Development of *Muntingia calabura* Fruit Based Squash

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ABSTRACT

**Background:** *Muntingia calabura* (Panama berry), is a wholesome fruit borne to a multipurpose tree. It is one of the tropical fruits native to Mexico and Central America. *Muntingia calabura* plant is being widely cultivated in India, South Asia, Malaysia, Indonesia and Philippines. This tropical fruit, is known for its nutritional, anti-microbial and anti-inflammatory properties, but lacks commercial value. The objective of the present study was to formulate, standardize and analyse a processed product, squash from Panama berry.

**Methods:** Squash was developed with 100% M.C (M.C) and in combination with mausambi and apple in different ratios. Different combinations of developed squash were assessed for acceptability by sensory panel members. The most acceptable combination of squash along with control was assessed for storage stability by storing in air tight bottles. The squashes were checked for their storage stability for a period of three months with a periodic evaluation of 15 day interval.

**Conclusion:** Sensory analysis showed that 100% M.C squash was as acceptable as other squashes. The squash developed with 100% M.C and M.C and mausambi (75: 25) were more acceptable than M.C with apple. Sensory analysis of the squash proved its acceptability up to 3 months. An increase in TSS, total sugars and reducing sugar content of squash was observed. The present study proves that widely available, untapped nutritious *Muntingia calabura* fruit can be used for developing healthy preserve and can also be promoted in large scale processing.

**Key words:** Apple, Evaluation, Mausambi, *Muntingia calabura*, Sensory analysis, Squash.

INTRODUCTION

*Muntingia calabura* which belongs to the family Muntingeaceae, is known throughout the world, as Jamaican cherry or Panama berry. It is the sole species in the genus Muntingia and is native to Southern Mexico, South America and Central America. It is widely cultivated in warm areas in India and Southeast Asia, Indonesia and Philippines. (Sani et al., 2012). The fruits were commercialized initially in the Mexican markets (Morton. 1987). The tree of *Muntingia calabura* (M.C) is widely branched, containing obliquely lanceolate leaves with small white flowers borne on stalks that are 2.5cm length (Wealth India, 2005). Its fruits are berry type and the berries are 1.5 cm in diameter with minute seeds embedded in the pulp. It is one of the common road side tree. The fruits are antinociceptive, antioxidant and antipyretic (Zakaria et al., 2006 and Zakaria, 2007) in nature Methanol extracts of fruit exhibited potent DPPH quenching capacity (Einbond et al., 2004). Acetone, ethanol, methanol and aqueous extracts of the fruit were found to posses significant antioxidant activities (Kolar et al., 2011). Apart from the medicinal uses, the fruits are eaten fresh and sometimes transformed into tarts or jam (Morton 1987). The fruits have been proven to have many phytochemicals properties but there not many commercialized products. The fruit is available in plenty but as many are unaware of its benefits, it is being wasted. The objective of the present study was to utilize the underexploited, readily available, nutrient rich fruit to develop squash and to assess its quality in comparison with well-known mausambi squash so as to increase its utilization. Further research could be carried out in development of economical and healthy beverage.
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(Chaudhary *et al.*, 2017) and pumpkin and guava based squash (Dhiman *et al.*, 2017).

**Flow chart for preparation of fruit pulp**

1. **Fruits**
2. Sorted, cleaned and washed
3. Extraction of juice by pulpers
4. Straining through strainer

**Flow chart for processing Squash**

1. Blending of *Muntingia calabura* pulp and mausambi pulp as per combination
2. Mixing with syrup
3. Boiling
4. Syrup
5. Straining through muslin cloth
6. Capping
7. Bottling
8. Labelling
9. Storage
10. Sugar+ citric acid+ water as per calculation

**Sensory evaluation**

All the developed squashes were further diluted and were subjected to sensory evaluation by a sensory panel of 12 members by using 9-point Hedonic scale. The squashes that were accepted by the sensory panel were 100% *Muntingia calabura* (M.C.), 100% Mausambi (M) and 75:25 M.C : M (MCM).

These squashes were further stored in previously sterilized glass bottles with adequate head space and analysed for their storage behaviour.

Squash was analysed for its TSS by using hand refractometer, colour using colour reader of Konica MINOLTA CR-10 make, titratable acidity by titrimetry method against sodium hydroxide using phenolphthalein as indicator and expressed in terms of anhydrous citric acid, vitamin-C by titrimetry method, total sugars and non-reducing sugars by using Fehling’s solution based on (Ranganna, 1986) and measured absorbance in spectrophotometer, reducing sugars by DNS method (Miller, 1959) and total carotenoids as per the procedure given by (Raghuramulu *et al.*, 2003) measuring O.D at 425 nm.

