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Aloe vera gel coating maintains physicochemical parameters, extends the storage life, and preserves the qualities of Lantundan and Cavendish bananas

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ABSTRACT

Purpose: Bananas have been experiencing increased production worldwide due to increased cultivated areas over the last three decades. However, postharvest losses of bananas are the major concern due to their highly perishable nature and therefore require appropriate treatments and storage methods to extend storage life. This study evaluates the effects of *Aloe vera* coating and storage temperatures on the physiological changes, and sensorial attributes of Lantundan and Cavendish bananas. **Research method:** These fruits were coated with *Aloe vera* and stored at 10°C or 25 ± 2°C and relative humidity of 70-75% or 50-55% respectively. The fruits were evaluated every 2 days for 10 days. **Findings:** *Aloe vera* treatment reduced weight loss, inhibited peel colour changes, delayed total soluble solids and titratable acidity changes, and minimised decay of the two banana cultivars. Coating did not significantly affect taste and overall acceptability, although panelists preferred coated bananas. The combined effects of *Aloe vera* coating and storage at 10°C was the most effective treatment in maintaining Lantundan and Cavendish bananas qualities. **Research limitations:** This study could not measure endogenous ethylene and respiration to ascertain their impact on peel colour changes to a lack of equipment**. Originality/Value:** It therefore extended the shelf life of the fruits to 10 days, compared with uncoated bananas which had a shorter shelf life of 6 days.

INTRODUCTION

Bananas (*Musa* spp) are a perennial crop that grows quickly and can be harvested all year round. Bananas are grown in tropical regions using sucker, and tissue culture and play a key role in the economies of many developing countries. Bananas are climacteric; they ripen rapidly and soften after harvest (Huang & Jiang, 2012), and have a short storage life (Gol & Rao, 2011), due to their susceptibility to decay caused by microorganisms (Deka et al., 2006). Most cultivars are yellow when ripe but some are purplish or red. About 1,000 banana cultivars have been identified in more than 150 countries (Li & Ge, 2017). Banana production increased from 97 million tonnes (Mt) in 2008 to about 120 Mt in 2020 from cultivating 5.2 million hectares (FAOSTAT, 2022), indicating an increase in production worldwide, but postharvest losses of bananas are about 40% in developing countries, such as Ghana (Al-Dairi et al., 2023). Bananas are ready for harvest when they are still green, and when ripening begins, they are subject to physiological and biochemical changes, hence synthesizing various volatile compounds that affect flavour and peel colour changes (Maduwanthi & Marapana, 2019). This influences ripening and browning therefore leading to critical quality problems, such as weight loss due to respiration and transpiration, softening of flesh, and lack of resistance capacity against microbial attack (Aziz et al., 2021). These physiological issues cause considerable economic losses to banana producers (Aziz et al., 2021). To solve this problem, treatments with edible coating before storage could be used to maintain the quality of banana fruits.

An edible coating is a thin layer coating on the surface of food through application, dipping, spraying, etc., to provide physical protection while selectively preventing the permeation of gases and escape of water from horticultural produce (Baldwin & Hagenmaier, 2011; Firdous et al., 2023). Edible coatings are biodegradable, environmentally friendly, and possess antifungal properties (Saks, 1995), hence have preservative effects (Kuorwel et al., 2015). The main materials for making edible coating usually originate from plants and animal products, especially *Aloe vera* gel (Petersen et al., 1999). Several studies have evaluated the effects of coatings on fresh agricultural produce (Supa et al., 2024). For instance, the applications of edible coatings have been shown to have provided a selective barrier to moisture loss and retained firmness of table grapes (Valverde et al., 2005), and gas and solute migrations, therefore extending the storage life (Aloui & Khwaldia, 2016). In addition, edible coating improved the sensual qualities of fruit, giving it a gloss and preventing colour change (Kim et al., 2022), maintaining textural quality, retaining volatile flavour compounds, and reducing microbial growth (Debeaufort et al., 1998). Moreover, reports showed that *Aloe vera* coating maintained firmness, delayed kiwifruit fruit yellowing, and ascorbic acid decline (Benítez et al., 2015), and decreased respiration rate, oxidative browning and the growth of microorganisms in table grapes (Valverde et al., 2005).

