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Enhancing the shelf life of tomato fruits using plant material during storage

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ABSTRACT

Purpose: Postharvest losses of fruits and vegetables are major problem for countries that agriculture is one of the source economy and that losses in tomato have reported from 20 to 50%. It is one of the very perishable fruit and it changes continuously after harvesting. The aim was to evaluate the effect of guava (*Psidium guajava*) and physic nut (*Jatropha curcas*) leaf extract on fresh ripe tomato fruits. **Research method:** Two tomato varieties obtained (UTC and Tandilo) from Gombe Main Market and were then treated with aqueous and ethanolic extract of *Psidium guajava* and *Jatropha curcas* leaves to extend their shelf life and maintain the quality of tomato fruits during storage. The experiment was laid out using completely randomized block design, (CRBD). Number of days to deterioration was recorded on visual eating quality. The recorded data were analyzed using analysis of variance. **Findings:** Ethanolic extracts of *P. guajava* and *J. curcas* was highly effective on UTC variety. The postharvest decay that was the main quality factor in this experiment significantly reduced in Tandilo and UTC tomato fruits after using 2.5g/1000ml ethanolic J. curcas leaves extract by 24 and 25 days respectively; and 22 and 23 days after using 2.5g/1000ml ethanolic P. guajava leaves extract. **Limitations:** No limitations were founded. **Originality/Value:** These findings indicate that application of leaves extracts proved to be effective in extending the shelf life of test tomato fruits.

INTRODUCTION

Tomato (*Solanum lycopersicum* L.) is one of the most widely cultivated and extensively consumed horticultural crop (Abrar et al., 2016). In Nigeria, is one of the most important vegetable fruit grown for consumption in every home, consumed both fresh and in paste form and a cheap source of vitamin A, C, E and minerals which protect the body against diseases, Babatola et al. (2008) and Hosea et al. (2017). Tomato and tomato base products are believed to be healthy food owing to its low calories, cholesterol-free and good fiber source (Zamora et al., 2005). Tomato is believed to be an important functional food in preventing and curing malignant diseases like prostate cancer, breast cancer (Canene-Adams et al., 2005), lungs cancer (Feskanich et al., 2000) and other diseases like cataracts, heart disease (Rao & Rao, 2007), diabetes, hyperglycemia (Subash et al., 2007), inflammation, arthritis, immune system decline, brain dysfunction (Petr & Erdman, 2005), and maintenance of body homeostasis (Kennedy et al., 2006).

The storage and preservation of tomato is vital to the economy of homes, farmers and country considering the important role played by tomato in health and food security (Irokanula, et al., 2015). Deterioration of fresh tomato fruits can results from physiological breakdown due to ripening process, loss of water, injury, temperature or microorganism invasion (Babatola, et al., 2008). Postharvest losses of fresh fruits and vegetable including tomatoes are estimated to be 20-25% in developing countries (Neeta et al., 2010).

Due to high perishable nature of tomato fruits, many of them rot before they reached various areas of country where they are not cultivated and demand is high. Owing to the lack of knowledge on postharvest handling, packing and preservation, the fruits lose their quality (Ahmed & Tariq, 2014). This result in quantitative and nutritional losses to farmers, consumers as well as rural and urban dwellers far from areas of production who have to pay more to get them (Ejale & Abdullah, 2004). Commercially, preservation of vegetable products is difficult in the tropics because of poor transportation networks and high environmental temperatures that favor decay rather than storage. Many synthetics have been used to preserve tomato fruits but consumers are becoming very concerned on the use of synthetics on horticultural crops like tomatoes. The use of plant materials as preservatives apart from extending shelf life of foods, are less toxic to humans and animals than synthetic preservatives. These attributes of plant in preservation of food enhances the economic value of such foods (Irokanula et al., 2015). Attempt has been made to investigate on the use of plants as bio-preservatives, which are multipurpose, cheap, easy to use and have tremendous uses as food and medicine. This study seeks to investigate the preservative activities of *Psidium guajava* and *Jatropha curcas* leaves extract on postharvest shelf life and quality of tomato fruits.

