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Post-harvest storage of fresh Chayote (*Sechium edule*) under preservation condition

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Chayote (*Sechiumedule*) fruit has various pharmacological and medicinal properties. However, it's highly perishable under ambient condition. This study was aimed to examine postharvest senescence of fresh chayote (*Sechiumedule*). It was primarily washed in peracetic acid in various concentrations (20, 30, 40, 50 ppm) and stored in linear low-density polyethylene (LLDPE) bag in different preservation temperature (4^{o}C, 12^{o}C, 20^{o}C, 28^{o}C). Physico-chemical and organoleptic characteristics of chayote (*Sechiumedule*) fruit during 8 days preservation were observed for postharvest manipulation. Weight loss (%), firmness (N), reducing sugar (g/L), total acidity (%), total phenolic (mg GAE/100g), flavonoid (mg GE/100g) content and overall acceptance (sensory score) were highly affected by accelerated storage temperature. Chayote (*Sechiumedule*) which was primarily sanitized in 40 ppm peracetic acid in 2 minutes, kept in LLDPE bag at 12^{o}C up to 8 days still maintained its major quality attributes. Through peracetic washing and packaging in linear low-density polyethylene bag, the shelf-life of chayote (*Sechiumedule*) fruit could be prolonged in commercial distribution. From that, the added value of this agricultural crop would be enhanced; local farmers had more chance to increase their profit in its cultivation.

Keywords: Chayote, peracetic acid, LLDPE, physico-chemical, organoleptic, storage

INTRODUCTION

Chayote (*Sechiumedule*) fruit is a member of the Cucurbitaceae family. There were different forms, colors, sizes, and flavors of the *S. edule* fruit (Avendano et al., 2012). The neutral flavor and softness of chayote fruit make it particularly suitable for culinary purposes. Chayote is utilized as ingredient for children to formulate purees, juices, sauces, pasta dishes, and jams (Gajar and Badrie, 2001; Cadenalñiguez and Arévalo Galarza, 2011). The major phytochemical components of *S. edule* extract have been proven as peroxidases, alkaloids, flavonoids, phenols, polyphenols, saponins, steroids, triterpenes, and tannins (Ibarra-Alvarado et al., 2010; Firdous et al., 2012; Noumedem et al., 2013; Lombardo-Earl et al., 2014; Chao et al., 2014). The immature fruit contains high levels of folate, vitamins like vitamins C and E, minerals like iron, calcium, potassium and phosphorus. It's beneficial to prevent health risks related to diabetes, obesity, diuretic, hypertension, inflammation, tumor, hepato, coronary etc (Dire et al., 2007; Yang et al., 2015; CadenaIniguez et al., 2007; Ibarra Alvarado et al., 2010; Lombardo-Earl et al., 2014). These benefits may be associated with its potential antioxidant activity (Firdous et al., 2012). Chayote (*Sechiumedule*) has a high respiration rate. It's quickly shrivelled and degraded in poor storage condition. It's necessary to have proper preservation method to extend its stability for consumption. Objective of our study focused on various parameters of peracetic acid concentration as primary treatment and storage

temperature in linear low-density polyethylene bag to the physico-chemical and organoleptic attributes of chayote (*Sechiumedule*) fruit.

MATERIALS AND METHODS

Material

Chayote (*Sechiumedule*) fruits were collected in the North of Vietnam. After collecting, they must be kept in dry cool box and quickly conveyed to laboratory for experiments. They were subjected to washing, packaging and preserving. Chemical substances such as Folin-Ciocalteureageant, Na_2CO_3, NaOH, Gallic acid etc were all supplied from Rainbow Trading Co. Ltd. Linear low-density polyethylene bag was purchased from local market.

Researching method

Chayote (*Sechiumedule*) fruits were sanitized by peracetic acid for 2 minutes in different concentrations (20, 30, 40, 50 ppm). Then they were drained for 15 minutes before packing in LLDPE bag. They were preserved in different temperature (4, 12, 20, 28 ^oC) for 8 days. At the end of preservation peroid, they were sampled to measure weight loss (%), firmness (N), reducing sugar (g/L), total acidity (%), total phenolic (mg GAE/100g), flavonoid (mg GE/100g) content and overall acceptance (sensory score).

Physico-chemical, sensory and statistical analysis

Weight loss (%) was measured with precision balance. The firmness (N) of chayote fruit was measured using a texture analyzer. Reducing sugar (g/L) was determined using a colorimetric method by UV/Vis Spectrophotometer. Total acidity (%) was measured using titration method. Total phenolic content (mg GAE/g) was evaluated using Folin–Ciocalteu assay (Nizar et al., 2014). Total flavonoid content (mg GE/g) was avaluated by the aluminium calorimetric method (Formagio et al., 2015). Sensory score was estimated by a group of panelists using 9-point Hedonic scale. The experiments were run in triplicate with three different lots of samples. Statistical analysis was performed by the Statgraphics Centurion XVI.

