*Bulgarian Journal of Agricultural Science, 15 (No 1) 2009, 41-46*
*Agricultural Academy*

# EFFECT OF DIFFERENT STORAGE METHODS ON NUTRITIONAL QUALITY OF WATERAPPLE FRUITS (*SYZYGIUM JAVANICA* L.)

P. RAJKUMAR[1]* and D. MITALI[2]
[1] *Department of Biotechnology, Madhav Institute of Technology and Science,Gwalior, India*
[2] *Department of Horticulture, Institute of Agricultural Sciences, University of Calcutta, Kolkata, India*

## Abstract

RAJKUMAR, P. and Das MITALI, 2009. Effect of different storage methods on nutritional quality of waterapple fruits (*Syzygium javanica* L.). *Bulg. J. Agric. Sci.*, 15: 41-46

Waterapple (*Syzygium javanica* L) is one of the valuable minor fruits for its nutritional and economic importance. The marketability of this fruit is lost very rapidly after harvesting due to quick discoloration, desiccation as well as spoilage of fruits for its perishable nature. Cold storage is used to extend storage life of fruits and vegetables in many countries and sometimes, may show chilling injury of stored materials. For economically under-developed countries, it is necessary to find out a cheap and effective storage method to increase its shelf-life by means of retarding the natural physiological deterioration and preventing the activity of decay organisms. The present study is concerned to standardize storage in polythene bags and wax emulsion coating as non-expensive and easy method for extending the shelf life of waterapple without allowing quantitative changes in content of total sugar, reducing sugar and total titratable acids.

*Key words:* waterapple, wax emulsion coating, polythene bags, total sugar, total titratable acids

## Introduction

Among the tropical minor fruits, waterapple (*Syzygium javanica* L.) is valuable one for its nutritional and economic importance. For its perishable nature, this fruits cannot be stored for more than 4-6 days under normal ambient condition. The marketability of this fruit is lost very rapidly after harvesting due to quick discoloration, desiccation as well as spoilage of fruits. The seasonal production and rapid deterioration of fruits after harvest make preservation and storage essential in order to ensure steady and extended supply to the market. Refrigerator is generally used to extend shelf life of many fruits and vegetables. Cold storage plays an important role in storage of fruits and vegetables in many countries and sometimes, may show chilling injury of stored materials. For economically undeveloped countries, it is necessary to find out a cheap and effective storage method to increase its shelf-life by means of retarding the natural physiological deterioration and preventing the activity of decay organisms. Different types of packaging can be used depending on requirements of the produce and the target market. These are polymer film bags, trays with ridged or sealed film lids, over-wrapped trays, and clamshells (Forney, 2007). Several treatments such as storage in polythene bags and wax emulsion coating and low temperature have

* *E mail:rajkumarpaul81@gmail.com*

showed their promise in extending the storage life of fleshy fruits. The present study will develop and standardize an expensive and easy method for extending the shelf life of waterapple without allowing quantitative changes in content of total sugar, reducing sugar and total acid.

Worakeeratikul et al. (2007) studied Chitosan retarded browning, maintained L value, total soluble solids, reducing sugar content and titratable acidity in rose-apple fruit (4°C) at concentrations of 0 (control), 0.05, 0.1 and 0.2% (v/v), wrapped with PVC film and stored at 5°C for 72 h. The Carambola fruits in refrigeration storage suffered lower weight and volume loss than ambient stored fruits up to 0-5% of wrapped and 5-10% of unwrapped fruits (Sankat and Balkissoon, 1990). Wrapping has no effect on quality such as solid soluble content (SSC), total titratable acidity and SSC: Acid in film-wrapped Dancy mandarins kept in cold storage for up to 8 weeks (Saucedo-Veloz et al., 1997).

Banik et al. (1998) reported storage of ber fruits coated with paraffin wax kept at10-12$^0$C and 85-90% RH for up to 18 days with minimum spoilage and physiological weight loss in comparison with 100% spoilage in untreated fruits at 28$^0$C and 70% RH on 9$^{th}$ day of storage. Fruits coated with paraffin wax emulsion (2%) and fruits with 100 ppm NAA or 100 ppm ascorbic acid can be retained for up to 12 days at 28-30$^0$C minimum spoilage. The storage life of breadfruits at 28$^0$C is 8 days which can be extended upto 18 days at 16$^0$C without any characteristic changes (Maharao and Sankat, 1990).

