Environment Conservation Journal 19 (1&2) 217-222, 2018
ISSN 0972-3099 (Print) 2278-5124 (Online)
Abstracted and Indexed

Physiological and biochemical responses of harvested rambutan (*Nephelium lappaceum* L.) fruits to postharvest dip treatments during storage

Shetty Manjunath J.[1]✉, Geethalekshmi P.R.[2], Mini C.,[3] Kumar Vijayaraghava & Beena R.

Received: 22.02.2018 **Revised: 26.03.2018** **Accepted: 29.04.2018**

Abstract

The effect of pretreatments on rambutan fruit (*Nephelium lappaceum* L.) browning properties during storage or shelf-life was determined. Water loss in rambutan fruits induces degradation of nutritional value and imposes stress that increases respiration and ethylene production. In the present investigation, Good quality rambutan fruits of uniform size and maturity with red skin colour were used. The fruits were dipped in paraffin wax emulsions, ozonated and sulphited water, were air dried and stored under room temperature (30±2°C; RH 80-85%) for standardizing the best pretreatment. Weight loss, TSS, pH, acidity, vitamin C, sugars, and antioxidant activity were measured till the end of shelf life. The application of ozone reduced browning of rambutan fruit. The inhibition of browning was associated with increased consumer acceptance. Thus, ozone treatment can be an effective means to extend the shelf life of rambutan fruit.

Key words: Rambutan, spinterns, browning, paraffin, ozonization, sulphitation, pre treatment

Introduction

Rambutan (*Nephelium lappaceum* L.) belongs to family Sapindaceae and genus Nephelium (*Nephelium lappaceum*). Fresh rambutan fruits are perishable in nature and a considerable amount of produce is wasted due to lack of post-harvest processing facilities. This leads to market scarcity in availability and sharp rise in price in the lean period. The fresh rambutan fruits if properly pretreated, packaged and stored may help in increasing its availability for long period. In the present study the physiological and biochemical composition of fresh fruits were determined by applying various procedures after harvest and at final day of shelf life. These features allow it to be identified for prolonged use and classified among other tropical fruits available in the international market.

Materials and methods

The investigation was carried out in the Department of Post Harvest Technology, College of Agriculture, Vellayani (KAU). The investigation was carried out with three types of treatments *viz.*, Waxing (1%), Sulphitation (350 ppm) for 5 minutes and Ozonisation (2 ppm) for 5 minutes. Rambutan fruits of optimum maturity and uniform red skin colour were procured from the identified homesteads of Thiruvananthapuram districts. Waxing was done using 1% paraffin wax and sulphitation was carried out by dissolving potassium metabisulphite (KMS) in water limiting the SO_2 concentration to 350 ppm while ozonizer (Plate 1 and 2) was used for ozonization of rambutan fruits. The pre-treated fruits were spread out to remove excess surface moisture and stored at room temperature. Effectiveness of pretreatments was analyzed based on physiological and biochemical fruit quality parameters. Effects of treatments were statistically analyzed and found that treatments differed significantly.

Author's Address
[1] Department of Post Harvest Technology, College of Horticulture, Bengaluru, UHS (B), Karnataka
[2] Department of Post Harvest Technology, College of Agriculture, Vellayani, KAU, Kerala
E-mail.: *jshettymanju@gmail.com*

Physiological loss in weight (PLW)

For determining physiological loss in weight, sample was weighed accurately after the pre-treatment and weight was taken daily till the end of shelf life and cumulative weight loss was calculated using the formula and expressed as percentage.

$$PLW\ (\%) = \frac{Initial\ weight - Final\ weight}{Initial\ weight} x\ 100$$

Total solids: Total Soluble Solids (TSS) of fruit pulp was recorded with digital refractrometer (Atago - 0 to 53 ^{0}B) and expressed in ^{0}B.

pH: pH of the fruit pulp was measured by using pocket pH tester (HANNA instruments, pHep tester).

Titratable acidity: The method described by Ranganna (1986) was followed to measure titratable acidity. The titratable acidity was expressed in terms of per cent citric acid.

Vitamin C: Vitamin C content was estimated by 2,6- dichloro phenol indophenol (DCPIP) dye method Sadasivam and Manickam,1992 and expressed as mg/ 100g.

