IJPS INTERNATIONAL JOURNAL OF PLANT SCIENCES
Volume 8 | Issue 1 | January, 2013 | 48-51

RESEARCH ARTICLE

# Effect of heating of the gel at different temperatures on quality components of aloe (*Aloe barbadensis* Miller.)

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## SUMMARY

The experiment consisted of three accessions of aloe *viz.*, yellow flowering accession-1, yellow flowering accession-2 and orange flowering accession-3 and three temperatures *viz.*, $50^0$ C, $75^0$ C and $100^0$ C temperatures. The quality components like total soluble solids, moisture, reducing sugars and total sugars of aloe gel was studied in three accessions heated at different temperatures. At all storage intervals (day 1, 10th day, 20th day and 30th day) highest gel TSS was recorded with yellow flowering accession-1 heated at $75^0$ C, but the highest gel moisture, reducing sugars and total sugars was recorded with yellow flowering accession-1 heated at $50^0$ C. Irrespective of the temperatures highest TSS, moisture, reducing sugars and total sugars was recorded with yellow flowering accession-1 while the lowest was recorded with orange flowering accession-3.

**Key Words :** Yellow flowering accession-1,Yellow flowering accession-2, Orange flowering accession-3, Quality components, Aloe gel

**How to cite this article :** Amareswari, B., Padma, M. and Rajkumar, M.(2013). Effect of heating of the gel at different temperatures on quality components of aloe (*Aloe barbadensis* Miller.). *Internat. J. Plant Sci.*, **8** (1) : 48-51.

**Article chronicle : Received :** 02.07.2012; **Revised :** 20.08.2012; **Accepted :** 14.10.2012

The herb aloe is as old as human civilization. It belongs to the family Liliaceae. The genus is found in Tropical and Southern Africa, Malagasey and Arabia. It was introduced into other parts of the world for ornamental purposes (Reynolds, 1985). There are more than 400 identified species of aloe plants, of which a few have medicinal or economic value (Kawai *et al.*, 1993). For centuries, this plant has been used for its medicinal and therapeutic properties. It has a history of use in folk medicine for treating skin and other disorders. The leaves are to be harvested at the right age and cut exactly at right place on the plant to ensure the best gel (Chauhan *et al.*, 2007). Heating of gel is an effective method of pasteurization and add better flavour (He *et al.*, 2005). Gel heating may change the composition which also has effect on storage. aloe gel can be stored for more number of days (up to 30 days) at $5^0$C without any deterioration in quality (Hemalatha *et al.*, 2008). Keeping in view the composition, importance and usage of aloe gel, the present investigation is carried out.

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## MATERIALS AND METHODS

The experiment was conducted during 2010 at Herbal garden, College of Horticulture, Rajendranagar, Hyderabad to study the effect of temperatures on quality components like total soluble solids (TSS), moisture, reducing sugars and total sugars in different accessions of aloe during storage. It comprised with three accessions of aloe *viz.*, yellow flowering accession-1, yellow flowering accession-2 and orange flowering accession-3 and three temperatures *viz.*, $50^0$C, $75^0$C and $100^0$C temperatures. The 9 treatments were evaluated in Completely Randomized Design with factorial concept in three replications (Table A).

Healthy and matured leaves of different accessions with different ages as per the treatments were harvested manually. After harvesting, aloe leaves are washed thoroughly two times. The aloetic juice was separated from the leaves by cutting them transversely at the base and kept the cut portion touching the ground. The leaf was allowed to stand in slanting position for half an hour. Thus, it helped for removal of yellow latex

Yellow flowering accession-1

Yellow flowering accession-2

Orange flowering accession-3

**Table A : Details of treatments imposed**

| Treatment | Combination of treatments |
|---|---|
| $T_1$ | $A_1$ $t_1$ (Yellow flowering accession-1+50°C) |
| $T_2$ | $A_1$ $t_2$ (Yellow flowering accession-1+75°C) |
| $T_3$ | $A_1$ $t_3$ (Yellow flowering accession-1+100°C) |
| $T_4$ | $A_2$ $t_1$ (Yellow flowering accession-2+50°C) |
| $T_5$ | $A_2$ $t_2$ (Yellow flowering accession-2+75°C) |
| $T_6$ | $A_2$ $t_3$ (Yellow flowering accession-2+100°C) |
| $T_7$ | $A_3$ $t_1$ (Orange flowering accession-3+50°C) |
| $T_8$ | $A_3$ $t_2$ (Orange flowering accession-3+75°C) |
| $T_9$ | $A_3$ $t_3$ (Orange flowering accession-3+100°C) |

