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ORIGINAL RESEARCH ARTICLE

Effects of Gibberellic acid (GA3) on shelf life and physiochemical properties of mango (*Mangifera indica* L. var Bombay green)

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ABSTRACT

The present study investigated the effect of GA3 on the physicochemical properties and shelf life of mango (*Mangifera indica* L. var. Bombay green) from 31st May 2022 to 8th June 2022 at the Central Laboratory of GPCAR collage Gothgaun, Morang, Nepal. The study's goal was to find the right gibberellic acid concentration to use in mangoes that were collected at a mature stage to delay fruit ripening, preserve quality, and lengthen shelf life. The experiment was laid out in a Completely Randomized Design (CRD) with five treatments and four replications. Mature freshly harvested mango fruits of uniform size were dipped into an aqueous solution of gibberellic acid at 0 ppm (T1), 100 ppm (T2), 200 ppm (T3), 300 ppm (T4) and 400 ppm (T5) for 10 minutes. Data on physicochemical parameters (mango pulp pH, total soluble solids, titratable acidity, physiological weight loss, and shelf life) were statistically analyzed through biochemical analyses. Further, fruits treated with 400 ppm of GA3; resulted in the lowest physiological loss in weight (22.08%), the minimum pulp pH (5.02), and the minimum titratable acidity (0.14%) on the 8th day after storage. The highest total soluble solid (19.85°B) was recorded with GA3 @400ppm, while the lowest soluble solids (16.90°B) were recorded with control ppm on the 8th day after storage. Fruits treated with GA3 at 400 ppm had the longest shelf life (7.17 days), while fruits treated with GA at 300 ppm had the shortest shelf life (7.19 days). Therefore, the best results were obtained when gibberellic acid was applied at 400 ppm, which extended the shelf life and physiochemical traits of mango fruits.

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INTRODUCTION

In tropical and subtropical climates, the Mango, or *Mangifera indica* L., is a common plant (Fitmawati *et al*., 2017). Mango is native to South East Asia or the Indo-Burma region and has 69 recognized species descended from forest trees with fibrous and resinous fruits. In addition to having a delicate taste, it also has high palatability, sweet fragrance, attractive colour, and nutritional value, earning it the title of "king of tropical fruits" (Shah *et al*., 2010). Mangos are the third most-produced tropical fruit in the world, with a total output of 23.87 million (FAO, 2020). Generally, Mango is grown in Terai, inner Terai and the foothills of Nepal up to 1100 MASL. In Nepal, Mango is one of the high-value agricultural products and a significant fruit in terms of potential growing area, production and domestic consumption. The central pocket area for Mango is Siraha (6 mt/ha), Sarlahi (10 mt/ha), Mahottari (11 mt/ha), Dhanusha (11 mi/ha), Kapilvastu (9 mt/ha), Dang (6 mt/ha), Banke (9 mt/ha), Bardiya (9 mt/ha) (MoAD, 2016/17). The main issue in tropical and subtropical parts of the globe is postharvest losses and a decrease in the nutritional content of fresh fruits. Mangoes are climacteric fruits. Due to the trigger of ethylene's quick ripening, it has a short shelf life after harvest, which significantly reduces its economic worth (Singh, 2016; Wongkhot *et al*., 2012). Mango fruit is very perishable and has a limited shelf life due to its quick loss and short storage life. A fruit's decay is caused by its rapid ripening and short shelf life, which restricts its ability to be stored, handled and transported (Hoa *et al.*, 2002; Wang *et al.*, 2006). Mango postharvest losses are estimated to be between 25 and 40 per cent from harvest to consumption (Ravindra and Goswami, 2008; Bhande *et al.*, 2008). Many postharvest treatments are utilized to increase the shelf life of fruits, including wax emulsion, plant growth regulators, fungicides, polythene film, and different chemicals (Chauhan *et al.*, 2001).

Gibberellins are known as the senescence-delaying agent and are available in powder form. Exogenous application of GA3 delays the ripening change, such as de-greening and synthesis of carotenoids. Gibberellic acid keeps mango fruits firm, reduces amylase activity, and slows the degradation of peel chlorophyll (Khader, 1992). GA3 decreased tissue permeability and thereby reduced physiological losses in weight and decay per cent in tomatoes (Kanzaria *et al.*, 2022). The shelf life of mangoes is relatively short since they are climacteric fruits that release ethylene after harvest. The most significant issues with horticultural products are postharvest losses and the decline in the nutritional content of fresh fruits (Islam *et al.*, 2019; Hodges *et al.*, 2011; Mwaurah *et al.*, 2020).

