



Relationship of Waxing Treatments to Certain Physiological, Browning and Sensory Characteristics of Rambutan (*Nephelium lappaceum* L.)

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ABSTRACT

Dipping of rambutans in 1% wax formulations viz. KAU wax (bee wax), palm wax (carnauba wax) and paraffin wax helped to reduce % unacceptable fruits when fruits were stored under room temperature ($30\pm 2^{\circ}\text{C}$; 80-85% RH) for standardizing the best wax formulation. Dipping of rambutans in bee wax and carnauba wax treatments were found to be less effective in prolonging the shelf life compared to paraffin wax. Dehydration is the major problem in rambutan which induces the browning of spinterns and degradation of nutritional value. Techniques which slow down respiration and dehydration rate were found to be more effective in prolonging the shelf life of rambutans. Fruits treated with 1 % paraffin wax, showed minimum physiological loss in weight (PLW) (18.36%), lowest browning score (3.43) and superior in general appearance, taste and flavour with minimum pulp browning at the end of shelf life.

Key words: Browning, Paraffin, Formulation, Emulsion, Scores

INTRODUCTION

Rambutan (*Nephelium lappaceum* L.) is an important exotic fruit, indigenous to Southeast Asia, including Thailand, Malaysia, and Indonesia¹⁴. 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 Karnataka¹². 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. The fruit is harvested ripe when visual and organoleptic attributes are optimal but within 2-3 days at ambient, the fruit pericarp consisting of soft spines called spinterns and peel, turns brown as the fruit desiccates due to its high rate of water loss¹⁴. It is a very delicate fruit and highly perishable in nature, with an average moisture content of 84.3%²¹. The spinterns have five times more stomatas than that of the peel or main fruit axis¹⁶ lose water faster and usually turn brown earlier than the peel.

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Extreme desiccation leads to browning of the entire pericarp even if the pulp or aril is still acceptable or edible. 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. The objective of present investigation was to determine whether waxing treatments can be used to prolong the shelf life of fresh rambutans.

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 of optimum maturity and uniform red skin colour 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.

Physiological loss in weight:

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

Browning score:

A score card proposed by Follet and Sanxter⁷ at five point hedonic scale was used for assessing the browning of fruits with following scores. 10% spinterns darkened =1, 25%

spinterns darkened =2, 50% spinterns darkened =3, All spinterns and 50% or less of the pericarp surface area distinctly darkened =4, All spinterns and 50% or more of the pericarp surface area distinctly darkened =5.

General appearance:

A nine point hedonic scale score card proposed by Brown and Wilson⁴ was used for assessing the visual appearance.

Internal fruit quality:

a. Taste

Taste of fruit was subjectively rated by 30 panelists using a scale of 1, 2, 3, 4 and 5 as Excellent, Very good, Good, Fair, Poor respectively.

b. Flavour

Flavour of fruit was subjectively rated by 30 panelists using a scale score card proposed by Brown and Wilson (1988) was used for assessing with following scores,

Excellent - 1, Very good - 2, Good - 3, Fair - 4, Poor - 5.

c. Pulp browning

A five point scale score card was used for assessing the pulp browning with following scores, No browning - 1, 5% browning - 2, 10% browning - 3, 25% browning - 4, 50% browning - 5.

1. Statistical design:

Effects of different waxing treatments on browning score and organoleptic parameters viz. taste, flavour and pulp browning were statistically analyzed using Kruskal-Wallis test and found that treatments differed significantly²⁰.

RESULTS AND DISCUSSION

Physiological weight loss is a phenomenon of loss in weight from produce during storage caused due to various physiological activities which in turn is related with the shelf life of fruits. At the end of shelf life, the lowest PLW of 18.36% was recorded for paraffin wax (T₃), which showed no significant difference with bee wax (19.11%). The highest PLW of 22.70% was observed in control (T₄). This result was consistent with the findings of Bhullar and Farmahana³, Dikki *et al.*⁵ and Armugham and Balamohan¹. Pericarp

browning does not affect the aril but reduce the consumer acceptance. Pericarp colour is often associated with quality of the product and may be taken as indicator of level of natural deterioration of fruits¹¹. Fruits treated with paraffin wax (T₃) had the lowest

browning (3.43) and the highest browning (4.70) was recorded by the control (T₄) after 4 days of storage. The results were in tune with Kittur *et al*¹⁰.Elkashif *et al.*⁶ in guava; Bhattacharjee and Dhua² in bitter gourds.