from leaf. The leaves were again washed thoroughly and then cut into pieces by stainless steel knife under hygienic conditions. Then the outer peels were separated. Then the extracted gel from the leaves was thoroughly homogenized in a mixer and gel of each accession was heated at $50^0$ C, $75^0$C and $100^0$ C for 15 minutes and stored at room temperature. Standard preservative (sodium benzoate 1000 ppm + citric acid 1%) was added to aloe gel. Then the juice was analyzed for pH, acidity and microbial content at every 10 days intervals up to 30$^{th}$ day of storage.

## RESULTS AND DISCUSSION

The data recorded on TSS and moisture was presented in Table 1.

**Total soluble solids (TSS) :**

The TSS of the gel has gradually increased with increase in storage period up to 30$^{th}$ day in all the treatments. Highest initial gel TSS on day 1 (0.93) was recorded with yellow flowering accession-1 heated at $75^0$C has increased to 1.03, 1.10 and 1.30 at 10$^{th}$, 20$^{th}$ and 30$^{th}$ day of storage, respectively and it was at par with the same accession heated at $50^0$C (0.90, 0.97, 1.03 and 1.17 at all storage intervals) while the lowest initial gel TSS (0.57) was recorded with orange flowering accession-3 heated at $100^0$C has increased to 0.60, 0.67 and 0.87 at 10$^{th}$, 20$^{th}$ and 30$^{th}$ day of storage, respectively.

Significantly superior gel TSS was recorded by yellow flowering accession-1 at all heating temperatures during the storage period followed by yellow flowering accession-2 while the lowest gel TSS was recorded with orange flowering accession-3 at all temperatures.

**Moisture (%) :**

The results revealed that there was a decreasing trend in gel moisture during the storage period from day 1 to day 30th. Highest gel moisture on day 1 (96.07%) was recorded by yellow flowering accession-1 heated at $50^0$C on day1 has decreased to 95.10, 93.13 and 91.07 per cent at 10$^{th}$, 20$^{th}$ and 30$^{th}$ day of storage, respectively and it was at par with the same accession heated at $75^0$C (95.83, 94.70, 92.80 and 90.67% at all storage intervals). While the lowest moisture content (78.30%) was recorded with orange flowering accession-3 heated at $100^0$C has decreased to 76.80, 74.30 and 72.53% at 10$^{th}$, 20$^{th}$ and 30$^{th}$ day of storage, respectively.

Yellow flowering accession-1 at all heating temperatures recorded the highest moisture content followed by yellow flowering accession-2. But the lowest moisture was recorded by orange flowering accession-3 at all temperatures.