Reducing sugar: The titrimetric meth.od of Lane and Eynon as described by Ranganna, 1986 was adopted for the estimation of reducing sugar and expressed as per cent.

Non reducing sugar: The observations under total sugar and reducing sugar were used for calculating non reducing sugar based on the procedure suggested by Ranganna, 1986 and expressed as percent on fresh weight basis.

Total sugar: The total sugar content was expressed as per cent in terms of invert sugar (Ranganna, 1986).

Antioxidant activity: Total antioxidant activity of fruit pulp was determined using 2, 2- diphenyl-1-picrylhydrazyl (DPPH) radical scavenging assay. The scavenging effect on DPPH free radical was measured according to the procedure described by Sharma and Bhat, 2009.

Shelf life: Shelf life is expressed in days and 50% browning of spinterns is considered as the end of shelf life of rambutan fruits (O'Hare, 1995)

Results and Discussion

Fruits pretreated with 2 ppm ozone had the lowest PLW of 20.24% which showed no difference with paraffin wax after five days of storage and the highest weight loss (22.04%) was recorded for control (Table 1). This result was in agreement with findings of Nadas *et al*., 2003 that fruits treated with ozonised water showed less weight loss than non-treated samples after storage. Zhang *et al.,* 2005 reported that treatment with ozonated water reduced microbial population and retarded physiological metabolism in fresh fruits and vegetables. Sothornvit and Kiatchanapaibul, 2009 reported that shelf life fresh or fresh-cut fruits can be extended by ozone treatment. At the end of shelf life, the highest TSS of 18.70 ^{o}B was recorded for 2 ppm ozonization. Among all, control recorded lowest soluble solids of 18.07 ^{o}B which might be due to the utilization of carbohydrates as metabolites during storage. Tavarini *et al.,* 2008 and Barboni *et al.*, 2010 reported that ozone treated kiwifruit showed highest retention of TSS during storage and Alencar *et al.,* 2014 reported the same effect of ozone in pears. This clearly indicates delay in senescence of fruits and increased shelf life. pH is dependent on the strength of acids as well as total acids present in fruits (Schmidl and Labuza, 2000). The highest pH of 4.22 was noticed in control and the lowest pH was for 2 ppm ozonization (T_3), sulphitation 350 ppm (T_2) and paraffin wax (T_1), showing no difference among treatments whereas acidity of different pre-treated fruits differed significantly at the end of shelf life and treatment of 2 ppm ozonization had the highest acidity of 0.51% . This might be due to reduced respiration of fruits which helped in extending shelf life. Similar result was reported by Perez *et al.,* 1999 and the titratable acidity of papaya fruits cv. Sekaki treated with 2.5 ppm ozone was highest with the advancement of storage (Tzortzakis *et al.,* 2007). Najafi and Shaban,2015 reported the similar results in strawberries with proper balance of organic acids that improved flavour over storage.In the present study, highest vitamin C content (22.20 mg/100g) was retained by the fruits with 2 ppm ozone (Fig 2). Ali *et al.*, 2014 reported that treatment of papaya fruits with 2.5 ppm of ozone retained maximum amount of vitamin C at the end of 10 days of storage. Alwi and Ali, 2014 claimed similar results in bell pepper also and stated that this can be due to the fruit defense system that retains highest level of ascorbic acid to neutralize the excess oxidative activity caused by ozone. Total sugar was found to be the highest (15.58%) in fruits with 2ppm ozonization. This can be attributed to sustainability of dominant non structural carbohydrates like glucose and fructose in ozone treated fruits over storage. During storage, decrease in reducing sugar content was observed with advancement of storage period. Rambutan pretreated with 2 ppm ozonisation and stored at room temperature exhibited maximum retention of

Table 1. Effect of pre-treatments on physiological loss in weight (%) of rambutan fruits

Treatments	Physiological loss in weight (%)				
	Days after storage				
	1	2	3	4	5
Paraffin wax (T_1)	2.87	5.14	9.60	13.56	20.76
Sulphitation (T_2)	2.90	5.21	9.62	13.62	21.70
Ozonization (T_3)	2.88	5.14	9.44	13.47	20.24
Control (T_4)	2.98	5.66	9.88	14.10	22.04
CD(0.05)	NS	0.321	0.204	0.170	0.423
SE± (m)	0.177	0.148	0.103	0.074	0.191

