Madras Agric. J., 95 (1-6): 162-169 January-June 2008
https://doi.org/10.29321/MAJ.10.100552

Studies on the shelf life of fully ripe mango fruits using wax emulsions

P. RAJKUMAR, R. KAILAPPAN AND DAWN CP. AMBROSE
Department of Food and Agricultural Process Engineering, Agricultural Engineering College and Research Institute, Tamil Nadu Agricultural University, Coimbatore

Abstract : Four levels of wax emulsions *viz.*, 3, 4, 5 and 6% were prepared by adding oleic acid, triethanolamine and hot water. The wax emulsions were coated on fully matured mangoes to assess the shelf life of wax coated mangoes stored at ambient conditions. A hand operated wax coating machine was developed to coat wax on mango fruits. Physiological loss in weight (PLW) and organoleptic properties of wax coated fruits and uncoated fruits (control) were measured periodically during the storage period. It was observed that the PLW was lower in wax coated samples than the control. From the results, it was also found that the shelf life of 6% wax emulsion coated mango fruits could be extended up to 12 days and for the control it was only 7 days.

Key words : Paraffin wax, Wax emulsion, Mango fruits, Shelf life, Organoleptic evaluation, Physiological loss in weight, Physical characteristics.

Introduction

Most of the tropical fruits have a short shelf life. Mango is such a seasonal fruit which has a shelf life of around 7 days at ambient conditions. It is one of the most common sub-tropical fruits grown in India and occupies fourth in area and production. The fruit is highly perishable and utmost care should be taken in the post harvest handling and processing to reduce the post harvest losses. Incompetent handling of fruits results in injury to the surface layer making them more susceptible to attack by spoilage organisms with consequent reduction in consumer appeal in the market. The fruit is being a seasonal commodity as it creates glut during the season and becomes scarce during the off- season usage.

The post harvest life of fruits generally depends upon the factors like water vapour losses, ripening rates, storage temperature, atmospheric composition, skin thickness, infestation *etc.* by reducing these factors, the shelf life can be increased up to certain period.

There are different methods of extending shelf life of fruits *viz.*, pre-cooling, cold storage, controlled atmosphere storage and wax coating. In all these methods, the shelf life is extended by reducing the respiration rate and moisture loss from the fruits. Except wax coating method, all the methods are sophisticated and costly. Also in India, cold storage facilities are not within the easy reach of farmers / fruit growers. Application of physical barrier such as wax coating regulates permeability of water vapour and other gases, retards ripening and restricts insect infestation and microbial growth.

Therefore, the wax coating method seems to be the cheapest and easy to practice for prolonging the shelf life of fruits by considering

its following advantages *viz.*, controlling moisture loss and respiration rate, enhancing appearance by the glossiness of the wax. Role of skin coating for extending the storage life of fruits has been reported by several workers (Thomas *et al.*, 1971; Erbil and Muftagil, 1986; Dhalla and Hanson, 1988; Kahlon and Bajwa, 1991; Castrillo and Bemudez, 1992; Diaz-Sobac *et al.*, 1996; Alache and Munoz, 1998; Ozdemir and Dunder, 2001).

Materials and Methods

Physiologically fully mature mangoes were obtained from the Horticulture College and Research Institute, Coimbatore for the research programme. The fruits were carefully selected to ensure uniform in maturity, size and colour. A hand operated wax applicator has been used for coating wax emulsions.

Among the waxes, paraffin wax is cheaper than carnauba and bee wax. Therefore paraffin wax was used for the experimental study. Different paraffin wax emulsions were prepared by taking 50g waxes with oleic acid (40ml) as solving agent, triethonolamine (60- 100ml) as emulsifying agent and hot water (700-1300 ml) as diluting agent for each trial (Nithya Devi, 2003).

Wax emulsion is filled in the wax vat to the level of 1 inch above the bottom of the impeller. The impeller is given a constant rotation of about 10 rpm through the handle manually for 2 minutes. Uniform size and weight of mango (200-250g) fruits were selected for wax coating. The fruits are fed through the feed hopper. These fruits are received by the impeller blades, taken through the wax column; the wax coated fruits are passed on to the outlet chute. Then these fruits are collected on perforated trays and finally dried under sunshine for 2 hours to remove the excess moisture in the wax emulsion. The weight loss was determined by weighing the samples immediately after coating wax. Physical characteristics *viz.*, texture, flavour, taste and overall acceptance were judged organoleptically by a panel of 7 judges based on the Hedonic scale ranging from 1- dislike extremely to 9-like extremely. The physiological loss in weight (PLW) was measured by weighing the fruits during the storage period. The storage life was assessed based on the organoleptic evaluation. The results are given in Table 2.

