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Extending Shelf Life Of Citrus Tangerina L. (Tangerine) Fruits Using Zingiber Officinale Rosc. And Psidium Guajava L. Leaf Extracts

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***Abstract:** Citrus tangerina is one of the most important fruits in the Citrus family. However, its highly perishable nature limits its postharvest life. Thus, this study aimed at determining the effects of Zingiber officinale extract and Psidium guajava leaf extract on the shelf life of tangerine fruit in storage. P. guajava leaf and Z. officinale were collected and the two plant materials were blended to fine powdered extract. This was then used to coat the body of the tangerine respectively. The postharvest decay, firmness and shelf life of the coated and uncoated samples were determined throughout the duration of the experiment. Fungi associated with the decay of the tangerines were isolated using Potato Dextrose Agar (PDA) and Malt Extract Agar (MEA). The direct plating method was used. The samples treated with Z. officinale preserved the fruits for 15 days while the untreated lasted only for 9 days, the ones treated with P. guajava preserved it for 18 days. Four fungi were isolated from the decayed fruits namely; Alternaria alternata, Aspergillus flavus, A. niger and Penicillium notatum. The result obtained in this study showed that application of Z. officinale and P. guajava in coating tangerine fruits is effective in the extension of its shelf life.*

***Keywords:** Citrus tangerina, Postharvest decay, Psidium guajava, Shelf life, Zingiber officinale*

I. INTRODUCTION

Citrus tangerina L. is one of essential fruits in the citrus family. Fruits and vegetables have an important role in poverty alleviation, household nutrition, income enhancement, food security, and sustainability of agriculture (Auta *et al.*, 2011). Pathogens have been found to reduce the shelf life period of fruits thereby leading to reduction in their economic values. Postharvest losses in fruits have been described to range from 5 to 25 percent in developed countries and about 50 percent in developing countries. Principally, the losses are due to the activities of pathogenic fungi among other factors (Ewekeye et al., 2013). Preservation of food involves treatment and management of foodstuff to prevent or delay food wastage, loss of quality, edibility or nutritional value and thus allow for longer food storage for human consumption. Preservatives have been reported to enhance the lastingness of food by preserving the food from harmful consequences of microbial growth and intrinsic declension. Thus, preservatives target infective microorganisms and or spoilage microbes, thereby reducing their effects (Joseph and Priya, 2011). Lately, synthetic preserving agents are commonly utilised to lengthen the shelf life of food materials to meet the needs of users. Therefore, sustaining the fresh quality of fruits and controlling the growth of spoilage and pathogenic microbes is a challenging problem for fruit industries. However, loss of interest on chemically preserved fruits by consumers due to its toxicity and stimulated negative reaction on human wellbeing (Zaman *et al*., 2007, Mohammed *et al*., 2017) is of great concern. Also, extended use of a particular fungicide on fresh fruits and vegetables may result in the development of resistant fungal strains and reduce the effectiveness of fungicide against the organisms of interest (Ali *et al*., 2010, Magbool *et al*., 2011, Edirisinghe *et al*., 2014). Thus, there is need for more eco-friendly and active compounds of plant base.

Guava leaf extract contains compounds such as antioxidants which are used to reduce damage due to oxygen; that is, those caused by free radicals. Free radicals create a gap in the metabolic pathways leading to food spoilage, damaged cells and reduction in the quality of some materials (Cushnie and Lamb, 2011). The extract increases the storage life of fruits and vegetables by decreasing oxidation. Thus, preventing pathogenic spore germination of plant origin and consequently against fungal pathogens of man (Fernandes *et al*., 2014). *Zingiber officinale* is a flowering plant whose rhizome (ginger root) is widely used as a spice and folk medicine. Several works have reported that extracts of plant and compounds separated from ginger has potent antioxidant (Stoilova *et al.,* 2007), anti-bacterial, anti-fungal, anti-cancer and anti-inflammatory reactions (Habib *et al*., 2008). Therefore, the aim of this study was to determine the effects of *Zingiber officinale* extract and *Psidium guajava* leaf extract on the shelf life of tangerine fruit in storage.