The storage life of pomegranate (cv. Baaluang) in sealed polythene bags at 10$^0$C is extended upto 12 weeks with slight changes in quality such as weight loss, total soluble solids (TSS), titratable acidity (TA) and TSS/TA (Pota et al., 1987). The shelf life of sapota can be extended up to 13-15 days by packing in polythene bags in CFB box or in polythene bags respectively and storing in a cool chamber (Waskar et al., 1999). Maximum sugar of waterapple content (10.10%) was found in newspaper + $Ca(NO_3)_2$ where as minimum pH (3.94) was found in newspaper + 2% $CaCl_2$ (Kirad et al, 2007). The effect of whey protein concentrate (WPC) on the quality and biochemical changes of fresh-cut rose apple fruit wrapped with PVC film and stored at 5°C for 72 was investigated. Increasing concentrations of WPC resulted in high accumulations of internal $CO_2$ levels, but no effect on the changes in phenolic concentrations, polyphenol oxidase activity, weight loss, flesh texture, total soluble solids, total ascorbic acid and dehydroascorbic acid in the sections of fresh-cut rose apple during storage (Worakeeratikul et al., 2007).

## Materials and Method

Freshly harvested Waterapple fruits of uniform size and maturity were taken. The weight and volume were measured by balance and water displacement method respectively. Total Soluble Solids (TSS), total sugar, reducing sugar and total acid content in fresh fruits were analyzed.

***Polythene bag sealing:*** One set of air-dried fresh fruits were stored in sealed polythene bag and other set in perforated polythene bag. Then, they were kept in a refrigerator (4.5$^0$C) and at room temperature (30$^0$C).

***Wax coating:*** Two sets of fruits are momentarily were dipped in paraffin wax emulsion (1% and 2%) separately and stored in a refrigerator (4.5$^0$C) and at room temperature (30$^0$C).

The shelf life termination was taken when about 10% of fruits showed spoilage. Then, the level of Total Soluble Solids (TSS), total sugar, reducing sugar and total titratable acid content in stored fruits were analyzed. Total Soluble Solids (TSS), Total sugars and Reducing sugar and Total Titratable Acid were measured by Refractometer, Fehling's method and titration with Phenolphthalein indicator respectively.

## Result and Discussion

· ***Wax coating extends shelf life***

Wax coating and polythene bags in refrigerator and wax coating at room temperature appreciably extended the shelf-life of freshly harvested water apple fruits. At room temperature (30$^0$C), the shelf-life was extended by 7-8 days for both concentrations of wax emulsion and at 4.5$^0$ C, the shelf-life was extended 13 days in polythene bags; whereas 23 and 24 days in 1% and 2% wax emulsion coating, respectively (Figures 1A & 2A).

· ***Perforated polythene shows minimal weight loss***

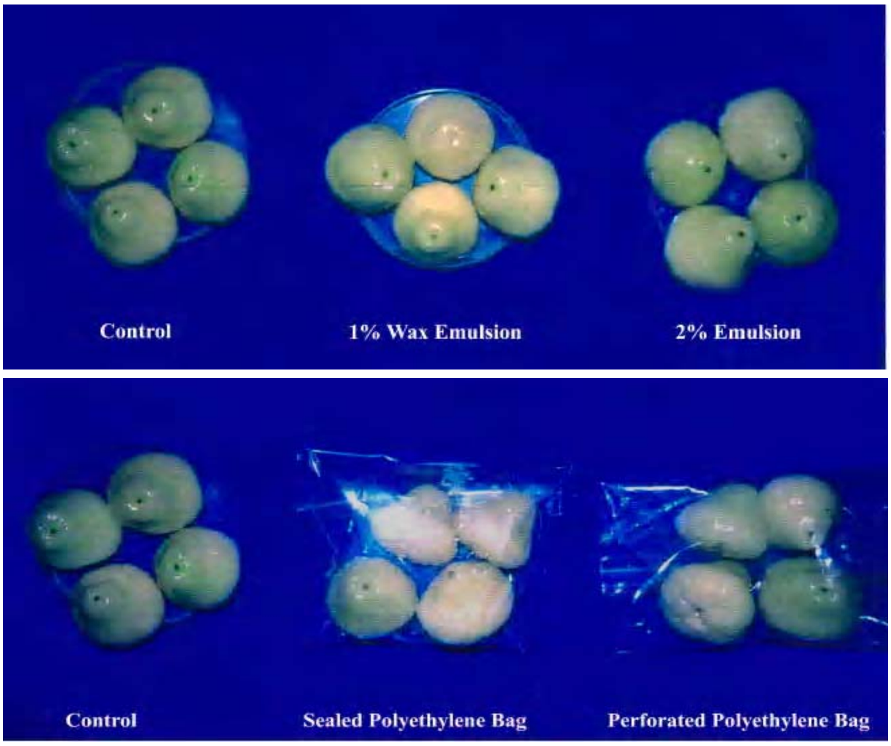
The percentage of weight loss was minimal under sealed polythene at room temperature (0.21% per day) and at 4.5$^0$C, there was no weight loss (Figures 1B & 2B). The minimal weight loss per day was then followed by perforated polythene (1.65% and 0.27%) and 2% wax coating (3.80% and 0.92%) at room temperature (30$^0$C) and in the refrigerator (4$^0$C) respectively; while control showed 8.75% and 2.74% of weight loss per day at room temperature and refrigerator respectively.