In Nepal, there is excellent potential for mange production, there are few commercial mango plantations, and current productivity could be higher. Most postharvest losses occur during the transportation from producer to consumer due to spoilage. Therefore, it is essential to maintain fruit quality and nutritional value during transport (Khadar, 1992, Rodov *et al.*, 1996). The climacteric fruits' shelf life is extended, and ripening is delayed because of the anti-senescing and ethylene antagonist capabilities of gibberellic acid (GA3) (Vega-Vega *et al.*, 2013; Hedden, 2012). It lowers the Mango's metabolic processes, which slows down the body's natural weight reduction. Reduces tissue permeability, slows down water loss and delays fruit ripening, resulting in less fruit degradation (Wahdan *et al.*, 2011; Islam *et al.*, 2013). The kind of fruit, its size, content, structure, the storage area's relative humidity, and the air circulation speed all affect how much weight is lost during storage. Due to the increase in respiration and water evaporation during mango storage, it has been shown that physiological fruit weight loss increases dramatically with increased storage time (Dirpan *et al.* 2018). The majority of the study found that mangoes lose weight physiologically when they mature and are stored. According to Wahdan *et al.* (2011) and Islam *et al.* (2013), dipping mango fruits in GA3 prevented physiological weight loss while in storage. Gibberellic acid (GA3) has significantly decreased physiological weight loss in mangoes (Kumar, 1998), guava (Selvan and Bal, 2005), and papaya during storage (Rajkumar *et al.*, 2005). The physiological weight loss caused by dipping plum fruits in a solution of GA3 @ 40 mg/litre was significantly decreased, and the fruits maintained their firmness for extended periods (Mahajan *et al.*, 2008). By delaying the pre-climacteric respiration rate and ensuing ethylene generation, gibberellic acid (GA3) treatments may slow down the ripening process. The banana fruits treated with GA3 @150 ppm had minor physiological weight loss during storage, according to Butani *et al.* (2016). It might be because of the effects of GA3 and the reduced rate of respiration and transpiration, which caused more water to be held against the forces of transpiration. Sembok *et al.* (2016) investigated the impact of gibberellic acid (GA3) on the quality and shelf life of bananas (Musa spp.). They found that fruit treated with 300 ppm of GA3 had minor physiological weight loss.

The shelf life starts when the fruit's green life finishes (Kilcast and Subramanian, 2000). The most crucial factor in fruit loss reduction biotechnology is shelf life. Fruit shelf life is influenced by a property called fruit softening rate (Brummell and Harpster, 2001). A class of growth hormones known as gibberellins is known to delay ripening and function as an anti-senescent agent during storage. Fruits have a longer shelf life because of GA3 (Wills, 2001). Gautam and Chundawat (1992) discovered that 250 ppm GA3 was more effective in extending the shelf life in their study of the impact of postharvest treatment on the biochemical transformations of mango cv. "Kasur" fruit during storage. According to Pinaki *et al.* (1997), the best method for extending the shelf life of banana fruits is to dip ripe, wholly formed, uniform-sized banana fruits into 150 ppm GA. After harvest, papaya fruits were immersed in an aqueous GA3 solution, which prevented chlorophyll deterioration and reduced amylase and peroxidase activity (Khader, 1992). The papaya fruit's ripening was delayed by gibberellic acid (GA3) at 300 mg/litre, and it had the most extended shelf life of 15.3 days. The succinate activities of malate dehydrogenases in papaya fruits during ripening were dramatically reduced by administering gibberellic acid (GA3) to fruits, extending their shelf life. The complete development of GA3 bananas by 150 ppm GA3 was considerably documented at the maximum day's shelf life (20.23 days) (Butani *et al.*, 2016). This could be because GA3 controls ethylene production and enzymatic activity, which slows down the ripening process. Postharvest dipping of mangos with gibberellic acid GA3 extends the pre-climacteric period and shelf life (Khader, 1992). Banana fruits treated with @ 300 PPM mg/litre extends the shelf life compared to other treatment (Bailen *et al.*, 2014).

