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POST HARVEST APPLICATION OF SALICYLIC ACID ENHANCED SHELF LIFE AND MAINTAINED QUALITY OF BANANA CV. 'GRAND NAINE' AT AMBIENT STORAGE

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ABSTRACT
Six concentrations of Salicylic Acid (SA: 0.25, 0.5, 1.0, 1.5, 2.0 and 4.0 mM) along with control (water dipped) were tested on shelf life and quality of banana fruits stored at 23 ± 2^0C and 70 ± 5% relative humidity. Eight days after storage (DAS), fruits treated with SA at 4.0 mM showed reasonably less skin colour development (average score: 4.3) than control (average score: 7.0). Moreover, TSS (13.82°Brix), titrable acidity (0.22%, TSS:acid ratio (62.82), total sugar (13.42%) content was found low with high ascorbic acid level (11.53 mg $100g^{-1}$) which signified that fruits had delayed ripening under this treatment. Fruit decay (5.62%) and weight loss (11.85%) was also remained low for SA (4.0mM) treated fruits and thus increased the shelf life up to six days more than control. However, SA at 2.0 mM had also caused high shelf life (13.05 days) with low fruit decay (8.85%). Study revealed that SA at 2.0-4.0 mM may be effective post-harvest treatment for extending shelf life and maintaining fruit physico-chemical qualities at ambient condition.

INTRODUCTION

Banana and plantains are one of the most important commercial food crops especially in tropics. It is major starch staple crop of considerable importance. They are consumed both as an energy yielding food and as a dessert. A dessert banana weighing 100 g contains 368 kilo joules energy while plantain of the same weight contains 556 kilo joules energy (Chattopadhyay *et al.*, 2001). Further it contains nearly all essential nutrients including minerals and vitamins. Banana and plantain are today grown in every humid tropical region and constitute the 4th largest food crop of the world after rice, wheat and maize (Arias *et al.*, 2003; Mulagund *et al.*, 2015). Banana and plantains are one of the cheapest foods to produce. The cost of production of one kg of plantain is less than that for most other staples, including sweet potato, rice, maize and yam (Hailu *et al.*, 2012).

India ranked 1st in the world banana (Anon.2014a) production (26.51 million tonnes). Though India is leading producer in the World, but fresh fruit export is quite less. Only 50 thousand tonnes worth rupees 13.06 thousand lakhs got exported in neighbouring countries like Gulf, Pakistan, Nepal and Maldives (Anon., 2014b). It implies that domestic consumption of fresh banana fruits is reasonably high in India. Bananas are mostly traded in ambient condition in India. Even, harvest at green stage, it ripens very quickly in ambient condition because of enhanced respiration and ethylene release and consequently, affected by diseases which in turn reduce the shelf life and hinder fresh fruit export and reduce the value in domestic market. Worldwide post-harvest losses in fruits and vegetables ranged from 25 to 40 % (Raja and Khokhar, 1993). Post-harvest life of banana is reported of about 4 weeks when kept at 12^0C-16^0C (Yahia and Singh, 2009). However, Chattopadhyay *et al.* (2001) opined that it got ripened in a week when kept at 21^0C. Modified atmosphere storage can extend the shelf life of banana up to 20 days (Yahia and Singh, 2009). But, in general, in developing country like India, these set of infrastructure are not there for majority of the grower and thus indulging them to have low market return because of glut in market as shelf life extension is considered as tough challenge in ambient condition.

Salicylic acid, an endogenous plant growth regulator, has been found to generate a wide range of metabolic and physiological responses in plants. It is considered as a natural and safe phenolic compound exhibit a high potential in controlling post-harvest losses of horticultural crops and also delay in ripening through inhibition of ethylene biosynthesis or action (Asghari and Aghdam, 2010). Salicylic acid has successfully been used for extending shelf life and maintaining physico-chemical qualities of fruits like kiwifruit (Aghdam *et al.*, 2010), peach (Tareen *et al.*, 2012), navel orange (Renhua *et al.*, 2008), mango (Netravati *et al.*, 2015) and strawberry (Shafiee *et al.*, 2010) etc. Therefore, the present investigation was taken up to study the effect of salicylic acid in a view to extend the shelf life and maintain the quality of banana fruits at room (ambient) temperature.

