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Studies on the shelf life of fully ripe guava fruits using wax emulsion

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Abstract: Shelf life of guava fruits was assessed by coating with wax emulsions. Four levels of wax emulsions *viz.* 3, 4, 5 and 6% were prepared by adding oleic acid, triethanolamine and hot water. A hand operated wax-coating machine was developed to coat wax on guava fruits. Physiological loss in weight of wax-coated fruits was assessed during the storage period. Organoleptic evaluation was also performed on the wax-coated fruits to assess the shelf life. From the results, it was found that the shelf life of 6% wax emulsion coated guava fruits could be extended up to 7 days and for the control it was only 4 days.

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

Introduction

Guava 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 they create glut during the season and become scarce during the off- season usage.

It has been estimated that inadequate storage and handling facilities result in losses in the order of 35 to 40% of the total production of fruits. By considering the nutritive value it is necessary to deploy modern methods to extend the shelf life for better distribution and also processing techniques to preserve them for using in the offseason.

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 easyreach of farmers / fruit growers. Thomas *et al.* (1971) reported that wax coating (6%) in banana cv. Dwarf Cavendish found to increase the storage life by 6 days in ambient temperature and 7 days in cold storage (12-18°C) than control. He also observed that waxing in poovan increased the shelf life by 8 days than untreated in ambient storage. Kahlon and Bajwa (1991) reported that the storage life was extended up to 20 days in litchi cv. Calcuttia using wax emulsion (6%) and packed in perforated polyethylene bags with paper cuttings and kept in cold storage. Sarkar *et al.* (1995) concluded that banana cv. Giant Governor could be kept for 14 days after

Table 1. Wax emulsion treatments.

Treatments	Wax (g)	Oleic acid (ml)	Triethonolamine (ml)	Hot water (ml)	Average wax emulsion %
T_1	100	80	120	1400	6
T_2	100	80	160		
T_3	100	80	200		
T_4	100	80	120	1800	5
T_5	100	80	160		
T_6	100	80	200		
T_7	100	80	120	2200	4
T_8	100	80	160		
T_9	100	80	200		
T_{10}	100	80	120	2600	3
T_{11}	100	80	160		
T_{12}	100	80	200		
Control					0

Table 2. Physiological loss in weight (percent) for guava fruits.

Treatments	Initial weight (g)	Storage days						
		1	2	3	4	5	6	7
T_1	65.16	1.86	3.56	5.11	6.61	8.00	9.33	10.49
T_2	63.17	1.74	3.23	4.55	5.75	6.81	7.87	8.78
T_3	64.12	1.55	2.86	4.01	5.07	5.99	6.85	7.55
T_4	65.67	2.21	4.08	5.80	7.33	8.84	10.24	11.49
T_5	64.76	2.06	3.66	5.16	6.52	7.75	8.82	9.88
T_6	66.12	1.88	3.40	4.79	6.04	7.20	8.16	9.02
T_7	64.38	2.47	4.48	6.41	8.12	9.79	11.30	13.17
T_8	65.71	2.19	4.14	5.93	7.64	9.17	10.55	11.80
T_9	64.89	2.00	3.75	5.38	6.89	8.25	9.43	15.12
T_{10}	65.12	2.78	5.29	7.51	9.53	11.45	13.56	15.23
T_{11}	66.23	2.57	4.81	6.88	8.79	10.54	12.70	14.10
T_{12}	65.41	2.36	4.49	6.37	8.33	9.87	11.26	13.82
Control	64.15	4.62	8.26	11.35	14.23	17.21	20.48	22.29

Treatments	SEd	CD (5%)	CD (1%)
Wax emulsion	0.034	0.067	0.08
Storage	0.025	0.049	0.06
Wax x Storage	0.09	0.17	0.23