Edible coating and ambient storage reduced weight loss and extended Cavendish bananas' storage life (Dwivany et al., 2020). Bananas stored at low temperatures alone have less weight loss and deterioration compared with fruit kept at ambient conditions (Cano et al., 1997; Moradinezhad et al., 2008). The primary mechanism that contributes to fruit weight loss is vapour-phase diffusion driven by water vapour gradient between the inside and outside of the fruit leading to increase transpiration (Suseno et al., 2014). Recently, Bantayehu and Alemayehu (2020) indicated that holding bananas at 15°C was optimum for inhibiting peel colour changes relative to ≥20°C storage. Consumers often evaluate banana fruit quality mainly by colour, brightness, and size. These criteria are complemented by firmness, total soluble solids (TSS), and acidity (Moreno et al., 2021). A study reported that a decrease in TA of bananas due to a decrease in organic acid content, adversely affected internal quality

(Thakur et al., 2019). Other investigations observed that changes in sugar and acid ratios in bananas influenced the organoleptic taste and consumer acceptability during storage (Pott et al., 2020).

The application of edible coating is promising to improve the quality and extend the storage life of fruits since it can form a perfect coating on fruit surfaces to delay the ripening and retain quality properties, and it is regarded as a safe material. Banana storage using *Aloe vera* gel as the edible film is relatively a new treatment method. Currently, little study has applied this concept to a few banana cultivars as discussed in previous sections. Hence, the objective of this study was to evaluate the impact of *Aloe vera* coating and two storage temperatures (10°C or 25 ± 2°C) on physiological and biochemical changes in two banana cultivars (Cavendish and Lantundans) and to maintain desirable quality factors and extend their postharvest life.

MATERIALS AND METHODS

Aloe vera gel preparation

Aloe vera plant (*Aloe barbadensis*) was obtained from a farmer in the Wa municipality in the Upper West Region of Ghana. The plant was cleaned to remove dirt using napkins and the edges were cut. The central part of the leaf averaging 85% of total weight was the pulp used as the portion for the gel coating. To extract the gel, the pulp was cut into smaller pieces using a sharp knife, and this material was washed for a minute with tap water and left in an ambient for 5 hours to air dry off the residue water. Immediately after drying the water off, the pulp was homogenised with an electric blender and filtered to remove purities. One percentage of 2.5% citric acid and 2.5% ascorbic acid were then added to the gel solution obtained to stabilise its content to form an *Aloe vera* gel of 25% of the total extract, according to the method of Arrubla-Vélez et al. (2021).

Plant materials and experimental design

Green mature Lantundan and Cavendish bananas were obtained from a farmer who is into the production of bananas from Techiman-Koase at Bono Ahafo region of Ghana. During harvesting, the bunches were removed from the plant by cutting a notch in the pseudo stem. The fruits were packaged in baskets lined with fresh banana leaves and jute sacks to minimise damage. The fruits were transported from Techiman for 5 h to Dr. Hilla Limann Technical University Postharvest Laboratory in Wa for the experiment to start. The hands were sorted based on visual defects, uniformity of weight, and shape. The hands were randomly divided into different treatment groups. Each treatment group consisted of eight uniform hands (8 fingers into a hand). In total sixty-four (64) hands of uniform-sized bananas were used for the experiment for both cultivars.

The bananas were wiped dry and the entire sample was divided into two based on cultivar with each cultivar having 32 hands of eight (8) fingers. The cultivars were further divided into four groups. The bananas hands were then dipped for 2 min with 25% *Aloe vera* gel, while control fruit were dipped in tap water and stored as follows; uncoated Lantundans stored at ambient (V0LaTA); vera coated Lantundans stored at ambient (V1LaTA); uncoated Lantundans at cold storage (V0LaTc); vera coated Lantundans at cold storage (V1LaTc); uncoated Cavendish stored at ambient (V0CaTA); vera coated Cavendish stored at ambient (V1CaTA); uncoated Cavendish at cold storage (V0CaTc), or vera coated Cavendish at cold storage (V1CaTc). The cold storage temperature was 10°C and relative humidity (RH) of 70-75%, while the ambient storage temperature was 25 ± 2°C with a 50-55% RH for 10 days. Fruits of each cultivar were randomly divided into two equal lots after cleaning and sorting.