MATERIALS AND METHODS

Location of experiment

The experiment was carried out during May-June, 2014, with mature green banana fruits of cv. Grand Naine obtained from a local grower of Tanhril, Aizawl, at Research Laboratory, Department of Horticulture, Aromatic and Medicinal Plants, Mizoram University, stored at 23 ± 2^{o}C temperature and relative humidity of $70 \pm 5\%$.

Treatments

Seven post-harvest treatments viz. fruit dipping in Salicylic Acid (SA) at 0.25 mM L^{-1} (T_1), 0.50 mM L^{-1} (T_2), 1.0 mM L^{-1} (T_3), 1.5 mM L^{-1}(T_4), 2.0 mM L^{-1} (T_5), 4.0 mM L^{-1} (T_6) and control (treated with water: T_7) with three replications were used and statistical analysis was done by following complete randomized design (Gomez and Gomez, 1984). Comparison of treatment means were made with the help of Critical Differences. Duncan Multiple Range Test (DMRT) was used to group the treatment means on the basis of C.D. (Duncan, 1955). The values were marked with English alphabets. The alphabet 'a' denoted the minimum value and subsequent higher values in increasing order were marked alphabetically. The values marked with same alphabet(s) indicated that they were statistically at par.

Scores of visual observation for skin colour

Fruits were visually observed and scored for skin colour using the Standard USDA index (Anon., 2001). Appearance wise scores were as follows: Green:1, Light green:2, Yellowish:3, More yellow than green:4, Yellow with green tips:5, yellow:6 and Yellow, flecked with brown:7.

Determination of weight loss

Fruits for each treatment were tagged and weighed at 4 days interval using a digital electronic balance. The percentage weight loss was calculated by the following equation:-

Percentage weight loss at n^{th} day = [Weight Loss (0 day- n^{th} day)/Weight Loss (at 0 Day)] $\times$ 100

Weight at 0 day

Determination of pulp: peel ratio

Fruits from each treatment were peeled off and the pulp and peel portions were weighed separately on a laboratory balance at 4 days interval. The ratio of pulp to peel of each finger was calculated and mean value was recorded.

Biochemical parameters

Analyses were carried out for biochemical parameters viz. total soluble solids (TSS), titrable acidity, TSS: acid ratio, total sugar, reducing sugar and ascorbic acid content following standard procedure described by Ranganna (1997).

Percentage of fruit decay

The decay or rotting of the stored banana fruits were determined by their visual observations. Decay percentage of banana fruits was calculated as the number of decayed fruit divided by initial number of all fruits.

Shelf life of fruit

Optimum shelf life (days) of fruits were determined depending on the visual observation of fruit decay, fruit physico-chemical parameters and spoilage and counting the days from harvest to the day with maximum visual colour score and edible quality.

RESULTS AND DISCUSSION

Skin colour

Colour and texture are important in banana fruit quality. Bananas, like other fruits undergo significant colour transformation as they pass through the ripening process. The

Table 1: Effect of salicylic acid treatments on percentage of weight loss, decay and shelf life of banana fruits

Treatments	Percentage of weight loss (%)			Fruit Decay (%)	Shelf Life (Days)
	0 DAS	4 DAS	8 DAS	8 DAS	
T_1: SA at 0.25 mM	0.00	5.23bc	16.84bc	18.52d	9.00
T_2: SA at 0.5 mM	0.00	4.87bc	16.41b	16.45d	10.25
T_3: SA at 1.0 mM	0.00	4.56abc	16.15b	14.28cd	10.50
T_4: SA at 1.5 mM	0.00	4.23ab	16.00b	11.61bc	11.00
T_5: SA at 2.0 mM	0.00	3.17a	12.25a	8.85ab	13.05
T_6: SA at 4.0 mM	0.00	3.12a	11.85a	5.62a	14.85
T_7: Control	0.00	5.78c	18.58c	26.40e	8.33
LSD (p = 0.05)	-	1.3428	1.6976	2.7055	-