One of the leading fruit taste characteristics is sweetness, which may be gauged by the percentage of total soluble solids (TSS) in fruits whose primary source of carbs is sugars (Kader, 1992). According to Ueda *et al.* (2000), chloroplasts collect starch content throughout the mango growth stage, which is entirely hydrolyzed to sugar during ripening. Ripe mango fruit contains 10–20% total sugar depending on the cultivar and stage of ripening (Litz, 2020). Mango ripening has been linked to an increase in total soluble solids (Abdelfadeel, 2015). The buildup of TSS was reduced due to the gibberellic acid (GA3) solution delaying ethylene production and ripening. Reddy and Haripriya (2002) demonstrated that treating "Bangalore" and "Neelam" mangoes with 200 mg/litre GA3, storing them in polythene bags, and allowing them to mature at room temperature inhibited the rises in TSS. In papaya, gibberellic acid (GA3) influences the production of sucrose and the breakdown of complex carbohydrates. During storage, papaya fruit treated with 100 ppm GA3 maintained its increased TSS level (Rajkumar *et al.*, 2005). The delayed conversion of insoluble carbohydrates into soluble forms and the sparse use of organic acid during respiration may be to blame for the rise in TSS. Owing to the delayed conversion of tomato's carbohydrates to sugar due to the slower respiration, the biosynthesis process results in lower TSS (Pal *et al.*, 2018). Reni *et al.* (2000) assessed the storage stability of 12 papaya cultivars and found that after four months, TSS in pulp had reduced during storage, whereas TSS in papaya peel had grown as the fruit ripened. Compared to the control, guava fruit treated with gibberellic acid (GA3) and kinetin had lower total soluble solids after storage (Kumar *et al.*, 2021; Hiwale and Singh, 2003; Mahajan *et al.*, 2008; Selvan and Bal, 2005). Compared to controls and other treatments, banana fruit treated with 300 ppm of GA3 delays the rise in total soluble solids (Bailen *et al.*, 2014). When bananas were stored, 150 ppm GA3 had the least total soluble solid (Tapas, 2016). Due to the decreased respiration rate and delayed ripening, sapota fruit treated with GA3 at 150 mg/litre concentrations had the lowest TSS.

Titratable acidity, a crucial factor in preserving fruit quality, is directly connected to the amount of organic acid in fruits (Shirzadeh *et al.*, 2011). Fruits alter their pattern of organic acid changes as they mature. The acidity of most fruits decreases as they mature (Illeperuma & Jayasuriya, 2002). Fruit acidity decreased with storage, which may be related to the enzyme invertase's conversion of acids into salts and sugar (Hiwale and Singh, 2003; Mahajan *et al.*, 2008; Selvan and Bal, 2005). The acid may be considered the fruit's energy store, which is anticipated to decrease as the fruit ripens (Wills, 2001). Other organic acids, including tartaric, succinic, shikimic, and fumaric, are only found in trace amounts in ripe mango fruit. Citric and malic acid make up most of the fruit's acid content. Higher citric acid losses and fewer malic acid losses are to blame for the significant drop in acidity. An experiment done by Selveraj (1993) found that acidity rose as a product matured. According to Munasque and Mendoza (1990), titratable acidity rose until the fruit's hue was more green than yellow, which began to drop. The fact that fruit treated with GA3 had more excellent titratable acidity may have resulted from the control ripening process using less organic acid in respiration. Up to the ninth day of storage, papaya fruit treated with 100 ppm GA3 retained a higher acidity value (Rajkumar *et al.*, 2005). Similarly, the titratable acidity of the GA3-treated tomato was higher than the control. While stored, 150 ppm GA had the maximum acidity (Tapas, 2016). Compared to other treatments, postharvest administration of GA: @300 ppm has been shown to enhance titratable acidity in banana fruits, which coincides with ethylene and ripening and then begins to fall after that (Bailen *et al.*, 2014).

The pulp pH is an essential postharvest factor in determining the quality of fruit ripening. Azad *et al.* (2009) noted an upward pH value trend during storage. This occurrence of a growing pH trend may be caused by the oxidation of acids, which raises the pH level (Islam *et al.*, 2013). Because of the action of gibberellic acid (GA3) on the fruit, which caused slow respiration, the pH of the fruits treated with GA3 remained low after the storage period. According to Vendrell and Palomer (1997), postharvest dipping of papaya fruits in an aqueous gibberellin solution delayed chlorophyll deterioration and reduced amylase and peroxidase activity. In a study, Penyimpanan (2013) examined how varying amounts of gibberellic acid (GA3) during storage influenced the postharvest quality of mango (*Mangifera indica* L) fruits. They found that the 400 ppm of GA3 delayed acid oxidation, resulting in a lower pH value.