MATERIALS AND METHODS

Collection of tomato fruits and plant materials

Two fresh tomato fruits varieties, Tandilo and UTC, were collected from Gombe Main Market and used in the study. Collected tomato fruits were transported to the Department of Biological Sciences Laboratory, Gombe State University for treatment and observation. Leaves of *P. guajava* and *J. curcas* were collected from the University Botanical Garden, transported to the laboratory and cleaned, air dried and grounded into powder.

Preparation of plant extract

Powdered leaves of *P. guajava* and *J. curcas* (50 g) each was dissolved in 500 ml of ethanol and distilled water in a 1 liter capacity flask (Olamifin, 2002). Flasks were allowed to stand for 7 days and shaken at regular intervals. The solutions were filtered using filter paper. Filtrates were evaporated in water bath to obtain the extracts.

Preparation of aqueous and ethanolic extracts concentration

Ethanolic and aqueous extracts (0.5g in 1000 ml and 2.5g in 1000ml respectively) were prepared as explained by Adoum et al. (1997). The solutions of extracts were kept in refrigerator for daily use.

Qualitative analysis of plant materials

Phytochemical screening of bioactive constituents on extracts (aqueous and ethanol) was carried out as explained by Akponah et al. (2013).

Shelf life determination of tomato fruits

The experiment was laid in complete randomize block design with nine treatment and ten replication each. Fresh, ripe, firm and smooth tomato fruits were grouped into nine, each group containing ten (10) tomato fruits, first and second group were surface washed daily with 0.5g.ml^{-1} aqueous extract of *P. guajava* and *J. curcas* respectively, third and fourth group with 2.5g.ml^{-1} aqueous extract of *P. guajava* and *J. curcas* respectively, fifth with ethanolic extract of *P. guajava* (0.5g.ml^{-1}) concentration, sixth group with ethanolic extract of *P. guajava* (2.5g.ml^{-1}) concentration, group seven with ethanolic extract of *J. curcas* (0.5g.ml^{-1}) concentration, group eight with ethanolic extract of *J. curcas* (2.5g.ml^{-1}) concentration and the ninth group with distilled water for 3 minutes respectively. Each group was allowed to dry and kept in cup board for shelf life determination. Tomato fruits were recorded spoilt or deteriorated on rating of 4 (excellent), 3 (good), 2 (fair), 1 (poor) and 0 (very poor) (Mustapha et al., 2005).

Statistical analysis

The result of preservative effect of guava and jatropha leaves extracts on tomato fruits was analyzed using Analysis of Variance (ANOVA) at 5% level of significance.

RESULTS

Phytochemical constituents of leaves extract of *P. guajava* and *J. curcas*

The result for phytochemical screening is presented in Table 1. The result showed that alkaloids, tannins, steroid, were presents in ethanolic extracts of *P. guajava* while saponins, flavonoids, glycoside and phenols are absent. Aqueous extracts of *P. guajava* shows that alkaloids, tannins, saponins and steroids are presents while flavonoids, glycosides and phenols are absent. Alkaloids, tannins, saponins, flavonoids and steroids were present in both ethanolic and aqueous extracts of *J. curcas* leaves while glycosides, phenols are absent in both ethanolic and aqueous extracts of *J. curcas* leaves.

Shelf life determination of tomato fruits

The result showed that Tandilo and UTC variety recorded 14 and 15days respectively after treatment with 0.5g.1000ml^{-1} aqueous extracts of *P. guajava* leaves, while Tandilo and UTC variety recorded 18 and 20days respectively after treatment with 0.5g.1000ml^{-1} ethanolic extract of *P. guajava* (Fig. 1).

Table 1. Phytochemical constituents of *P. guajava* and *J. curcas* Leaves

	Ethanolic extract		Aqueous extract	
	P. guajava	*J. curcas*	*P. guajava*	*J. curcas*
Alkaloids	+	+	++	+
Tannins	++	++	++	+++
Saponins	++	+	+++	++
Flavonoids	+	-	-	+
Steroids	++	+++	++	++
Glycosides	-	-	-	-
Phenols	-	-	-	-

Key: +++ = Abundantly present; ++ = strongly present; + = Present; - = absent.

