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**RESEARCH NOTE**

# Storage Studies of Amla Products

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**Abstract**

Amla fruit is known for its antioxidant activity (Vitamin C) and medicinal properties. Value added products make the fruit available throughout the year and help to promote the use of amla among the public. Hence, an attempt was made to standardized sweet based products viz., jam, squash and jelly with different treatments. The prepared amla products were standardized on the basis of sensory evaluation. The bio-active components and sensory evaluation of amla products were analysed during storage. The shelf-life studies of amla jam, squash and jelly were also determined at room temperature.

**Keywords**: Amla products, bio-active components, sensory evaluation, sugars

Amla also known as Indian gooseberry (*Emblica officinalis*) is one of the useful fruit. It is consumed as a fresh fruit or in the form of food products like preserves besides being the main ingredient in many ayurvedic preparations like chyvanprash which is regarded as a rejuvenating products. Amla is a rich source of vitamin C, ranks second next to Barbados cherry which has maximum vitamin C. It is found to posses anti-aging, expectorant, purgative, antibacterial, antioxidant and hypoglycemic activity (Rastogi RP and Mehrotra BN, 1993). Many different products are from amla like ready–to-serve beverage, candy, jam, powder, Amla bar (Deka *et al*. 2001). Amla berries can also be used as a valuable ingredient for the production of an herbal fermented beverage. The Indian gooseberry is native to India and also grows in tropical and sub-tropical regions. In addition of being an important medicinal herbs, it has potent antioxidant, several active tannoid principles (Emblicannin A, Emblicannin B, Punigluconin and Pedunculagin) have been identified which account for its health benefits like antioxidant activity, and antiaging property (Pater SS and Goyal RK, 2012). The amla fruit, because of its high acidity and astringent taste however is not preferred for direct consumption; hence it is consumed mainly after processing, as processed product. Present study was undertaken to prepare preserved product utilizing bioactive rich underutilized fruit amla.

## MATERIALS AND METHODS

### Selection of Amla fruit

Fully matured and fresh Amla fruit (*Kanchan var*.) were procured from the local market of Madurai city, Tamil Nadu, India.

### Standardization of Amla Jam

The selected fresh amla fruits were washed in clean water, surface dried, cut into small pieces, pulped in

a mixie, passed through hand pulper and strained using muslin cloth and were used in the preparation of amla jam. The amla jam was standardized with addition of different level (0.1 0.2 and 0.3 %) of pectin contents and without pectin. The storage behaviour of the jam was recorded by noting the changes in the chemical composition at regular interval of once in 30 days. Among the jam prepared with and without addition of pectin, the jam prepared with 0.1% of pectin was found to be best. The product was standardized on sensory evaluation in terms of acceptability with special reference to colour and appearance, flavour, texture taste and overall acceptability.

**Standardization of Amla squash**

Amla squash was standardization as per the FPO specification with addition of mint extract (1, 1.5 and 2%), honey (10, 15 and 20%) and date syrup (10, 15 and 20). The prepared amla squash samples were poured in to a sterilized bottle (cap.680 ml) leaving one inch head space and capped air tightly. The prepared amla squash was organoletpically evaluated using a 9 point hedonic scale.

**Amla jelly**

The amla jelly were tried with different proportions (50: 50, 65: 35 and 75: 25) of amla and guava extract and amla and jack fruit rind at different levels (0.75, 1.0 and 1.5%) of commercial pectin and agar at 2,3 and 4 per cent level also. Among the above, the amla jelly was set at 1.5% level of pectin and 4% of agar. The prepared amla jelly was packed in air tight plastic jar and glass bottle. Amla jelly samples were organoletpically evaluated using a 9 point hedonic scale by panel of 20 semi trained judges.

**Chemical Components Analysis**

The standard methods were adopted to analyses the various components of the amla products before and during storage at regular intervals (30 days intervals).