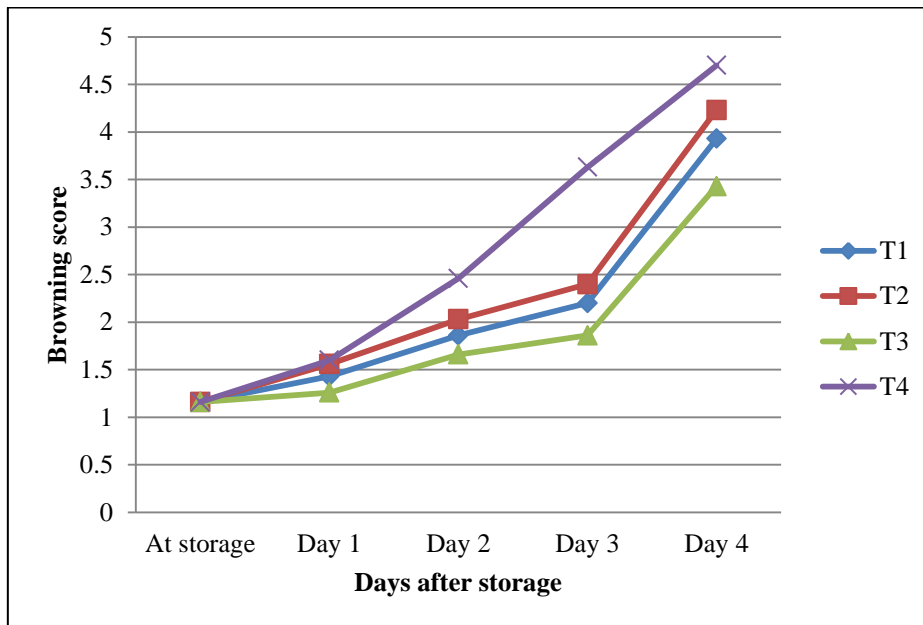


Fig. 1: Effect of waxing treatments on browning score of rambutan fruits

Visual quality plays an important role in general appearance and consumer acceptability of rambutan fruits as they are more sensitive to weight loss and loss of freshness. Rambutan fruits treated with paraffin wax (T₃) recorded the highest mean score of 6.66 with rank one followed by bee wax (T₁) and the lowest mean

score of 3.80 was obtained for control (T₄) after 4 days of storage. The results were in concurrent with Kittur *et al.*¹⁰ in mango; Patikabutr and Kanlayanarat¹⁷ in rambutan; Sun *et al.*²² in litchi and Hu *et al.*⁹ in pineapple.

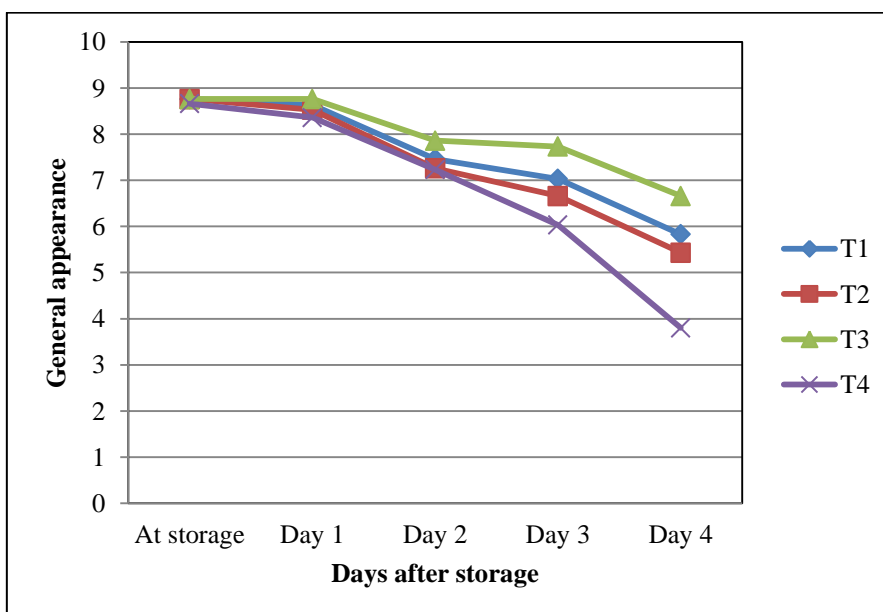


Fig. 2: Effect of waxing treatments on general appearance of rambutan fruits

Rambutan fruits waxed with paraffin (T₃) and stored at room temperature recorded rank 1 with mean score of 2.63 after 4th day after storage respectively. Taste of the fruits mainly depends on the type of coating and its concentration when stored at room temperature as reported by Ladaniya and Sonkar¹³, Raje *et al.*¹⁸ and Kittur *et al.*¹⁰ in mangoes; Malik *et al.*¹⁵. Flavour is an important parameter for consumer acceptance. Paraffin wax (T₃) recorded highest ranking with the score of 2.13 at the end of shelf life. The control fruits (T₄) recorded the lowest ranking throughout the storage period. The

