findings are in close conformity with the works of Yadav *et al.* (2017) [17] in guava pulp and Desai (2006) [3] in mango pulp.

The effect of succeeding storage months of pulp on overall acceptability of squash is depicted in Table 1. The squash prepared monthly from both species' stored pulp, scored above average concerning to overall acceptability. The squash prepared from *Annona atemoya* (S<sub>2</sub>) stored pulp scored in the range of like very much to like slightly grades, *i.e.* 8.22 (P<sub>0</sub>) to 6.17 (P<sub>8</sub>). *Annona squamosa* L. (S<sub>1</sub>) achieved higher scores of 8.78 in the initial stage (P<sub>0</sub>) to 5.83 at the end (P<sub>8</sub>). The thawing and process of squash preparation also contribute to modifying the sensory and nutritive profile of a product. A similar decline in sensory quality during storage of pulp has been reported by Sonia *et al.* (2003) [14] in sand pear; Akhtar *et al.* (2009) [1] in mango.

**Table 1:** Effect of stored pulp of *Annona* species on overall acceptability of squash prepared from the stored pulp (Mean of two years' data)

| Storage period | Overall acceptability |       |                |      |
|----------------|-----------------------|-------|----------------|------|
|                | S <sub>1</sub>        | ΔP ↓  | S <sub>2</sub> | ΔP ↓ |
| P <sub>0</sub> | 8.78                  |       | 8.22           |      |
| P <sub>1</sub> | 8.40                  | 4.36  | 7.93           | 3.45 |
| P <sub>2</sub> | 7.95                  | 5.36  | 7.72           | 2.73 |
| P <sub>3</sub> | 7.72                  | 2.94  | 7.47           | 3.24 |
| P <sub>4</sub> | 7.55                  | 2.16  | 7.10           | 4.91 |
| P <sub>5</sub> | 7.32                  | 3.09  | 6.92           | 2.58 |
| P <sub>6</sub> | 7.00                  | 4.33  | 6.77           | 2.17 |
| P <sub>7</sub> | 6.63                  | 5.24  | 6.48           | 4.19 |
| P <sub>8</sub> | 5.83                  | 12.06 | 6.17           | 4.88 |

S<sub>1</sub> = *Annona squamosa* L.; S<sub>2</sub> = *Annona atemoya* P<sub>0</sub> – P<sub>8</sub> = Storage duration (Initial to eight months of storage at -20°C); ↑ = increasing &, ↓ = decreasing with storage duration, ΔP = per cent change in the variable as storage duration proceeds

## Conclusion

Since the *Annona* species is having the drawback of unattractive colour & off-flavour development during processing and deterioration is fast even during storage. Although, the organoleptic scores were above average even till the end of the storage period under low-temperature (-20°C), *i.e.* acceptable by the panel for consumption. Hence, the storage of *Annona* species pulp under -20 °C temperature with the added preservative, *i.e.* KMS (Potassium metabisulphite) evidenced as a beneficial combination for preservation concerning the sensory stability of the squash samples prepared monthly successively throughout pulp storage. Owing to the minimum loss of quality and sensory characteristics as observed during the storage in the present study, *Annona* species pulp can be stored for a longer duration in a frozen state.

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