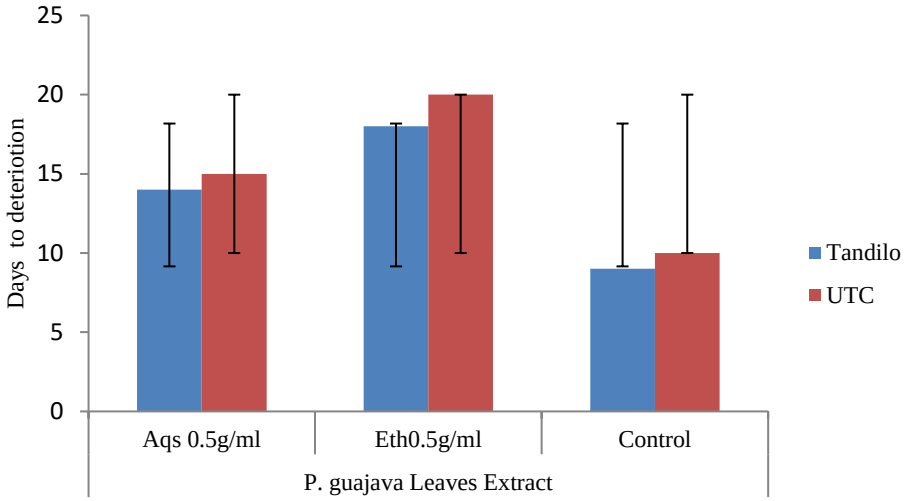

Fig. 1. Effect of P. guajava extract (0.5 g/ml) on shelf life of tomato fruits.

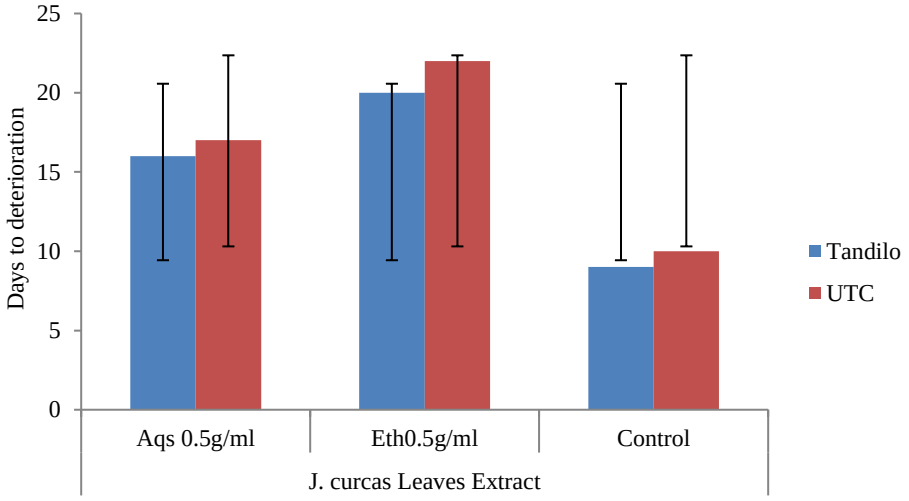

Fig. 2. Effect of J. curcas extract (0.5 g/ml) on shelf life of tomato fruits.

Tandilo and UTC variety recorded 16 and 17days respectively after treatment with 0.5g/1000 ml aqueous extract of *J. curcas* leaves, while after treatment with 0.5g.1000 ml^{-1} ethanolic extract of *J. curcas* leaves, Tandilo and UTC variety recorded 20 and 22 days respectively (Fig. 2). After treatment with 2.5g.1000ml^{-1} aqueous extract of *P. guajava*, Tandilo and UTC variety recorded 18 and 20 days respectively while, Tandilo and UTC variety recorded 22 and 23 days respectively after treatment with 2.5g.1000ml^{-1} ethanolic

extract of *P. guajava* leaves (Fig. 3). At 2.5g.1000ml^{-1} aqueous extract of *J. curcas*, Tandilo and UTC recorded 19 and 22 days while after treatment with 2.5g.1000ml^{-1} ethanolic extract of *J. curcas*, Tandilo and UTC recorded 24 and 25 days respectively. Control Tandilo recorded 9days and UTC recorded 10 days (Fig. 4).