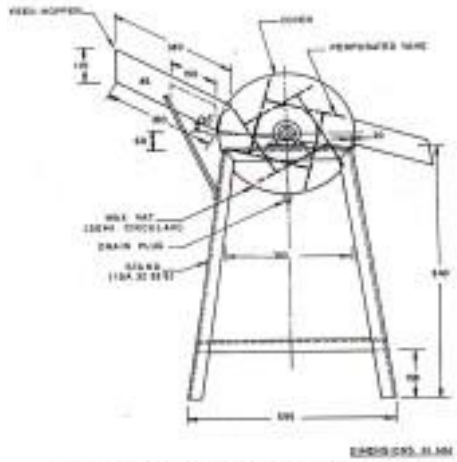

Fig. 1 CONTINUOUS WAX COATING MACHINE

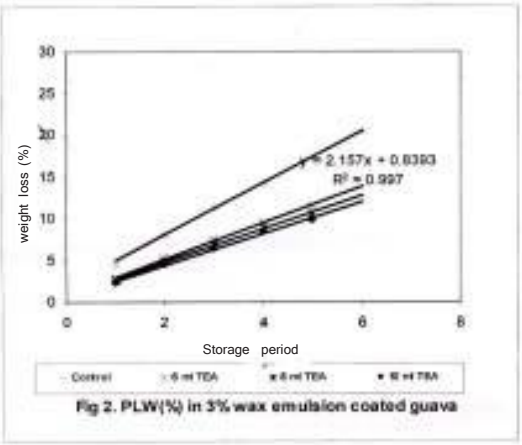

Fig 2. PLW(%) in 3% wax emulsion coated guava

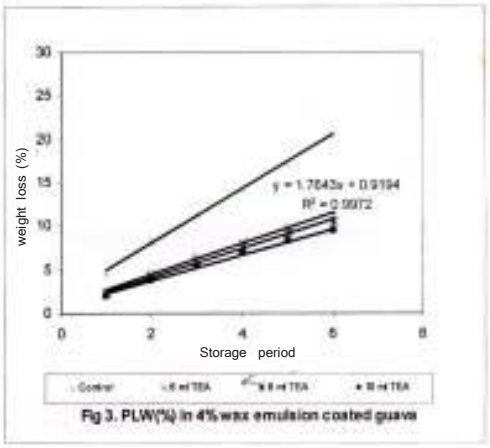

Fig 3. PLW(%) in 4% wax emulsion coated guava

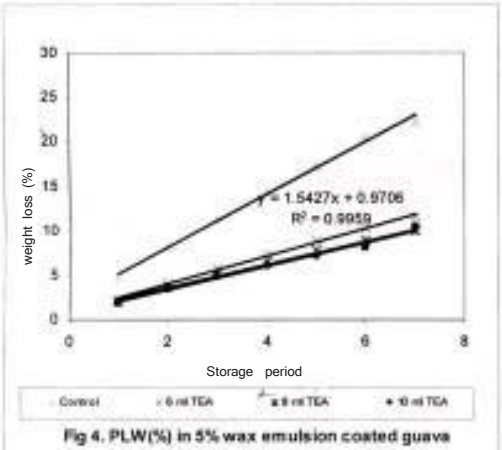

Fig 4. PLW(%) in 5% wax emulsion coated guava

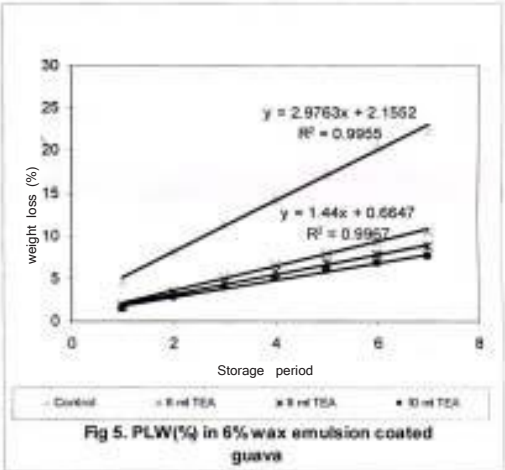

Fig 5. PLW(%) in 6% wax emulsion coated guava

harvest without significant effects on their total and reducing sugars, acidity and ascorbic acid content if they were treated with bavistin or dithane M-45 or 6 per cent waxol. Alache and Munoz (1998) stated that mango fruits treated with prima fresh 50-E wax extended the shelf life of fruits up to 21 days at low temperature and also maintains its quality and acceptability. Sapota treated with nature seal or candle wax and then with CIPA (Ethepon - 2000 mg/L), stored at 20° C up to 8 days showed no increase in shelf life with wax coating, but enhanced the appearance and significantly reduces the weight loss. Ozdemir and Dunder (2001) showed that weight loss of orange cv. Valencia fruits treated with hot water for 3 minutes at 53°C followed by wax coating was lesser than that of control. Wax treated fruits accumulated more ethanol during storage. Therefore, the wax coating method seems to be the cheapest and easy to practice for prolonging the shelf life of fruits by considering advantages *viz.* controlling moisture loss and respiration rate, enhancing appearance by the glossiness of the wax. Further, the wax-coated fruits can be easily accepted by the consumer and can also be exported to fetch more values under this liberalized economic policy.

Materials and Methods

A hand operated wax applicator has been fabricated and the schematic diagram is shown in fig 1. It consists of a feed hopper, cylindrical drum known as wax vat, impeller fitted with four paddles mounted on a shaft and outlet chute. A handle is provided at one end of the shaft to rotate the impeller at 10 rpm. The vanes are made up of perforated sheets with oblong perforations. The vanes are positioned at an angle of 45° to the tangent. This angle is greater than the angle of repose of guava fruits used for the experiment. The impeller is housed inside a casing which is split into two halves. The bottom half of the casing is used to hold the wax, also known as wax vat. The successive vanes of the impeller along with the casing form four pockets. These pockets receive the fruits from the feed hopper, conveying them through the wax emulsion contained in the wax vat and also deliver the fruits due to gravity through the outlet chute. The entire unit is supported on an L angle frame of convenient height.