The first lot was then surface coated with aloe vera while the second lot was used as control fruit. After the treatments, the fruits were stored at 10°C or 25 ± 2°C for ten (10) days. The fruits were kept in corrugated cardboard boxes and stored under the respective temperatures. Fruit were evaluated after every two days for weight loss (%), peel colour changes, titratable acidity, total soluble solids, fruit firmness, and fruit decay incidence. Cold and ambient temperature storage was monitored daily using tinny-tag data loggers during the experiment to determine the RH.

Evaluation of weight loss

The weight of individual treatments was recorded once every 24-hour interval for 10 days. The physiological weight loss was calculated for the above interval and converted into percentages. The percentage weight losses were obtained by subtracting the initial weight (W1) from the final weight (W2) divided by the final weight multiplied by 100% (1), i.e.,

$$\text{Weight} = W1\text{-}W2/W1 \times 100\% \qquad (1)$$

Assessment of colour changes

The average peel colour of the sample fruits was determined using banana maturity stage standardized colour charts. The peel colour of individual fruit was scored according to Venkata-Subbaiah (2013) with little modification. Briefly, the peel colour of the bananas was scored 1 to 7 scale, where 1 = all green, 2 = still green with traces of yellow, 3 = more green than yellow, 4 = more yellow than green, 5 = green tip, 6 = full yellow, and 7 = yellow with brown spots. The least numerical values in these ranging assessments show the betterment of the fruit's quality during the storage regime.

Internal quality measurement

The fruit TSS was measured by using a refractometer (Atago Co., Tokyo, Japan). The banana flesh was prepared to form a homogenous sample by blending in a blender after the removal of the banana peels. The sample was well mixed and a few drops of the juice were put on the prism of the refractometer, and readings were taken by recording the figures on the meter according to AOAC (1994). The TA was determined by titrating 5 ml of juice of two (2) fruits each from each hand. with 0.1 N sodium hydroxide, using phenolphthalein as an indicator (Mazumdar & Majumder, 2003), and the data expressed as percentage citric acid.

Determination of decay incidence

The decay percentage of the stored bananas was assessed according to Gol and Rao (2011) with little modifications. Briefly, on the assessment days of the experiment, all the fruit visual inspections were conducted, and fruits with physiological and microbial decay were discarded in each sample, and the decay percent was calculated and recorded.

Evaluation of sensory qualities and consumer acceptability

A blind taste test was performed on the fruits on day zero and day 10 of the experiment to ascertain consumer acceptance. In this, twenty (20) panel members tasted the fruit samples on the last day of storage for the treated and control samples and scored their observation according to a four-point hedonic scale; 1 = excellent, 2 = very good, 3 = good: limited of marketability, and 4 = Poor: unsalable.

Statistical analysis

The experimental design was a 3 × 2 factorial design arranged in a Completely Randomised Design. Banana fruits were selected based on uniformity and freed from defects. The data on external quality and physicochemical factors were statistically analyzed using two-way Analysis of Variance (ANOVA) using SPSS version 19. P-values of < 0.05 were considered statistically significant for the evaluated parameters. The average means comparison was done using Fisher's least Significant Difference (FLSD).

RESULTS AND DISCUSSION

Effect of coatings on weight loss

Bananas are one of the horticultural produce that is highly perishable and therefore need effective treatments and storage conditions to enhance fruit-keeping qualities. The results obtained on weight loss of Cavendish and Lantundan bananas coated with *Aloe vera* and stored at 10°C for 10 days showed that Cavendish coated with aloe vera coatings on day 4 produced an average weight loss of 2.3% as compared with coated Lantundans of 0.9% as opposed to control fruit experiencing a weight loss of 4.6% and 3.9% respectively. On day 10, the results obtained from weight losses indicated that there was an increase in weight on coated Cavendish lost 2.7% compared to Lantundans with 2.1%, but the weight loss of control increased to 10.6% and 7.9% respectively (Fig. 1), which confirms the results of Suseno et al. (2014) where control bananas lost more weight compared with coated bananas. According to Quoc (2021), *Aloe vera* coating is capable of forming a natural gas barrier and extends banana storage life.