results were in concordance with Ladaniya and Sonkar¹³, Malik *et al.*¹⁵, Rodov *et al.*¹⁹ in mango. Browning of aril is mainly attributed to increase in water loss due to respiration, transpiration of fruits and also due to enzymatic reaction. Fruits waxed with paraffin (T₃) recorded first ranking with the lowest pulp browning scores of 2.83. The highest browning score was for control (T₄) as 4.60 after 4th day of storage. This result was in agreement with findings of Hashmi *et al.*⁸ where paraffin wax was found effective for the improvement of sensory characteristics and retained pulp quality of apple.

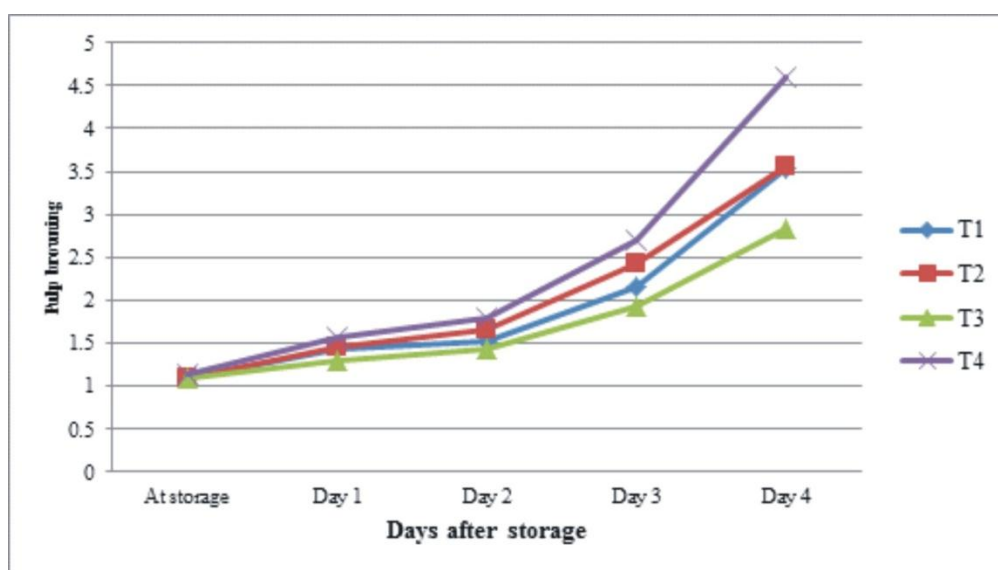


Fig. 3: Effect of waxing treatments on pulp browning of rambutan fruits

Table 1: Effect of waxing treatments on physiological loss in weight (%) of rambutan fruits

Treatments	Physiological loss in weight (%)			
	Days after storage			
	1	2	3	4
T ₁ (Bee wax)	5.17	8.56	13.64	19.11
T ₂ (Carnauba wax)	5.19	8.70	13.84	19.78
T ₃ (Paraffin wax)	4.97	8.28	13.12	18.36
T ₄ (Control)	6.22	10.70	14.92	22.70
CD(0.05)	0.40	0.655	0.855	0.779
SE± (m)	0.137	0.226	0.289	0.261

Table 2: Effect of waxing treatments on browning score of rambutan fruits

Treatments	Days after storage									
	At storage		1		2		3		4	
	Rank	Mean score	Rank	Mean score	Rank	Mean score	Rank	Mean score	Rank	Mean score
T ₁ (Bee wax)	1	1.16	2	1.43	2	1.86	2	2.20	2	3.93
T ₂ (Carnauba wax)	1	1.16	3	1.56	3	2.03	3	2.40	3	4.23
T ₃ (Paraffin wax)	1	1.16	1	1.26	1	1.66	1	1.86	1	3.43
T ₄ (Control)	1	1.16	4	1.60	4	2.46	4	3.63	4	4.70
KW value	--		26.06**		28.21**		25.89**		30.33**	
χ^2 (0.05)	7.81									