Gibberellic acid (GA3) applied postharvest delays the ripening and softening of fruit colours, decreases amylase activity, and preserves quality by reducing ethylene production and respiration rate throughout the ripening stage. Thus, this research aids in determining the proper gibberellic acid (GA3) content for extending shelf life, maintaining nutritional quality, and minimizing postharvest mango losses during transit and storage.

MATERIALS AND METHODS

The experiment was carried out at the G.P. Koirala College of Agriculture and Research Centre in Gothgaun, Morang, Nepal, from May 31 to June 8. Below is a discussion of the specifics of the tools, methods, and procedures used throughout the study:

Experimental materials and design

Ripe Bombay green mangoes were plucked from Siraha's Zero Mile on May 31, 2022. Fruits that had been harvested had reached full maturity, were uniform in size, shape, and colour, and had no visible faults, diseases, or insect infestations. The mangoes were subsequently sent to the Central Laboratory of the G.P. Koirala College of Agriculture and Research Center in Gothgaun Morang, Nepal. To avoid mechanical or abrasive damage, extra care was taken during harvesting and transportation. The experiment was laid out in a completely randomized design (CRD) with five treatments replicated four times.

Treatment details

Gibberellic acid concentrations of 500 mg, 1000 mg, 1500 mg, and 2000 mg were weighed using a digital scale. The Gibberellic acid (GA3) powder was then dissolved in 5 litres of distilled water to produce solutions containing 100 ppm, 200 ppm, and 300 ppm of GA3, respectively (Table 1). The fruits were thoroughly cleansed with tap water to eliminate any foreign debris, including dust, grime, and mud, and then allowed to air dry. A total of 24 fruits were randomly chosen from the experiment fruit lot and submerged in a bucket containing prepared solutions of gibberellic acid (100, 200, 300, and 400 ppm) for 10 minutes. The fruits were then grouped into similar-sized groups after being washed with tap water and used for the experiment treatment with four replications. It was carefully monitored to make sure the fruits absorbed enough gibberellic acid. The fruits were retained after being exposed to gibberellic acid solutions and were allowed to dry naturally on the laboratory floor. The treated mangoes were laid out on cardboard paper on the lab table and kept at room temperature for a short while.

Table 1. Treatment (different concentrations of gibberellic acid).

Treatment	Doses	Amount of GA3/distilled Water (mg/litre)
T1 (control)	Distilled water	-
T2	100 ppm GA_3	500/5
T3	200 ppm GA_3	1000/5
T4	300 ppm GA_3	1500/5
T5	400 ppm GA_3	2000/5

Observation

A total of 20 experimental units were made. In each treatment and replication, six mangoes were kept in which, and four mangos were observed as the destructive sample to see the chemical parameters like TSS, TA, and pH. Similarly, two mangos were kept as a non-destructive sample to observe physical observations such as mango shelf life and physiological loss.

Shelf life

The shelf life of mango fruits was determined by calculating the number of days needed for them to ripen to maintain their best marketing and consumable properties altogether (Hasan *et al.*, 2020).

Physiological loss

The physiological loss was calculated using the following formula at every two-day interval from destructive sampling:

$$PLW\ (\%) = \frac{(IW - FW)}{IW} \times 100$$

Where,
PLW = Physiological loss in weight
IW = Initial weight of fruits (g)
FW=Final weight of fruits (g)

Potential of hydrogen (pH)

The pH level of mango fruit juice was assessed using a pH meter. First, the pH meter was tested using a buffer solution with a pH of 4.0 or 7, and then the pH of the pulp juice was measured.

Total soluble solids (TSS)

The total soluble solids content of mango fruit pulp was determined using a digital refractometer. With the aid of a clean pipette, a few drops of mango juice were extracted from the fruit pulp and applied to the prism of the refractometer (Hasan *et al.*, 2020). The measurement was taken at room temperature. After each usage, distilled water and a muslin towel were used to clean the specimen chamber.

