Development of Composite Wax Formulation for Shelf- Life Extension of Papaya

RMNA Wijewardane and BMKS Thilakarathne
Institute of Postharvest Technology, Jayanthi Mawatha, Anuradhapura, Sri Lanka

Abstract

Loss of weight and reduction of overall quality characteristics of fresh fruits due to moisture evaporation and other metabolic activities are most critical economic problems for both producers and retailers. This affects for wilting and shriveling and also helps to higher economic loss and less demand for local produce. The present investigation relates to find out the applicability of different compositions of lipid based edible coating (wax) for shelf life extension of papaya, which include palm oil, glycerol, Sorbitan monooleate (tween 80) and guar gum. Papaya fruits harvested at correct maturity stage having 25% yellow colour strips on the fruits. Fruits washed with 200 ppm chlorine solution and air dried to remove surface water. Two different coating formulations were used in different concentrations of ingredients such as formula A; palm oil 2%, glycerol 30%, tween 80, 2%, guar gum 2% and formula B; palm oil 0.8%, glycerol 12%, tween 80, 0.8%, guar gum 1.2%. The treatment solutions were prepared by mixing wax formula with distilled water in 1:1 and 1:2 ratios. The fruits were analyzed for physicochemical and physiological characteristics such as physiological weight loss percentage, fruit firmness, and fruit juice pH, total soluble solid content and consumer acceptability by sensory evaluation using 16 trained panelists. Treatment (T_2) showed significantly higher performances ($p< 0.05$) compared to the other treatments tested. The selected treatment appeared to extend the shelf life of papaya up to 9 days at 29-32°C and 65%- 70% RH with appreciable retention of all quality parameters tested.

Key words: Edible coating, Papaya, Shelf-life, Storage

Introduction

The magnitude of postharvest losses in fresh fruits is estimated to be more than 30% depending upon the commodity and the technological level of postharvest operations. This reflects the lack of knowledge by postharvest handlers of the biological and environmental factors involved in the deterioration or the absence of adequate postharvest technologies required preserving fresh quality. Edible films and coatings have received considerable attention in recent years because of their advantages over synthetic films. The films are produced exclusively from renewable, edible ingredients and therefore are anticipated to degrade more readily than polymeric materials (Bourtoom, 2008).

Several composite films have been investigated with goal of combining the desirable properties of different materials to improve permeability characteristics. This approach enables one to utilize the distant functional characteristics of each class of film former (Kester and Fennema,1986). The main objective of producing composite film is to improve the permeability or mechanical properties as dictated by the need of a specific application (Kamper Fennema 1984). Examples of these studies are using lipid and hydroxyprophyl cellulose (Hagenmaier and Shaw 1990), fatty acid, gelatin and soluble starch (Arvanitoyannis et al. 1997). The present investigations relate to composition for preparing and evaluate the use of lipid based edible coating (wax) for fruits, which include palm oil, glycerol, Sorbitan monooleate (tween 80) and guar gum. Therefore, major objective of this study course to produce formula for preserving fruits by in cooperating ingredients that can be increased permeability characteristics, strength, and flexibility and general performance of coating formulation without adversely affecting colour or flavor thereof.

Materials and Methods

Papaya was harvested at commercial maturity level from farmer field at Anuradhapura. The fruits washed with 200 ppm chlorine solution and kept for air drying at room temperature. Palm oil, glycerol, Sorbitan

monooleate (tween 80) and guar gum were purchased from the market and coating solution was prepared on the percentage weight basis with distilled water with the concentrations of formula A; palm oil 2%, glycerol 30%, tween 80, 2%, guar gum 2% and B; palm oil 0.8%, glycerol 12%, tween 80, 0.8%, guar gum 1.2%. the treatment solutions were prepared by mixing wax formula with distilled water in 1:1 and 1:2 ratios. The fruits were treated with above solutions and allowed to air dry for fixing it with fruit peel properly. The quality of treated fruits was monitored in 3 day intervals for 9 days. Weight loss (OHAUS, model ARA 520, New Jersy, 07058,USA), Fruit firmness (Effegi penetrometer, model FT 327, Effegi, Alfonsine, Italy) were measyred. Total soluble solids (TSS) (ATAGO, model:HR 5, Japan), pH (pH meter, Thermoorin, model 230A, 9157,BN,Witchford, England), were measured during storage at 29-32°C and 65%- 70%RH. The sensory evaluation was conducted with 5 point hedonic scale (5- Like extremely, 4- Like, 3- Neither like or dislike,2- Dislike, 1- Dislike extremely) using trained panelists to evaluate the appearance (peel and flesh), texture, taste and overall acceptability.

Statistical analysis: Three replicates were used in each treatment and the results were assessed by completely randomized design. Each replicate consist of 20 fruits and mean separation was done by using Least Significant Difference (LSD) at $\alpha=0.05$. The nonparametric data were analyzed using Friedman test with Minitab statistical package.