Table 2. Effect of pre-treatments on TSS (^oB), pH and acidity (%) of rambutan fruits

Treatments	TSS (^oB)		pH		Acidity (%)	
	Initial	Final	Initial	Final	Initial	Final
Paraffin wax (T_1)	20.24	18.31	3.42	4.14	0.60	0.39
Sulphitation (T_2)	20.28	18.46	3.40	4.14	0.62	0.48
Ozonization (T_3)	20.30	18.70	3.38	4.00	0.62	0.51
Control (T_4)	20.26	18.07	3.50	4.22	0.63	0.38
CD(0.05)	NS	0.175	NS	0.124	NS	0.136
SE± (m)	0.113	0.072	0.093	0.052	0.105	0.056

Table 3. Effect of pre-treatments on total sugar (%), reducing sugar (%) and non reducing sugar (%) of rambutan fruits

Treatments	Total sugar (%)		Reducing sugar (%)		Non-reducing sugar (%)	
	Initial	Final	Initial	Final	Initial	Final
Paraffin wax (T_1)	21.01	14.04	6.81	5.07	14.19	8.96
Sulphitation (T_2)	22.11	14.06	6.35	4.79	14.75	9.25
Ozonization (T_3)	21.11	15.58	6.68	5.74	14.42	9.84
Control (T_4)	22.84	12.17	6.90	4.61	14.08	7.93
CD(0.05)	NS	1.416	NS	0.470	NS	1.261
SE± (m)	0.958	0.667	0.360	0.227	0.430	0.188

Table 4. Effect of pre-treatments on vitamin C (mg/100g) and antioxidant activity (%) of rambutan fruits

Treatments	Vitamin C (mg/100g)		Antioxidant activity (%)	
	Initial	Final	Initial	Final
Paraffin wax (T_1)	28.46	21.23	89.71	62.35
Sulphitation (T_2)	27.39	20.81	89.64	64.37
Ozonization (T_3)	28.03	22.20	89.60	70.64
Control (T_4)	27.72	20.41	89.53	44.06
CD(0.05)	NS	1.005	NS	3.776
SE± (m)	1.522	0.474	0.531	1.778