The moisture was measured in Hot air Oven by AOAC (1995) method. pH was measured by pH meter as per the method of Hart and Fisher. TSS was measured by Hand refractometer was used to measure TSS as per the method of Saini *et al*.(2001). Reducing sugar and total sugars were estimated by Shaffer somogyi micro method as descrived by McDonlad and Foley (1960). Vitamin – C estimation was done by 2,6 dichlorophenol indophenol visual titration by method given Sadasivam and Manickam (1996).

**Storage Study**

The storage study of prepared products was analysed by noting the changes in the bioactive components and sensory evaluation at regular intervals initial and during storage.

**Statistical Analysis**

The data obtained were subjected to statistical analysis to find out the impact of storage period and packaging materials on the quality of amla products during storage. Factorial Completely Randomized Design (FCRD) was applied for the analysis (Rangaswamy, 1995).

## RESULTS AND DISCUSSION

**Shelf-life studies of amla products during storage period**

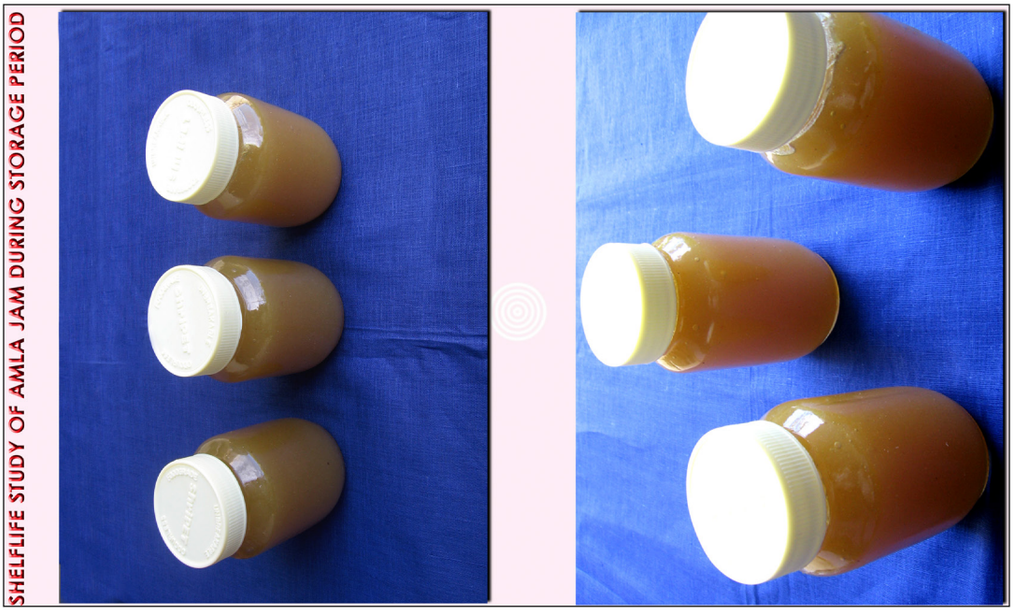
***Amla Jam***

Table 1 summaries the changes observed in the moisture content of amla jam during storage. The freshly prepared amla jam contained 24.94 g per cent which had changed to 24.00 g per cent at the end of nine months of storage due to atmospheric temperature. Amla jam exhibited a gradual increase in acidity during storage. Initially, the sample had 1.05 g per cent and it was increased to 1.95 g per cent after nine months of storage. Significant changes were observed in total soluble solids and total sugar. At the end of the storage period the TSS and total sugar were 67.62°bx and 52.23 g per cent respectively. Similar parameters changes were also observed by Sudhagar and Manimegalai, (2001).