**Table 1: Effect of heating of the gel at different temperatures on TSS and moisture in different accessions of Aloe**

| Treatments | TSS ($^0$ Brix) days of storage | | | | Moisture (%) days of storage | | | |
|---|---|---|---|---|---|---|---|---|
| | Fresh | 10$^{th}$ day | 20$^{th}$ day | 30$^{th}$ day | Fresh | 10$^{th}$ day | 20$^{th}$ day | 30$^{th}$ day |
| $A_1$ | 0.90 | 0.97 | 1.04 | 1.20 | 95.78 | 94.73 | 92.80 | 90.63 |
| $A_2$ | 0.77 | 0.81 | 0.89 | 1.07 | 88.97 | 87.42 | 85.81 | 83.07 |
| $A_3$ | 0.62 | 0.67 | 0.74 | 0.97 | 78.57 | 77.19 | 74.74 | 73.02 |
| S.E.± | 0.0952 | 0.0816 | 0.0806 | 0.0846 | 0.2254 | 0.3448 | 0.2508 | 0.2867 |
| C.D. at5% | 0.1999 | 0.1715 | 0.1694 | 0.1778 | 0.4735 | 0.7244 | 0.5269 | 0.6023 |
| $t_1$ | 0.76 | 0.80 | 0.88 | 1.08 | 88.07 | 86.82 | 84.78 | 82.68 |
| $t_2$ | 0.81 | 0.89 | 0.97 | 1.16 | 87.77 | 86.46 | 84.47 | 82.27 |
| $t_3$ | 0.72 | 0.76 | 0.83 | 1.0 | 87.48 | 86.07 | 84.11 | 81.78 |
| S.E.± | 0.0952 | 0.0816 | 0.0806 | 0.0846 | 0.2254 | 0.3448 | 0.2508 | 0.2867 |
| C.D. at 5% | 0.1999 | 0.1715 | 0.1694 | 0.1778 | 0.4735 | 0.7244 | 0.5269 | 0.6023 |
| **Accessions×Temperatures** | | | | | | | | |
| $A_1$ $t_1$ | 0.90 | 0.97 | 1.03 | 1.17 | 96.07 | 95.10 | 93.13 | 91.07 |
| $A_1$ $t_2$ | 0.93 | 1.03 | 1.10 | 1.30 | 95. 83 | 94.70 | 92. 80 | 90.67 |
| $A_1$ $t_3$ | 0.87 | 0.90 | 1.0 | 1.13 | 95. 43 | 94.40 | 92. 47 | 90.17 |
| $A_2$ $t_1$ | 0.77 | 0.80 | 0.87 | 1.07 | 89.30 | 87.83 | 86.07 | 83.47 |
| $A_2$ $t_2$ | 0.80 | 0.87 | 0.97 | 1.13 | 88.90 | 87.43 | 85.80 | 83.10 |
| $A_2$ $t_3$ | 0.73 | 0.77 | 0.83 | 1.0 | 88.70 | 87.00 | 85.57 | 82.63 |
| $A_3$ $t_1$ | 0.60 | 0.63 | 0.73 | 1.0 | 78.83 | 77.53 | 75.13 | 73.50 |
| $A_3$ $t_2$ | 0.70 | 0.77 | 0.83 | 1.03 | 78.57 | 77.23 | 74.80 | 73.03 |
| $A_3$ $t_3$ | 0.57 | 0.60 | 0.67 | 0.87 | 78.30 | 76.80 | 74.30 | 72.53 |
| S.E.± | 0.1648 | 0.1414 | 0.1397 | 0.1466 | 0.3904 | 0.5972 | 0.4343 | 0.4965 |
| C.D. at 5% | 0.3463 | 0.2971 | 0.2934 | 0.307 | 0.8202 | 1.2548 | 0.9126 | 1.0432 |

**Table 2: Effect of heating of the gel at different temperatures on reducing sugars and total sugars in different accessions of Aloe**

| Treatments | Reducing sugars (%) days of storage | | | | Total sugars (%) days of storage | | | |
|---|---|---|---|---|---|---|---|---|
| | Fresh | 10$^{th}$ day | 20$^{th}$ day | 30$^{th}$ day | Fresh | 10$^{th}$ day | 20$^{th}$ day | 30$^{th}$ day |
| $A_1$ | 1.86 | 1.49 | 0.98 | 0.69 | 1.91 | 2.09 | 2.27 | 2.53 |
| $A_2$ | 1.76 | 1.29 | 0.88 | 0.61 | 1.81 | 1.92 | 2.12 | 2.41 |
| $A_3$ | 1.73 | 1.30 | 0.88 | 0.60 | 1.78 | 1.89 | 2.09 | 2.39 |
| S.E.± | 0.0188 | 0.0270 | 0.0195 | 0.0391 | 0.0187 | 0.0223 | 0.0222 | 0.0214 |
| C.D. at 5% | 0.0395 | 0.0568 | 0.0409 | 0.0822 | 0.0393 | 0.0449 | 0.0467 | 0.0449 |
| $t_1$ | 1.79 | 1.35 | 0.93 | 0.64 | 1.84 | 2.00 | 2.19 | 2.46 |
| $t_2$ | 1.78 | 1.35 | 0.91 | 0.64 | 1.83 | 1.97 | 2.16 | 2.44 |
| $t_3$ | 1.78 | 1.34 | 0.90 | 0.63 | 1.82 | 1.94 | 2.13 | 2.42 |
| S.E.± | 0.0188 | 0.0270 | 0.0195 | 0.0391 | 0.0187 | 0.0223 | 0.0222 | 0.0214 |
| C.D. at 5% | 0.0395 | 0.0568 | 0.0409 | 0.0822 | 0.0393 | 0.0449 | 0.0467 | 0.0449 |
| **Accessions×Temperatures** | | | | | | | | |
| $A_1$ $t_1$ | 1.87 | 1.44 | 1.00 | 0.70 | 1.92 | 2.13 | 2.31 | 2.55 |
| $A_1$ $t_2$ | 1.86 | 1.45 | 0.97 | 0.69 | 1.91 | 2.10 | 2.26 | 2.53 |
| $A_1$ $t_3$ | 1.86 | 1.44 | 0.97 | 0.67 | 1.90 | 2.06 | 2.24 | 2.50 |
| $A_2$ $t_1$ | 1.76 | 1.30 | 0.89 | 0.61 | 1.81 | 1.95 | 2.15 | 2.43 |
| $A_2$ $t_2$ | 1.76 | 1.29 | 0.88 | 0.62 | 1.81 | 1.92 | 2.12 | 2.40 |
| $A_2$ $t_3$ | 1.76 | 1.29 | 0.86 | 0.61 | 1.81 | 1.90 | 2.09 | 2.39 |
| $A_3$ $t_1$ | 1.75 | 1.30 | 0.89 | 0.60 | 1.80 | 1.91 | 2.12 | 2.41 |
| $A_3$ $t_2$ | 1.73 | 1.30 | 0.88 | 0.60 | 1.77 | 1.89 | 2.09 | 2.38 |
| $A_3$ $t_3$ | 1.71 | 1.30 | 0.87 | 0.60 | 1.76 | 1.87 | 2.06 | 2.36 |
| S.E.± | 0.0326 | 0.0468 | 0.0337 | 0.0678 | 0.0324 | 0.0387 | 0.0385 | 0.0370 |
| C.D. at 5% | 0.0685 | 0.0984 | 0.0709 | 0.1425 | 0.0681 | 0.0813 | 0.0809 | 0.0778 |