Results and Discussion

From the study it was found that the solvents could be used to dilute the wax emulsion and the wax could be stabilized as liquid under atmospheric temperature. To prepare low viscous uniform wax emulsion, 10 minutes stirring at 1000 rpm was required. The wax emulsion requirement to coat 100 kg of mango fruits was found to be 275 ml.

The physiological loss in weight (PLW) gradually increased when the storage period extended.

From the figure 1 it is observed that the PLW varied between 9.15% and 10.47% for the mango fruits coated with 3% wax emulsion after 10 days of storage period. The PLW was significantly lesser in T12 and higher in T10. In the study period, the unwaxed mango fruits recorded the PLW of 9.60 % after 7 days of storage.

From the figure 2 it is found that the PLW was higher (9.94%) in T7 and lower (8.91%) in T9 after 10 days of storage.

Table l. Wax emulsion treatments

Treatment	Wax,g	Oleic acid, ml	Triethonolamine, ml	Hot water, ml	Average wax emulsion %
Tl	50	40	60	700	6
T2	50	40	80		
T3	50	40	100		
T4	50	40	60	900	5
T5	50	40	80		
T6	50	40	100		
T7	50	40	60	1100	4
T8	50	40	80		
T9	50	40	100		
T10	50	40	60	1300	3
T11	50	40	80		
T12 Control	50	40	100		

From the figure 3 and 4 it is observed that the shelf life of wax coated mango fruits could be increased to 7 days. Among the wax emulsion treatments, the PLW recorded the lowest (7.83%) in treatment T3.

Generally after the above said storage periods, the mango fruits devoid of wax showed decay symptoms rendering it unfit for further evaluation. The wax emulsion treatments significantly reduced the physiological losses in weight of fruits. It is also found that the triethanolamine used as emulsifying agent influenced the variation in PLW during storage.

Flavour

Data presented in Table 3 indicate that there is significant loss of flavour during the storage period. The loss was highest in control (2.01) than with wax emulsion treated fruits. Among the wax emulsion treated mango fruits, the flavour retention was highest (7.45) in T3 after 12 days of storage. Jawanda *et al.* (1978) stated that kinnow mandarin treated with 6 % wax emulsion retained the usual flavour during the storage period.

Texture

The highest texture value was with 6 % wax emulsion treated fruits after 12 days of storage. However there was no significant difference in texture value for the fruits coated with 5 and 6 % wax emulsion. But in the case of mango fruits coated with 4%, 3% and Control recorded the lowest texture values. It may be possible that the higher concentration of wax emulsion reduce microbial activity and respiration rate of cells there by helping in retaining good texture.

Taste

Wax emulsion treatments significantly helped in retaining the taste of fruits after 12 days of storage. The highest taste value of 7.31 was recorded in T3 followed by T2 and Tl. The control lost all its taste after 7 days of storage. Banana treated with wax and rice starch possessed better taste than

Table 2. Physiological loss in weight (percent) in mango fruits

Treatments	Initial weight,g	Storage days 1	2	3	4	5	6	7	8	9	10	11	12
Tl	211.56	1.38	2.35	3.28	4.12	4.92	5.65	6.36	6.99	7.62	8.20	8.77	9.30
T2	212.72	1.32	2.26	3.15	3.93	4.65	5.37	6.02	6.60	7.13	7.63	8.12	8.59
T3	212.56	1.30	2.20	3.02	3.75	4.45	5.11	5.71	6.20	6.64	7.06	7.45	7.83
T4	210.31	1.39	2.71	3.63	4.49	5.31	6.09	6.83	7.51	8.14	8.73	9.31	9.89
T5	209.67	1.36	2.33	3.24	4.06	4.84	5.58	6.26	6.93	7.52	8.05	8.54	9.03
T6	209.41	1.34	2.29	3.14	3.95	4.70	5.42	6.05	6.66	7.16	7.62	8.05	8.48
T7	209.25	1.67	2.94	4.04	5.09	6.03	6.92	7.75	8.53	9.27	9.94	*	*
T8	207.72	1.57	2.69	3.71	4.67	5.59	6.46	7.27	8.04	8.75	9.37	*	*
T9	209.32	1.49	2.50	3.46	4.41	5.31	6.12	6.91	7.63	8.30	8.91	*	*
T10	207.7	1.76	3.11	4.30	5.35	6.35	7.28	8.16	8.99	9.76	10.47	*	*
T11	209.54	1.65	2.86	3.95	4.94	5.87	6.77	7.62	8.43	9.17	9.89	*	*
T12	208.52	1.51	2.53	3.47	4.41	5.30	6.19	7.01	7.77	8.48	9.15	*	*
C	213.4	2.29	4.09	5.45	6.63	7.67	8.66	9.60	*	*	*	*	*