Titratable acidity (TA)

The titration of diluted fruit juice (5 mL) with 100 mL distilled water and five drops of phenolphthalein indicator against base 0.1 N NaOH solutions was used to determine titratable acidity. TA of the mango juice was measured by using the following formula.

$$TA\ (\%) = 0.1N\ of\ NaOH\ used\ \times Volume\ of\ NaOH\ used \times\ Molecular\ weight\ of\ predominat\ acid\ \times 100\ ml\ of\ juice\ used$$

Where,
TA = Titratable acidity
N = Normality of NaOH
NaOH = Sodium hydroxide
Molecular equivalent weight of predominant acid = 0.0679

Statistical analysis

The collected raw data of various parameters were entered into MS Excel (2019 version) and subjected to ANOVA with the help of Gen-stat (18th Edition) for data analysis. The mean comparison among significant variables was carried out by the Fisher-LSD test at a 5% significance level. Additionally, MS Excel was used for the construction of graphs and tables.

RESULTS AND DISCUSSION

Effect of GA3 on the shelf life of mango

Varied gibberellic acid concentrations affected Mango fruit shelf life (Figure 1). Fruits treated with GA3 at 400 ppm had the best shelf life (7.17 days), followed by those treated with 200 ppm (6.33 days), 300 ppm (6.17 days), and 100 ppm (5.42). Fruits treated with control had the lowest shelf life (4.25 days).

Effect of GA3 on physiological loss and other physiochemical properties of mango

The effects of the various dosages of gibberellic acid on mango physiological loss after eight days following treatment were significantly different ($p \leq 0.001$). The fruits treated with GA3@400 ppm had the lowest physiological weight losses (22.06%), which was substantially different from other treatments, while the controls had the most significant physiological losses (42.31%) (Table 2). Likewise, no significant difference exists in the pH of mango on the 8th day of treatment application. However, maximum pH was found in fruit treated with GA3 @ 200 ppm (5.27), and minimum pH was found in fruit

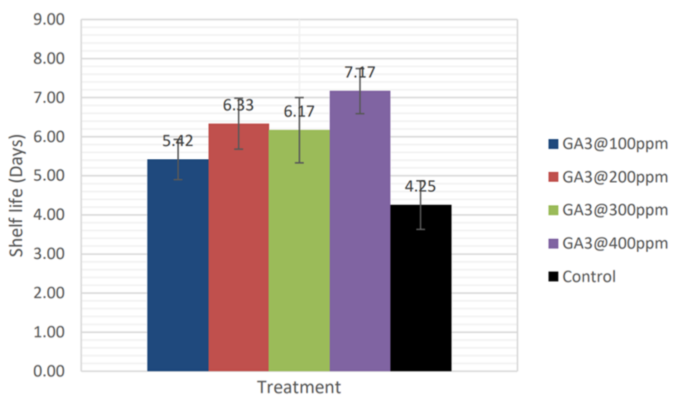

Figure 1. *Effect of GA_3 on shelf life of mango.*

Table 2. Effect of treatments on physiological loss and other physiochemical properties of mango during 2022.

Treatments	Physiological loss (%)	pH	TSS (Brix)	TA (%)
GA_3 @400ppm	22.05^{c} (28.00)	5.05	19.85^{a}	0.14^{b}
GA_3 @200ppm	24.90^{b} (29.93)	5.27	19.50^{a}	0.15^{b}
GA_3 @100ppm	26.45^{b} (30.10)	5.2	19.05^{a}	0.21^{a}
GA_3 @300ppm	26.73^{b} (31.13)	5.12	19.02^{a}	0.18^{a}
Control	45.33^{a} (42.31)	5.22	16.90^{b}	0.14^{b}
Mean	29.09	5.175	18.865	0.168
LSD (0.05)	1.26	0.55	1.10	0.02
CV %	4.534058	7.113106	6.800357	11.70517
F-test	***	NS	*	***

Values are mean of three replications at 4th observation; CV: Coefficient of variation; NSNon-significant at 5% level of significance; ***Significant at 0.1% level of significance; **Significant at 1% level of significance; *Significant at 5% level of significance; LSD: Least Significant Difference; Values with the same letters in a column are not significantly different at 5% level significance by Fisher-LSD test and figures in the parenthesis indicate arc sine transformation values.