· ***Volume loss may be controlled through wax coating***

The effect of sealed polythene and perforated polythene and 2% wax emulsion coating markedly reduce the percentage of volume loss per day at both temperature conditions (0.80%, 1.60% and 2.55% at room temperature and 0.00%, 0.73% and 0.82% at refrigerator). Sealed polythene packaging at 4.5$^0$C, showed no change in volume loss. Control showed 6.55% of volume loss at room temperature and 3.41% of volume loss at refrigeration.

· ***Wax coating with refrigeration increases TSS***

The effect of different storage treatments at both temperature conditions on total soluble solids (TSS) was investigated. The fruits treated with 2% wax emulsion coating and sealed polythene increased the percentage of TSS up to 97.67% and 86.05% at room temperature and 155.81% and 174.42% in refrigerator respectively; whereas perforated polythene at 4.5$^0$C showed 141.86% increase in TSS, compared with control 62.79% at room temperature and 132.56% at 4.5$^0$C (Figure 2C).




(A)

(B)

**Fig. 1. Waterapple fruits in different storage conditions:**
**(A) Waterapple fruits treated with 1% and 2% wax emulsion coating at the time of storage;**
**(B) Waterapple fruits in sealed and perforated polythene at the time of storage**

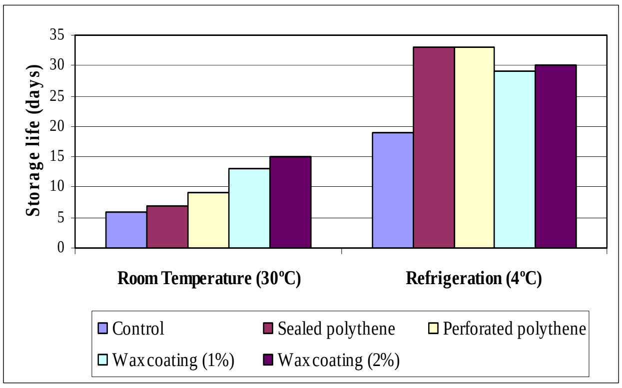



Figure 2(A)

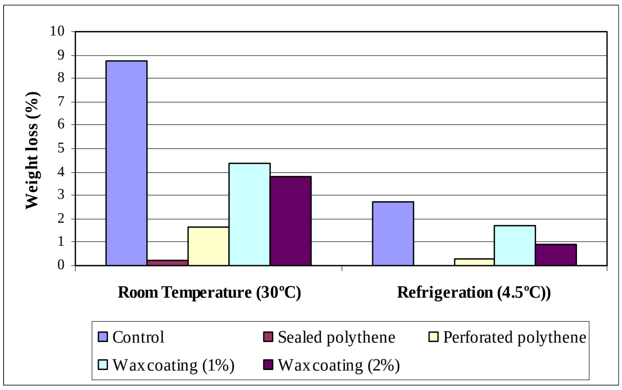



Figure 2(B)

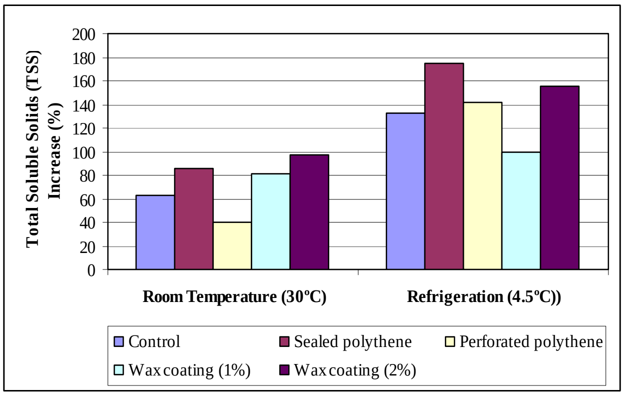



Figure 2(C)

