Original Research Article

Effects of *Psidium guajava* L. leaf powder and *Aloe vera* L. gel on shelf life of *Citrus sinensis* L. fruits

ABSTRACT

Postharvest loss of fruits is a critical problem due of rapid deterioration during handling, transportation and warehousing. Eatable coverings over fruits are utilised to boost their quality and shelf life. The effects of leaf extracts of *Psidium guajava* and *Aloe vera* gel on the elongation of the shelf life of orange fruits were evaluated. Orange fruits were treated with Guava leaf powder and *A. vera* gel to assess their effectiveness in extending their shelf life and quality in storage. Weight loss, firmness, post-harvest decay, marketability and shelf life of uncoated and coated samples were evaluated all through the period of this study. Fungi were also isolated from deteriorating samples. *A. vera* was able to preserve the orange samples for 21 days; *P. guajava* preserved them for 17 days while the untreated fruit samples stayed for 14 days. Three fungi viz: *Botryodiplodia theobromae, Fusarium oxysporum* and *Rhizopus stolonifer* were isolated from the decomposing orange fruits. The result shows that orange fruits coated with *A. vera* gel and guava leaf powder is effective in extending the shelf-life of orange fruits when compared to untreated fruit (control) in the following order: *A. vera*>*P. guajava* > control. The findings from this study indicate that plant extracts could be employed to prolong the shelf life and improve quality of orange fruits.

Keywords: Citrus sinensis, Plant extracts, Postharvest loss, Shelf life

1. INTRODUCTION

Citrus sinensis L. is one of the most widely grown fruit crops, currently being planted in over 80 countries. In a less developed county like Nigeria, the fruit and vegetable sector plays a vital part in home nutrition, income generation, poverty mitigation, food availability and sustainable agriculture [1]. However, most of these products are lost after harvest because of poor preservation method; high moisture content and nutrient composition make these fruits more susceptible to fungal contamination [2]. The health benefits of fruits makes its preservation and storage an important area as it also adds to the incomes of individual household, breeder and the nation at large [3].

In folk medicine, *P. guajava* (guava) is used as a phytotherapeutic plant as it helps to treat and manage various diseases because it is believed to have active component and *A. vera* gel coatings has various favourable effects on fruits like imparting a shiny outlook and enhanced colour, slowing down loss of weight, or lengthening storage time by impeding deterioration by microbes [4]. This aim of this study was to assess the effect of *A. vera* gel and *P. guajava* leaf powder on postharvest shelf life of orange fruit in storage.

2. MATERIAL AND METHODS

2. 1 Collection of fruits and plant extracts

Thirty orange fruits were bought from Iyana Iba market, Lagos Nigeria. Clean, unwrinkled and uninfected fruits were used, fresh leaves of *P. guajava* were placed in a blender to be ground, sieved and the pulverized sample were kept away from direct radiation in tight container while *A. vera* leaves were rinsed with sterile distilled water, the leaf skins were peeled and the resulting mixture was filtered to remove the fibres. The liquid obtained constituted the fresh *A. vera* gel extracted into a bowl. Authentication and identification of the plants was done at the Botany Department, LASU, Ojo Lagos.

2.2 Treatment and storage of Orange fruits using plant extracts

The guava leaf powder was mixed with 250 mL of sterile distilled water and coated (treated) with 10 orange samples while 10 oranges were coated with *A. vera* gel and 10 oranges were used for control and arranged in fruit rack and stored at normal temperature. Data collected included:

Weight Loss Percentage (WLP): Orange fruits were initially measured and during the storage period using beam balance. WLP = $\frac{\text{Original weight - final weight}}{\text{Original weight}} \times 100$

Postharvest decay percentage (PDP): Postharvest decomposition was evaluated physically for symptoms during the storage period. PDP = $\frac{\text{No. of decayed fruits}}{\text{Total no. of fruits}} \times 100$

Shelf life: Shelf lives of orange fruits were estimated by examining the marketable fruits per day and this was done on physical appearance and decayed fruits [5].