The acceptability of stored squash was carried out by a panel of 12 members. Samples were analysed for their microbial content by using ready to use potato-dextrose agar (PDA) as media as the method given by (Aneja, 2001).

**Statistical analysis**

The tests in the present study were assessed in triplicates (n=3). Values expressed are means of three independent samples analyzed in triplicate ± standard error of means (SEM). The results obtained were subjected to one-way analysis of variance (ANOVA). The mean values were compared using the least significance difference test (LSD) at 5% level using SPSS software.

**RESULTS AND DISCUSSION**

**Total soluble solids**

An increase in total soluble solid content from 50 to 52.85°B was observed during storage studies of M.C squash, where as it increased from 48.11 to 51.80°B and 49.36 to 52.25°B for mausambi squash and a combination squash of mausambi and M.C respectively as shown in Fig 1. Dhiman, *et al.*, 2017 and Vikram and Singh, 2018 reported that the blended pumpkin and guava squash and Kinnow-anola-aloë squash showed a linear increment in the TSS content. The TSS content of the developed squash increased with time, which could probably be due to the breakdown of complex sugar molecules (Chaudhary, *et al.*, 2017). Fig 1 represents the increase in TSS content of the developed squashes on storage. An increase in TSS of developed squashes was observed after 30 days of storage which was not so
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significant when tested at 5% level of significance. The percentage of increase was 0.028% for M.C, 0.036% for M.S and 0.028% for MCMS.

**Titratable acidity**

Titratable acidity of developed fruit squash increased as shown in Fig 2 with storage, which could be due to production of organic acids during storage as seen in case of wood apple squash during its 5-months storage life (Kumar and Deen 2018). The acid content of the MCS squash was 0.028 to 0.26%. The acid content increased from 0.593 to 0.657% for mausambi squash while it increased from 0.458 to 0.561% for the combination squash. The above mentioned results were in harmony with the results given by Priyanka et al., (2015) and Kumar and Deen (2017) in jamun blended squash and wood apple beverage.

**Vitamin-C content**

With storage, the total ascorbic content of the fruit squash has reduced linearly as shown in Fig 3, which could be due to the degradation of dehydroascorbic acid or unstable nature of ascorbic acid by the action of heat, light and air/ conversion to dehydroascorbic acid by its participation in browning (Dhiman et al., 2017). The Vitamin C content reduced from 0.5454 to 0.1818 mg/100gms while it was 3.166 mg/100gms and 2 mg/100gms for mausambi and mausambi + M.C squash. The degradation of vitamin was not significant.

The reason behind the reduction of ascorbic acid content with storage might be due to an increment in moisture content, O₂, Dennison and Krik, 1982; Eison-Perchonok and Down, 1982. The degradation of ascorbic content could be due to water activity of the sample.

**Total carotenoids**

The total carotenoid content of the developed *Muntingia calabura* fruit based squash increased for one and half month and reduced later during the two and half month study. The values ranged from 2.838 mg to 1.217 mg for M.C squash. Mausambi and the combined squash showed 0.4063 and 1.06 mg of carotenoids per 100gms. According to Mir and Nath (1993), the decrease in total carotene content could be due to the photosensitive nature of carotenoids and due to loss of β- carotene. A decrease in β-carotene content was observed in ripe pumpkin based squash (Dhiman et al., 2017).

**Reducing sugars**

The reducing sugar content of squash increased with time as shown in Fig 4. The results could be correlated with the results that were reported by Garg et al., (2008). The increase in reducing sugars of samples is not significant in all the three. This was also observed in Karonda squash by Deen and Singh, (2011). Increment in concentration of reducing sugars resulted due to conversion of non-reducing sugars. This increment could also be due to the breakdown of pectin polysaccharides (Kumar and Deen, 2018).
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**Colour**

Colour is one of the most important parameters to which consumers are attracted while selecting different foods. The parameters with respect to colour have increased with time. The changes in the colour were observed using the colour reader. As shown in Table 2, there was an increase in L values of all the samples. The rate of increase was more in M.C squash.

There was a significant difference in the increase in the L values of the squash samples. Of all the three samples, M.C squash showed slight higher values than M and MCM after 60 days. In CIEL *a* "b is sometimes abbreviated as “Lab color space” L represents the lightness, a and b represents (-) green- (+) red component to (-) blue (+)yellow component. CIELAB was designed so that the same amount of numerical change in these values corresponds to roughly the same amount of visually perceived change. The values of "a and "b are in positive which indicates that the colour of squash was acceptable. The colour of the squash became lighter on storage.

**Sensory characteristics**

The sensory acceptability of the squash has increased for a while and then reduced linearly with increase in storage time, which could be due to the chemical changes occurring in the squash. Fig 5 represents the acceptance of the developed squashes.