II. MATERIALS AND METHODS

MATERIALS

Guava leaves, ginger, tangerine, Petri dishes, Potato dextrose agar (PDA) and Malt extract agar (MEA), microscope, spirit lamp, inoculating needle and ethanol.

EXTRACTION PROCESS

Guava leaves were obtained from LASU staff quarters and were taken to Botany lab, Lagos State University. The guava leaves were rinsed with distilled water and air dried for 5 days. Ginger was gotten from Obadore market and was peeled, after peeling it was washed with distilled water and later sliced into tiny pieces. The ginger was left to air dry for 2 days and was also oven dried for 2 days. The dried guava leaves were blended with a Binatone blender to get the powdered form. The dried ginger was also blended to get the powder. The powder was then sieved several times to get a very smooth and fine powder. After this was done, the powders were kept in separate air tight plastic containers. The plants were identified and authenticated at the Department of Botany, Lagos State University, Ojo Lagos. Voucher specimens with reference numbers were deposited at the University Herbarium.

APPLICATION OF EXTRACTS

C. tangerina was obtained from Iyana-Iba market and were arranged on foil papers in three different sets. The first one was for the guava leaf powder extract, the second is for the ginger powder extract and the third was the control in which samples were not coated with any plant extracts. A total of 14 tangerine fruits were used. The guava leaf powder was mixed with distilled water to form a paste. The pastes were applied on the four samples of tangerine. This was also done for ginger. Tangerine fruits were set in plastic crates and maintained at room temperature and the pastes were applied on five samples of *Citrus tangerine*.

III. DATA COLLECTION

The following information was compiled:

POSTHARVEST DECAY PERCENTAGE (PDP): This was ascertained by visible assessment for samples showing decay in storage. Samples with symptoms of decay were numbered, documented and shown in %

$$PDP = \frac{\text{No. of decayed fruits}}{\text{Total no. of fruits}} \times 100$$

FIRMNESS: The firmness was evaluated using hand estimation and scoring range of 1-5. Where 1= extremely bad, 2= bad, 3= satisfactory, 4= fine and 5= splendid.

SHELF LIFE: This was assessed by taking note of the number of days the tangerine were still marketable. It was determined by the manifestation of deterioration (Monerzumma *et al.,* 2009). The weights of the *Citrus tangerina* fruits were taken at different days to check for the changes in the weights.

PREPARATION AND STERILIZATION OF MEDIA

Two different media were used namely: Potato Dextrose Agar (PDA) and Malt Extract Agar (MEA).

ISOLATION AND PURIFICATION OF FUNGI

The method for the isolation of fungi from the spoilt tangerine was direct plating method. The work bench was disinfected by swabbing with cotton wool soaked in absolute ethanol. The diseased *Citrus tangerina* was excised into tiny pieces using a sterile razor blade. The excised pieces were surface sterilized in 70% ethanol to remove contaminants and then rinsed in sterile distilled water. The pieces were blotted dry on a sterile filter paper. The tiny pieces were picked with a sterile inoculating needle into the media. The Petri dishes were incubated at room temperature 26-28^{0}C and observation of fungal growth was carried out after 72 hours. Repeated sub-culturing was done until pure cultures were obtained.

IDENTIFICATION OF FUNGI

Fungi were identified based on their cultural and morphological features. Microscopic identification of the isolates followed the description of Chukwura *et al.* (2010).

IV. RESULTS

Table 1 shows the change in the weight of the *C. tangerina* treated with ginger extract while Table 2 shows the weight of the *C. tangerina* treated with guava leaf extract and Table 3 is the change in weight of the control.