RESULTSAND DISCUSSION

Effectiveness of peracetic concentration to physico-chemical and organoleptic attributes of chayote fruit

Peroxy acetic acid or PAA ($C_2H_4O_3$) is an aqueous mixture of acetic acid and hydrogen peroxide. It is emerging as better alternative to the chlorine sanitizers. Peroxy acetic acid disinfects by oxidizing of the outer cell membrane of vegetative bacterial cells, endospores, yeast and mold spores. It works by focusing on the cell wall and cell membrane and oxidizing the H-S and S-S bonds in the cell's enzyme. Microbes are then unable to function and die (Gawande H M et al., 2013). It has been proven to be useful in removing biofilms. PAA has been considered as a powerful oxidant capable of producing water quality advantages comparable to those expected with ozone application (John Davidson et al., 2018). Peroxyacetic acid decomposes rapidly, remains minimal residue and changes to relatively harmless naturally-occurring substances (Evans, 2000). In our study, the chayote fruits were sanitized in peracetic acid (20, 30, 40, 50 ppm) for 2 minutes. Then they were packed in LLDPE bag and stored at 28^oC for 8 days. Based on physico-chemical and sensory indicators, the appropriate peracetic acid concentration was noticed at 40 ppm (table 1). So this value was selected for further experiment.

Effectiveness of storage temperature to physico-chemical and organoleptic attributes of chayote fruit

The chayote fruit has a relatively high caloric content. The immature chayote fruit also has huge amount of vitamins, phenolics, flavonoids as excellent free radical scavengers with an antioxidant activity (Al-Abd et al., 2015). In our experiment, the chayote fruits were sanitized in peracetic acid 40 ppm for 2 minutes. Then they were packed in LLDPE bag and stored at different temperature (4, 12, 20, 28^oC) for 8 days. Based on physico-chemical and sensory indicators, the appropriate storage temperature was noticed at 12^oC (table 2). The shrivelled appearance owing to weight loss detracts from the utility, appeal and salability of the fruits. Suitable packaging material could minimize condensation within the package (Kleinhenz et al., 2000). Wrapping the fruit in a commercial grade polyvinyl chloride film significantly limited weight loss. The best storage of fruits was achieved with PVC film wrap at 10°C. Firmness of the fruit remained relatively unaffected by storage at 10°C–25°C (Aung et al., 1996).

Table 1: Effect of peracetic acid concentration (ppm) to quality of chayote fruit after 8 days of preservation

Peracetic acid concentration (ppm)	20	30	40	50
Weight loss (%),	4.65±0.01^{a}	4.57±0.00^{ab}	4.42±0.03^{b}	4.40±0.02^{b}
Firmness (N)	6.13±0.00^{b}	6.21±0.02^{ab}	6.34±0.00^{a}	6.35±0.03^{a}
Reducing sugar (g/L)	32.79±0.01^{b}	33.65±0.01^{ab}	34.81±0.01^{a}	34.90±0.02^{a}
Total acidity (%)	0.11±0.02^{a}	0.10±0.03^{a}	0.10±0.03^{a}	0.09±0.00^{a}
Total phenolic (mg GAE/100g)	43.07±0.01^{b}	44.15±0.02^{ab}	45.74±0.01^{a}	45.80±0.03^{a}
Flavonoid (mg GE/100g)	13.58±0.03^{b}	14.12±0.00^{ab}	15.01±0.02^{a}	15.04±0.01^{a}
Overall acceptance (sensory score)	6.32±0.02^{c}	7.84±0.01^{b}	8.25±0.00^{a}	8.06±0.03^{ab}

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant (α = 5%).

Table 2: Effect of storage temperature (ºC) to quality of chayote fruit after 8 days of preservation

Storage temperature (ºC)	4	12	20	28
Weight loss (%),	7.69±0.00^{a}	3.13±0.01^{c}	3.68±0.02^{bc}	4.42±0.03^{b}
Firmness (N)	4.06±0.03^{c}	7.13±0.02^{a}	6.85±0.01^{ab}	6.34±0.00^{b}
Reducing sugar (g/L),	29.53±0.02^{c}	35.97±0.03^{a}	35.19±0.00^{ab}	34.81±0.01^{b}
Total acidity (%)	0.04±0.01^{c}	0.13±0.00^{a}	0.11±0.01^{ab}	0.10±0.03^{b}
Total phenolic (mg GAE/100g)	40.06±0.00^{c}	47.19±0.03^{a}	46.52±0.02^{ab}	45.74±0.01^{b}
Flavonoid (mg GE/100g)	13.05±0.03^{c}	15.77±0.01^{a}	15.48±0.00^{ab}	15.01±0.02^{b}
Overall acceptance (sensory score)	7.32±0.01^{c}	8.65±0.02^{a}	8.46±0.03^{ab}	8.25±0.00^{b}

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant (α = 5%).

CONCLUSION

Chayote (*Sechiumedule*) fruit is an important source of various bioactive compounds with important pharmacological activities and health benefits. In this research, we have successfully examined the efficacy of primary sanitization, storage temperature to the physico-chemical and organoleptic characteristics of chayote (*Sechiumedule*) fruit during 8 days preservation. Major quality indicators were in acceptable levels by washing in peracetic acid 40 ppm in 2 minutes, packing in LLDPE bag and preserving at 12ºC. These findings will give valuable information for farmers to store their horticultural crop for long extension during handling and distribution in commerce.

CONFLICT OF INTEREST

The authors declared that present study was performed in absence of any conflict of interest.

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AUTHOR CONTRIBUTIONS

Minh Phuoc Nguyen arranged the experiments and also wrote the manuscript.

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