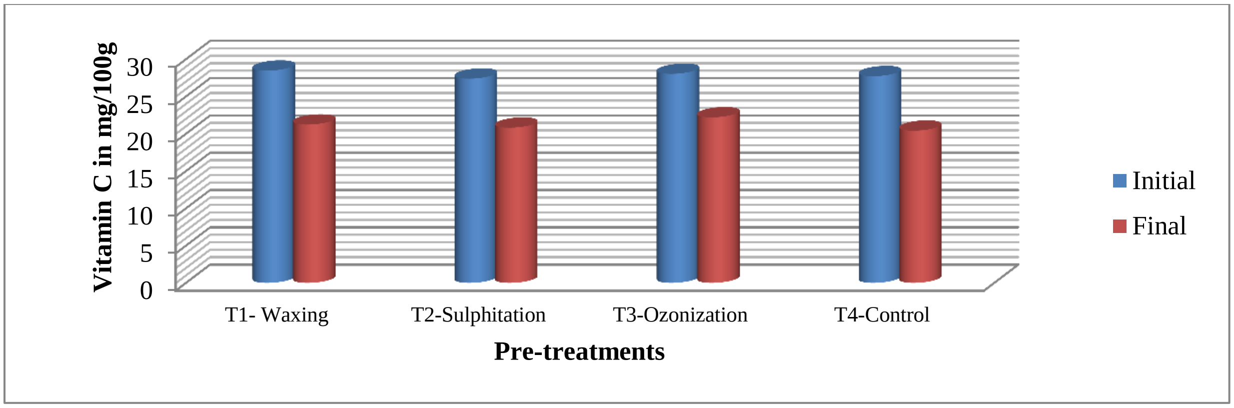

Fig 1. Effect of pre-treatments on vitamin C (mg/100g) of rambutan fruits

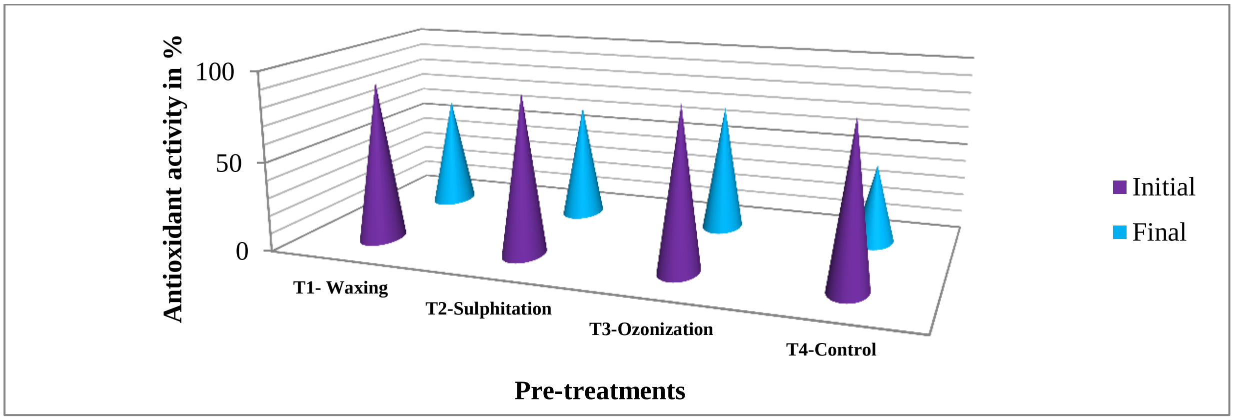

Fig 1. Effect of pre-treatments on vitamin C (mg/100g) of rambutan fruits

Plate 1. Ozonizer

Plate 2. Ozonization process

reducing and non reducing sugar. This is in agreement with Barboni *et al.,* 2010 who reported that ozone treatment of kiwifruit had strong influence on reducing sugar with maximum retention and therefore indicated low metabolism at storage. Non reducing sugar was retained at maximum (9.84%) with fruits with 2 ppm ozone at the end of shelf life of 5 days of storage while untreated fruits had the lowest sugar. Several studies reported that ozone retained maximum sucrose content in apples and pears (Skog and Chu, 2001), persimmons (Salvador *et al.*, 2006) and papayas (Tzortzakis *et al.*, 2007; Ali *et al.*, 2014).

Highest retention of antioxidant activity of rambutan was recorded with 2 ppm ozonised water (Fig. 2). Perez *et al.,* (1999) reported that strawberries when treated with the ozone elucidated the antioxidant activity in comparison with non treated fruits. Papaya fruits treated with ozone concentration of 3.5 ppm had highest antioxidant activity after 10 days of storage (Tzortzakis *et al.*, 2007; Ali *et al.*, 2014). Ozonization (2 ppm) helped in extending shelf life of rambutan to 5 days under room temperature storage with minimum loss of nutrients and highest consumer acceptability. Ozone is known to reduce the levels of ethylene, delays ripening and senescence process and this increases shelf life of fruits and vegetables (Skog and Chu, 2001; Palou *et al.*, 2002 and Allende *et al.*, 2009). Fresh and fresh cut amaranthus treated with ozone maintained its freshness and shelf life was extended with low microbial population (George, 2015 and Ambareesha, 2016).

Conclusion

It can be concluded that 2 ppm ozone was best treatment for rambutan fruits. Treatment with ozone was very effective in improving postharvest life of rambutan fruit stored at room temperature. It delayed browning and hence increased acceptability. When nutritional qualities were analyzed, ozone treated rambutan fruits were superior till the end of shelf life. Based on the efficiency of postharvest dip treatments in maintaining quality of rambutan fruits, ozone was selected as one of the pre-treatment for further pre-treatment studies which recorded a shelf life of 5 days at room temperature. Ozone treatment exerted a significant influence on shelf life of rambutan fruit, indicating delayed senescence of fruits.

References

Alencar, E. E., Faroni, L. R., Pinto, M. S., DaCosta, A. R. and Carvalho, A. F. 2014. Effect of ozone on postharvest conservation of pear. ***J. Food Process Technol.*** 5. 317-321.

Ali, A., Ong, M. K. and Forney, C. F. 2014. Effect of ozone preconditioning on quality and antioxidant capacity of papaya fruit during ambient storage. ***Food Chem***.142: 9-26.