	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5
Initial	212.60	161.00	165.80	155.80	172.91
Day 1	212.40	160.53	165.10	154.72	172.80
Day 3	209.80	158.60	163.45	152.80	170.52
Day 5	199.52	154.30	161.80	150.30	167.70
Day 6	198.70	153.80	159.60	149.80	167.10
Day 8	188.40	147.70	155.82	143.50	164.65
Day 9	188.00	146.90	154.50	142.30	163.70
Day 12	170.50	131.20	139.90	129.70	159.50
Day 15	166.70	126.80	135.40	125.65	155.30
Day 18	162.38	122.45	131.80	121.33	150.90
Mean±SD	190.9±19.02	146.33±14.41	153.26±12.83	142.6±12.70	164.51±7.36

Table 1: Weight (g) of Citrus tangerina treated with Ginger extract

	Sample 1	Sample 2	Sample 3	Sample 4
Initial	142.40	158.80	182.60	195.80
Day 1	142.10	157.60	182.22	194.50
Day 3	140.70	156.20	180.73	192.60
Day 5	137.52	154.53	177.90	190.20
Day 6	136.70	154.20	176.70	189.70
Day 8	134.30	152.60	173.80	187.30
Day 9	133.60	151.80	172.50	186.90
Day 12	128.50	147.32	167.30	181.30
Day 15	124.20	142.70	162.70	176.40
Day 18	120.80	137.40	157.44	171.11
Mean±SD	134.1±7.46	151.32±6.86	173.39±8.53	186.6±8.02

Table 2: Weight (g) of Citrus tangerina treated with Guava leaf extract

	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5
Initial	142.50	166.00	158.40	172.40	182.30
Day 1	142.30	165.70	157.20	171.60	181.70
Day 3	139.70	162.44	154.72	169.20	178.50
Day 5	137.50	159.80	151.40	165.50	175.10
Day 6	136.47	158.20	150.80	164.30	174.80
Day 8	133.10	155.40	147.20	161.40	170.30
Day 9	132.70	154.70	146.80	160.60	169.80
Day 12	128.20	150.60	142.50	155.72	160.10
Day 15	124.60	147.30	138.30	150.40	156.20
Day 18	118.70	140.50	133.60	146.60	152.00
Mean ±SD	133.58±7.81	156.1±8.18	148.1±8.10	161.8±8.71	170.1±10.66

Table 3: Weight (g) of the control

POSTHARVEST DETERIORATION OF *CITRUS TANGERINA*

The postharvest deterioration of *C. tangerina* in storage depicted that there was considerable variation in tangerine fruit coated with *Zingiber officinale* and control fruits (Table 4) on days 5, 8, 9, 12 and 15 while *C. tangerina* coated with *Psidium guajava* showed high significance ($p < 0.05$) on all days except on day 3 (Table 5).

Extract	Day 3	Day 5	Day 8	Day 9	Day 12	Day 15	Day 18
Zingiber officinale	10.0	20.0	30.0	40.0	60.0	80.0	100.0
Control	20.0	40.0	50.0	80.0	90.0	100.0	100.0
LSD	NS	1.0	1.0	2.0	1.5	1.0	NS

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

Table 4: Postharvest decay percentage of Citrus tangerine fruit with Zingiber officinale extract during storage

Extract	Day 3	Day 5	Day 8	Day 9	Day 12	Day 15	Day 18
Psidium guajava	0	0	10.0	30.0	50.0	70.0	80.0
Control	10.0	40.0	60.0	70.0	90.0	100	100
LSD	NS	2.0	2.0	3.0	2.0	1.5	1.0

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

Table 5: Postharvest decay percentage of Citrus tangerina fruit with Psidium guajava leaf extract during storage

FIRMNESS OF CITRUS TANGERINA DURING STORAGE

Result for firmness of *C. tangerina* coated with *Z. officinale* revealed that there was no considerable variation (p>0.05) in (Table 6) in firmness amid treated and control fruits apart from days 5 and 12. On days 5 and 12, the treated fruits had a mark of 5 and 3 in that order while the control fruit on day 5 and 12 had a score of 3 and 1 respectively.

