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EXTENSION OF SHELF LIFE OF BANANA WITH WAX EMULSION

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A wax emulsion developed at these laboratories was investigated for its suitability to extend the shelf-life of banana. Freshly harvested green bananas were coated with the emulsion and changes in moisture content, total and reducing sugar, starch, ascorbic acidity, weight ratio of pulp to peel and respiration rate were determined. Results indicated that coating of bananas with the emulsion reduced gaseous exchange between the fruit and the outside atmosphere, thus modifying the atmosphere within the fruit without impeding the ripening process. The major characteristics associated with normal ripening were generally slower for coated fruits than for the fruits without coating. The rate of weight loss in the uncoated bananas was much greater than in the coated fruits under ambient conditions. The treated bananas had a good taste after ripening and no unwanted flavour was detected.

Key words: Banana, Shelf life of banana, Preservation of banana.

Introduction

Bananas are important to local food economics because of the quantum of production and popularity. Grown in Sindh region, bananas are transported to all parts of the country by train and truck. A substantial quantity of the fruit is wasted in the existing channels of commerce, particularly because of exposure to high temperature. The wastage can be reduced by appropriate post harvest practices and technology. One of the standard commercial practices to reduce desiccation and increase shelf life of certain fruits is to coat the fruits with wax and other emulsion. Lowings and Cutts [1] have described a fruit coating named Prolong, which consisted, principally, of sucrose esters of fatty acids and sodium carboxy methyl cellulose. Bananas coated with prolong were shown to degreen and accumulate sugar more slowly during ripening than untreated fruits [2]. Semperfresh is another newer coating material which is also based on sucrose esters of fatty acids and carboxy methyl cellulose. Freshly harvested banana coated with Semperfresh had a reduced climacteric peak and the duration of the climacteric was extended [3].

A fungicidal wax emulsion was developed in our laboratories for extending storage life of citrus fruits [4]. A process for the preparation and application of the emulsion on oranges was leased out for commercial purposes under the name Fruitex Application of Fruitex on bananas, however, did not give satisfactory results. The emulsion was, therefore, modified by changing the composition and ratio of the ingredients. The present work investigated the effect of coating bananas with this new emulsion on the ripening process under ambient condition.

Material and Methods

Bananas were purchased from the local market in the green stage. Bananas free from bruises and spots were washed and air dried. They were divided into two equal lots. The first lot was diped in emulsion containing 3% wax for 3 mins followed by air drying with an electric fan. Second lot was kept as control. Both lots were kept at 20-22° and relative humidity ranging between 30 and 70% during the experimental period.

The weight of each lot of fruits was determined at two day intervals and percentage moisture loss calculated. The weight of pulp and peel from each lot was noted and ratio of pulp weight was determined. The banana fingers were removed manually and subjected to various physical and chemical analysis during storage, which included:

Moisture. Moisture content of the whole bananas was determined by AOAC method [5].

Pulp and peel. Ten bananas from both groups were taken at random, and the peels separated from the pulp, and the weights of pulp and peels were determined separately.

Starch and sugars. 20 to 25.0 grams of banana pulp were homogenized in about 100 ml of warm water in an electric blender. The whole mixture was transferred to a 250-300 ml beaker. An equal portion of 50% ethyl alcohol was added and allowed to stand for 1 hr. The mixture was centrifuged until the precipitate was closely packed to the bottom of the bottle. The supernatant was separated and the precipitate was made free of soluble sugars by successive washings with 50 ml portions of 50% ethyl alcohol. Sugars were determined in the supernatant, according to the method of Lane and Eynon [6].

Precipitate from the bottle was transferred to a 250-300 ml beaker with 50-60 ml of warm water. The beaker was immersed in boiling water with constant stirring until all the starch was gelatinized. Starch was determined according to the procedure as outlined in AOAC [5].

Acidity and ascorbic acid. Fifty gms of fresh banana pulp from each group were weighed and homogenized separately in a waring blender with 480 ml of distilled water for 5 mins. Both

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mixtures were centrifuged and the supernatants collected in 500 ml measuring flasks separately, and volumes were made up to 500 ml with distilled water. 20 ml from each of the prepared mixture were titrated against O. IN NaOH using phenolphthalein as indicator and expressed as ml of O.IN NaOH required to neutralize 100 gm of fresh pulp.

Ascorbic acid was estimated from the above prepared solutions according to Barkat *et al.* [7] and expressed as mgm per 100 gm.

Respiration rate. This parameter was measured by continuous current method as described by Paul Thomas *et al.* [18]. Air was passed through 40% KOH solution to make air supply to banana free of CO_2. The CO_2 evolved was absorbed in standard Ba $(OH)_2$ solution which was titrated against standard H_2SO_4. The results were expressed as mg CO_2 evolved per Kg of banana per hr. The treated bananas were checked for taste and flavour after ripening.

Results and Discussion

Weight loss. The rate of weight loss in the untreated bananas was greater than that in the emulsion treated fruits (Table 1). The untreated bananas lost 14.8% weight after storage for 7 days as comapred to 8.6% in the treated ones. Weight losses in treated bananas on the 12th day of their storage were almost the same as those in untreated samples on the 7th day. This means that the shelf life of bananas can be extended, through use of the emulsion.

Pulp and peel contents. Table 2 indicates that there was an increase in pulp weight and a decrease in peel weight as the bananas ripened. There was increase in the weight ratio of pulp to peel from 1.8 : 1 to 2.7 : 1, by the 7th day in the control group. Almost the same ratio (2.8 : 1) was observed in the emulsion treated bananas on the 12th day of storage, thus showing that the rate of ripening was delayed in these samples. The study also indicates that weight ratio of pulp to peel i.e. 2.7 : 1 may be considered as a criterion to judge the maturity standard of bananas.