DISCUSSION

The phytochemical analysis of *P. guajava* aqueous and ethanolic leaf extract showed presence of alkaloids, saponins, tannins, flavonoids, and steroids. Bansode and Chavan (2014), confirmed the presence of flavonoids, tannins, phenols and terpenoid in their work of screening for screening of guava for effective phyto-medicines and study on its antimicrobial effect against selected enteric pathogens. Also, Okunrobo et al. (2010) and Lincy et al. (2016) reported that *P. guajava* leaves contains secondary metabolites which include alkaloids, saponins, flavonoids, glycosides, anthraquinones, vitamins, reducing sugar, tannins, terpenoids, carbohydrates and amino acids.

Qualitative analysis of secondary metabolites in *J. curcas* leaf was confirmed in this study. Nwokocha et al. (2011) reported the presence of alkaloids, tannins, saponins, flavonoids and phenols in all parts of *J. curcas* plant. Present study confirmed the presence of metabolites with the exception of phenols and flavonoids in aqueous extracts. Also, tannins were found to be abundantly present. Qasim et al. (2017) also stated that secondary metabolites were present in different quantities in leaf of *J. curcas* when extracted using different solvent.

The surface washing of tomatoes with aqueous extract of *P. guajava* and *J. curcas* leaves at different concentration has enhanced shelf life and decreases deterioration of tomato varieties. This maybe as a result of bioactive component (alkaloids, tannins, saponins and steroids) present in the leaf extracts. Also, factors that aided in increasing the shelf life of tomatoes treated with aqueous extract is the treatment time and method employed in applying the extracts. This agrees with Bukar and Magashi (2013), who reported preservative activities of aqueous suspension of *Balanites aegyptiaca*, *Guiera senegalensis* and *Parkia biglobosa* leaves on tomatoes, oranges and pepper. They also reported that duration of treatment and vehicle used in treatment application of extract help in extending shelf life.

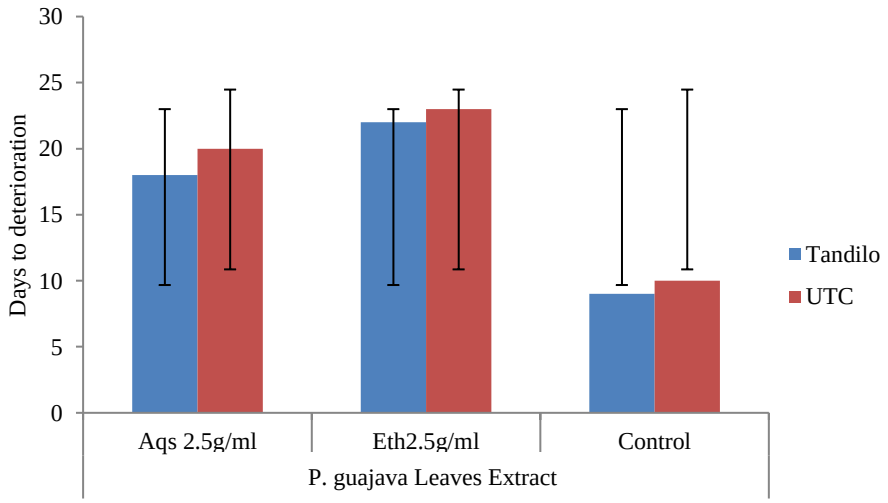

Fig. 3. Effect of P. guajava extract (2.5 g/ml) on shelf life of tomato fruits.