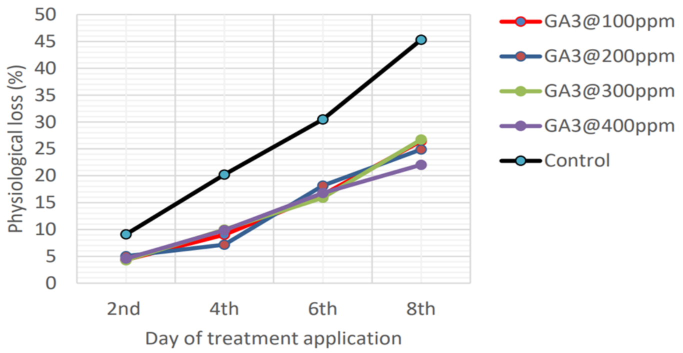

Figure 2. *Effect of GA3 on physiological losses at different days of treatment application.*

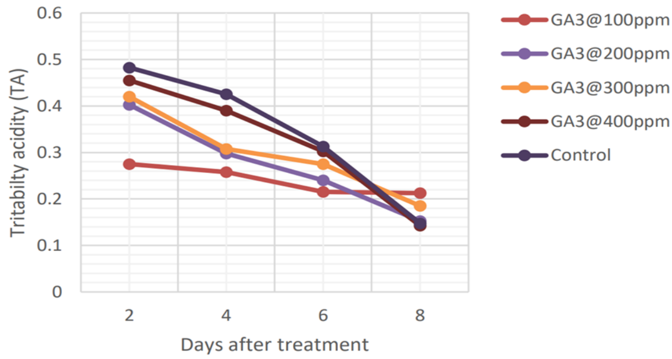

Figure 5. *Effect of GA3 on TA of mango on different days of treatment application.*

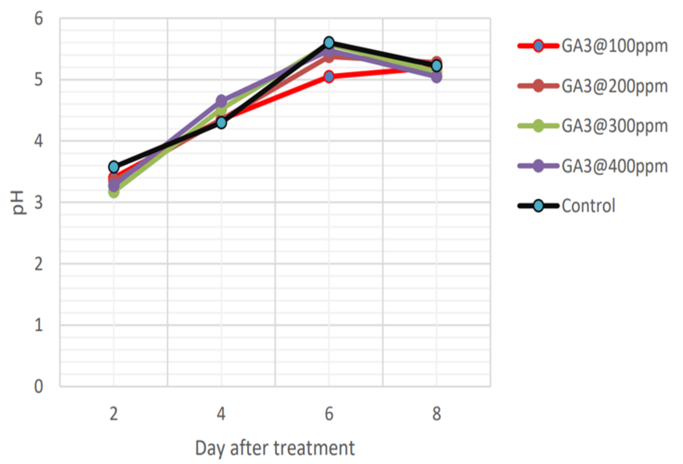

Figure 3. *Effects of GA3 on the pH of mango on different days of treatment application*

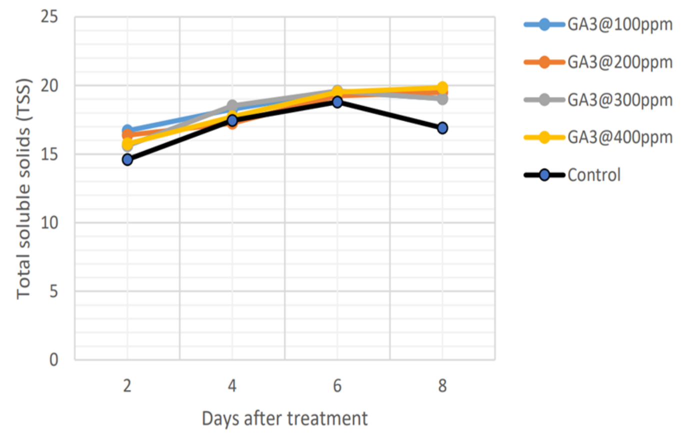

Figure 4. *Effects of GA3 on mango TSS on different treatment days.*

treated with GA3 @ 400 ppm (5.05). There was a significant difference ($p \leq 0.05$) among the TSS of mango on the 8th day of treatment application. Minimum TSS was found in control (16.90◦Brix), whereas maximum TSS was found in fruit treated with GA3 @ 400 ppm (19.85◦ Brix). There was a highly significant difference ($p \leq 0.001$) among the titratable acidity (TA) of mango on the 8th day of treatment application. Minimum TA was found in fruit treated with GA3@ 400 ppm (0.14%), whereas the maximum was observed in fruit treated with GA3 @ 100 ppm (0.21%).

