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Effect of waxing treatments on biochemical composition and postharvest shelf life of Rambutan (*Nephelium lappaceum* L.)

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Abstract

Browning due to high transpiration, high respiration rate and decay are the main causes for quality deterioration and postharvest loss of rambutan. Water loss also 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 for the study. The harvested fruits dipped in 1% wax formulations *viz.* KAU wax (bee wax), palm wax (carnauba wax) and paraffin wax were air dried and stored under room temperature (30±2°C; RH 80-85%) for standardizing the best wax formulation. The results obtained from paraffin waxes were better than the other treatment combinations after 4 days of postharvest life.

Keywords: Waxing, Paraffin, Formulation, Emulsion

Introduction

Rambutan (*Nephelium lappaceum* L.) is an important exotic fruit, indigenous to Southeast Asia, including Thailand, Malaysia, and Indonesia (Lam *et al.*, 1987)^[10]. It is a good source of vitamin C, calcium and provides fairly a good amount of niacin, iron, phosphorus, carbohydrate, protein, and fibre. Farmers in many parts of Kottayam and Pathanamthitta in Central Travancore have taken rambutan cultivation to cater the demand of fruits from traders in Tamil Nadu and Karnataka (Kuttoo, 2009)^[9]. Even though rambutan has good demand and vast export potential, it is not a major commercial crop mainly because of its seasonal availability and short shelf life. It is a very delicate fruit and highly perishable in nature, with an average moisture content of 84.3% (Singh *et al.*, 1963)^[16]. Suitable postharvest handling practices can enhance the shelf life by preserving its nutritional quality and there by extending the availability for domestic and distant market.

Materials and Methods

Materials

The investigation was carried out in the laboratory of Post-Harvest Technology, College of Agriculture, Vellayani, Kerala Agricultural University. The investigation was carried out with three types of waxes *viz.* KAU wax (bee wax), palm wax (carnauba wax) and paraffin wax. Rambutan fruits were procured from the identified homesteads of Thiruvananthapuram districts.

Methods

Preparation of emulsions

Bee and palm wax-oil emulsions of 1% were made by adding 1 gm of bee wax and palm wax to 100 ml of oil with temperature sufficient enough to dissolve the wax. The emulsion made was allowed to cool for few minutes. Similarly, paraffin wax-water emulsion (1%) was made by adding 1 ml of liquid paraffin wax to 100 ml lukewarm water along with the emulsifier and stirred constantly. Later on fruits dipped in the emulsions for uniform coating of wax on the fruit surface were air dried and stored at room temperature.

Determination of total solids

Total Soluble Solids (TSS) of fruit pulp was recorded with digital refractometer (Atago - 0 to 53 °B) and expressed in °B.

Determination of pH

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

Determination of titratable acidity

The method described by Ranganna (1986)^[13] was followed to measure titratable acidity. The titratable acidity was expressed in terms of per cent citric acid.

Determination of vitamin C

Vitamin C content was estimated by 2, 6- dichloro phenol indophenol (DCPIP) dye method Sadasivam and Manickam (1992)^[14] and expressed as mg/ 100g.

Determination of reducing sugar

The titrimetric method of Lane and Eynon as described by Ranganna (1986)^[13] was adopted for the estimation of reducing sugar and expressed as per cent.

Determination 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)^[13] and expressed as percent on fresh weight basis.

Determination of total sugar

The total sugar content was expressed as per cent in terms of invert sugar (Ranganna, 1986)^[13].

Determination of 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)^[15].

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)^[12].

Results and Discussion

The total solids of rambutan samples were in range of 21.0-21.3%. Paraffin wax treated fruits recorded the maximum retention of TSS (18.46 °B) and the lowest TSS of 17.83 °B was recorded for the fruits without wax treatment (control) at the end of shelf life. This result was consistent with the findings of Dikki *et al.* (2010)^[1] and Bisen *et al.* (2012) in kagzi limes.

The pH in paraffin treated fruits was lowest (3.73) meanwhile it showed highest retention of acidity (0.40%) after 4 days of storage (Fig. 1). The reduction in acidity during storage was less with waxed fruits as compared to control. Guar and Bajpai (1978)^[3] reported that increase in pH of rambutan aril is due to decrease in acidity.

Vitamin C content of rambutan fruits ranged from 30.05 to 30.03 (mg/100g) before storage. After 4th day of storage, paraffin wax treated fruits (T₃) recorded the highest retention of vitamin C (22.05 mg/100g). Similar results were reported by Khin (1991)^[8] in guava and Hu *et al.* (2011)^[5] in pineapple fruits.

Total sugar in all the samples ranged from 20.67% to 21.43% before storage. Maximum total sugar content was showed by paraffin treated fruits (16.78%). Reducing sugar ranged between 6.56-6.61%. Maximum reducing sugar was showed by paraffin waxed fruits sample (5.33%). Maximum non reducing sugar was also retained in the same samples. The results are in harmony with Janesh and Nair (2001)^[6] in banana and Sun *et al.* (2010)^[17] in litchi fruits, Hu *et al.* (2011)^[5] in pineapple.

After 4th day of storage, paraffin wax treated fruits recorded the highest anti oxidant activity (66.04%) (Fig. 2). The results showed synchronization with the findings of Ghasemnezhad *et al.* (2013)^[4] in strawberries, Meighani and Ghasemnezhad (2015)^[11] in paraffin coated pomegranate fruits with higher antioxidant activity of 76.4% after 40 days of storage.