Firmness: Firmness of orange fruits was ascertained by physical counting using a rating scale of 1 to 5. Where 1= extremely bad, 2= bad, 3= satisfactory, 4= fine, and 5= splendid.

Marketability: Using survey features such as intensity of noticeable blemish, shriveling, smoothness and freshness of fruit, % of saleable fruits during the study.

Marketability = $\frac{\text{No. of saleable fruits}}{\text{Total no. of fruits}} \times 100$

2.3 Isolation of fungi associated with spoilage of Orange fruits.

Potato Dextrose Agar was used to isolate fungi from Citrus fruits. The fungal isolates were identified using their cultural and morphological characteristics as well as microscopic identification with reference to standard texts [5,6]**.**

2.4 Statistical analysis

Data were computed using SPSS version 20. Data were expressed as mean ± standard error and were subjected to one way analysis of variance (ANOVA). Where there is considerable difference, Fisher's Least Significance Difference (LSD) was applied at $\alpha = 0.05$.

3. RESULTS AND DISCUSSION

3.1 Weight assessment of orange fruits in storage

There was considerable variation ($p<0.05$) between the untreated samples and those treated with *A. vera* and *P. guajava* extracts from days 13 upward (Table 1). Comparing the differences it was observed that the weight of the orange fruits treated with *A. vera* and *P. guajava* was still above 70g while the untreated orange (weight) was 47g at day 21. The extracts made the orange weight to still remain well above 50g but there was high reduction per day especially from day

11, this is to suggest that orange fruit will be unable to stay in form after day 11. The weight difference between day 11 and day 13 is about 14g while for the treated samples; it was just around 4 g difference.

Table 1. Effects of *Aloe vera* gel and *Psidium guajava* leaf extracts on shelf life of *Citrus sinensis*

Days	Control	*A. vera*
1	114.57±2.49[a]	115.30±6.06[a]	122.18±7.32[a]
3	108.80±2.64[a]	112.15±6.30[a]	117.30±7.32[a]
5	104.18±2.86[a]	107.73±6.11[a]	117.2±7.20[a]
7	97.11±2.36[b]	104.25±6.16[a]	105.80±7.06[a]
9	91.03±32.32[b]	99.34±6.02[a]	99.63±6.92[a]
11	83.81±2.15[b]	96.58±7.05[a]	94.58±7.05[a]
13	69.70±8.04[c]	92.48±6.03[ab]	90.91±7.19[b]
15	64.41±7.48[c]	89.06±5.76[ab]	82.38±6.40[ab]
17	58.89±6.90[c]	85.11±5.98[ab]	82.38±6.40[ab]
19	53.23±6.35[c]	81.35±5.96[a]	77.5±6.53[b]
21	47.49±5.72[c]	77.79±5.91[a]	74.11±6.53[ab]

Means with the same superscript alphabets and in the same row are not significantly different (p>0.05)

3.2 Postharvest decay of Orange fruits in storage

Postharvest deterioration of orange fruits in storage revealed that there was considerable variation in orange fruit coated with *Aloe vera* gel and control fruits (Table 2) except on day 3, 5 and 7. On days 9, 11, 13, 15 and 17 the maximum postharvest decomposition was recorded on control fruits as against the coated fruits. On day 19 and 21, the maximum postharvest decay was observed on the treated fruits compared with the control fruits. No fruit decay was observed on treated fruits on day 3 and control fruits on day 21.

For orange fruit treated with *P. guajava*, significant difference in decomposition was observed in all the days when coated and control orange fruits were compared (Table 3) except on day 3, 5, 7, 11 and 21. On days 9, 13, 15, 17 and 19 the maximum postharvest decay was recorded on the control fruits compared with the treated fruits. No fruit decay was observed on treated fruits on day 3 and control fruits of day 21.