Comparison of physiological loss (%), pH, TSS and TA at different observations

The effects of different doses of gibberellic acid showed a further increment in physiological loss pattern from the 2nd day to the 8th day of treatment application (Figure 2). The physiological loss was higher in each observation in control as compared to other treatments. Different doses of GA3 had an almost similar increment in each statement from the 2nd to the 8th day of treatment application. Similarly, the pH in all treatments was found to be lowest in the first observation, increased until the third observation, and then decreased (Figure 3). The highest pH was located at 3rd observation in all treatments. Likewise, the TSS of all treatments was found to increase at an increasing rate until the 6th day of application; after that, it constantly increased in all other treatments except the control (Figure 4). TSS under control gradually decreases after the sixth day. Further, the TA of all the treatments was found to be decreasing except for mango treated with GA3 @100 ppm. TA in that treatment remains constant after the 6th day (Figure 5).

In our investigation, the use of GA3 extended the shelf life of mango. The fruit treated with GA3 @ 400 ppm had the most extended shelf life (7.17 days). The findings of the current experiment are consistent with those of Islam and Azad (2016), who claimed that 400 ppm GA3 treatment is superior for increasing mango shelf life. Gibberellic acid solution slows down metabolic processes, delays ethylene production, and slows down the breakdown of starch and pectin, according to Taduri *et al.* (2017). Even though Mohamed *et al.* (2016) found that fruits treated with distilled water considerably extend the shelf life of mangoes, this outcome is inconsistent with what we discovered. This could be caused by a genotypic variation or a difference in environmental circumstances.

Gibberellic acid (GA3) has reduced mango physiological losses in this study. Gibberellic acid (GA3) 400 ppm administration demonstrated little physiological losses compared to other treatments. This outcome is consistent with the findings of Surendar *et al.* (2019), who revealed that Gibberellic acid (GA3) decreases the metabolic activities of mango, resulting in a slower physiological weight loss. They research the postharvest mango's physiological components and colour change. *Mangifera indica* L. was affected by various gibberellic acid (GA3) concentrations. They found that dipping mango fruits in 300 ppm of the compound resulted in minor physiological weight loss during storage compared to other treatments and controls. In this experiment, there was no discernible variation in the pH values of the various treatments. However, 400 ppm of gibberellic acid treatment produced the lowest pH value. This current research finding is supported by Penyimpanan (2013)'s report. According to the paper, GA3 treatment kept the pH low after the storage time and delayed acid oxidation, which lowered the pH value. All treatments' TSS increased at first and then decreased with time (Figure 4). Treatment GA3@400 ppm had the highest TSS. The results of Amro *et al.* (2016), who revealed that the rise of GA3 concentration astonishingly induces the impact of GA3 on TSS, agree with our conclusion.

Additionally, Maurya *et al.* (2020) obtained a similar outcome and said that an increase in the application of GA3 to fruits significantly increases the TSS concentration. According to Taduri *et al.* (2017) and Osama *et al.* (2015), the initial increase in the TSS content of fruits and the resulting changes in flavour was caused by the conversion of starch and other insoluble carbohydrates into soluble sugar. In contrast, slight declines at a later stage were attributed to using soluble solids in the respiratory process. Likewise, the most excellent acidity was found in fruits treated with GA3 @100 ppm since the application of GA3 reduced the titratable acidity of every treatment in this investigation. The current investigation's observation of a reduction in titratable acidity is consistent with the study by Tsomu and Patel (2019). This result also demonstrates agreement with Amro *et al.* (2016), whose conclusion on the use of TA with GA3 is consistent with the findings of our experiment. According to Singh *et al.* (2017), pulp's high acidity is beneficial since it improves storage quality. These organic acids decreased in titratable acid as the fruit ripened due to their use in the respiration process and conversion into sugar. Additionally, the results conflict with the outcome reported by Ray (2021).

Conclusion

The findings of this research suggest that the use of different concentrations of GA3, which increased the capacity of the fruits to remain fresh for 4.25 to 7.17 days by delaying their ripening, may increase the shelf life of mangoes. According to the research, physiochemical traits such as physiological weight loss, total soluble solids, pulp pH, and titratable acidity were swiftly raised in untreated mangoes, whereas titratable acidity was promptly decreased. On the other hand, mangoes treated with 400 ppm gibberellic acid performed better in terms of preventing postharvest quality change and increasing mango shelf life. Similar to the study's limitations, the postharvest care of mango study's findings is difficult to generalize since they were completed in a short period and a narrow area. The selected cultivar, postharvest practices, and meteorological conditions might influence the outcomes.

Conflict of interest

The authors declare no conflict of interest and every author contributed equally to the preparation and final approval of the manuscript.

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