**Table 1:** Changes in chemical analysis of amla jam during storage

| Storage period (in months) | Chemical Characteristics | | | | | | |
|---|---|---|---|---|---|---|---|
| | Moisture (%) | Titrable Acidity (%) | TSS (°Bx) | Total sugar (%) | Reducing sugar (%) | Vitamin C (mg/100g) | Tannin (mg/100g) |
| Initial | 24.94 | 1.05 | 68.10 | 52.76 | 13.43 | 388.13 | 0.96 |
| 1 | 24.94 | 1.06 | 68.10 | 52.71 | 13.51 | 388.13 | 0.96 |
| 2 | 24.81 | 1.06 | 68.10 | 52.54 | 13.63 | 388.13 | 0.96 |
| 3 | 24.70 | 1.19 | 68.02 | 52.47 | 13.64 | 388.04 | 0.95 |
| 4 | 24.54 | 1.32 | 67.94 | 52.41 | 13.67 | 387.93 | 0.93 |
| 5 | 24.39 | 1.53 | 67.94 | 52.33 | 13.73 | 387.88 | 0.93 |
| 6 | 24.26 | 1.70 | 67.88 | 52.30 | 13.80 | 387.81 | 0.90 |
| 7 | 24.12 | 1.82 | 67.80 | 52.30 | 13.82 | 387.68 | 0.86 |
| 8 | 24.03 | 1.88 | 67.70 | 52.25 | 13.85 | 387.50 | 0.85 |
| 9 | 24.00 | 1.95 | 67.62 | 52.23 | 13.92 | 387.42 | 0.82 |

| | Moisture | Acidity | TSS | Total sugar | Reducing sugar | Vitamin C | Tannin |
|---|---|---|---|---|---|---|---|
| SED | 0.0077 | 0.0081 | 0.0322 | 0.0100 | 0.0161 | 0.0351 | 0.0077 |
| CD (0.01) | 0.0246 ** | 0.0256** | 0.1022 ** | 0.0317 ** | 0.0511 ** | 0.1112** | 0.0246 ** |




The notable changes were exhibited (13.43 to 13.92%) in reducing sugar content of amla jam. The conversion of total sugar to simple sugar during storage might have increased the reducing sugar level in the stored samples. The strawberry fruit jam had also showing the increasing trend during storage period (Saravanakumar and Manimegalai (1999)). The vitamin C and tannin content of amla jam are also presented in Table 5. There was a gradual reduction in vitamin C and tannin during storage. Initially 388.13 mg/100g and 0.96 mg/100g in vitamin C and tannin content respectively due to increasing

**Table 2:** Changes in chemical charateristics of Amla squash during storage

| Treatments | Percentage levels | Acidity ( g/100ml) | | | | | pH | | | | | Tannin ( mg/100ml) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Storage period (in month) | | | | | Storage period (in month) | | | | | Storage period (in month) | | | | |
| | | Initial | 1 | 3 | 6 | 9 | Initial | 1 | 3 | 6 | 9 | Initial | 1 | 3 | 6 | 9 |
| Control ($T_1$) | — | 1.04 | 1.05 | 1.10 | 1.17 | 1.24 | 3.38 | 3.37 | 3.34 | 3.29 | 3.20 | 3.85 | 3.82 | 3.75 | 3.65 | 3.40 |
| Amla + Mint extract ($T_2$) | 1% | 1.06 | 1.08 | 1.12 | 1.17 | 1.20 | 3.41 | 3.40 | 3.37 | 3.33 | 3.25 | 3.69 | 3.68 | 3.60 | 3.51 | 3.29 |
| | 1.5% | 1.04 | 1.06 | 1.10 | 1.15 | 1.19 | 3.46 | 3.44 | 3.43 | 3.36 | 3.27 | 3.68 | 3.66 | 3.55 | 3.46 | 3.23 |
| | 2% | 1.01 | 1.05 | 1.09 | 1.14 | 1.21 | 3.47 | 3.46 | 3.44 | 3.37 | 3.24 | 3.69 | 3.66 | 3.59 | 3.45 | 3.23 |
| Amla + Honey ($T_3$) | 10% | 1.04 | 1.08 | 1.10 | 1.16 | 1.21 | 3.50 | 3.48 | 3.46 | 3.41 | 3.27 | 3.72 | 3.70 | 3.61 | 3.47 | 3.25 |
| | 15% | 1.03 | 1.05 | 1.10 | 1.17 | 1.20 | 3.52 | 3.52 | 3.49 | 3.40 | 3.26 | 3.71 | 3.68 | 3.61 | 3.48 | 3.26 |
| | 20% | 1.01 | 1.03 | 1.06 | 1.12 | 1.19 | 3.55 | 3.54 | 3.51 | 3.40 | 3.25 | 3.74 | 3.70 | 3.65 | 3.51 | 3.24 |
| Amla + Date syrup ($T_4$) | 10% | 1.05 | 1.05 | 1.10 | 1.16 | 1.20 | 3.51 | 3.50 | 3.47 | 3.37 | 3.25 | 3.61 | 3.59 | 3.53 | 3.45 | 3.28 |
| | 15% | 1.03 | 1.08 | 1.10 | 1.15 | 1.20 | 3.52 | 3.50 | 3.47 | 3.40 | 3.24 | 3.65 | 3.62 | 3.53 | 3.41 | 3.23 |
| | 20% | 1.02 | 1.03 | 1.09 | 1.14 | 1.21 | 3.57 | 3.55 | 3.53 | 3.40 | 3.25 | 3.69 | 3.64 | 3.55 | 3.40 | 3.18 |