Allende, A., Selma, M. V., Lopez-Galvez, F., Villaescusa, R. and Gil, M. I. 2009. Role of commercial sanitizers and washing systems on epiphytic microorganisms and sensory quality of fresh-cut escarole and lettuce. ***Postharvest Biol. Technol.*** 49: 155-163.

Alwi, N. A. and Ali, A. 2014. Reduction of *E. coli* 0157, *Listeria* and *Salmonella* populations on fresh cut bell pepper using gaseous ozone. ***Food Control***. 46: 304-311.

Ambareesha, K. N. 2016. Standardization of minimal processing of amaranthus (*Amaranthus tricolor* L.). M. Sc. (Hort) thesis, Kerala Agricultural University, Thrissur, 160p.

Barboni, T., Cannac, M. and Chiromente, N. 2010. Effect of cold storage and ozone treatment on physiochemical parameters, soluble sugars and organic acids in *Actinidia deliciosa*. ***Food Chem.*** 121: 946-951.

George, G. M. 2015. Postharvest handling studies for extending shelf life of amaranthus (*Amaranthus tricolor* L.). M. Sc. (Hort) thesis, Kerala Agricultural University, Thrissur, 128p.

Nadas, A., Olmo, M. and Garcia, J. M. 2003. Growth of *Botrytis cinerea* and strawberry quality in ozone-enriched atmospheres. ***J. Food Sci.*** 68:1798-1802.

Najafi, N. and Shaban, S. 2015. The effect of chitosan coatings on quality of fresh strawberries (*Fragerria ananasa* L.) preserved into modified atmosphere packaging (MAP). ***Int. J. Biosci.*** 6 (1): 98-108.

O'Hare, T. J. 1995. Postharvest physiology and storage of rambutan. ***Postharvest Biol.Technol.*** 6: 189-199.

Perez, G. A, Sanz, C, Rios, J. J, Olias, R. and Olias, J. M. 1999. Effects of ozone treatment on postharvest strawberry quality. ***J. Agric. Food Chem.*** *47*(4): 1652–1656.

Palou, L., Crisosto, C. H., Smilanick, J. L., Adaskaveg, J. E. and Zoffoli, J. P. 2002. Effects of continuous 0.3 ppm ozone exposure on decay development and physiological responses of peaches and table grapes in cold storage. ***Postharvest Biol. Technol.*** 24: 39–48.

Ranganna, S. 1986. Handbook of Analysis and quality control for fruit and vegetable products. Tata McGraw Hill Publishing company Limited. New Delhi. 182p.

Sadasivam, S. and Manickam, A. 1992. Biochemical method for agricultural sciences. Wiley Eastern Limited and Tamil Nadu Agricultural University, Coimbatore, 246p.

Salvador, A., Abad, I., Arnal, L. and Martinez-Javega, J. M. 2006. Effect of ozone on postharvest quality of persimmon. ***J. Food Sci***. 71: 443-446.

Schmidl, M. K. and Labuza, T. P. 2000. Essential and functional foods. Aspen publishers. Inc. USA. 108pp.

Sharma, R. and Bhat, T. K. 2009. DPPH antioxidant assay revisited. ***Food Chem.*** 113: 1202-1205.

Skog, L. J. and Chu, C. L. 2001. Effect of ozone on qualities of fruits and vegetables in cold storage. ***Can. J. Plant Sci.*** 81: 773-778.

Sothornvit, R. and Kiatchanapaibul, P. 2009. Quality and shelf-life of washed fresh cut fruits and vegetables in modified atmosphere packaging. ***Food Sci. Technol.*** 42: 1484-1490.

Tavarini, S., Degl' Imracentis, E., Remorini, D., Maassai, R. and Guidi, L. 2008. Antioxidant capacity, ascorbic acid, total phenols and carotenoid change during harvest and after storage of Hayward kiwifruit. ***Food Chem.*** 107: 282-288.

Tzortzakis, N., Borland, A., Singleton, I. and Barnes, J. 2007. Impact of atmospheric ozone-enrichment on quality-related attributes of papaya. ***Postharvest Biol. Technol.*** 45. 317–325.

Zhang, L., Lu, Z., Yu, Z. and Gao, X. 2005. Preservation of fresh-cut fruits by treatment of ozonated water. ***Food Control.*** 16: 279-283.