On day 4, the weight loss of coated Cavendish fruit held at 25 ± 2°C recorded an average weight loss of 1.8% compared with Lantundans of 1.5%, however, both their controls had a weight loss of 4.4%. However, on day 10, the weight loss of coated Cavendish increased to 5.3% compared to Lantundans with 4.4% relative to control fruit with a weight loss of 15.3% and 13.1% respectively, and prolonged shelf life up to 10 days. However edible coatings and storage at ambient reduced weight loss and extended Cavendish bananas' storage life to 13 days (Dwivany et al., 2020). The primary mechanism that contributes to the weight loss of fruits is vapour-phase diffusion driven by water vapour gradient between the inside and outside of the fruit leading to an increase in transpiration (Suseno et al., 2014).

Storage temperature and cultivar had an interacting effect on the weight loss of fruits. The results showed that Cavendish bananas lost less moisture (about 10%) than the Lantundans, which could be due to differences in plant genetics. However, uncoated fruit stored at 10°C had a lower weight loss (13.1%) relative to the weight loss (15.3%) of fruits stored at 25 ± 2°C. The results also showed a significant effect of cultivar and temperature levels on weight loss, as Lantundans lost more moisture relative to Cavendish throughout storage under all the treatment and storage conditions (Fig. 1). The lowest weight loss was observed in both Lantundan and Cavendish bananas coated with *Aloe vera* and held at cold storage, which agreed with the finding of Quoc (2021), who decreased banana fruit weight loss with *Aloe vera* coatings.

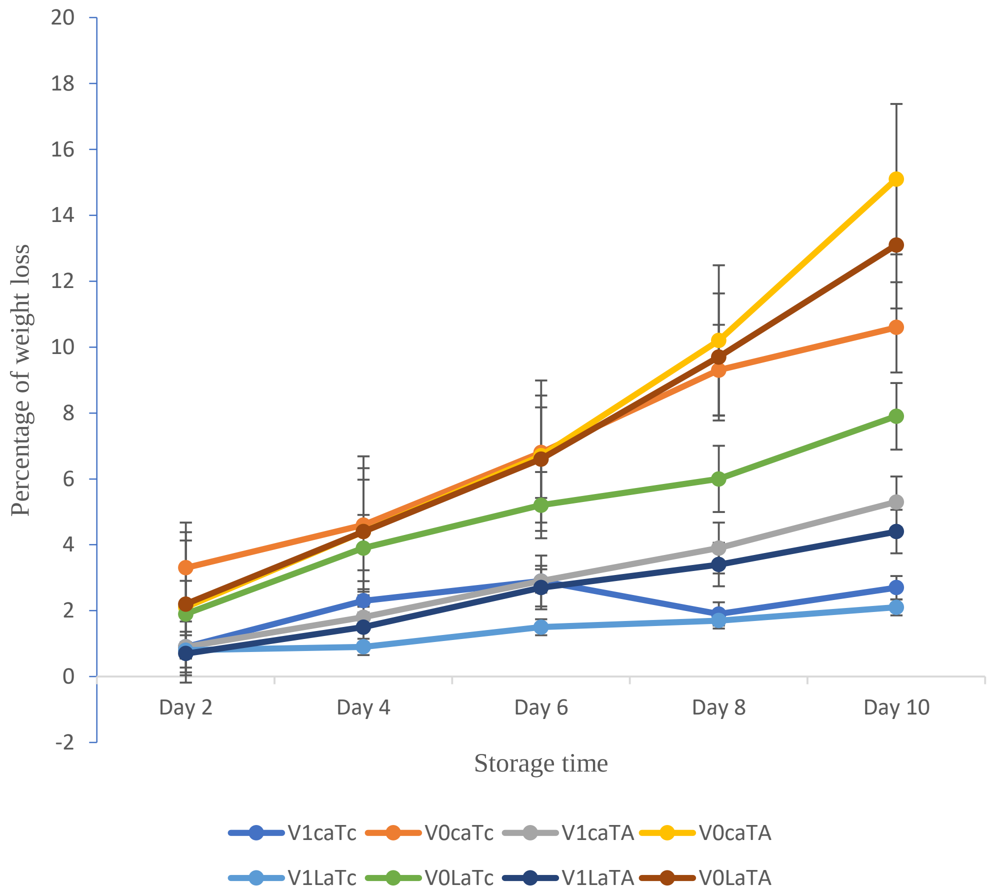

Fig. 1. Weight loss of coated and uncoated Lantundan and Cavendish bananas stored at cold and ambient temperatures. Uncoated Lantundans stored at ambient (V0LaTA); vera coated Lantundans stored at ambient (V1LaTA); uncoated Lantundans at cold storage (V0LaTc); vera coated Lantundans at cold storage (V1LaTc); uncoated Cavendish stored at ambient (V0CaTA); vera coated Cavendish stored at ambient (V1CaTA); uncoated Cavendish at cold storage (V0CaTc), or vera coated Cavendish at cold storage (V1CaTc). Each value is a mean of triplicate determination.

