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# APPLICATION OF ASCORBIC ACID IN MAINTENANCE OF MINIMALLY PROCESSED PRODUCT QUALITY OF JACKFRUIT (*ARTOCARPUS HETEROPHYLLUS*)

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## Abstract

Physiochemical changes of minimal processing of jackfruit (*Artocarpus heterophyllus* Lam.) were studied by treating with different concentration of ascorbic acid (AA) and stored at different storage temperatures. Result showed that there were significant differences in fresh weight, firmness, ascorbic acid content, titratable acidity (TA), and soluble solid content (SSC), during increasing period of storage in both ambient and cold storage of minimal processed jackfruit. Treatment of different concentration of AA showed significant in fruit firmness, pulp fresh weight and AA content of minimal processed jackfruit kept under ambient temperature. Minimal processed jackfruit keeps under ambient storage exhibit greater fruit weight loss and softening as compared with cold storage. However, the AA content of minimal processed jackfruit increased in ambient storage and it was greater after one day treatment than cold storage fruit.

## Introduction

Jackfruit (*Artocarpus heterophyllus* Lam.) belongs to Moraceae family and usually distributed in Southeast Asia and found occasionally in Pacific island (Elevitch and Manner 2006). Jackfruit is an important tropical fruit in India, Bangladesh, Sri Lanka, southern China, Southeast Asian countries (Saxena *et al.* 2011).

Jackfruit bulbs have unique flavour and sweet taste. In order to experience their rich taste, consumers are enjoying the fruit by eating freshly without addition of any preservative. It has high nutritional value because of their fibre, protein and vitamin C content when eaten fresh. It also can be transformed to any product for instances dessert, sauces, juices and other food products like chips by using vacuum techniques. Products of minimal processing of jackfruits receiving high demand from consumers as the size is big and difficult to remove the bulb.

Fresh cut or minimal processed fruit has experienced rapid growth and is one of the industries that have been successful in food processing. As human society progress, health consciousness is becoming increasingly important. People are gaining awareness of what they eat and how it affects their health (Senauer 2001). As such, vegetables and fruits are becoming a major part of their daily diet, providing nutrients and fibres. Vegetables and fruits are known to play a preventive role to some of chronic disease such as cancer, heart disease and stroke (van Duyn and Pivonka 2000).

Minimally processed products have a shorter life compare to uncut vegetable or fruits. Especially on fruits where have tendency of getting damage as the fruits cannot be kept for a long time and it tends to get browning and become soften. So, to avoid the fruits from damage and getting browning, many treatments can be used such as organic acid, non-organic salt, modified atmosphere storage and others (Gil *et al*. 1998, Alvindia *et al*. 2004, Arias *et al*. 2007).

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Previous studies have found that application of ascorbic acid (AA) enhance the improvement of quality of fruits and vegetables because of prevention of browning and oxidation reaction (Bauernfeind and Pinlcert 1970). Cold storage is one of the postharvest practices to make sure the quality of horticulture products. The physiological changes like respiration also depend on the temperature effects. The objective of this study was to investigate the physio-chemical changes of minimal processing of jackfruit treated with AA and stored at different storage temperature.

**Materials and Methods**

The study was conducted at Laboratory of Plant Physiology, Department of Crop Science, Faculty of Agriculture, Universiti Putra Malaysia. Jackfruit (*Artocarpus heterophyllus* Lam.) variety CJ3 at green maturity stage was obtained from commercial grower in Rawang, Selangor. The whole fruit was cut into half vertically and the pulp as sample material is removed for further study. Fleshy pulps which have uniform in size, free from any infection pest or disease as well as physical damage is choosen for further treatment. The peel fruits were dipped into different concentration of ascorbic acid (AA) with 0, 1, 2 and 3% for 5 minutes at ambient temperature. After treatments, the peel fruits were dried and placed in polystyrene plates with proper plastic sealed. Each plate contained three replications (three treated pulps per replication) and was stored at ambient temperature (21±1ºC) or cold storage. The experiments were arranged in a completely randomized design (CRD).