Table 2: **Postharvest decay percentage of Orange fruit coated with *A. vera* extract during storage**

Extracts/Day	Day 3	Day 5	Day 7	Day 9	Day 11	Day 13	Day 15	Day 17	Day 19	Day 21
A. vera	0.0	20.0	20.0	30.0	40.0	50.0	50.0	60.0	60.0	70.0
Control	10.0	30.0	40.0	50.0	70.0	80.0	90.0	90.0	100.0	100.0
LSD	NS	NS	1.0	2.0	1.0	2.0	1.0	3.0	4.0	3.0

Table 3: **Postharvest decay of orange fruit coated with *P. guajava* extract during storage**

Extracts/Day	Day 3	Day 5	Day 7	Day 9	Day 11	Day 13	Day 15	Day 17	Day 19	Day 21
A. vera	0	20.0	20.0	30.0	50.0	50.0	60.0	60.0	70.0	80.0
Control	10.0	30.0	40.0	50.0	70.0	80.0	90.0	90.0	100.0	100.0
LSD	NS	NS	1.0	NS	1.0	1.0	1.0	2.0	NS	NS

KEY: LSD– Least significant difference (p<0.05) NS-No significant difference.

Table 3: **Postharvest decay of orange fruit coated with *P. guajava* extract during storage**

Extracts/Day	Day 3	Day 5	Day 7	Day 9	Day 11	Day 13	Day 15	Day 17	Day 19	Day 21
A. vera	0	20.0	20.0	30.0	50.0	50.0	60.0	60.0	70.0	80.0
Control	10.0	30.0	40.0	50.0	70.0	80.0	90.0	90.0	100.0	100.0
LSD	NS	NS	1.0	NS	1.0	1.0	1.0	2.0	NS	NS

KEY: LSD– Least significant difference (p<0.05) NS-No significant difference.

3.3 Marketability of orange fruits during the time of storage

Marketability of orange fruit coated with *Aloe vera* extract within the storage duration revealed considerable variation ($p < 0.05$) (Table 4) between coated and control orange fruits except on days 3, 5 and 7. On day 9, 11, 13, 15, 17, 19 and 21 the maximum marketability was seen on the treated fruits in relation to the control.

For the orange fruit coated with *P. guajava* extract, no considerable variation ($p < 0.05$) (Table 5) in marketability was observed between treated and control orange fruits but for days 9, 11, 13, 15 in which the highest marketability was observed on the treated fruits compared to the control fruits.

3.4 Firmness of orange fruits during storage

Result for firmness of Orange fruits coated *Aloe vera* extracts

No considerable variation ($p > 0.05$) (Table 6) in firmness between coated and control fruits were noticed but for days 15 and 17. On days 15 and 17, the treated fruits had a value of 3 respectively whereas for control fruit day 15 had a score 1. The maximum firmness recorded in storage was 4, noticed on the coated fruits of days 3, 5, 7 and the control fruits of day 3

For *P. guajava*, no considerable variation in firmness was recorded between coated and control fruits at ($p > 0.05$) (Table 7). Though, the maximum firmness was reported on both treated and control fruits of day 3 with a rating of 4 respectively.

3.5 Shelf life of Orange fruits during storage

Result obtained showed that the Orange fruits coated with *Aloe vera* had a higher shelf life of 21 days compared with 14 days for control fruits. For Orange fruits coated with Guava extract, it has a higher shelf life of 17 days compared with 14 days for the control fruits.

3.6 Isolated fungi from deteriorating orange fruits

Three fungi were isolated namely; *Botryodiplodia theobromae, Fusarium oxysporum* and *Rhizopus* sp.