Peel colour changes

Banana peel colour is an important factor that influences consumers to buy from the market and therefore must be maintained. This investigation showed a significant ($p<0.05$) difference in the peel colour of coated bananas and control stored at cold and ambient conditions. Bananas coated with *Aloe vera* appeared to have less brown peel than the control. A study has demonstrated that uncoated bananas showed an unsatisfactory appearance after 4 days of storage when compared with coated bananas which had an acceptable appearance for up to a week of storage (Suseno et al., 2014). Peel colour changes of Cavendish and Lantundans coated with *Aloe vera* and stored at 10°C showed that, on day 4 coated Cavendish was 1.9 compared with 1.8 for coated Lantundan bananas, regarding a score of 1.0 on day 0 of our study. While the peel colour of control Cavendish and Lantundans were 2.0 and 1.9 respectively. On day 10, the results showed that coated Cavendish recorded 1.9 compared with Lantundans of 2.4, control Cavendish and Lantundans scored 1.9 and 1.8 respectively. Colour changes of Cavendish and Lantundans stored at 25 ± 2°C indicated on day 4 that, colour changes occurred with both Cavendish and Lantundans as compared with the peel colour on day 0, where the peel scored 1.0. Cavendish and Lantundans coated with *Aloe vera* produced an average colour of 2.8 and 2.3, while uncoated Cavendish and Lantundan had an average colour value of 5.5 and 2.8 respectively. On day 10 of storage, the results showed that coated Cavendish and Lantundans had an average colour of 5.1 and 4.5 respectively, relative to control Cavendish (7.0) and Lantundans (5.8), which demonstrated a steady peel colour development (Fig. 2). This result affirms the findings by Aziz et al. (2021), who showed steady colour changes in bananas with chitosan coating treatment. A study attributed delayed bananas' colour changes to the reduction of chemical changes, such as chlorophyll breakdown (Aziz et al., 2021). Generally, the results of the present study demonstrated that fruit kept at 10°C was better than those held at 25 ± 2°C. Similarly, Bantayehu and Alemayehu (2020) demonstrated that keeping bananas at 15°C had a superior peel colour to those held at room temperature (≥20°C).