Fruit quality parameter like fresh weight, fleshy firmness, soluble solid content (SSC), titratable acidity (TA), and ascorbic acid were recorded throughout the experimental study. The change of fruit quality was determined since day 0 on both ambient and cold storage of treated jackfruit peel. All parameters for treated jackfruit stored under ambient temperature were collected for 2 day of ripening. However, treated jackfruit stored under cold storage temperature were collected every 2 days interval till day 8 of ripening.

The experimental data were analyzed by ANOVA using SAS release 9.3 (SAS Institute Inc., Cary, North Carolina, USA). LSD were calculated following a significant ($p \leq 0.05$) F-test.

**Results and Discussion**

The results showed there were significant difference among the treatment of AA concentration in regulating fresh weight in both ambient and cold storage temperature. However, the interaction between treatment and storage period were not significantly affected the fresh weight of minimal processed jackfruit stored in both ambient and cold storage (Fig. 1A and B).

Previous study showed weight loss was affected by storage temperature. According to Thanh and Acedo (2006) temperature higher than 20°C would increase respiration rate and resulted to water loss to the surrounding which results reduction in weight loss. Additionally, Rab *et al.* (2010) also found the increasing period of storage will give water loss in sweet orange.

Analysis of variance indicated that differences on AA concentration significantly affected the firmness of the minimal processed jackfruit in both ambient and cold storage (Fig. 2B). Loss of fruit firmness over the storage time is influenced by increases of enzymatic hydrolysis of cell wall components (Watada *et al*. 1990). Fruit cell walls consist of pectin, hemicellulose, and cellulose polysaccharide polymers (Owino *et al*. 2004) and rapid softening and deterioration of minimal process or fresh-cut fruit has been attributed to hydrolytic enzymes which is associated with degrading activity of cell wall enzyme on these components which accelerated the senescence of fresh-cut fruit (Karakurt and Hubber 2003). Fruit firmness losses are generally related with high polygalacturonase (PG) and pectin methylesterase (PME) activity is increased during storage (Mohammad Ali *et al*. 2011, Chuni *et al*. 2010).

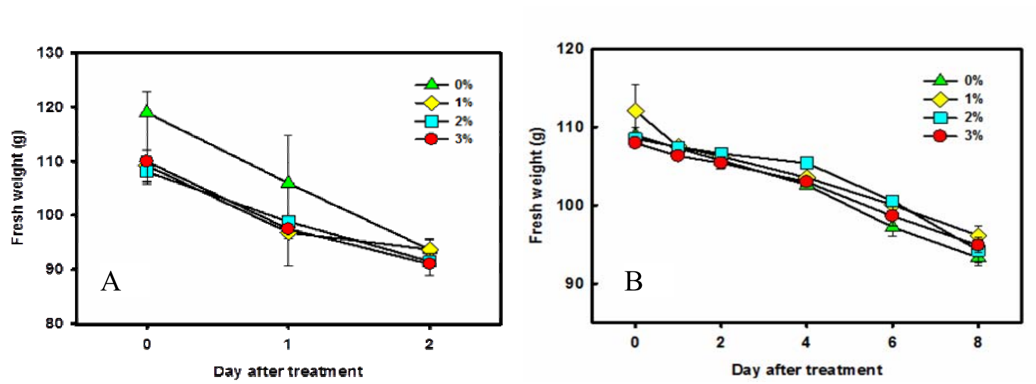


Fig. 1. Fresh weight of minimally processed jackfruit stored in ambient (A) and cold storage (B) as influenced by concentration AA treatment and storage period. Vertical bar represents SE of means and are invisible when the values are smaller than the symbol.