| Acidity | | | pH | | | Tannin | | |
|---|---|---|---|---|---|---|---|---|
| | SED | CD (0.01) | | SED | CD (0.01) | | SED | CD (0.01) |
| t | 0.01451 | 0.03887 ** | t | 0.00767 | 0.02055 ** | t | 0.00477 | 0.01280 ** |
| s | 0.01026 | 0.02748 ** | s | 0.00542 | 0.001453 ** | s | 0.00338 | 0.00905 ** |
| ts | 0.03243 | 0.08691 NS | ts | 0.01715 | 0.04595 ** | ts | 0.01068 | 0.02861 ** |

**Table 3:** Changes in chemical characteristics of Amla squash during storage

| Treatments | Percentage levels | Total sugar ( g/100ml) | | | | | Reducing sugar ( g/100ml) | | | | | Vitamin C ( mg/100ml) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Storage period (in month) | | | | | Storage period (in month) | | | | | Storage period (in month) | | | | |
| | | Initial | 1 | 3 | 6 | 9 | Initial | 1 | 3 | 6 | 9 | Initial | 1 | 3 | 6 | 9 |
| Control ($T_1$) | — | 41.04 | 41.00 | 40.88 | 40.35 | 40.02 | 2.93 | 2.99 | 3.27 | 3.66 | 3.96 | 535.16 | 535.10 | 534.82 | 533.45 | 528.08 |
| Amla + Mint extract ($T_2$) | 1% | 40.95 | 40.93 | 40.80 | 40.52 | 40.30 | 2.80 | 2.85 | 2.99 | 3.42 | 3.81 | 537.12 | 537.03 | 536.81 | 535.64 | 533.18 |
| | 1.5% | 40.91 | 40.87 | 40.71 | 40.56 | 40.28 | 2.76 | 2.81 | 2.97 | 3.32 | 3.79 | 537.20 | 537.15 | 536.88 | 535.11 | 532.94 |
| | 2% | 40.90 | 40.87 | 40.75 | 40.58 | 40.26 | 2.71 | 2.80 | 2.94 | 3.27 | 3.77 | 537.21 | 537.11 | 536.84 | 535.05 | 532.68 |
| Amla + Honey ($T_3$) | 10% | 40.70 | 40.64 | 40.58 | 40.38 | 40.22 | 2.92 | 2.97 | 3.19 | 3.54 | 3.92 | 534.72 | 534.58 | 534.31 | 533.79 | 532.15 |
| | 15% | 40.74 | 40.66 | 40.41 | 40.22 | 40.10 | 2.95 | 3.01 | 3.22 | 3.58 | 3.95 | 534.86 | 534.80 | 534.54 | 533.22 | 532.89 |
| | 20% | 40.80 | 40.70 | 40.52 | 40.31 | 40.12 | 2.97 | 3.05 | 3.23 | 3.60 | 3.95 | 535.13 | 535.08 | 534.85 | 533.85 | 531.44 |
| Amla + Date syrup ($T_4$) | 10% | 40.72 | 40.70 | 40.53 | 40.30 | 40.10 | 3.05 | 3.10 | 3.25 | 3.64 | 3.99 | 534.33 | 534.25 | 533.99 | 532.66 | 530.69 |
| | 15% | 40.75 | 40.66 | 40.54 | 40.32 | 40.13 | 3.09 | 3.19 | 3.38 | 3.72 | 4.05 | 534.55 | 534.43 | 534.17 | 533.33 | 531.48 |
| | 20% | 40.85 | 40.80 | 40.62 | 40.34 | 40.12 | 3.15 | 3.21 | 3.50 | 3.81 | 4.18 | 535.20 | 535.09 | 534.79 | 533.59 | 531.77 |