The overall acceptability of MCS was the highest amongst all followed by MS and MCMCS on storage. The score for the colour was the maximum for MCS was 7.4 and least for MCMS as 7.2. The flavour was maximum for MCS followed by MS and MCMCS. MCS ranked highest for the appearances followed by MS, MCMCS. Blending of *Muntingia calabura* with mausambi was as acceptable as 100% mausambi. On storage, there was a slight decrease in sensory score of products. Significant difference was observed from 60th day of storage.

**Microbial analysis**

All the three developed squashes were analyzed for yeast and microbial growth. Growth was not observed during the initial day of study. Microbial analysis showed the absence of bacteria, yeast and mold. The total plate count (TPC) of the squash was determined on the initial day and on the 60th day. The results are represented in the Table 3. Total plate count was found to be nil on the initial day for MS, C, MMCS but MCS showed the TPC of about 1 on 60th day. Production of reduced sugar pomegranate juice jelly supplemented with an aqueous extract of pomegranate peel did not record any microbial growth when stored at room temperature and at 4°C (Ventura *et al.*, 2013).

**CONCLUSION**

The main objective was to develop a squash from economical and nutritious fruits that are under exploited. The results of the present study showed that the squash with MC was a good source of vitamin C. Mausambi squash is commercially available and to check the feasibility of M,C

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**Table 1:** Formulation of squash.

| Type                  | M.C | Mausambi | Apple |
|-----------------------|-----|----------|-------|
| Squash 1 (100% M.C)  | 100 | -        | -     |
| Squash 2 (100% M)    | -   | 100%     | -     |
| Squash 3 (100% A)    | -   | -        | 100%  |
| Squash 4 (75:25 - M.C:M) | 75% | 25%      | -     |
| Squash 5 (50:50 - M.C:M) | 50% | 50%      | -     |
| Squash 6 (25:75 - M.C:A) | 25% | 75%      | -     |
| Squash 7 (75:25 - M.C:A) | 75% | -        | 25%   |
| Squash 8 (50:50 - M.C:A) | 50% | -        | 50%   |
| Squash 9 (25:75 - M.C:A) | 25% | -        | 75%   |

**Table 2:** Changes in colour of squashes on storage.

| Samples | Storage | L     | a     | b     |
|---------|---------|-------|-------|-------|
| M.C     | 0 day   | 39.2±0.173 | 2.9±0.251 | 7.06±0.305 |
|         | 30 days | 43.66±0.252 | 2.36±0.150 | 3.0±0.1 |
|         | 60 days | 46.43±0.503 | 3.16±0.208 | 2.7±0.1 |
|         | 75 days | 48.8±0.25 | 3.5±0.12 | 1.2±0.01 |
|         | 90 days | 50.25±0.36 | 3.89±0.11 | 0.09±0.2 |
| M       | 0 day   | 43.7±0.7 | 2.5±0.1 | 10.5±0.6 |
|         | 30 days | 46±0.7 | 1.8±0.2 | 8.3±0.15 |
|         | 60 days | 49.5±0.26 | 1.7±0.05 | 6.9±0.2 |
|         | 75 days | 51.3±0.1 | 1.4±0.02 | 4.2±0.2 |
|         | 90 days | 53.4±0.02 | 1.2±0.1 | 2.24±0.06 |
| M.M.C   | 0 day   | 41±0.5 | 2.6±0.25 | 3.5±0.15 |
|         | 30 days | 45.7±0.2 | 1.22±0.1 | 5.9±0.1 |
|         | 60 days | 48.4±0.34 | 1.5±0.05 | 10.6±0.26 |
|         | 75 days | 50.2±0.2 | 1.6±0.1 | 13.4±0.16 |
|         | 90 days | 51.2±0.3 | 1.8±0.2 | 17.2±0.01 |

Values are expressed as mean±Standard deviation P < 0.05, significant difference exists at 5% level.

**Table 3:** Microbial quality of developed squash.

| Sample | Total plate count (10g CFU / g) on 60th day |
|--------|-------------------------------------------|
| M      | ND                                        |
| MC     | 1.0                                       |
| MCM    | ND                                        |

(n=3), ND= not detected.
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with mausambi, squash was developed in combination. The sensory characteristics of both squashes (100% MC and combination-MCM) were equally acceptable. In modern world, consumers prefer innovative and healthy products and a great demand for economical and natural sources of functional components is increasing. As Muntingia calabura is a tree which grows wildly with nutritious fruits, the cost of squash developed with this fruit can be economical. The results of the study proved that healthy squash can be developed from this fruit alone or in combination with mausambi fruit as it was acceptable by the selected panel. The present study leads to a scope of developing commercial products from Muntingia calabura fruits.

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