Table 2: Effect of salicylic acid treatments on total soluble solids (TSS), titrable acidity and TSS: acid ratio of banana fruits

Treatments	TSS (^{0} Brix)			Titrable Acidity (%)			TSS: Acid Ratio		
	0 DAS	4 DAS	8 DAS	0 DAS	4 DAS	8 DAS	0 DAS	4 DAS	8 DAS
T_1: SA at 0.25 mM	7.65b	17.68de	23.84c	0.13a	0.24cd	0.30c	58.85cd	73.67c	79.47c
T_2: SA at 0.5 mM	7.44ab	16.32cd	23.14c	0.12a	0.22bcd	0.28bc	62.00d	74.18c	82.64d
T_3: SA at 1.0 mM	6.62a	16.18cd	22.56c	0.13a	0.20abc	0.28bc	50.92abc	80.90d	80.57cd
T_4: SA at 1.5 mM	6.70a	14.21bc	20.67bc	0.14a	0.19abc	0.26abc	47.86ab	74.79c	79.50c
T_5: SA at 2.0 mM	6.54a	12.32ab	16.05ab	0.15a	0.18ab	0.23ab	43.60a	68.44b	69.78b
T_6: SA at 4.0 mM	7.84b	10.00a	13.82a	0.14a	0.16a	0.22a	56.00bcd	62.50a	62.82a
T_7: Control	7.88b	19.80e	25.86c	0.15a	0.26d	0.31c	52.53bc	76.15cd	83.42d
LSD (p = 0.05)	0.8505	2.5945	5.1909	0.0476*	0.0620	0.0448	8.0457	4.9058	2.8440

* Non significant

Table 3: Effect of salicylic acid treatments on total sugar, reducing sugar and ascorbic acid content of banana fruits

Treatments	Total sugar (%)			Reducing Sugar (%)			Ascorbic Acid (mg 100 g^{-1})		
	0 DAS	4 DAS	8 DAS	0 DAS	4 DAS	8 DAS	0 DAS	4 DAS	8 DAS
T_1: SA at 0.25 mM	3.22abc	14.26cd	18.25e	1.52b	6.78d	8.95d	14.75a	10.21a	8.75ab
T_2: SA at 0.5 mM	3.19abc	13.12bc	17.56de	1.78c	6.84d	8.12c	15.18ab	10.42a	8.87ab
T_3: SA at 1.0 mM	3.01ab	12.78b	16.48cd	1.12a	6.32d	7.89c	14.92ab	12.55b	9.25bc
T_4: SA at 1.5 mM	3.35bc	12.04b	15.48bc	1.15a	5.76c	7.28b	15.56abc	12.87bc	9.20bc
T_5: SA at 2.0 mM	2.87a	9.26a	14.61ab	1.08a	4.88b	6.72b	14.83a	13.25bc	10.26cd
T_6: SA at 4.0 mM	3.25abc	8.58a	13.42a	2.05d	4.32a	5.67a	16.25c	14.07c	11.53d
T_7: Control	3.45c	15.78d	19.86f	1.86cd	8.12e	10.82e	15.75bc	9.56a	7.86a
LSD (p = 0.05)	0.3715*	1.3941	1.2323	0.2137	0.5016	0.6079	0.8181	1.3113	1.1809