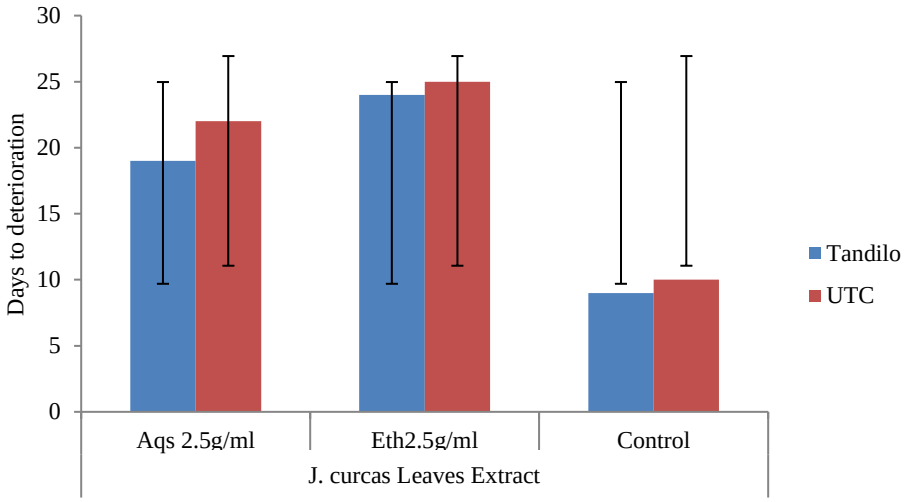

Fig. 4. Effect of plant extract (2.5 g/ml) on shelf life of tomato fruits.

Significant control of deterioration and shelf life enhancement of tomato varieties was observed in ethanolic extract of *P. guajava* and *J. curcas* at different concentration. This shows that tomatoes on retail can be preserved for up to 25 days while still maintaining firmness, flavor and texture. Irokanulo et al. (2015), reported similar result that tomatoes can be stored up to 30 days when covered with leaf and stem bark powder of *Moringa oleifera* and still remain fresh; and Jaiswal et al. (2018), that Aloe vera gel formulation has the ability to extend the shelf life of tomatoes to 30 days.

Sedighe et al. (2014) and Safiyaa et al. (2016) found a high record of deterioration and lowest shelf life in control treatment. Same result was observed in present study. Control treatment deteriorated at 9 and 10 days for Tandilo and UTC varieties respectively. Same result was observed by Bukar and Magashi (2013); but different from Hosea et al. (2017) who reported 19 days.

Extract application at $0.5g.1000ml^{-1}$ and $2.5g.1000ml^{-1}$ prove to be effective in increasing shelf life and decreasing rate of deterioration on tomatoes, because it can act as a barrier to oxygen and moisture which can speed up deterioration rate. This is because leaf extracts of *P. guajava* and *J. curcas* contains various compounds that can delay or inhibit microorganisms that are responsible for food born diseases in humans potentially. Jaiswal et al. (2018), reports same result in his work for development of Aloe vera based edible coating for tomato.

Surface washing of tomatoes not only prevents spoilage and increase shelf life and marketability, but also prevents fungal attack. Raheja and Thakore (2002) reported same results that extract from medicinal plants like *Alium sativum, Azadirachta indica, Mentha arvensis* and *Psoralea corylifolia* were found to be effective in preserving fruits from attack by pathogenic and environmental factors. Singh et al. (1999) also stated that, plants extracts are an alternative to commercial fungicides in preservation of plants products.

Among tomato varieties, UTC had the highest shelf life, this in an indication that UTC variety can withstands biotic and abiotic challenges better than Tandilo. Hosea et al. (2017) reported same result. Treatments of tomato varieties through aqueous and ethanolic extract of *P. guajava* and *J. curcas* leaves can serve in decreasing deterioration rate and increase shelf life of tomatoes as well as eliminating or reducing pathogenic and food spoilage microorganisms and enhancing food safety.

CONCLUSION

Understanding the postharvest treatment that could be a pesticide free method to reduce plant pathogens, control insect infestation and maintain fruit quality is important. Ultimately, the uses of plant materials as food preservatives apart from extending shelf life of foods are less toxic to humans and animals than synthetic or chemical preservatives. These attributes of plant materials in food preservation enhance the economic value of such foods. The present result obtained shows that extracts of *P. guajava* and *J. curcas* were able to extend shelf life and quality of tomato. This provides information on the use of plant leaves extract in postharvest preservation of fruits.

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Conflict of interest
There is no conflict of interest between the authors.

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