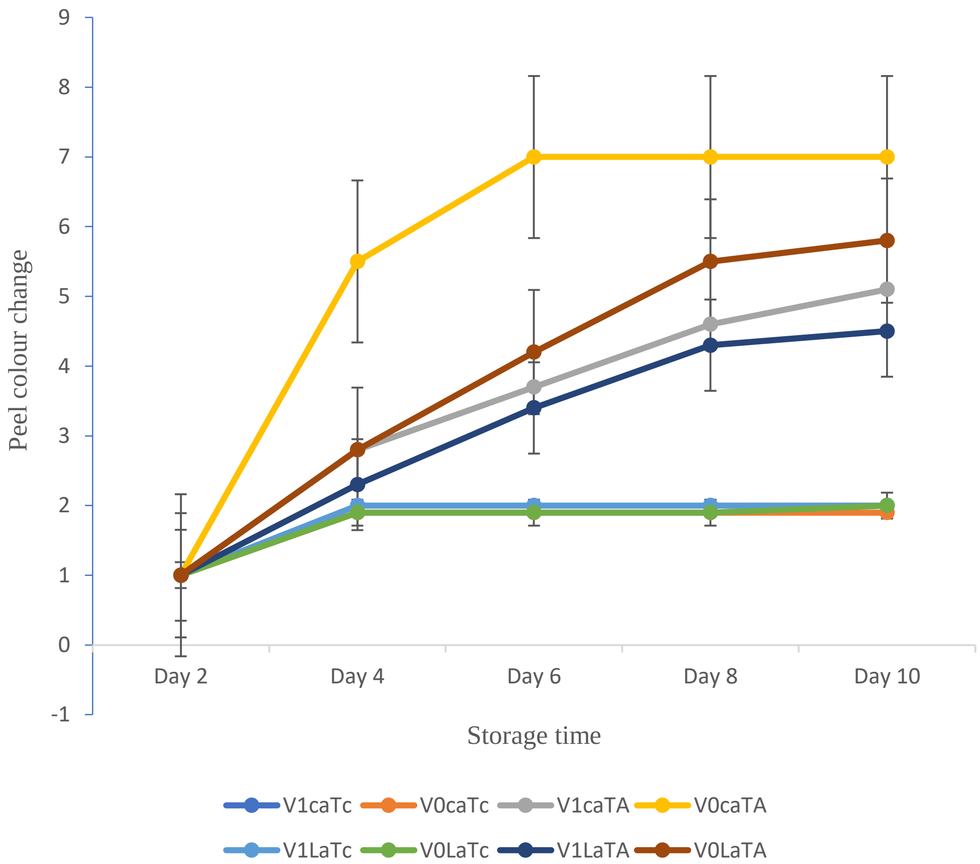

Fig. 2. Peel colour changes of coated and uncoated Lantundan and Cavendish bananas stored at cold and ambient temperatures. Uncoated Lantundans stored at ambient (V0LaTA); vera coated Lantundans stored at ambient (V1LaTA); uncoated Lantundans at cold storage (V0LaTc); vera coated Lantundans at cold storage (V1LaTc); uncoated Cavendish stored at ambient (V0CaTA); vera coated Cavendish stored at ambient (V1CaTA); uncoated Cavendish at cold storage (V0CaTc), or vera coated Cavendish at cold storage (V1CaTc). Each value is a mean of triplicate determination.

Total soluble solids and titratable acidity

There was a significant ($p<0.05$) effect of *Aloe vera* treatment and storage temperatures on the TSS of the fruits. Although, TSS usually shows a continuous increase with an increase in banana maturity (Wanna et al., 2001), in this study *Aloe vera* coating appeared to have significantly delayed a rise in TSS of Cavendish and Lantundan bananas. A comparison between the two cultivars in this investigation showed a similar trend, with Lantundans demonstrating a slight increase in TSS. Uncoated Lantundan held at 25 ± 2°C had a TSS of 18.6 °Brix relative to 23.4 °Brix for Cavendish stored at the same condition. TSS for coated Lantundan and Cavendish fruits showed an average of 15.1 and 19.2 °Brix respectively (Table 1). These differentials in TSS could not only be a result of levels of fruit maturity but rather could be due to plant genetics. On day 10, when the experiment was terminated, coated Cavendish bananas held at 10°C appeared attractive and with better eating quality. Coated bananas showed the lowest TSS values compared to uncoated bananas. Aloe vera, 0.6 and 1.2% for Arabic gum, and 100 and 200 g/l for starch are those that kept the TSS content of coated bananas low (Tchinda et al., 2023).

According to Thakur et al. (2019), the TA of bananas declined during storage as organic acid content decreased, and the reduction was ascribed to the conversion of organic acid into sugar. In this study, there was a significant effect of *Aloe vera* and storage temperature on TA of bananas. The average TA of control Lantundans was 0.37 on day 10, while that of coated Lantundans held at 10°C declined to 0.54, higher than an initial malic acid value of 1.02. However, coated Cavendish bananas held at 10°C showed the smallest decrease in TA compared with uncoated fruit kept at room temperature which showed a significant reduction of 0.63 from an initial 1.14. A cursory study of the decline in TA presented in Table 1, showed an interactive effect of treatments and storage conditions as well as in the two banana cultivars. In general, TA in this study showed a both banana cultivars decreased irrespective of whether it is coated. Still, the decline was more pronounced in uncoated Lantundans at room temperature. A slight decrease in the TA observed in coated Cavendish or Lantundans was observed, which was probably a result of the enzyme activity (Quoc, 2021). Moreover, Gol and Rao (2011) slowed the changes in TA by effectively delaying fruit senescence using chitosan coatings.

Table 1. Total soluble solids and titratable acidity of coated and uncoated bananas during cold and ambient storage.