Results and discussion

The weight loss decreased in the beginning from day 3 to day 6 except T_5 control. This was due to the fact that the coating consisting edible oil, guar gum and glycerol served as semi permeable membrane around fruit surface. However the fruits treated with (T_2) showed the minimum changes of weight loss than other treatments. Dorria (2007) reported that the use of jojoba oil as a coating significantly affect the reduction of weight loss percentage with its concentration increased. However weight loss was lowest in T_2 (3.7%) as compared to T_5 (control) having highest percent weight loss (6.1%) at the end of storage.

Table 1: Changes in weight loss %, Fruit firmness (N), pH and total soluble solids (TSS in °B) in coated papaya

Parameter	Treatments	Day 3	Day 6	Day 9
Weight loss %	T_1	2.2^{f}	1.2^{eg}	4.5^{b}
Initial value	T_2	1.8^{g}	1.1^{fg}	3.7^{ce}
	T_3	2.0^{f}	1.2^{g}	4.6^{b}
	T_4	2.0^{f}	1.4^{fg}	4.6^{b}
	T_5	3.0^{e}	4.3^{bc}	6.1^{a}
Fruit firmness(N)	T_1	170.0^{a}	165.1^{ab}	24.5^{fg}
Initial value: 178.4	T_2	144.1^{c}	56.8^{be}	34.5^{f}
	T_3	169.6^{a}	168.2^{a}	58.1^{de}
	T_4	175.7^{a}	172.7^{a}	23.2^{g}
	T_5	157.8^{ab}	68.5^{d}	23.1^{g}
Juice	T_1	5.9e	5.8^{f}	6.1^{b}
pH	T_2	5.7^{hij}	5.7^{hi}	6.1^{b}
Initial value: 5.6	T_3	5.8^{fgh}	5.9^{i}	6.3^{a}
	T_4	5.8^{fg}	5.9^{j}	6.3^{a}
	T_5	6.0^{d}	6.2^{b}	6.4^{a}
TSS (°B)	T_1	9.7^{e}	11.2^{b}	9.3^{f}
Initial value: 8.3	T_2	8.3^{i}	9.2^{f}	9.3^{f}
	T_3	10.3^{d}	11.1^{b}	11.2^{b}
	T_4	10.9^{c}	10.1^{d}	9.0^{h}
	T_5	9.7^{e}	11.9^{a}	9.1^{fh}

Means of the same parameter in the same column or in the same line with different letters are significantly ($p<0.05$) different T_1: Fomula A, 1:1 ratio; T_2: Fomula A, 1:2 Ratio; T_3: Fomula B, 1:1 ratio; T_4: Fomula B, 1:2; ratio T_5 : control (without any coating) formula A; palm oil 2%, glycerol 30%, tween 80, 2%, guar gum 2%. formula B; palm oil 0.8%, glycerol 12%, tween 80, 0.8%, guar gum 1.2%

The results of total soluble solids (TSS) in general showed an initial increase and then a decreasing trend except T2 and T3 which showed increase of TSS during storage. The fruits treated with T2: Formula A, 1:2 Ratio and T3: Fomula B, 1:1 Ratio are not significant. It was observed that the TSS and total sugar which were fairly low at harvest and increased as the storage period advanced due to hydrolysis of starch into sugars and after the completion of hydrolysis of starch, further increase in total soluble solid content and or in sugar content did not occur and hence a decline in these attributes are predictable (Smith et al. 1979).

The results showed the significant ($p<0.05$) decrease in fruit firmness during storage at 29-32°C and 65%- 70% RH. The fruits treated with T3 (Formula B 1:1 ratio) and T2 (Formula A, 1:2 Ratio) showed higher fruit firmness 58.1N and 34.5N, respectively at the end of storage. The retention of relatively higher fruit firmness under this treatment could be due to slower metabolic activities leading to slower ripening changes and delayed senescence. Rojas-Grau et al. (2007) found that, the calcium chloride and N-acetylcysteine containing apple puree-alginate coatings helped to maintain fruit firmness.

With the increase of acid content, the fruit juice pH was observed to be decrease and that among the different treatments; minimum pH was recorded in response to coating with Formula A, 1:1 ratio and 1:2 ratio significantly. Among the metabolic reactions, respiration is an important process, which may utilize organic acids as a substrate during the peak energy requirement of fruits, which usually commence with ripening leading to a decrease in pH (Sharma and Dashora, 2001).

The estimated median for appearance of peel, flesh, texture, taste and overall acceptability of waxed fruit were at the point which corresponding to the number 4 in the 5- point hedonic scale. There was no any significant difference ($p>0.05$) between the better performing treatment when comparing with the sample taken from the same cultivation at its same ripening stage. Therefore the wax treatment tested not given any significant changes of characteristics in consumer point of view, but the storage life can be extended.

Conclusion

The physicochemical and physiological characters of fruits were evaluated for 9 days storage and the fruits treated with T2: Formula A at the ratio of 1:2 exhibited better performances significantly ($P<0.05$) than other coating solutions tested. It extends storage life up to 09 days at 29-32°C and 65%- 70% RH with appreciable retention of all quality parameters.

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