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 100 g waxes with oleic acid (75-100 ml) as solving agent, triethonolamine (120-200ml) as emulsifying agent and hot water (1400 - 2600 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 guava *(60* - 70g) 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. 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 assessed by weighing the fruits during the storage period. The storage

Table 3. Effect of wax emulsion on Flavour, Texture, Taste and Overall acceptability based on organoleptic evaluation.

Treat-ments	Flavour	Texture	Taste	Overall acceptability	Flavour	Texture	Taste	Overall acceptability	Flavour	Texture	Taste	Overall acceptability	Flavour	Texture	Taste	Overall acceptability
	4th day of storage				5th day of storage				6th day of storage				7th day of storage			
T1	8.12	8.13	8.09	8.17	8.31	8.12	8.15	8.02	8.01	7.85	7.87	8.01	7.42	7.05	7.15	7.15
T2	8.26	8.17	8.17	8.31	8.25	8.15	8.16	8.25	8.05	8.01	7.85	8.05	7.51	7.23	7.31	7.21
T3	8.35	8.15	8.15	8.41	8.31	8.18	8.19	8.36	8.07	8.01	7.86	8.06	7.54	7.23	7.36	7.25
T4	8.03	8.16	8.03	8.38	8.12	8.11	8.02	8.05	8.01	7.92	7.96	7.89	7.01	7.05	7.09	7.04
T5	8.10	8.05	8.07	8.12	8.15	8.05	8.12	8.01	8.09	7.95	7.87	7.76	7.31	7.24	7.15	7.02
T6	8.15	8.31	8.15	8.34	8.13	8.11	8.09	8.09	8.04	7.96	7.90	7.82	7.25	7.36	7.24	7.21
T7	8.01	8.35	8.03	8.21	7.98	8.08	7.81	7.81	7.68	7.12	7.15	7.09	5.12	4.87	4.83	4.96
T8	8.07	8.21	8.02	8.26	7.95	8.12	7.35	7.85	7.68	7.05	7.17	7.08	5.05	5.12	5.23	4.81
T9	8.05	8.23	8.15	8.25	8.01	8.13	7.48	7.83	7.64	7.13	7.16	7.12	4.98	5.15	4.05	4.01
T10	7.98	7.85	7.95	7.85	7.12	7.45	7.15	7.03	6.15	6.05	6.08	6.01	3.98	4.12	2.67	2.45
T11	7.95	7.61	7.80	7.81	7.24	7.39	7.11	7.05	6.01	6.13	6.04	6.12	2.46	2.67	2.32	2.12
T12	7.92	7.35	8.01	7.92	7.23	7.48	7.15	7.02	6.08	6.09	6.12	6.08	2.23	2.34	2.67	2.13
Control	6.97	6.85	7.21	7.15	6.01	5.49	5.09	5.12	3.51	3.34	3.12	3.04	1.97	2.05	1.95	1.55

Mean values of three replications.

Treatments	SEd	CD (5%)	CD (1%)
Wax emulsion	0.082	0.163	0.216
Storage days	0.045	0.090	0.120
Wax x storage	0.165	0.327	0.433

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 guava fruits was found to be 275 ml.

The physiological loss in weight (PLW) gradually increased when the storage period extended. From the figure 2 it is observed that the PLW varied between 15.23 and 22.29% for the guava fruits coated with 3% wax emulsion after 7 days of storage period. The PLW was significantly lesser in T12 and higher in T10. In the same period, the unwaxed guava fruits recorded the highest PLW of 22.29% after 7 days of storage.

From the figure 3 it is found that the PLW was higher (13.17%) in T7 and lower (15.12%) in T9 after 7 days of storage. From the figure 4 and 5 it is observed that the shelf life of wax coated guava fruits could be increased to 7 days. Among the wax emulsion treatments, the PLW recorded the lowest (7.55%) in T3.

Generally after the above said storage peirods, the guava 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.

The capacity of the wax coating machine was found to 300 kg per hour. The cost of operation is Rs. 20/- per hour.

Flavour

Data presented in Table 3 indicate that there is significant loss of flavour during the storage period. The loss was highest in control (1.97) than with wax emulsion treated fruits. Among the wax emulsion treated guava fruits, the flavour retention was highest (7.54) in T3 after 7 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 7 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 guava 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 7 days of storage. The highest taste value of 7.36 was recorded in T3 followed by T2 and T6. The control lost all its taste after 7 days of storage. Banana treated with wax and rice starch possessed better taste than control during the 15 days storage period (Sarkar *et al.*, 1995).

Overall acceptability

Based on the organoleptic evaluation performed on the guava fruits, it was found

that the shelf life of 6 % wax emulsion treated fruits could stored up to 7 days and unwaxed (control) could be stored only up to 4 days. The other wax emulsion treatments like 3 % and 4% treated fruits could be stored up to 5, and 6 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 and triethanolamine as an emulsifying agent 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 guava and mango fruits could be extended up to 7 days against 4 days only for the unwaged (control) guava fruits.

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