Parameter	Treatment and storage conditions								
	Temperature	V0LaTA	V0LaTc	V1LaTA	V1LaTc	V0CaTA	V0CaTc	V1CaTA	V1CaTc
Banana spp		Lantundan bananas				Cavendish bananas			
TSS (°Brix)	Day 0	7.1				8.6			
	10°C	15.7^{b}	15.2^{b}	15.6^{b}	15.1^{b}	21.8a	20.3a	21.5a	19.2^{b}
	25°C	18.6^{d}	17.7^{d}	18.1^{d}	18.3^{d}	25.4^{c}	24.1^{c}	25.2^{c}	23.4^{c}
LSD (0.05)					2.6				2.6
TA (malic acid)	Day 0	1.02				1.14			
	10°C	0.54^{d}	0.69^{c}	0.66^{c}	0.75^{b}	0.67c	0.64c	0.72b	0.81^{a}
	25°C	0.37^{i}	0.51^{g}	0.54^{g}	0.58^{f}	0.52^{f}	0.46^{h}	0.57^{f}	0.73^{e}
LSD (0.05)					0.08				0.08

Uncoated Lantundans stored at ambient (V0LaTA); vera coated Lantundans stored at ambient (V1LaTA); uncoated Lantundans at cold storage (V0LaTc); vera coated Lantundans at cold storage (V1LaTc); uncoated Cavendish stored at ambient (V0CaTA); vera coated Cavendish stored at ambient (V1CaTA); uncoated Cavendish at cold storage (V0CaTc), or vera coated Cavendish at cold storage (V1CaTc). Values in the same column and rows with the same letters are not significantly different.

Table 2. Taste and flavour of coated and uncoated bananas during cold and ambient storage.

Parameter	Treatment and storage conditions								
	Temperature	V0LaTA	V0LaTc	V1LaTA	V1LaTc	V0CaTA	V0CaTc	V1CaTA	V1CaTc
Banana spp		Lantundan bananas				Cavendish bananas			
	Taste	2.2[f]	2.1[g]	2.4[f]	2.5[e]	2.6[d]	3.4[b]	3.2[c]	3.8[a]
	Flavour acceptability	2.6[a]	3.4[c]	3.0[b]	3.7[d]	4.1[f]	3.8[e]	3.5[c]	4.2[g]
LSD (0.05)					0.9				0.9

Uncoated Lantundans stored at ambient (V0LaTA); vera coated Lantundans stored at ambient (V1LaTA); uncoated Lantundans at cold storage (V0LaTc); vera coated Lantundans at cold storage (V1LaTc); uncoated Cavendish stored at ambient (V0CaTA); vera coated Cavendish stored at ambient (V1CaTA); uncoated Cavendish at cold storage (V0CaTc), or vera coated Cavendish at cold storage (V1CaTc). Values in the same column and rows with the same letters are not significantly different.

Sensory qualities and consumer acceptability

Fresh eating quality of bananas is an important parameter for consumer satisfaction and should be maintained after harvest. The results obtained from the taste test on fresh bananas scored by 20 panelists indicated that coated Cavendish and Lantundan bananas stored under 10˚C recorded an average value of 3.8 and 2.5 and their control recorded 3.2 and 2.4 respectively, while uncoated Cavendish and Lantundans stored under ambient recorded 3.4 and 2.1 compared with 2.6 and 2.4 for uncoated bananas. Meanwhile, the overall acceptance for Cavendish and Lantundan bananas coated and stored under 10°C obtained 4.2 and 3.7 as compared with the control of 3.4 and 3.0 averages. The overall acceptance for control observed under ambient was recorded at 3.8 and 3.4 for coated Cavendish and Lantundans respectively, and uncoated samples held at room temperature rated as 4.1 and 2.6 for Cavendish and Lantundans respectively (Table 2). Generally, samples coated and kept at cold storage were rated higher than control but did not have significant effects on taste. However, there was a significant preference of tasters for Cavendish bananas relative to Lantundans. This is a demonstration that *Aloe vera* and storage temperature did not significantly improve bananas' sensory attributes. This effect contrasts the finding by Choi et al. (2016) who established that coatings had a greater impact on fruits and therefore provided a better flavour than control fruit.

Aloe vera coating had no significant effect on consumer acceptance due to coating and storage temperatures. However, storage temperatures and coating affected the bananas' taste. The highest acceptability score was observed in fruit coated with *Aloe vera* and stored at 10°C. Pott et al. (2020), observed that fruit taste and acceptability depend on the ratio of sugars and acids, which therefore determine flavour acceptability. However, treatment with *Aloe vera* maintained the peel colour of bananas in this study, especially those stored in a cold room. Both coated and control held at ambient conditions was off-flavoured, but this was more pronounced with uncoated fruit. Fruit with small colour changes due to *Aloe vera* coating did not also show off-flavour, hence had greater consumer acceptance. This positive effect of *Aloe vera* in this study is consistent with the findings of Valverde et al. (2005), who preserved the eating quality of sweet cherry with *Aloe vera* application.