Scores:

10% spinterns darkened-1 25% spinterns darkened-2 50% spinterns darkened-3
 All spinterns and 50% or less of the pericarp surface area distinctly darkened-4
 All spinterns and 50% or more of the pericarp surface area distinctly darkened-5

Table 3: Effect of waxing treatments on general appearance of rambutan fruits

Treatments	Days after storage									
	At storage		1		2		3		4	
	Rank	Mean score	Rank	Mean score	Rank	Mean score	Rank	Mean score	Rank	Mean score
T ₁ (Bee wax)	1	8.76	2	8.63	2	7.46	2	7.03	2	5.83
T ₂ (Carnauba wax)	1	8.76	3	8.53	3	7.26	3	6.66	3	5.43
T ₃ (Paraffin wax)	1	8.76	1	8.76	1	7.86	1	7.73	1	6.66
T ₄ (Control)	2	8.66	4	8.36	4	7.23	4	6.03	4	3.80
KW value	24.17**		28.22**		25.70**		29.49**		32.20**	
χ^2 (0.05)	7.81									

Scores:

Like extremely-9 Like very much-8 Like moderately-7
 Like slightly-6 Neither like nor dislike-5 Dislike slightly-4
 Dislike moderately-3 Dislike very much-2 Dislike extremely-1

Table 4: Effect of waxing treatments on taste of rambutan fruits

Treatments	Days after storage									
	At storage		1		2		3		4	
	Rank	Mean score	Rank	Mean score	Rank	Mean score	Rank	Mean score	Rank	Mean score
T ₁ (Bee wax)	1	1.03	3	1.16	3	1.53	2	1.66	2	2.96
T ₂ (Carnauba wax)	1	1.03	3	1.16	2	1.50	3	1.73	3	3.30
T ₃ (Paraffin wax)	1	1.03	2	1.10	1	1.46	1	1.60	1	2.63
T ₄ (Control)	1	1.03	1	1.03	4	1.73	4	2.33	4	4.13
KW value	--		24.12**		24.45**		26.37**		28.47**	
χ^2 (0.05)	7.81									

Scores:

Excellent – 1 Very good – 2 Good – 3 Fair – 4 Poor – 5

Table 5: Effect of waxing treatments on flavour of rambutan fruits

Treatments	Days after storage									
	At storage		1		2		3		4	
	Rank	Mean score	Rank	Mean score	Rank	Mean score	Rank	Mean score	Rank	Mean score
T ₁ (Bee wax)	1	1.10	3	1.50	3	2.30	3	2.70	3	3.43
T ₂ (Carnauba wax)	1	1.10	2	1.33	2	1.76	2	2.26	2	2.76
T ₃ (Paraffin wax)	1	1.10	1	1.20	1	1.63	1	1.86	1	2.13
T ₄ (Control)	2	1.13	4	1.70	4	2.40	4	3.36	4	4.20
KW value	24.06**		25.38**		26.20**		28.47**		32.13**	
χ^2 (0.05)	7.81									

Scores:

Excellent – 1 Very good – 2 Good – 3 Fair – 4 Poor – 5

Table 6: Effect of waxing treatments on pulp browning of rambutan fruits

Treatments	Days after storage									
	At storage		1		2		3		4	
	Rank	Mean score	Rank	Mean score	Rank	Mean score	Rank	Mean score	Rank	Mean score
T ₁ (Bee wax)	1	1.10	2	1.43	2	1.53	2	2.16	2	3.53
T ₂ (Carnauba wax)	1	1.10	3	1.46	3	1.66	3	2.43	3	3.56
T ₃ (Paraffin wax)	1	1.10	1	1.30	1	1.43	1	1.93	1	2.83
T ₄ (Control)	2	1.13	4	1.56	4	1.80	4	2.70	4	4.60
KW value	24.06**		24.39**		24.74**		25.80**		29.57**	
χ^2 (0.05)	7.81									

Scores:

No browning - 1 5% browning - 2 10% browning – 3 25% browning - 4 50% browning -5

CONCLUSION

It can be concluded that paraffin was best treatment with 1% emulsion for waxing of rambutan fruits. Surface coating with paraffin wax was very effective in improving postharvest life of rambutan fruit stored at room temperature. It delayed browning and hence increased acceptability. When internal fruit qualities were analyzed, paraffin treated rambutan fruits were superior in taste and flavour with lowest pulp browning at the end of shelf life. Based on the efficiency of waxing treatments in maintaining pericarp colour of rambutan fruits, 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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