

Effect of gibberelic acid and calcium nitrate on the physiological and physico-chemical changes and shelf-life of aonla (*Emblica officinalis* Gaertn) fruits

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ABSTRACT

Postharvest management is the burning issue in the present horticultural scenario. Aonla is full of medicinal and antioxidant properties. The present investigations were carried out at main experiment station (Horticulture Garden) of Chandra Shekhar Azad University of Agriculture and Technology, Kanpur, UP during the year 2009-10 to study the effect of gibberelic acid and calcium nitrate on the physiological and physico-chemical changes during storage and shelf-life of aonla (Banarsi Aonla) fruits. The experiment comprised of five treatments T_1 (control), T_2 (calcium nitrate 0.5%), T_3 (calcium nitrate 1.0%), T_4 (GA_3 50 ppm), T_5 (GA_3 100 ppm) with three replications under completely randomized design. The minimum physiological loss in weight (PLW) of fruits (11.84%) was noted with 1 per cent calcium nitrate treatment and there was no spoilage of fruits in first day of storage in all the treatments including control. The spoilage of fruits gradually increased with increasing storage period. The minimum spoilage per cent was observed under 100 ppm GA_3 (8.58%) whereas it was maximum (16.58%) under control. The maximum TSS value and total sugar content were recorded with 50 ppm GA_3 . Thus it may be summed up that the quality of fruits was favorably influenced during storage under postharvest treatment of calcium nitrate and GA_3 .

Keywords: Aonla; physico-chemical; acidity; TSS; GA_3 ; calcium nitrate

INTRODUCTION

Aonla (*Emblica officinalis* Gaertn) also known as 'Indian Gooseberry' belongs

to the family Euphorbiaceae with the chromosome number of $2n=28$. The aonla tree is native of tropical south east Asia particularly central and southern India

(Morton 1960). Naturally growing aonla trees have also been reported from Ceylon, Cuba, Puerto Rico, Hawaii, Florida, Iran, Iraq, Java, West Indies, Trinidad, Pakistan, Malaya and China (Benthall 1946). Aonla cultivation is more common in northern India particularly in districts of Uttar Pradesh at Pratapgarh, Varanasi, Raibareilly, Faizabad etc (Bajpai and Shukla 2002) and is spreading fast in drier parts of the country viz Andhra Pradesh, Rajasthan, Haryana, Gujarat, Madhya Pradesh etc. In India Pratapgarh is the major aonla producing area covering 10000 hectares under this crop. It is also grown easily in calcareous and slightly saline and alkaline soils where other fruit crops generally do not thrive. The tree also flourishes well in dry areas and is not affected by serious insect pests or diseases. The fruit is highly nutritive and second richest source of vitamin C after Barbados cherry (Chadha 2002). It is used for Ayurvedic medicines or processed into products such as Chyawanprash commonly consumed for growth, vigour and general upkeep of human health. The fruit has also fair amount of iron, calcium and lysine. However it is not consumed much as fresh fruit as it is highly acidic and astringent in taste. Several value added products like RTS, nectar Murabba, pickle and candy (Pathak 1988), herbal squash, herbal jam and sauce (Singh 1988). Aonla fruit is non-climacteric and does ripen on the tree. Fruits remain on the tree until flowering and drop down from the tree when pathogen attack aonla fruit particularly during the later stages

of growth and development. Very meager information is available on the keeping quality of aonla fruits which needs proper investigation so that fruits can be stored for maximum possible period without any deterioration in the quality.