* Non significant

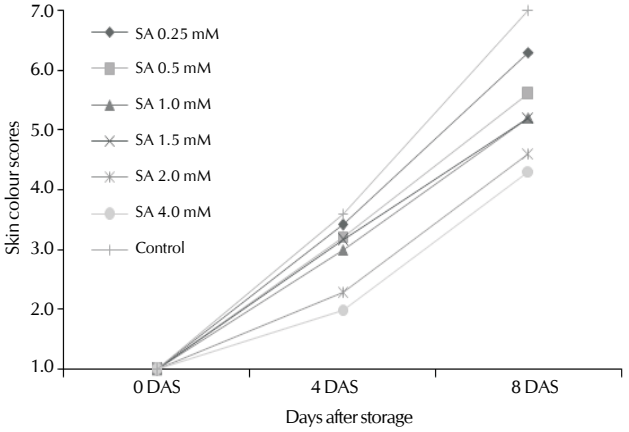

Figure 1: Skin colour of banana fruits as influenced by salicylic acid at ambient storage

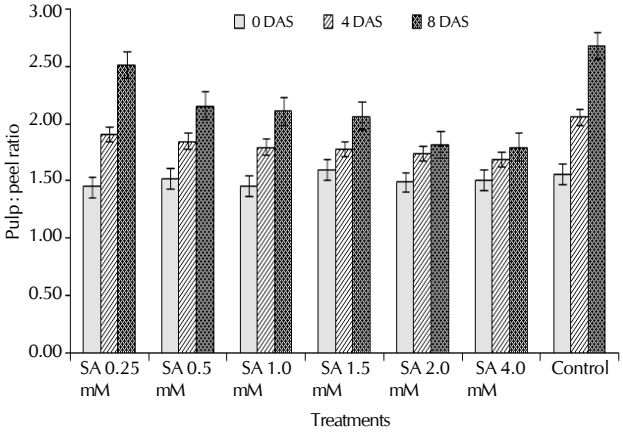

Figure 2: Pulp to peel ratio of banana fruits under different treatments at ambient storage. Each value is the mean of three replicates. Vertical bars represent the standard error of the means.

crisp, hard and dark green banana turns into a yellowish fruit with tender and soft internal pulp at the optimal ripening stage, and becomes mushy as it advances towards senescence. In the present study also, it was found that mature green bananas got change in peel colour from green to yellow during the period of storage. It was found that fruits at control attained maximum peel colour (average score: 7, yellow flecked with brown) after 8 days of ambient storage. Hakim *et al*. (2013) also reported that fruits of two banana varieties viz. Amritasagar and Sabri, got completely yellow colour after 9 days of storage at ambient condition. Hailu *et al*. (2013) reported that there was a decrease in chlorophyll content from between 50 to 100 μg per gram fresh weight to almost zero in ripe fruit, while carotenoids levels remained approximately constant.

There is reduction in total carotenoid content in the peel during the early stage of ripening followed by carotenoid biosynthesis at the yellow-green to yellow ripe stage (Seymour *et al.*, 1987) which may be the reason of post-harvest change in fruit colour from green to yellow in banana fruit during storage. At 8 days after storage (DAS), it was found the change in peel colour of banana treated with different SA concentrations, was considerably low than that of the fruits under control. SA treated fruit showed average peel colour between 4.3 (more yellow than green) and 6.3 (yellow) after 8 days of ambient storage, whereas fruits at control showed average peel colour score 7 (yellow flecked with brown) at 8 DAS (Fig.1). Shafiee *et al*. (2010) also reported that SA treated strawberry fruits showed delaying in colour development at post-harvest storage. Moreover, Tareen *et al*. (2012) found that peach fruit developed less red and yellow colour when treated with SA at 1.5 to 2 mM during post-harvest cold storage. They opined that colour of peach fruit shifts from green to yellow in result to decline in chlorophyll and carotenoids start increasing. Anti-senescent effect of SA may be the reason for delaying development of carotenoid pigments in banana. It was found that SA at 4.0 mM significantly reduced the peel colour formation among the different SA treatments under study. Srivastava and Dwivedi (2000) found yellowing of banana fruit peel was less in SA treated fruits than control.