*.unfit for comsumptions

Treatments	SED	CD (5%)	CD (1%)
Wax emulsion	0.034	0.067	0.08
Storage days	0.025	0.049	0.06
Interaction	0.09	0.17	0.23

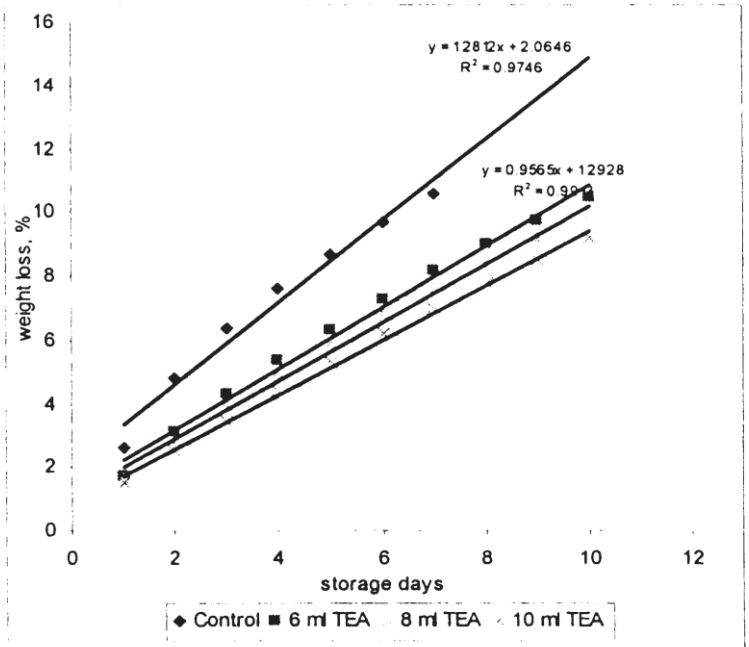

Fig 1.PLW (%) in 3 % wax emulsion coated mango

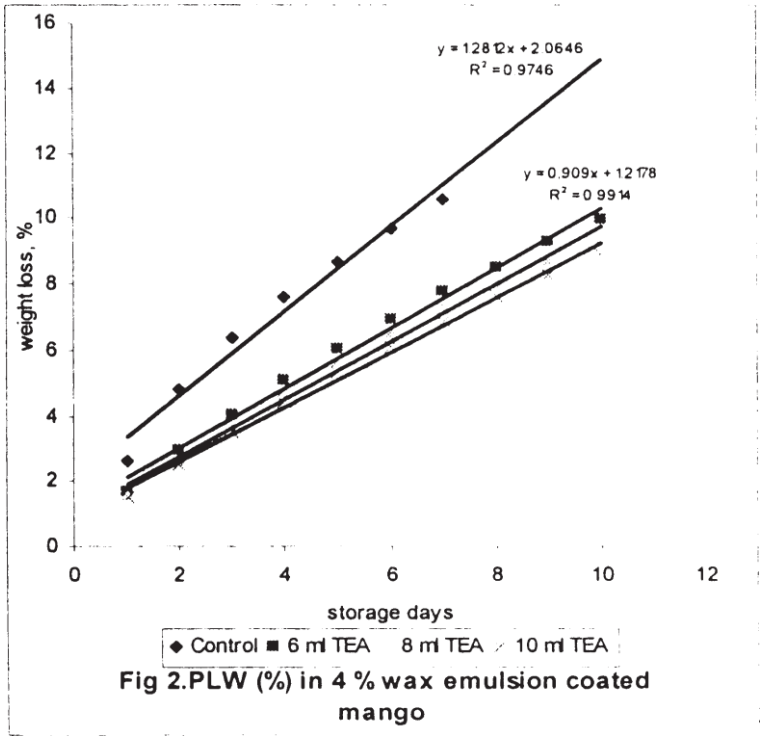

Fig 2.PLW (%) in 4 % wax emulsion coated mango

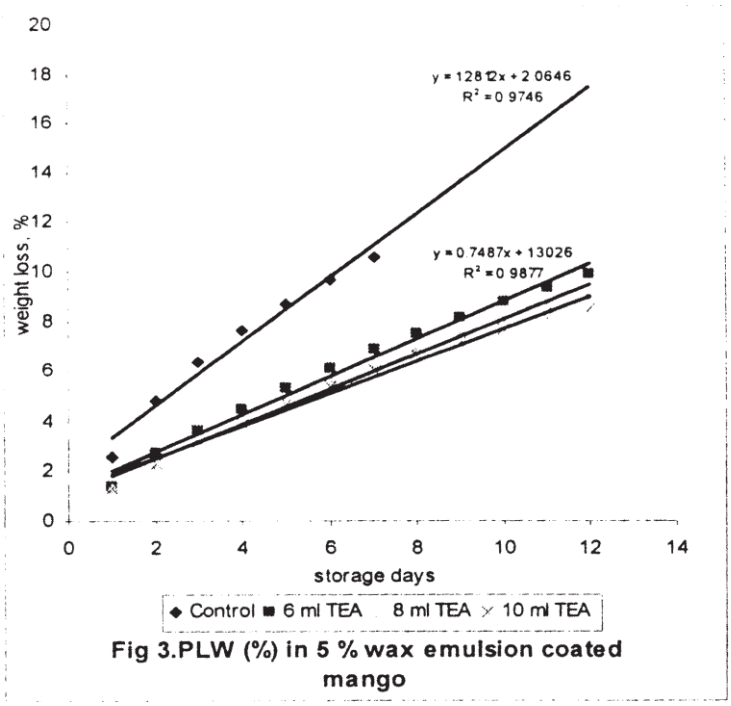

Fig 3.PLW (%) in 5 % wax emulsion coated mango

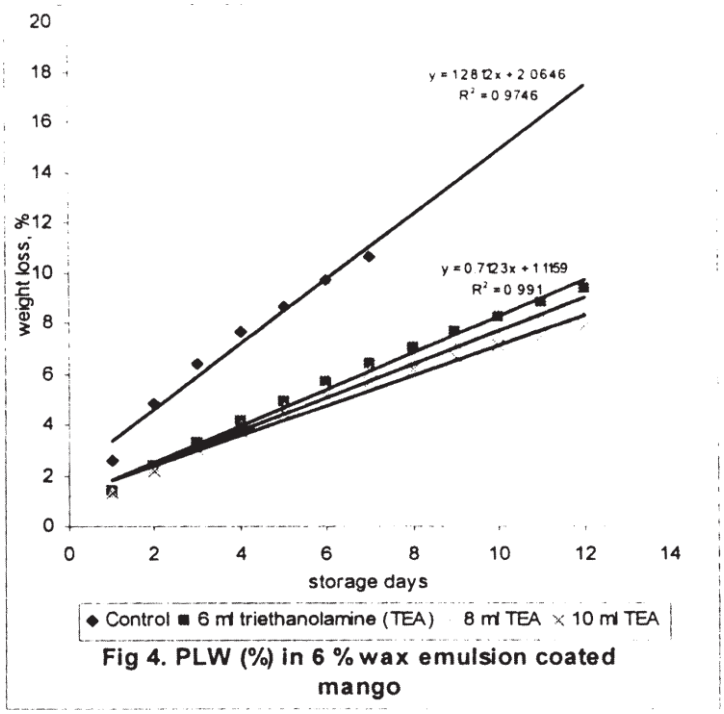

Fig 4. PLW (%) in 6 % wax emulsion coated mango

Table 3. Organoleptic evaluation

Treatments	Flavour	Texture	Taste	Overall acceptability	Flavour	Texture	Taste	Overall acceptabilty
	7th day of storage				9th day of storage			
Control	6.86	6.81	7.16	7.15	4.95	4.18	4.16	4.01
Tl	8.15	8.11	8.1	8.13	8.16	8.16	8.11	8.1
T2	8.25	8.15	8.15	8.25	8.20	8.15	8.16	8.25
T3	8.27	8.14	8.19	8.24	8.21	8.18	8.19	8.36
T4	8.05	8.17	8.06	8.26	8.14	8.11	8.02	8.05
T5	8.11	8.06	8.04	8.09	8.12	8.05	8.12	8.01
T6	8.12	8.29	8.11	8.24	8.17	8.11	8.09	8.09
T7	8.01	8.35	8.1	8.21	8.11	8.08	7.81	7.81
T8	8.05	8.19	8.05	8.29	7.95	8.12	7.35	7.85
T9	8.04	8.21	8.12	8.19	8.12	8.13	7.48	7.83
T10	8.01	7.95	8.01	7.89	7.13	7.45	7.15	7.03
T11	7.98	7.69	8.06	7.84	7.16	7.39	7.11	7.05
T12	7.99	7.46	8.01	7.92	7.18	7.48	7.15	7.02

Table 3. continued..