| Total sugar | | | Reducing sugar | | | Vitamin C | | |
|---|---|---|---|---|---|---|---|---|
| | SED | CD (0.01) | | SED | CD (0.01) | | SED | CD (0.01) |
| t | 0.00687 | 0.1841 ** | t | 0.80706 | 2.16268 NS | t | 32.91136 | 88.19215 NS |
| s | 0.00486 | 0.1302 ** | s | 0.57068 | 1.52925 NS | s | 23.27184 | 62.36127 NS |
| ts | 0.01536 | 0.04117 ** | ts | 1.80465 | 4.83590 NS | ts | 73.59203 | 197.20364 NS |

of sugars. After nine months of storage, the amla jam contained 387.42 mg/100g in vitamin C and 0.82 mg/100g in tannin respectively.

**Amla squash**

Data on the changes in chemical composition of amla squash during the storage are given in Table 2 and 3. The freshly prepared amla squash had 1.04g / 100 ml of acidity in control ($T_1$), 1.06,1.04 and 1.01 g of acidity in 100 ml of amla squash treated with 1,1.5 and 2% of mint extract ($T_2$), 1.04, 1.03 and 1.01g / 100 ml of acidity treated with 10, 15 and 20% of honey ($T_3$) and 1.05, 1.03 and 1.02 g of acidity in 100 ml of the amla squash treated with 10, 15 and 20% of date syrup ($T_4$). A slight variation was observed between the treatments during storage period. A gradual increase of acid content was observed during storage. After nine month of storage, the acidity was increased to 1.24 % in control ($T_1$) 1.20, 1.19 % of acidity in amla squash treated with 1, 1.5, and 2% of mint extract ($T_2$), 1.21, 1.20 and 1.19 g per cent acid content treated with honey ($T_3$) and 1.20, 1.20 and 1.21 g / 100 ml of acidity treated with 10, 15 and 20% of date syrup ($T_4$) respectively. Saravanakumar and Manimegalai (1999) reported that the strawberry squash showed an increasing trend in acid content from 1.20 to1.43 percent during storage period. The patharnakh pear juice had 0.44 per cent acid content after 3 month of storage (Saini and Grewal, 2000). Similar trend was noted in the present study during storage.