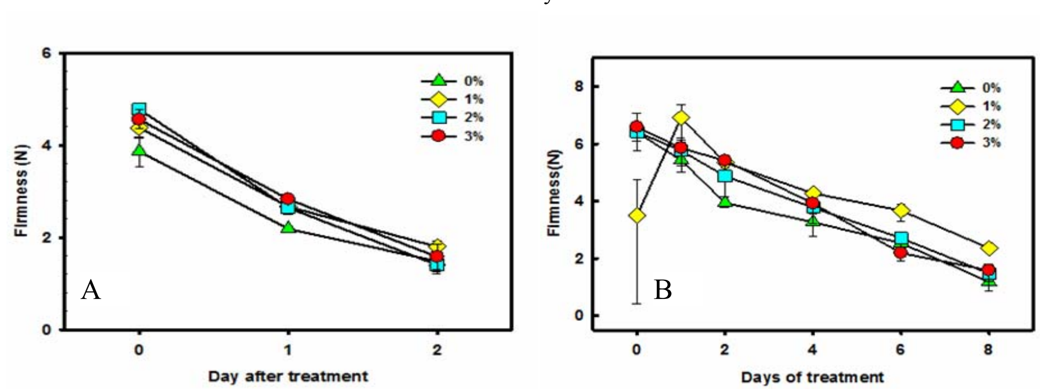


Fig. 2. Firmness of minimally processed jackfruit stored in ambient (A) and cold storage (B) as influenced by concentration AA treatment and storage period. Vertical bar represents SE of means.

Results on the soluble solids concentration (SSC) of fruit showed significantly ($p \leq 0.0001$) decreased with increase of storage time in both ambient and cold storage minimal processed jackfruit (Fig. 3). Chan (1979) have reported there was a negative correlation between SSC and metabolic activity when pitaya or dragon fruits are stored for a longer period. This study showed that minimal processed jackfruit treated with 2 and 3% AA kept at ambient temperature were reducing over the time (Fig. 3 A). This is probably due to active respiration activity of fruits kept at ambient than in cold storage. This is in line with the Rivera-Lopez *et al*. (2005) who said that sugars are the first substrates used during respiration, and this could be the main reason for the depletion of SSC in the produce during storage.

Results on the titratable acidity (TA) of minimal processed jackfruit showed there were significantly ($p \leq 0.0001$) increased over the storage period either in ambient or cold storage (Fig. 4). Analysis of variance indicated that differences concentration of AA treatment affected the ascorbic acid content of minimal processed jackfruit in both ambient and cold storage. The losses of AA was mainly due to oxidation; in particular, the oxidation of vitamin C to dehydroascorbic acid, and followed by hydrolysis of the latter for 2,3-diketogulonic acid, when then become nutritional inactive product after undergo polymerization process (Dewanto *et al*. 2002).

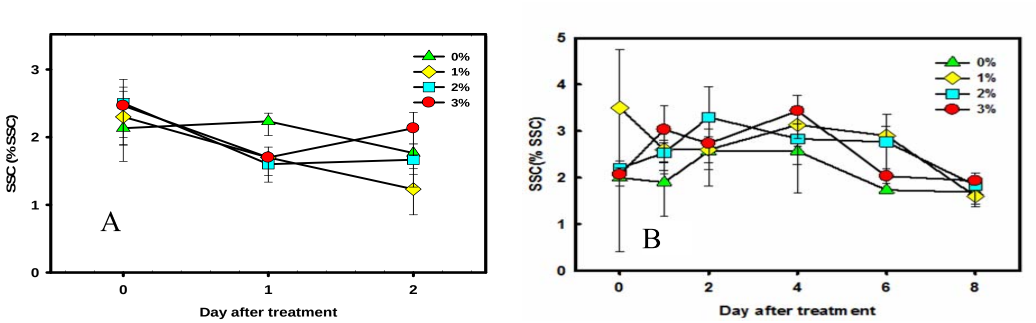


Fig. 3. Soluble solid concentration (SSC) of minimally processed jackfruit stored in ambient (A) and cold storage (B) as influenced by concentration AA treatment and storage period. Vertical bar represents SE of means.