Percentage weight loss

Present study manifested that banana fruits lost its physiological weight significantly during the period of storage (Table 1). It was found the weight loss of fruits ranged between 3.12 and 5.78 per cent after 4 days of storage, whereas, it was raised to 11.85-18.58 per cent at 8 DAS. Abd El- Naby (2010) also found that Maghrabi banana fruit lost its physiological weight significantly during storage at 18 ± 2ºC with 70 ± 5 % relative humidity. During normal ripening, the banana peel loses water to both the pulp and the atmosphere (Burdon *et al.*, 1994). Fruit weight loss is attributed to physiological weight loss due to respiration, transpiration and other biological changes taking place in the fruit during ripening (Rathore *et al.*, 2007). From the present study, it was evident that SA treatments at different concentration had reduced the percentage of fruit weight loss both at 4 and 8 DAS. It was found that SA at 4.0 mM (T_6) recorded minimum weight loss

(3.12 and 11.85%) compared with control (5.78 and 18.58 %) after 4 and 8 days of ambient storage. SA treatment at 2.0 mM also reduced the fruit weight loss (12.25%) at 8 DAS and was statistically at par with T_6. Sahithya *et al*. (2015) found that SA at 100μM caused significant reduction in weight loss (8.27%) compared with control (10.13%). Tareen *et al*. (2012) reported that kiwi fruits treated with SA at 0.2 mM showed lowest loss in fruit weight. SA has been reported to close stomata which resulted in suppressed respiration rate and minimize weight loss of fruits (Manthe *et al*., 1992).

Pulp to peel ratio

Present study manifested that fruits pulp: peel ratio significantly increased during the period of storage. Abd El- Naby (2010) also found similar result in Maghrabi banana fruit. In the present study, it was found that at 0 DAS pulp: peel ratio of banana fruit ranged between 1.45 and 1.60 which increased significantly and ranged between 1.80 and 2.68 across the treatments at 8 DAS. Hakim *et al*. (2013) found that two banana cultivars viz. Sabri and Amritasagar also showed increase in pulp: peel ratio when stored in laboratory condition.

It was found that in cv. Sabri, ratio was 1.44 at 3 DAS which increased to 2.52 at 12 DAS. Similarly, they observed increased ratio in other cv. Amritsagar, which was recorded 2.15 at 3 DAS and found high pulp: peel ratio (3.40) at 12 DAS. Among the treatments used in the present study, fruits at control showed maximum pulp: peel ratio (2.68) compared with the fruits treated with SA at 2.0 and 4.0 mM (1.82, 1.80). However, it was found that in all the SA treatments, that pulp: peel ratio was lesser than that of control (Fig. 2). The ripening of banana fruit was accompanied by increase in pulp to peel ratio. Similar observation has been reported by Singh *et al*. (1980). Rise in pulp to peel ratio during fruit ripening was suggested to be due to change in sugar concentration into the tissues. A rapid increase in sugar contents in the pulp leads to a change in osmotic pressure, as a result of which water is withdrawn from the peel and hence pulp: peel ratio increases accordingly. Salicylic acid treatments reduced this increase in pulp to peel ratio, leading to a delay in banana ripening. Srivastava and Dwivedi (2000) also found that banana fruits treated with SA at 1000 μM showed minimum pulp: peel ratio (1.63 ± 0.15) after 6 days of storage in ambient conditions.

Total soluble solids (TSS)

From the present study it was found that banana fruits increased in TSS content during its storage period. On the day of installation of treatments, fruits TSS ranged between 6.54 and 7.88°Brix, whereas, at 8 DAS, it was between 13.82 and 25.86°Brix. Opara *et al*. (2012) found that banana fruits when kept at room condition (20-22°C, 82-85% relative humidity) recorded low TSS (4.59%) at unripe stage and later at fully ripe stage TSS amount was increased (18.89 %) and it raised further at overripe stage (27.24%). Total soluble solids have shown to increase gradually during fruit development and maturity as reported for banana cultivar 'Montel' and 'Berangan' (Mustaffa *et al*., 1998). As maturity increases, starch is converted to sugars and hence the higher TSS content observed as the banana fruits matured. Increased TSS during maturation and ripening could also have been due to partial breakdown of pectins and celluloses (De Lima *et al*., 2001). After 8 days of storage in room condition, it was found that fruit under control had maximum TSS (25.86ºBrix) compared to other treatments (fruit dipping at different SA concentration). At 8 DAS, SA treated fruits showed low TSS (<25.86°Brix) than control (Table 2). Among, those treatments, SA at 4.0 mM showed minimum TSS content (13.82°Brix) of fruits followed by T_5(16.05°Brix) at 8 DAS. Treatment of kiwifruit with MeSA of 32μl L^{-1} maintained a lower TSS content than the control fruits at the end of cold storage (Aghdam *et al*., 2010). Hu *et al*. (2009) opined that SA can decrease the degradation rate of starch to soluble sugar in banana during storage, which may be the potential reason behind low TSS content even at 8 DAS, as sugar considered to the major contributor in fruit TSS value.