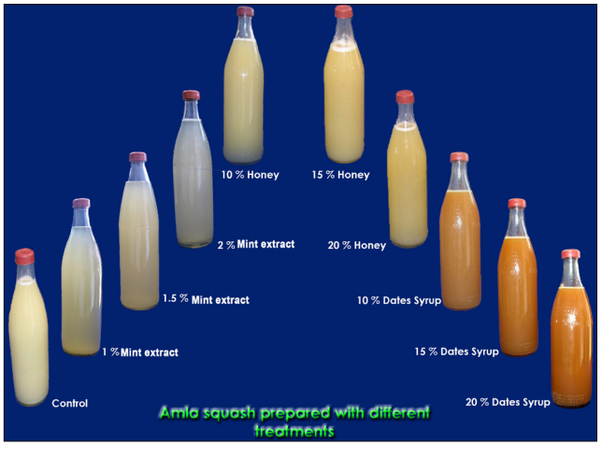



Table 3 summarizes the changes noted in the vitamin C content of the amla squashes during the study period. The significant changes were observed between the squashes throughout the storage period. The initial vitamin C content of amla squashes were 535.16 mg /100 ml in control ($T_1$) which had decreased to 528.08 mg/100ml after nine month of storage. Amla squash treated with mint extract samples ($T_2$) initially had 537.12, 537.20 and 537.21 mg/100 ml which changed to 533.18, 532.94 and 532.68 mg per cent in 1, 1.5 and 2% respectively after nine month of storage at room temperature. Similarly the vitamin C content was 534.72, 534.86 and 535.13 mg/100ml in 10, 15 and 20% at initially. After nine months of storage, it was (honey treated amla squash) decreased to 532.15, 532.89 and 531.44 mg/100 ml in 10, 15 and 20% respectively. Likewise date syrup treated amla squash contained 534.33, 534.55 and 535.20 mg/ 100 ml in 10, 15 and 20% in freshly prepared samples at room temperature. After nine month of storage, it was decreased to 530.69, 531.48 and 531.77 mg of vitamin C per 100 ml in 10, 15 and 20% of date syrup treated samples. The vitamin C content of the stored sample showed a significant difference between treatments throughout the study period. The vitamin C content of the mango squash was 2.10, 2.08 and 2.05mg/100ml in $T_1$, $T_2$ and $T_3$ during storage due to increasing of sugars (Sivakumar and Malathi, 2004).

Total sugar and tannin content of amla squashes decreased during storage period. Total sugar was 40.02 g per cent in control ($T_1$) 40.30, 40.28 and 40.26 in amla squash treated with 1, 1.5 and 2% mint extract ($T_2$), 40.22, 40.10 and 40.12 g per cent in amla squash treated with 10, 15 and 20% honey ($T_3$) and 40.10, 40.13 and 40.12 g per cent in amla squash treated with 10, 15 and 20% of date syrup ($T_4$) at end of the storage. The similar result were observed from Sudhagar and Manimegalai (2001) reported that the total sugar content was decreased in pear squash (35.05 to 34.52%) and pear and pineapple blended squash (35.19 to 34.06%) during the storage period due to increasing of acidity. Likewise the tannin content of amla squash was 3.40 mg/100 ml in $T_1$, 3.29, 3.23 and 3.23 mg/100 ml in amla squash treated

**Table 4:** Changes in chemical characteristics of Amla jelly during storage

| Storage period (in month) | Moisture (%) | | | | Acidity (g/100g) | | | | Tannin (mg/100g) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Pectin | | Agar | | Pectin | | Agar | | Pectin | | Agar | |
| | Glass bottle ($PC_1$) | Plastic jar ($PC_2$) | Glass bottle ($AC_1$) | Plastic jar ($AC_2$) | Glass bottle ($PC_1$) | Plastic jar ($PC_2$) | Glass bottle ($AC_1$) | Plastic jar ($AC_2$) | Glass bottle ($PC_1$) | Plastic jar ($PC_2$) | Glass bottle ($AC_1$) | Plastic jar ($AC_2$) |
| Initial | 20.10 | 20.10 | 20.92 | 20.92 | 1.02 | 1.02 | 1.03 | 1.03 | 0.92 | 0.92 | 0.94 | 0.94 |
| 1 | 20.09 | 20.10 | 20.90 | 20.92 | 1.03 | 1.04 | 1.05 | 1.06 | 0.91 | 0.91 | 0.93 | 0.92 |
| 2 | 19.98 | 20.00 | 20.82 | 20.85 | 1.05 | 1.07 | 1.07 | 1.09 | 0.89 | 0.89 | 0.91 | 0.90 |
| 3 | 19.90 | 19.96 | 20.68 | 20.73 | 1.08 | 1.09 | 1.10 | 1.11 | 0.89 | 0.88 | 0.90 | 0.89 |
| 4 | 19.77 | 19.81 | 20.56 | 20.64 | 1.12 | 1.13 | 1.12 | 1.14 | 0.87 | 0.86 | 0.90 | 0.88 |
| 5 | 19.55 | 19.66 | 20.39 | 20.29 | 1.12 | 1.14 | 1.13 | 1.16 | 0.85 | 0.84 | 0.88 | 0.87 |
| 6 | 19.27 | 19.40 | 20.22 | 20.15 | 1.14 | 1.17 | 1.14 | 1.18 | 0.85 | 0.82 | 0.86 | 0.84 |