MATERIAL and METHODS

Field experiment was carried out in the garden of the department of horticulture, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur, UP during the year 2009-10. The trees received uniform cultural operations throughout the experiment. The experiment site is situated in the Gangetic alluvial belt of central UP between 25.26° to 26.38° North latitude and 79.31° to 80.34° East longitude at an elevation of 125.90 m amsl. Climate of the experimental site is characterized as sub-tropical with hot dry summer and cold winter; the annual rainfall is about 700 to 1000 mm most of which is received from July to September with scattered showers in winter from the north east monsoon. The maximum temperature ranged from 20°C to 45°C and minimum from 6.6°C to 22.6°C with relative humidity of 40-80 per cent in different months of the year. The soil of experimental field is sandy loam of average fertility with pH 7.9, water holding capacity 40.30 per cent and humus 2.54 per cent. The soil had 0.56 per cent organic carbon, 0.056 per cent total nitrogen, 0.027 per cent total phosphorus, 0.67 per cent total potash, total zinc 16.20

ppm and total boron 30.50 ppm. The uniform, mature and healthy fruits of aonla variety Banarsi Aonla picked on the same day from all the directions of trees at the same stage of maturity were selected for present investigations. The experiment comprised of five treatments T_1 (control), T_2 (calcium nitrate 0.5%), T_3 (calcium nitrate 1.0%), T_4 (GA_3 50 ppm), T_5 (GA_3 100 ppm). The experiment was laid out in completely randomized design with three replications. The observations were recorded on physiological loss in weight (PLW), spoilage loss, total soluble solids (TSS), acidity, ascorbic acid, organoleptic evaluation and total sugar content. Data were analyzed using analysis of variance (ANOVA) as per the procedure described by Panse and Sukhatme (1985). Critical difference (CD) within the treatments was calculated in order to compare the treatments at 1 and 5 per cent level of significance. The data on fruit quality parameters were analysed and tabulated.

RESULTS and DISCUSSION

The results obtained in the present investigations revealed that different postharvest treatments of fruits influenced the parameters viz physiological loss in weight (PLW), spoilage, organoleptic rating, total soluble solids, titratable acidity, ascorbic acid content, reducing sugar and total sugar content in aonla fruits cv Banarsi Aonla harvested at maturity.

Per cent physiological loss in weight (PLW)

A perusal of data in Table 1 shows that per cent PLW was influenced significantly by the various treatments and storage period and their interaction under the ambient conditions of storage. The weight loss increased gradually and progressively with advancement in storage period. The minimum PLW (11.84%) was observed under T_3 (calcium nitrate 1.0%) closely followed by T_5 (GA_3 100 ppm) (12.04%) as compared to the highest PLW (13.61%) observed in T_1 (control). These results are in conformity with the findings of Chandra et al (1994) who reported that calcium nitrate (1.5%) was the most effective treatment for minimizing weight loss during storage of guava fruits cv Allahabad Safeda. Singh and Singh (1999) revealed that the pre-harvest application of calcium nitrate (1.0%) resulted in the lowest mean PLW (5.61%) and maintained the firmness of fruits longer than the other calcium nitrate concentrations (1.5 and 2.0%) during storage.

Spoilage

The data presented in Table 1 reveal that fruits spoilage was maximum (16.58%) in T_1 (control). The minimum spoilage (8.58%) was recorded in T_5 (GA_3 100 ppm) followed by its T_4 (GA_3 50 ppm) (9.91%). All the treatments reduced spoilage per cent as compared to control. Earlier workers also reported that the calcium nitrate at 1.5 per cent was found

Table 1. Effect of gibberellic acid and calcium nitrate on PLW (%), spoilage (%), organoleptic ratings, TSS (°Brix), sugar content (%), ascorbic acid (mg/100 g) and acidity (%) of aonla fruits during storage

Treatment	PLW (%)	Spoilage (%)	Organoleptic rating	TSS (°Brix)	Sugar content (%)	Ascorbic acid (mg/100 g)	Acidity (%)
T ₀	13.61	16.58	46.32	11.99	7.94	572.25	2.37
T ₁	12.21	16.37	57.35	13.47	8.10	605.22	2.14
T ₂	11.84	12.29	54.20	13.90	8.00	605.40	2.23
T ₃	13.32	9.91	59.22	14.03	8.18	607.60	2.08
T ₄	12.04	8.58	56.83	13.42	8.12	610.40	2.03
SE± (T)	0.09	0.59	0.03	0.01	0.01	1.28	0.010
SE± (P)	0.08	0.66	0.03	0.01	0.01	1.15	0.011
SE± (T x P)	0.17	1.32	0.07	0.36	0.36	2.57	0.02
CD _{0.05} (T)	0.15	1.33	0.07	0.03	0.03	2.59	0.02
CD _{0.05} (P)	0.17	1.97	0.07	0.03	0.03	2.32	0.02
CD _{0.05} (T x P)	0.34	2.67	0.14	0.06	0.06	5.19	0.04