Table 4: **Marketability of Orange fruits coated with *Aloe vera* extract within storage duration**

Extracts/Day	Day 3	Day 5	Day 7	Day 9	Day 11	Day 13	Day 15	Day 17	Day 19	Day 21
A. vera	100.0	90.0	80.0	70.0	60.0	50.0	50.0	40.0	40.0	40.0
Control	90.0	70.0	60.0	50.0	30.0	20.0	10.0	10.0		
LSD	NS	NS	NS	1.0	2.0	1.0	3.0	2.0	3.0	4.0

KEY: LSD– Least significant difference (p<0.05) NS-No significant difference.

Table 5: **Marketability of Orange fruits coated with *Psidium guajava* extract within storage duration**

Extracts/Day	Day 3	Day 5	Day 7	Day 9	Day 11	Day 13	Day 15	Day 17	Day 19	Day 21
A. vera	100.0	80.0	70.0	60.0	40.0	40.0	30.0	30.0	20.0	20.0
Control	90.0	70.0	60.0	50.0	30.0	20.0	10.0	10.0		

LSD	NS	NS	NS	2.0	2.0	2.0	1.0	1.0	NS	NS

KEY: LSD– Least significant difference ($p<0.05$) NS-No significant difference

Table 6: **Firmness of Orange fruit coated with *aloe vera* extract during storage**

Extracts/Day	**Day 3**		**Day 5**	**Day 7**	**Day 9**	**Day 11**	**Day 13**	**Day 15**	**Day 17**	**Day 19**	**Day 21**
A. vera	4	4	4	3	3	3	3	3	2	2	
Control	4	3	3	3	2	2	1	-	-	-	
LSD	NS	NS	NS	NS	NS	NS	1.0	2.0	NS	NS	

KEY: NS= No Significant difference where ($p>0.05$); LSD-least significant difference, 1=very poor, 2=poor, 3=acceptable, 4=good, 5=Excellent

Table 7: **Firmness of Orange fruit coated with *Psidium guajava* extract during storage**

Extracts/Day	**Day 3**		**Day 5**	**Day 7**	**Day 9**	**Day 11**	**Day 13**	**Day 15**	**Day 17**	**Day 19**	**Day 21**
Guava	4	4	3	3	3	3	2	2	2	1	
Control	4	4	3	3	2	2	1	1	1	1	
LSD	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	

KEY: NS= No Significant difference where ($p>0.05$); LSD-least significant difference, 1=very poor, 2=poor, 3=acceptable, 4=good, 5=Excellent

4. DISCUSSION

Aloe vera and guava leaf powder can possibly help to avert decomposition of orange caused by disease causing agents like fungi. This statement concurs with the documentation of [8] who pointed out that extracts from botanicals like *Allium sativum* (cloves), neem leaves, *Mentha arvensis* (leaves) and *Psoralea corylifolia* were mostly potent in protecting crop plants from colonisation by biotic (fungi) and abiotic factors. It was discovered that *Aloe vera* gel and guava leaf powder had a significant effect in the extension of the storage life in relation to the control. The result of this study is in accordance with the findings of [9], who reported that treatment of orange fruits with *Aloe vera* gel significantly prolonged their shelf life. There was significant difference between the weight loss of the coated orange fruit and the uncoated orange fruits which showed the effectiveness of the coatings on the orange fruits. This significant difference was seen from Day 15 to day 21. Related studies were also documented to show that loss of weight of fruits increased as storage period progressed [10].

This study revealed that several fungi could be associated with decomposition of stored orange fruits and these fungi include *R. stolonifer, F. oxysporum* and *B. theobromae*; and were formerly documented as pathogens of fruits by [11] in which *Aspergillus niger* and *Fusarium* spp. were isolated from decaying tomato fruits. These results clearly established that these disease causing organisms are widely present regardless of geographical area and invariably exert decay in fruits such as orange.

5. CONCLUSION

From the findings of this study, the results show that *Psidium guajava* leaf powder and *Aloe vera* gel are capable of prolonging the storage life and appearance of the orange fruits. This has increased the awareness on the use of plant

leaves as a biocontrol method of postharvest preservation of fruits instead of using synthetic compounds which might have adverse effects on human health.

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