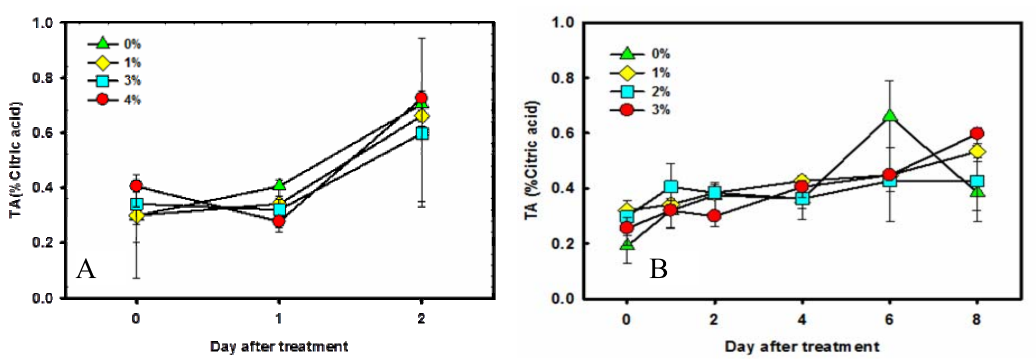


Fig. 4. Titratable acidity of minimally processed jackfruit stored in ambient (A) and cold storage (B) as influenced by concentration AA treatment and storage period. Vertical bar represents SE of means.

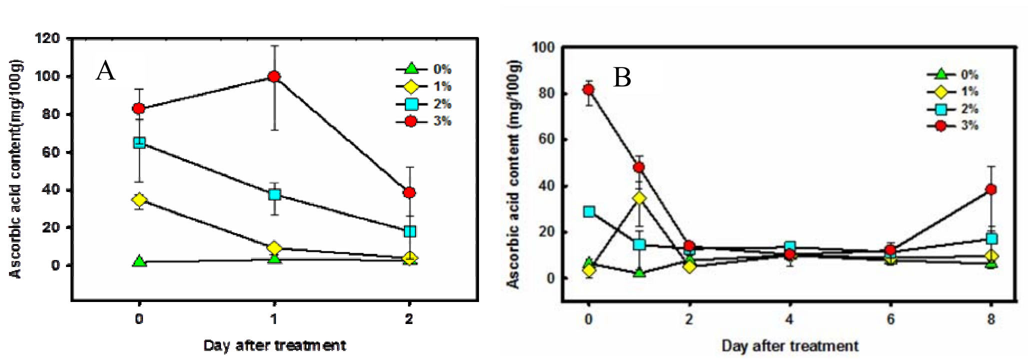


Fig. 5. Ascorbic acid content of minimally processed jackfruit stored in ambient (A) and cold storage (B) as influenced by concentration AA treatment and storage period. Vertical bar represents SE of means.

The results of the loss of AA during storage of minimal processed jackfruit are similarly with pink guava when the study reported 90% reduction in AA content when the fruit was stored for 24 days at 10 ± 2ºC (Ordonez-Santos and Vazquez-Riascos 2010). However, result from this study is in contrast with previous finding by Cocci *et al.* (2006), who found that apple slices treated with 1% AA showed increasing on vitamin C content than untreated.

In conclusion, this study provides information that shelf life of minimal processed jackfruit are able to extend if the fruit were kept under cold storage. The shelf life of minimal processed jackfruit was found can be extended up to 6 days longer if the fruit were kept at low temperature storage than ambient temperature. Base on the result of this study, the application of higher concentration of AA at least 3% as well as dip for more than 5 min warrants further investigation. Higher concentration of AA and increase time of imposing treatment could probably improve the quality and shelf life of minimal processed jackfruit.

**References**

Alvindia DG, Kobayashi T, Natsuaki KT and Tanda S 2004. Inhibitory influenced of inorganic salts on banana postharvest pathogens and preliminary application to control crown rot. J. Gen. Plant Pathology **70**: 61-65.

Arias E, Ganzales J, Oria R and Lopez-Buesa P 2007. Ascorbic acid and 4-hexylresorcinol effect on pear PPO and PPO catalyzed browning reaction. J. Food Science **72**: 8-10.