Paraffin waxed fruits had shelf life of 4 days of room temperature whereas bee wax, palm wax and uncoated fruits recorded a shelf life of only 3 days. The increased shelf life may be due to decreased respiration, transpiration rate and permeability of fruits skin for gas exchange. Similar results were reported by Doshi and Sutar, (2010)^[2] in banana; Kechinski *et al.* (2012)^[7] in litchi

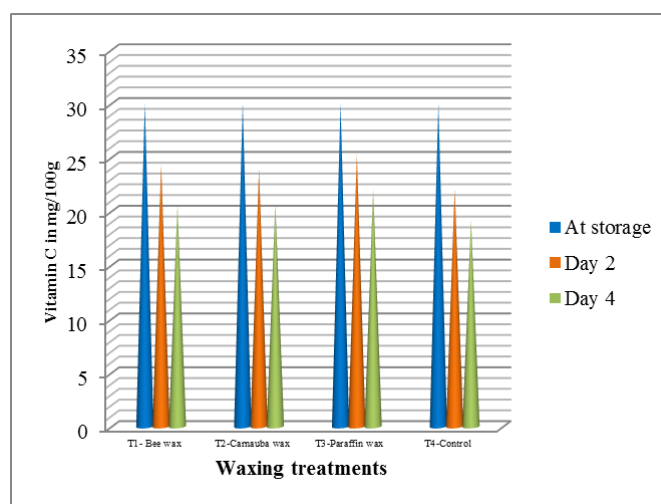


Fig 1: Effect of waxing treatments on acidity (%) of rambutan fruits

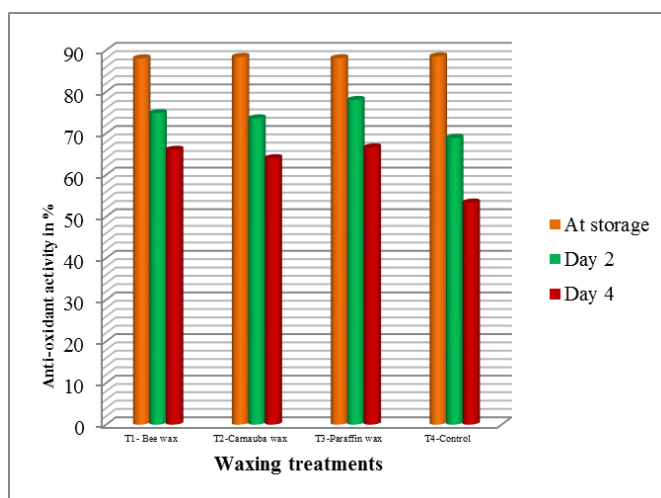


Fig 2: Effect of waxing treatments on antioxidant activity (%) of rambutan fruits

Biochemical analysis

Table 1: Effect of waxing treatments on TSS, pH, acidity, vitamin C, antioxidant activity of rambutan fruits

Treatments	TSS (°B)		pH		Acidity (%)		Vitamin C (mg/100g)		Antioxidant activity (%)	
	Days after storage		Days after storage		Days after storage		Days after storage		Days after storage	
	At storage	4	At storage	4	At storage	4	At storage	4	At storage	4
T1 (Bee wax)	21.00	18.13	3.23	3.83	0.58	0.39	30.05	20.52	88.02	66.04
T2 (Carnauba)	21.23	18.16	3.33	3.83	0.59	0.37	30.05	20.70	88.38	64.02
T3 (Paraffin)	21.30	18.46	3.26	3.73	0.58	0.40	30.03	22.05	88.06	66.60
T4 (Control)	21.16	17.83	3.26	4.03	0.59	0.35	30.03	19.14	88.50	53.35
CD(0.05)	NS	0.239	NS	0.178	NS	0.020	NS	1.343	NS	2.518
SE± (m)	0.066	0.084	0.056	0.034	0.020	0.020	0.582	0.447	0.386	0.842

Table 2: Effect of waxing treatments on total sugar, reducing and non reducing sugar of rambutan fruits

Treatments	Total sugar (%)		Reducing sugar (%)		Non Reducing Sugar (%)	
	Days after storage		Days after storage		Days after storage	
	At storage	4	At storage	4	At storage	4
T1 (Bee wax)	21.26	16.33	16.33	5.03	14.69	11.15
T2 (Carnauba)	21.43	16.18	16.18	5.17	14.48	11.16
T3 (Paraffin)	21.10	16.78	16.78	5.33	14.50	11.45
T4 (Control)	20.67	14.33	14.33	4.65	14.06	9.686
CD(0.05)	NS	0.622	0.622	0.277	NS	0.700
SE± (m)	0.588	0.204	0.204	0.105	0.521	0.234

Conclusion

It can be concluded that paraffin was best treatment with 1% emulsion for waxing of rambutan fruits. There was better retention of chemical composition like total solids, pH, titratable acidity, vitamin C, sugars and anti-oxidant activity as compared to control (without treatment). Based on the efficiency of waxing treatments in maintaining biochemical qualities of rambutan paraffin wax was selected as one of the pre-treatment for further pre-treatment studies which recorded a shelf life of 4 days at room temperature. Wax treatment exerted a significant influence on shelf life of rambutan fruit, indicating that wax treatments delayed senescence of fruits. The preparation of edible coating emulsions and to ascertain acceptability also needs investigation.

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