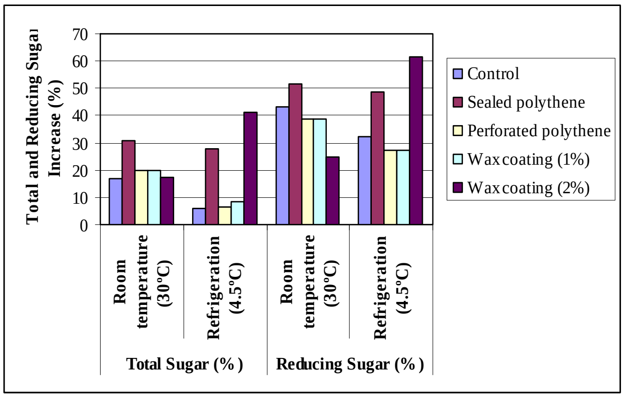



Figure 2(D)

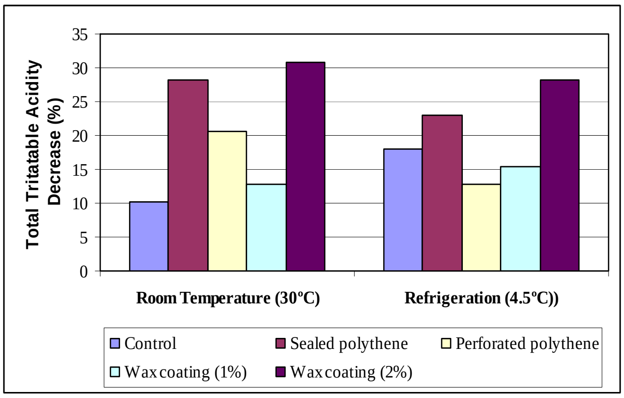



Figure 2(E)

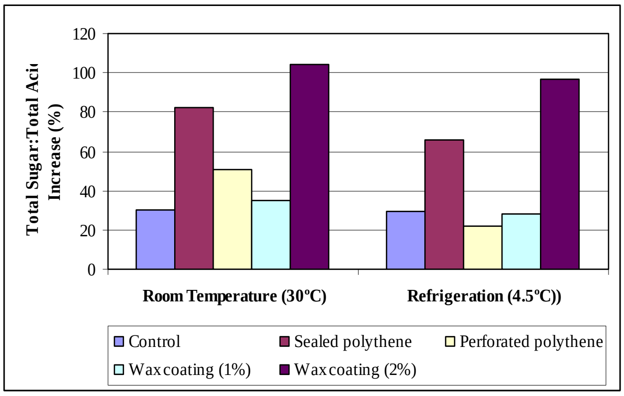



Figure 2(F)

**Fig. 2. Graphs showing comparative study of different biochemical parameters of waterapple fruits after shelf-life: (A) Storage life of waterapple fruits under different treatments; (B) Weight loss (%) of waterapple fruits during shelf life per day; (C) Increase of TSS (%) in waterapple fruits during storage life; (D) Increase of Total and reducing sugar (%) in waterapple fruits during storage; (E) Decrease of Total Titratable Acids (%) in waterapple fruits during storage; (F) Increase (%) of Total Sugar and Total Titratable Acids ratio in waterapple fruits during storage**

· ***Wax coating at room temperature increase total sugar and reducing sugars***

The effect of storage treatments on sugar contents (total sugar, reducing and non reducing sugar) in water apple fruits was analyzed at the end of storage period. All the treatments showed the increase of total sugar and decrease of non-reducing sugar in the fruits. The highest result was obtained with 2% wax coating and sealed polythene at both temperature conditions. Fruits with 2% wax coating (Figure 2D) showed increase of 42.93% total sugar and 55.76% reducing sugar at room temperature and 41.19% total sugar and 61.41% reducing sugar at 4.5$^0$C; whereas sealed polythene treated fruits showed 30.82% total sugar and 51.71% reducing sugar at room temperature and 27.83% total sugar and 48.67% reducing sugar at 4.5$^0$C.

· ***Wax coating and sealed polythene decrease total titratable acid and increase total sugar and total titratable acid ratio***

The effect of different storage conditions on total titratable acid (TTA) was measured. The decrease of TTA was more in 2% wax coating (30.77% and 28.21%), followed by sealed polythene (28.21% and 23.08%), whereas control showed 10.26% and 17.95% decrease of TTA at room temperature and at refrigerator (4.5$^0$C) respectively (Figure 2E). The highest sugar and acid ratio was recorded in fruits treated with 2% wax emulsion coating (104.54% at 30$^0$C and 96.63% at 4.5$^0$C); while sealed polythene treated fruits showed 82.16% at 30$^0$C and 65.60% at 4.5$^0$C, compared with control 30.35% at 30$^0$C and 29.31% at 4.5$^0$C respectively (Figure 2F).