Bauernfeind JC and Pinlcert DM 1970. Food processing with added ascorbic acid. Advances in Food Research **18**: 219-315.

Chan HT 1979. Sugar composition of pitaya during fruits development. HortScience **14**: 140-141.

Chuni SH, Yahya A and Mahmud TMM 2010. Cell wall enzyme activities and quality of calcium treated fresh-cut red flesh dragon fruit. International J. Agriculture and Biology **12**: 713-718.

Cocci, E, Rucculli, P, Romani S and Rosa M 2006. Changes in nutritional properties of minimally processed apples during storage. Postharvest Biology and Technology **39**: 265-271.

Dewanto, V., Wu, X., Adom, K.K. and Liu, R. H. (2002). Thermal processing enhancers the nutritional value of tomatoes by increasing total antioxidant activity. J. Agriculture and Food Chemistry, **50**: 3010-3014.

Elevitch CR 2006. *Artocarpus heterophyllus* (jackfruit) species profiles for pacific island agroforestry. permanent agriculture resources (PAR), Holualoa, Hawai, (April). Retrieved from http://www.traditionaltree.org

Gil M, Gorny J and Kader A 1998. Responses of Fuji apples slices to ascorbic acid treatments and low oxygen atmosphere. HortScience **33**: 305-309.

Karakurt Y and Hubber DJ 2003. Activities of several membrane and cell wall hydrolyses, ethylene biosynthesis enzymes and cell wall polyuronide degradation during low temperature storage of intact and fresh-cut papaya. Postharvest Biology and Technology **36**: 703-725.

Mohammad Ali S, Mahmood G, Bakshi D and Dadi M 2011. Change in phenolic compounds and antioxidant capacity of fresh-cut table grape cultivar “shahaneh” as influence by fruit preparation method and packaging. Aust. J. Crop Sci. **5**: 1515-1520.

Ordonez-Santos LE and Vazquez-Riascos SA 2010. Effect of processing and storage time on the vitamin C and lycopene contents of nectar of pink guava. Archivos Latino Americanos De Nutrition **60**: 280.

Owino WO, Nakanao R, Yasukata K and Akisugu I 2004. Alteration in cell wall polysaccharides during ripening in distinct anatomical tissue regions of the fig fruit. Postharvest Biology and Technology **32**: 67-77.

Rab A, Haq S, Khalil SA and Ali SG 2010. Fruit quality and senescence related changes in sweet orange cultivar blood red uni-packed in different packing material. Sarhad Journal of Agriculture **26**: 221-227.

Rivera-Lopez J, Vazquez-Ortiz FA, Ayala-Zavala JF, Sotelo-Mundo RR and Gonzalez-Aguilar GA 2005. Cutting shape and storage temperature affect overall quality of fresh-cut ppaya cv. “Maradol.” Journal of Food Science **70**: 482-489.

SAS Institute 2004. SAS/STAT user's guide. release. Release 9.0.4th ed. Statistical Analysis Institute, Cary, NC.

Saxena A, Raju PS and Bawa AS 2011. Effect of controlled atmosphere storage and chitosan coating on quality of fresh-cut jackfruit bulbs. Food and Bioprocess Technology **6**: 2182-2189. doi:10.1007/s 11947-011-0761-x

Senauer B 2001. The Food consumer in the 21st century. AgBioForum. **3**: 14-19.

Thanh CD and Acedo JAL 2006. Causes of quality losses and technological concerns fot fresh and processed tomato and chili. RETA 6208 Postharvest Technology Training and Development of Training Master Plan.

Van Duyn MA and Pivonka E 2000. Overview of the health benefits of fruit and vegetable consumption for the diebetics professional : selected literature. J. Amer. Diebetic Assoc. **100**: 1511-1521.

Watada AE, Abe K and Yamauchi N 1990. Physiological activities of partially processed fruits and vegetables. Food Technology **44**: 116-122.

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