most effective in minimizing the spoilage (Chandra et al 1994). Ahmed and Singh (1999) reported that mango fruits treated with GA₃ (50 ppm) when kept in perforated bags could be stored well up to 11 days with minimum spoilage loss. Selvan and Bal (2005) reported that treatment with calcium nitrate (0.5 and 0.1%) and calcium nitrate (1.0%) + Benlate (1000 ppm) was found to be effective in reducing spoilage in guava fruits. Lal et al (2007) reported that application of Bavistin (500 ppm) under modified atmosphere considerably reduced the spoilage of mango fruits.

Organoleptic rating

The organoleptic rating evaluation revealed that the fruits were rated lower with

the progress of storage period. The freshly harvested fruits scored maximum rating. The organoleptic rating of aonla fruits decreased gradually in treated fruits as compared to untreated ones during storage. The mean organoleptic rating during storage was high (59.22) in fruits treated with T₄ (GA₃ 50 ppm) followed by T₂ (calcium nitrate 0.5%) (57.35) and minimum in T₁ (control) (46.32). These findings are more or less similar to those observed by Singh et al (1981) and Chandra et al (1994) with regard to guava fruits. Higher rating could be mainly due to proper blend of total soluble solids, sugar and acid content of fruits under the applications of these treatments as observed in the present investigations.

Total soluble solids (TSS)

The maximum TSS content of fruits (14.3°Brix) was observed in T₄ (GA₃ 50 ppm) and minimum (11.99°Brix) in T₁ (control). The effect of interaction between storage period and treatments (T x P) was also found to be significant. The results are in agreement with the finding of Singh (1988) who reported that application of calcium nitrate (1%) favoured the accumulation of TSS in guava fruits during storage. Mishra et al (2003) reported that spraying of calcium nitrate (1%) twice reduced the physiological loss in weight, volume, specific gravity, TSS and total sugar of the fruits for more than 3 days at ambient storage temperature.

Lal et al (2007) reported post-harvest behaviour of mango cultivar Dashehari by applying wax emulsion (6.0%), calcium nitrate 1%, cycocel (1000 ppm) and Bavistin (500 ppm) with untreated fruits as control. The minimum PLW was recorded in fruits with wax emulsion followed by calcium nitrate stored under modified atmospheric condition along with maintaining the TSS and total sugars at lower levels throughout the storage period with higher levels of acidity and ascorbic acid.

Ascorbic acid

The ascorbic acid content of aonla fruits decreased throughout the storage period. However all the treatments showed better retention of ascorbic acid as

compared to control. The maximum ascorbic acid content (610.40 mg/100 g) was recorded under T₅ (GA₃ 100 ppm) followed by T₃ (calcium nitrate 1.0%) (605.40 mg/100 g) and T₄ (GA₃ 50 ppm) (607.6 mg/100 g). The minimum ascorbic acid content was found under T₁ (control) (572.25 mg/100 g). The interaction of storage period and treatment (T x P) was also found to be significant. The results are in conformity to those reported by Mishra et al (2003). Ram and Jain (2005) reported that calcium chloride (0.05%) was the best treatment as this treatment prolonged the shelf-life of fruits up to 9 days.