Titrable acidity

Present study revealed that banana fruit were having considerably low acidity of fruit which increased with the advancement of post-harvest ripening (Table 2). Siriboon and Banlusilp (2004) found that the total titrable acidity of banana cv. Namwa increased with ripening. It was reported that fully mature banana recorded high acidity (0.7%) after 6 days. Organic acids normally decrease in several fruits except in banana as they are respired or converted to sugar (Seymour, 1993). However, the increase in titrable acidity during ripening may be due to the increase in malic acid whose content has been shown to rise from 1.8 to 6.2 meq/100g with ripening (John and Marchal, 1995). Several enzymes can have an influence on the level of organic acids in banana; malate synthase, activity of which decreases during ripening; malic enzyme, which is involved in the decarboxylation of malic acid and phosphoenolpyruvate carboxylase, which plays a part in the formation of malic acid (John and Marchal, 1995), decrease of which may play a pivotal role in increase in fruit acidity during storage. At 8 DAS, it was found that fruits at control recorded maximum titrable acidity (0.31%), whereas SA at 2.0 and 4.0 mM significantly controlled increase of fruit acidity (0.23 and 0.22% at 8 DAS). Srivastava and Dwivedi (2000) found that SA at 1.0 mM resulted in a decrease in the rate of respiration as well as delay in appearance of climacteric peak, which may be the reason for lower value of acidity of fruits under those treatments.

TSS:acid ratio

In the present study, it was observed that banana fruits have got increased TSS value along with fruit acidity during storage period. Though, both value increased, however, increase in TSS content was quite higher compared with increase in acidity, which may be the reason that with the duration of storage, TSS: acid ratio has increased (Table 2). It was found that at 0 DAS, it ranged between 43.60 and 62.00, whereas, at 8 DAS between 62.82 and 83.42. Opara *et al*. (2012) found that fruit TSS: acid was low (29.80) during unripe stage, which further increased to 47.40 in over ripe stage under room temperature. At 8 DAS, control fruits showed maximum TSS: acid ratio (83.42), whereas fruit treated with SA at 2.0 and 4.0 mM showed considerably low TSS: acid ratio (69.78 and 62.82), which signified that these treatments has potential anti-ripening effect (Asghari and Aghdam, 2010).

Total and reducing sugar

Starch forms about 20 to 25 % of the fresh weight of the pulp

of unripe bananas. During ripening this starch is degraded rapidly and the sugars; sucrose, glucose and fructose accumulate; traces of maltose may also be present (Hailu *et al.*, 2013). It was suggested that sugar are present in the green fruit only very small amounts, average about 1 to 2% of the fresh pulp; they increase to 15 to 20% at ripening. Present study also manifested in a similar manner. Both total and reducing sugar content increased with the duration of storage, for all the treatments. Total sugar content ranged between 2.87 to 3.45 % at 0 DAS, whereas, it was between 13.42 to 19.86 % at 8 DAS (Table 3). Similar, trend was found in reducing sugar also, where maximum reducing sugar (10.82%) content was observed in fruits at control at 8 DAS. Thompson and Burden (1995) opined that during ripening, total carbohydrate content of banana fruit decreases progressively and the starch is degraded to reducing and non-reducing sugar. Srivastava and Dwivedi (2000) suggested that enhanced invertase activity manifested into breakdown of starch to sugar. They found that at post-harvest storage of banana, reducing sugar content significantly increase which in turn increase total sugar content of fruits. Present study showed that fruits treated with SA had low total and reducing sugar content than control even at 8 DAS. After 8 days of storage, sugar content was found minimum in fruits treated with SA at 4.0 mM (total sugar: 13.42%, reducing sugar: 5.67%) compared with control. Srivastava and Dwivedi (2000) found that SA treatment resulted in decreased level of invertase which ultimately delayed the breakdown of starch to sugar and resulted in comparatively low sugar content than control. Hu *et al*. (2009) also reported that SA can decrease the degradation rate of starch to soluble sugar.