For the *P. guajava* leaf extract, there was no considerable variation (p>0.05) in (Table 7) in firmness within treated and control fruits excluding on days 5, 9 and 12.

Extract	Day 3	Day 5	Day 8	Day 9	Day 12	Day 15	Day 18
Zingiber officinale	5	5	4	3	3	1	-
Control	4	3	3	2	1	-	-
LSD	NS	1.0	NS	NS	1.0	NS	NS

KEY: NS= No considerable variation where (p>0.05), LSD= Least significant difference, 1= extremely bad, 2= bad, 3= satisfactory, 4= fine and 5= splendid

Table 6: Firmness of Citrus tangerina with Zingiber officinale extract during storage

Extract	Day 3	Day 5	Day 8	Day 9	Day 12	Day 15	Day 18
Psidium guajava	5	5	4	4	3	2	1
Control	5	3	3	2	1	1	-
LSD	NS	1.0	NS	1.0	1.0	NS	NS

KEY: NS= No considerable variation where (p>0.05), LSD= Least significant difference, 1= extremely bad, 2= bad, 3= satisfactory, 4= fine and 5= splendid

Table 7: Firmness of Citrus tangerina with extract during storage Psidium guajava leaf extract during storage

SHELF LIFE OF *CITRUS TANGERINA* FRUITS DURING STORAGE

Results obtained revealed that tangerine fruits coated with *Z. officinale* had a higher shelf life of 15 days compared with 9 days for control fruits. For tangerine coated with *P. guajava* powder extract, a higher shelf life of 18 days compared with 9 days for control fruits were observed.

FUNGI ISOLATED FROM *CITRUS TANGERINA* SAMPLES IN STORAGE

The fungi isolated were *Alternaria alternata*, *Aspergillus flavus*, *A. niger* and *Penicillium notatum*.

V. DISCUSSION

The decrease in the decayed percentage of *C. tangerina* treated with *Z. officinale* and *P. guajava* leaf powder is a sign that both extract can serve as optional preventive sources of Tangerine against pathogens. Out of the two extracts used, *Zingiber officinale* have higher decay compared to *P. guajava*. The outcome of this research conforms to the work of Islam *et al.* (2018) which reported that treating various kind fruits with chitosan and guava leaf extract significantly increased the shelf life of the fruits. Also, this finding agrees with the report of Raheja and Thakore (2002) who noted that extracts obtained from plants such as neem leaves, garlic, wild mint leaves and babchi leaves were observed to be highly effective in reducing fruit deterioration from pathogenic and environmental factors.

The tangerines treated with *Psidium guajava* leaf extract showed low postharvest rot. Thus, the quantity of rotten fruits observed in treated and control were highly significant. The control fruits were fully decayed on day 9 while the treated fruits remained intact before finally being rotten on day 18. *P. guajava* has shown to prevent loss of firmness, oxidative browning and reduce proliferation of micro-organisms in banana, tomato and carambola. There was progressive weight loss in tangerine coated with *P. guajava* and *Z. officinale* and control during the period of the research and this agrees with the findings of Hiru *et al.* (2008) and Meseret *et al.* (2012), when they reported that the loss of weights in fruits increases as the storage period advanced. More so, this study showed that some fungi are associated with postharvest decay of stored *C. tangerina* fruits. These fungi include *Penicillium notatum*, *Aspergillus niger*, *A. flavus* and *Alternaria alternata.* Thus, similar organisms have been described earlier as pathogens of fruits by Bukar *et al*. (2009) who isolated and identified *Aspergillus* sp, *Mucor* sp, *Penicillium* sp, *Rhizopus* sp, *Fusarium* sp and *Alternaria* sp. from decayed orange fruits.

VI. CONCLUSION

The results obtained from this study showed that *Z. officinale* and *P. guajava* leaf extract extended the shelf life of tangerine fruits. This study has greatly proven to be an important source of information on the usage of plant extracts in the prevention of postharvest rots and general preservation of fruits.

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