## Conclusion

The actual storage life of a particular fruit depends considerably on many other factors such as type, variety, stage of maturity at the time of picking, treatment given before storage, climacteric region and and local seasonal conditions. The present study reveals that the sealed polythene and 2% wax emulsion coating in refrigerator are more effective in extending shelf life of Waterapple fruits. The fruits showed comparatively less weight loss and shrinkage during storage and remained quite fresh and turgid at the end of storage period. However, no noticeable chilling injury was found in fruits of present study. Appreciable changes in the biochemical constituents of fruits stored in both types of polythene bags at different temperature were noticed. In general, the level of total soluble solids and sugars increased during the storage period, while acidity in little variation. Irrespective of storage temperature, fruits kept in 2% wax coating and sealed polythene bags showed higher contents of TSS, total sugar, reducing sugar and lower content of total acids. Thus, the fruits stored in perforated polythene showed marked improvement in quality over the control. Therefore, it is clear the perforated polythene bag and 1% wax emulsion coating in refrigerator (4.5$^0$C) may play an important role in the storage of highly perishable fruits like Waterapple, since it extends the shelf life without impairing the fruit's quality. However, more studies involving several cultivars at different maturity and at different storage conditions are necessary before the treatment is recommended for commercial utilization.

***Acknowledgements***

We heartily acknowledge to Dr. M. K. Sadhu, Professor, Department of Horticulture, Institute of Agricultural Science, and University of Calcutta for giving his valuable suggestion about the experimental design. We also give special thank to Mr. Panchugopal Chakraborty, Agricultural Experimental Farm, University of Calcutta, Baruipur for his co-operation during field work.

## References

**Banik, D., J. K. Hore and S. K. Sen,** 1988. Studies on storage life of ber (*Zizyphus mauritiana* L.). *Haryana Journal of Horticultural Sciences*; **17** (1-2): 49-55.

**Forney, C. F.,** 2007. New innovations in the packaging of fresh-cut produce. *Acta Horticulturae,* **746**: 53-60.

**Kirad, K. S., S. Barche, A. Dash and R. K. Sharma,**

2007. Response of different packaging materials and chemicals on the shelf life of strawberry (*Fragaria ananassa* duch.) And correlation between different traits. *Acta Horticulturae.* **746**: 89-96.

**Maharao, R. and C. K. Sankat,** 1990. Refrigerated storage of breadfruit and the effect of waxing, packaging and storage of Waterapple. American Society of Agricultural Engineers; No. 90-6509, 31 pp.

**Pota, S., S. Kesta and M. L. C. Thongthaam,** 1987. Effect of packing materials and temperature on quality and storage of pomegranate fruits (*Punica granatum* L.). *Kasestart Journal of Natural Sciences*; **21** (4): 328-333.

**Sankat, C. K. and F. Balkissoon,** 1990. Refrigerated storage of the Carambola. American Society of Agricultural Engineers; No. 90-6513, 15 pp.

**Sankat, C. K. And Balkissoon, F**., 1992. The effect of packaging and refrigeration on the shelf life of the carambola. *Asean Food Journal*; **7** (2): 114-117.

**Saucedo-Veloz, C., R. Arman-Errasquin, S. Chavez-Franco, A. Pereza and M. I. Reyes,** 1997. Effect of individual film wrapping on quality and storage time of mandarin's fruit 'dancy'. *Post-harvest Horticulture*; **17**: 238-243.

**Waskar, D. P., S. K. Nikam and V. K. Garande,** 1991. Effect of different packaging materials on storage of sapota under room temperature and cool chamber. *Indian Journal of Agricultural Research,* **33 (**4): 240-244.

**Worakeeratikul, W., V. Srilaong, A. Uthairatanakij and P. Jitareerat,** 2007. Effects of Hydrocooling and Chitosan Coating on browning and physiological changes in fresh-cut Rose Apple. *Acta Horticulturae.* **746**: 427-434.

**Worakeeratikul, W., V. Srilaong, A. Uthairatanakij and P. Jitareerat,** 2007. Effect of whey protein concentrate on quality and biochemical changes in fresh-cut Rose apple. *Acta Horticulturae.* **746**: 435-442.

*Received October, 7, 2008; accepted for printing January, 12, 2009.*