The results indicated that the TSS content increased with the advancement of storage in all accessions at all the temperatures. It might be due to increase in soluble solids content and total soluble sugars caused by hydrolysis of polysaccharides like starch, cellulose and pectin substances into simpler substances. The moisture content also decreased during the storage. There was an inverse relationship between moisture and total soluble solids. This indicated that during storage, there was change in the aloe gel composition. Similar results were observed in amla juice during storage (Gajanana, 2002).

**Reducing sugars (%) :**

The data on the reducing sugars and total sugars as influenced by heating of the gel at different temperatures in different aloe accessions are presented in Table 2.

Yellow flowering accession-1 which recorded the maximum reducing sugars on day 1 (0.053%) heated at $50^0$C has resulted in (0.687, 1.310 and 1.853 per cent at $10^{th}$, $20^{th}$ and $30^{th}$ day of storage, respectively) followed by the same accession at $75^0$C (0.05, 0.647, 1.287 and 1.833 per cent at day 1, $10^{th}$, $20^{th}$ and $30^{th}$ day, respectively).

However, the orange flowering accession-3 which recorded the lowest initial reducing sugars (0.043%) has also recorded the lowest reducing sugar per cent at all intervals heated at $100^0$C (0.570, 1.197 and 1.760 at $10^{th}$, $20^{th}$ and $30^{th}$ day of storage, respectively).

Yellow flowering accession-1 heated at all temperatures has recorded the highest reducing sugars followed by yellow flowering accession-2 while the orange flowering accession-3 recorded the lowest reducing sugars compared to the other two accessions irrespective of heating temperature and storage intervals.

**Total sugars (%) :**

Highest initial total sugars content (1.92%) was recorded in yellow flowering accession-1 heated at $50^0$C which has increased to maximum (2.55%) at $30^{th}$ day of storage period which was at par with $75^0$C (1.91 to 2.53%) while the lowest initial total sugars (1.76%) was recorded with orange flowering accession-3 heated at $100^0$C which has increased (2.36%) during the storage period.

Highest total sugars were recorded by yellow flowering accession-1 at all the temperatures followed by yellow flowering accession-2 while the lowest total sugars were recorded with orange flowering accession-3 at all the temperatures.

The reducing sugars and total sugars were found to increase significantly throughout the storage period but there was a corresponding decline in non-reducing sugars. The reduction in non-reducing sugars might be due to the inversion of non-reducing sugars to reducing sugars which caused by acids present in the aloe gel. Similarly, hydrolysis of polysaccharides during storage might have resulted in increase of soluble sugars in aloe gel. These results are similar with the observations made by Lu *et al.* (2008) in compound juice made of aloe and apple and Gajanana (2002) in amla juice. Increase in reducing sugars and total sugars and decrease in non-reducing sugars during storage is a general phenomenon as noticed by Khambalkar *et al.* (2007) in aloe.

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