Treatments	Flavour	Texture	Taste	Overall acceptability	Flavour	Texture	Taste	Overall acceptabilty
	11th day of storage				12th day of storage			
Control	3.98	3.07	3.95	3.04	2.01	2.05	1.92	1.98
Tl	8.01	8.14	7.87	8.01	7.12	7.12	7.13	7.11
T2	8.05	8.15	7.85	8.05	7.45	7.33	7.28	7.18
T3	8.07	8.47	7.86	8.06	7.45	7.31	7.31	7.29
T4	8.01	7.98	7.96	7.89	7.08	6.96	7.04	6.98
T5	8.09	8.06	7.87	7.76	7.16	7.04	7.11	7.12
T6	8.04	8.11	7.9	7.82	7.21	7.09	7.10	7.18
T7	4.62	4.23	4.13	4.15	3.25	3.21	3.91	3.48
T8	4.56	4.55	4.18	4.16	3.51	3.53	3.45	3.56
T9	4.87	4.43	4.18	4.13	3.45	3.41	3.75	3.54
T10	4.12	3.92	4.01	4.11	2.91	2.9	2.64	2.11
T11	4.15	3.53	4.12	4.02	2.56	2.51	2.13	2.13
T12	4.16	3.18	4.15	4.0.3	2.87	2.16	2.32	2.12

Treatments	SEd	CD(5%)	CD (1%)
Wax emulsion	0.085	0.161	0.213
Storage days	0.041	0.092	0.119
Interactions	0.155	0.321	0.419

control during the 15 days storage period (Sarkar *et al*, 1995).

Overall acceptability

Based on the organoleptic evaluation performed on the mango fruits, it was found that the shelf life of 6 % wax emulsion treated fruits could stored up to 12 days and unwaxed (control) could be stored only up to 7days. The other wax emulsion treatments like 3 and 4% treated fruits could be stored up to 10 days respectively. It was also found that by increasing the wax concentrations with triethanolamine as emulsifying agent, the shelf life of fruits could be increased.

From the study it was found that the wax emulsion could be prepared by using oleic acid as a solvent triethanolamine as an emulsifying agent and with hot water the wax could be stabilized as liquid under atmospheric temperature. The wax applicator can be effectively used for coating fruits for extending the shelf life. It was also found that the wax emulsion coated mango and mango fruits could be extended up to 12 days against 7 days only for the unwaxed (control) mango fruits.

Acknowledgement

The authors wish to thank the ICAR PHT Scheme for providing necessary financial assistance for carrying out the research work.

References

Alache, G.J and Munoz, A.C. (1998). Use of wax in storage of mangoes cv. Piqueno. *IDESIA* **15:** 15-19.

Castrillo, M and Bemudez, A. (1992). Post harvest ripening in wax coated bocoda mango. *J Fd. Sci. Technol.,* **27(4):** 457-460.

Dhalla, R and Hanson, S.W. (1998). Effect of permeable coating on the storage life of fruits. *Int. J FdSci. Technol.,* **23 (2):** 107-109.

Diaz-Sobac, R., Luna, A.V., Beristain,C.V.,Cruz, J.D., and Gaycia, H.S. (1996). Emulsion coating to extend the post harvest life of mango (cv. Manila). *J FdProc and Presn.,* **20(3):** 191-195.

Erbil, H.Yand Muftagil,N. (1986). Lenthening the post harvest life of peaches by coating with hydrophobic emulsion. *J Food Proc and Presn.,* **10(2):** 269 - 270.

Jawanda, J.S. and Ragbir Singh,V.K. (1978). Studies on extending post harvest life of kinnow mandarin. *Punjab Hort. J.,* **18 (3-4):** 15-25.

Kahlon, P.S. and Bajwa, K.S. (1991). Effect of bavistin wax emulsion and wrappers on the storage life of litchi cv. Calcuttia. *Indian Fd. Packer,* **45(1):** 35-38.

Nithya Devi, A. (2003). Enhancing the shelf life of banana using wax, chemical and bio-fungicide. Unpublished M.Sc. Thesis. Department of Fruits, Tamil Nadu Agricultural University, Coimbatore.

Ozdemir, A.E. and Durdar, O. (2001). Effect of different post harvest applications on storage of oranges. *Ada Hort.,* **533 (2):** 561-564.

Sarkar, H.N., Hasan, M.D.A. and Chattopadhyay, P.K. (1995). Studies on shelf life of banana as influenced by chemicals. *J. of Tropical Agriculture,* **33(1):** 97-100.

Thomas, P., Paul, P., Nagaraja, N and Dalai, V.B.(1971). Physiological and respiratory changes in dwarf Cavendish variety of bananas during growth and maturation. *J.Fd. Sci. Technol.,* **20(2):** 51-56.