Table 3. Decay incidence percent of coated and uncoated bananas during cold and ambient storage.

Parameter	Treatment and storage conditions								
	Temperature	V0LaTA	V0LaTc	V1LaTA	V1LaTc	V0CaTA	V0CaTc	V1CaTA	V1CaTc
Banana spp		Lantundan bananas				Cavendish bananas			
Decay incidence	Day 0	0							
	10°C	25.3[a]	15.0[c]	20.0[b]	12.1[d]	15.0[c]	8.0[e]	10.0[d]	5.1[f]
	25°C	35.0[f]	20.0[b]	30.3[e]	26.0[b]	23.2[d]	18.0[b]	21.0[c]	15.1[a]
LSD (0.05)					2.4				2.4

Uncoated Lantundans stored at ambient (V0LaTA); vera coated Lantundans stored at ambient (V1LaTA); uncoated Lantundans at cold storage (V0LaTc); vera coated Lantundans at cold storage (V1LaTc); uncoated Cavendish stored at ambient (V0CaTA); vera coated Cavendish stored at ambient (V1CaTA); uncoated Cavendish at cold storage (V0CaTc), or vera coated Cavendish at cold storage (V1CaTc). Values in the same column and rows with the same letters are not significantly different.

Decay incidence

Aloe vera coating in combination with cold storage significantly ($p<0.05$) inhibited the decay of the bananas as compared with the control. The decay of control was about 3 times higher than fruits coated with *Aloe vera* at the end of storage. Coated bananas stored at low temperatures had less decay (5%) for Cavendish relative to 12% for Lantundan bananas (Table 3). The effects of *Aloe vera* coating in reducing decay could be attributed to antifungal properties. Previous studies showed that chitosan acted as an antifungal property against postharvest pathogens (Jiang & Li, 2001). Moreover, a study reported that chitosan induces chitinase, a defense enzyme, and catalyzes the hydrolysis of chitin, which are common component of fungal cell walls, hence preventing the growth of fungi on the oranges (El-Ghaouth et al., 1992). This study shows an increased decay of both banana cultivars held at ambient, with uncoated fruit having a significantly higher decay than coated ones. This effect affirms the finding by Aziz et al. (2021), who observed the lowest disease level in chitosan-coated bananas.

There was a significant difference in the decay of bananas during the storage regime. A decay of 35% was observed for the Lantundans held under ambient conditions compared with a loss of 25% for Cavendish fruit at the same storage conditions after 10 days. These results seem to suggest that Lantundan bananas are possibly more susceptible to decay than Cavendish bananas and hence had a higher decay percentage. Bananas are highly perishable due to physiological alterations such as weight loss, as a consequence of respiration and transpiration, fruit softening as well and less resistance capacity against microbial attack. Higher respiration rate for example is mostly a possible factor for higher decay. Hailu et al. (2014) noticed that an increase in respiration led to tissue softening of bananas, which in turn increased the level of rot during storage. Similarly, Aziz et al. (2021), reported that delaying the physiological process and loss of weight could inhibit microbiological activity and possibly prolong bananas' storage life.

CONCLUSION

The present study reveals that the combination of *Aloe vera* coating and storage at 10°C was the best treatment for maintaining the quality and extending the shelf-life of Lantundan and Cavendish banana cultivars. After a storage period of 10 days at 10°C and 25 ± 2°C, the results indicated that *Aloe vera* gel can be an effective coating material to perverse physicochemical and eating quality and inhibit banana fruit rot. It was shown that the lightness and yellowness of the coated bananas were delayed with small losses at the end of storage while uncoated samples had unacceptable appearance and taste. Moreover, *Aloe vera* coatings reduced moisture losses and colour changes, hence improving the bananas' quality. Based on these results, it can be safely concluded that the combination of *Aloe vera* coating and storage at 10°C was the most effective method in maintaining the quality and extending the shelf-life of both Lantundan and Cavendish bananas.

Conflict of interest

The author declares no conflict of interest regarding the publication of this work.

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