Starch and sugar. Starch and sugars are among the important criteria used for the determination of ripening and storage behaviour of banana. The relative composition of these two constituents is very much dependent on the stage of maturity. It could be observed from Table 3 that initial starch and total sugar contents were 17.5% and 2.5% respectively in unripe bananas. A sharp rise in total sugars content and a decline in starch were observed as the banana ripened as expected. Reducing and total sugars reached their maximum level of 6.0% and 17.9% respectively in untreated bananas on the 7th day of storage. Starch was almost completely hydrolysed with only 2.1% remaining in the fully ripe bananas. In contrast, the rate of hydrolysis of starch in the treated samples was not so rapid. Starch content decreased to a level of 2.5% whereas total sugars and reducing sugars were increased to 17.5% and 7.%% respectively on the 12th day of storage. This shows that the storage period of the treated samples was extended.

Acidity and ascorbic acid. Results in Table 4 show greater decrease in pulp acidity in control banana than in treated fruits. Ascorbic acid content of both samples fell

TABLE 1. PERCENTAGE LOSS IN WEIGHT OF BANANAS DURING STORAGE AT 20 -23° AND 30-70% RELATIVE HUMIDITY.

Sample	4th day % loss	7th day % loss	10th day % loss	12th day % loss
Control	7.9	14.8	–	–
Emulsion treated	4.3	8.6	12.7	15.8

TABLE 2. BANANA PULP AND PEEL WEIGHTS DURING STORAGE AT 20-23° AND 30-70% RELATIVE HUMIDITY.

Sample	Ist day		4th day		7th day		10th day		12th day	
	Wt. gm	Pulp to peel ratio	Wt. gm	Pulp to peel ratio	Wt. gm	Pulp to peel ratio	Wt. gm	Pulp to peel ratio	Wt. g	Pulp to peel ratio
Control pulp	64.5	–	69.5	–	73.0	–	–	–	–	–
Peel	35.5	1.8:1	30.5	2.2:1	27.0	2.7:1	–	–	–	–
Emulsion treated pulp	64.5	–	67.0	–	68.0	–	72.4	–	74.0	–
Peel	35.5	1.8:1	33.0	2:1	32.0	2.1:1	27.6	2.6:1	26.0	2.8:1

TABLE 3. PERCENTAGE OF STARCH, TOTAL SUGAR AND REDUCING SUGAR (mg/100 gm) OF BANANA PULP.

	Ist day			4th day			7th day			10th day			12th day		
	Starch	Total sugar	Reducing sugar	Starch	Total sugar	Reducing sugar	Starch	Total sugar	Reducing sugar	Starch	Total sugar	Reducing sugar	Starch	Total sugar	Reducing sugar
Control	17.5	2.5	1.0	9.0	11.0	4.0	2.1	17.9	6.0	–	–	–	–	–	–
Emulsion	17.5	2.5	1.0	12.2	7.8	3.0	6.5	13.5	5.0	5.4	14.6	6.0	2.5	17.5	7.5

steadily during the storage period and loss of vitamin C was slightly higher in control than in the treated bananas. The decrease in acidity and vitamin C is due to physiological changes as a result of ripening upon storage.

Respiration rate. Figure 1 demonstrates that the rate of CO_2 liberation during the ripening stage was less in the treated fruits than in the control. This indicates that the emulsion treatment prolongs the ripening stage of bananas.

It was observed from respiration curve that rate of respiration of ripened treated banana was 112 mg CO_2/Kg/Hr. at the ripened stage whereas in the control group this was 130 mg/CO_2/Hr. After reaching the peak the respiration rate fell slowly in the treated sample as the banana enters a senescent decline. In contrast, the control samples evidensed a sharper declines this indicates that the climacteric process occured faster in the control group.

After ripening the taste of the treated bananas was found good and no unwanted flavour was detected.

TABLE 4. ASCORBIC ACID AND TOTAL ACIDITY AT VARIOUS STAGES IN 100 mg OF BANANA PULP.

	Total titrable acid ml 0.1 N NaOH		Ascorbic acid contents in mgm	
	Control	Emulsion Treated	Control	Emulsion Treated
Ist day	62.5	62.5	5.0	5.0
4th day	50.0	55.0	4.0	4.0
7th day	27.5	37.5	3.5	3.5
10th day	–	30.0	–	3.0
12th day	–	27.5	–	3.0

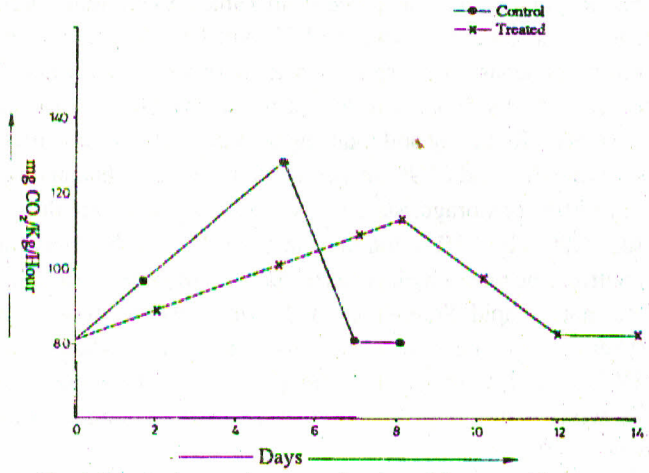

Fig. 1. Respiration rate in untreated and emulsion treated bananas.

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