Ascorbic acid

Banana fruits under storage got reduction in ascorbic acid content. It was found that at 0 DAS, it ranged between 14.75 and 16.25 mg $100g^{-1}$ which had been reduced and found between 7.86 and 11.53 mg $100g^{-1}$ at 8 DAS (Table 3). A decrease of ascorbic acid content of fruits indicates senescence. Opara *et al*.(2012) found that low ascorbic acid content (15.65 mg $100g^{-1}$) of banana fruit at unripe stage which further reduced to 14.58 mg $100g^{-1}$ at fully ripe stage and 9.64 mg $100g^{-1}$ at overripe stage. Ascorbic acid content generally reduced at storage because of its oxidative process. It was found that SA at 4.0 mM significantly reduced the loss of ascorbic acid and was found high (11.53 mg $100g^{-1}$) at 8 DAS. Renhua *et al*. (2008) reported that application of SA was found to be effective in reducing the rate of respiration and ethylene production and maintaining higher amount of ascorbic acid.

Fruit decay

At 8 DAS, it was found that fruits at control showed maximum decay (26.40%) whereas, it was found minimum (5.62%) at T_6 (SA at 4.0 mM) followed by T_5 (8.85%). However, it was observed that SA treatments caused significant reduction in fruit decay (Table 1). Hu *et al*. (2009) found that SA at 0.8 mM decreased the fruit decay index and in turn improved preservation of banana fruit during storage at 25ºC and 85 % relative humidity. Ingle *et al*. (2014) reported about the disease control properties of SA on Soybean. Exogenous application of SA at non-toxic concentration to susceptible fruits and vegetables could enhance resistance to pathogen and delay post-harvest decay (Asghari and Aghdam, 2010).

Shelf life

From the present study, it was evident that SA treated fruits showed higher shelf life (>8 days) than fruits at control. As fruits at control got higher respiration and reached to climacteric peak quickly so the post-harvest shelf life was found minimum (8.33 days) in that treatment (Table 1). Hakim *et al*. (2013) also found that banana cv. Sabri and Amritasagar had low shelf life (7.33 and 9 days) when stored under room temperature. Banana use to ripen in a week at 16.5-21ºC (Chattopadhyay *et al.*, 2001). SA treatments delayed ripening and related physico-chemical changes in banana as it delayed respiration climacteric and reduced ethylene production. Moreover, decaying was found less in SA treated fruits. These are to be considered behind the high shelf life of SA treated fruits. Similar results were found by the others (Hu *et al.*, 2009; Srivastava and Dwivedi, 2000). Maximum shelf life was found in SA at 4.0 mM (14.85 days) followed by SA at 2.0 mM (13.05 days). However, SA at 0.25 mM showed low shelf life (9.0 days).Present study showed that fruits treated with SA at 0.25 mM had comparatively faster ripening and consequent changes in physico- chemical attributes of fruits, which reduced the shelf life .There are reports that SA at lower concentration increased endogenous ethylene biosynthesis which may have caused earlier ripening (Nissen, 1994).

The result of the present experiment showed that SA at 2.0 to 4.0 mM may be the effective post-harvest treatment to extend shelf life while maintaining the fruit physico-chemical qualities of banana cv. Grand Naine during storage at room temperature.

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