| Moisture | | | Acidity | | | Tannin | | |
|---|---|---|---|---|---|---|---|---|
| | SED | CD (0.01) | | SED | CD (0.01) | | SED | CD (0.01) |
| t | 1.20000 | 3.31641 NS | t | 0.00598 | 0.01652 ** | t | 0.00443 | 0.01225 ** |
| s | 0.90712 | 2.50697 NS | s | 0.00452 | 0.01248 ** | s | 0.00335 | 0.00926 ** |
| ts | 2.40001 | 6.63283 NS | ts | 0.01195 | 0.03303 NS | ts | 0.00886 | 0.02450 NS |

**Table 5:** Changes in chemical characteristics of Amla jelly during storage

| Storage period (in month) | Total sugar(g/100g) | | | | Reducing sugar (g/100g) | | | | Vitamin C (mg/100g) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Pectin | | Agar | | Pectin | | Agar | | Pectin | | Agar | |
| | Glass bottle ($PC_1$) | Plastic jar ($PC_2$) | Glass bottle ($AC_1$) | Plastic jar ($AC_2$) | Glass bottle ($PC_1$) | Plastic jar ($PC_2$) | Glass bottle ($AC_1$) | Plastic jar ($AC_2$) | Glass bottle ($PC_1$) | Plastic jar ($PC_2$) | Glass bottle ($AC_1$) | Plastic jar ($AC_2$) |
| Initial | 51.75 | 51.75 | 51.84 | 51.84 | 9.42 | 9.42 | 9.48 | 9.48 | 302.12 | 302.12 | 310.44 | 310.44 |
| 1 | 51.64 | 51.68 | 51.76 | 51.79 | 9.57 | 9.60 | 9.55 | 9.58 | 302.05 | 302.00 | 310.31 | 310.28 |
| 2 | 51.57 | 51.60 | 51.68 | 51.71 | 9.72 | 9.77 | 9.62 | 9.71 | 301.22 | 301.08 | 309.87 | 309.33 |
| 3 | 51.45 | 51.49 | 51.55 | 51.60 | 9.72 | 9.81 | 9.70 | 9.80 | 300.86 | 300.73 | 308.82 | 308.43 |
| 4 | 51.30 | 51.33 | 51.43 | 51.50 | 9.79 | 9.86 | 9.84 | 9.88 | 300.05 | 299.44 | 307.98 | 307.27 |
| 5 | 51.20 | 51.16 | 51.37 | 51.31 | 9.88 | 9.90 | 9.86 | 9.90 | 291.43 | 283.61 | 300.11 | 297.36 |
| 6 | 51.08 | 51.00 | 51.22 | 51.17 | 9.98 | 10.02 | 9.96 | 9.99 | 280.17 | 268.84 | 292.24 | 273.53 |

| Total sugar | | | Reducing sugar | | | Vitamin C | | |
|---|---|---|---|---|---|---|---|---|
| | SED | CD (0.01) | | SED | CD (0.01) | | SED | CD (0.01) |
| t | 341.84851 | 944.75711 NS | t | 62.31062 | 172.20612 NS | t | 1997.97489 | 5521.74702 NS |
| s | 258.41318 | 714.16925 NS | s | 47.10240 | 130.17559 NS | s | 1510.32706 | 4174.04840 NS |
| ts | 683.69702 | 1889.51422 NS | ts | 124.62125 | 344.41223 NS | ts | 3995.94979 | 11043.49404 NS |

with 1, 1.5 and 2% of mint extract ($T_2$), 3.25, 3.26 and 3.24 mg/100 ml in amla squash treated with 10, 15 and 20% honey ($T_3$) and 3.28, 3.23 and 3.18 mg/100 ml in amla squash treated with 10, 15 and 20% of date syrup ($T_4$) at end of the storage. Seshadri *et al.* (1994) revealed that tannin content decreased after storing for 60 days. The statistical examination of the data concluded that there was a significant difference in the tannin between treatments and storage period.