Total sugar content (%)

The total sugar content increased up to 15 days of storage period in all the treatments. The maximum total sugar content (8.18%) was found in T₄ (GA₃ 50 ppm) followed by T₅ (GA₃ 100 ppm) (8.12%). These findings are in agreement with the reports of Ram and Jain (2005) in strawberry. Singh et al (2007) reported that calcium chloride recorded the best result in extending storage period and considerably reducing the physiological loss in weight of strawberry. The acidity and total sugar content of the fruits first showed an increasing trend and then started to decrease during the storage.

Acidity

The present investigations indicated that there was pronounced impact of

storage on the acidity of aonla fruits. The minimum acidity per cent was found in T₅ (GA₃ 100 ppm). The maximum acidity (2.37%) was recorded under T₁ (control). Earlier workers also reported that the application of calcium nitrate (2.0%) reduced the acidity in guava fruits during storage (Singh et al 2004).

REFERENCES

- Ahmad MS and Singh S 1999. Effect of various postharvest treatments on shelf- life of Amrapali mango. Orissa Journal of Horticulture **27(1)**: 29-33.
- Bajpai PN and Shukla HS 2002. Aonla. In: Fruits: tropical and subtropical. Vol II, Naya Udyog, 206 Bidhan Sarani, Calcutta, West Bengal, India, pp 527-528.
- Benthall AP 1946. Trees of Calcutta and its neighbourhood. Thacker Spink and Co Ltd, Calcutta, West Bengal, India, 513p.
- Chadha KL 2002. Hand book of horticulture. ICAR, New Delhi, India.
- Chandra R, Govind S and Basuchoudhury P 1994. Pre-harvest sprays of calcium nitrate and alar on quality and post-harvest behaviour of guava fruits. Indian Journal of Hill Farming **7(1)**: 51-56.
- Lal G, Singh RV and Saran PL 2007. Shelf-life and quality of mango cv Dashehari as influenced by various chemicals under different storage conditions. Haryana Journal of Horticultural Sciences **36(3/4)**: 259-261.
- Mishra DS, Tiwari JP, Misra KK and Shant Lal 2003. Effect of calcium nitrate and method of application on nutrient content of leaves and post-harvest quality of guava fruit. Scientific Horticulture **8**: 11-19.
- Morton JF 1960. The emblic (*Phyllanthus emblica* L.). Economic Botany **14**: 119-127.
- Panse VC and Sukhatme PV 1985. Statistical methods for agricultural workers. ICAR, New Delhi, India.
- Pathak S 1988. Post-harvest technology of aonla (*Emblia officinalis* Gaertn) fruits. PhD thesis, Narendra Deva University of Agriculture and Technology, Kumarganj, Faizabad, UP, India.
- Ram Asrey and Jain RK 2005. Effect of certain post-harvest treatments on shelf life of strawberry cv Chandler. Acta Horticulturae **696**: 547-550.
- Selvan MT and Bal JS 2005. Effect of post-harvest chemical treatments on shelf -life of guava during ambient storage. Haryana Journal of Horticultural Sciences **34(1/2)**: 33-35.
- Singh A, Singh JN and Srivastava AK 2007. Effect of chemicals and packaging on shelf-life and fruit quality of strawberry (*Fragaria x Ananassa* Duch). Agricultural Science Digest **27(2)**: 119-121.
- Singh BP, Pandey G, Sarolia DK, Pandey MK and Pathak RK 2004. Shelf-life evaluation of aonla cultivars. Indian Journal of Horticulture **62(2)**: 137-140.
- Singh BP, Singh HK and Chauhan KS 1981. Effect of post-harvest calcium treatments on the storage life of guava fruits. Indian Journal of Agricultural Sciences **91**: 44-47.
- Singh IS 1988. Fruit-vegetable utilization and preservation (in Hindi). Directorate of Extension, Narendra Deva University of Agriculture and Technology, Kumarganj, Faizabad, UP, India.
- Singh JP and Singh SP 1999. Effect of pre-harvest spray of calcium nitrate on shelf-life of guava (*Psidium guajava* L) fruits cv Allahabad Safeda. Journal of Applied Biology **9(2)**: 149-152.

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