**Amla jelly**

The changes observed in the chemical composition of amla jelly packed in glass bottles ($PC_1$) and plastic container ($PC_2$) are given in Table 4 and 5.


Initially moisture content of pectin and agar added jelly samples had 20.10 and 20.92/100g. A significant variation was observed between the samples in both packaging materials throughout the storage period. After six month of storage the samples in $PC_1$, $PC_2$, $AC_1$ and $AC_2$ contained 19.27, 19.40, 20.22 and 20.15 per cent respectively. The moisture content of the mango jelly was decreased in $T_1$, $T_2$ and $T_3$ during storage (Sivakumar and Malathi, 2004).

A gradual increase in acidity was noted was in the acid content of the amla jelly packed in both materials. The freshly prepared amla jelly was 1.03 g per cent acidity in pectin and agar added samples which had changed 1.14 in $PC_1$, 1.17 in $PC_2$, 1.14 in $AC_1$ and 1.18 in $AC_2$ after six month of storage. A decreasing trend may observed in tannin and vitamin C content of amla jelly was seen during the storage period. After six month of storage, the tannin content was 0.85 and 0.82 mg/100mg in $PC_1$ and $PC_2$, 0.86 mg/100mg and 0.84 mg/100mg in $AC_1$ and $AC_2$ respectively. Similarly the vitamin C was 280.17 mg/100g in $PC_1$, 268.84 mg/100g in $PC_2$, 292.24 mg/100g in $AC_1$ and 273.53 mg/100g in $AC_2$ at the end of the storage period. Seshadri *et al.* (1994) revealed that similar result after storing for 60 days in pineapple fruit jelly. The freshly prepared amla jelly had 65°brix TSS, which had been maintained upto four months in the samples packed in both packaging materials. There was an increasing in the TSS, after fourth month to sixth month storage and the final values noted were 65.30°brix, 66.00°brix, 65.20°brix and 65.80°brix in $PC_1$, $PC_2$, $AC_1$ and $AC_2$ respectively.

**Organoleptic Characteristics of Amla Products**

The amla products were stored at room temperature (nine months) and their organoleptic characteristics viz., colour, appearance, texture, taste and overall acceptability were also evaluated using a 9 point hedonic scale as per the procedure given by watts *et al.* (1989).

Neither the storage period nor the packaging materials had influenced the organolpetic evaluation score of the amla jam. Initially the amla jam had strong organoleptic scores at the end of the storage period, slight changes were observed. The score value were

8.4 (colour), 8.3 (appearance), 8.4 (texture), 8.3 (taste and overall acceptability), at the end of the storage (Table 6). Similarly, the amla jelly and squashes were evaluated using a nine point hedonic scale to assess the colour and appearance, flavour, taste, texture overall acceptability with a panel of twenty semi (trained judges) and it was highly acceptable at the end of the storage period.

**Table 6:** Organoleptic evaluation of amla jam during storage

| Storage period (in days) | Organoleptic characteristics | | | | |
|---|---|---|---|---|---|
| | Colour | Appear-ance | Texture | Taste | Overall acceptable |
| Initial | 8.7 | 8.5 | 8.6 | 8.5 | 8.5 |
| 90 | 8.6 | 8.5 | 8.5 | 8.5 | 8.5 |
| 180 | 8.5 | 8.4 | 8.4 | 8.4 | 8.4 |
| 270 | 8.4 | 8.3 | 8.4 | 8.3 | 8.3 |

## CONCLUSION

It can be concluded that sweet based amla products such as jam, squash and jelly are highly nutritious and medicinal properties because of the amla squash can be prepared with substitute of date syrup and mint extract. The shelf-life of amla products were found to be highly acceptable at ambient conditions.

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