

**EFFECT OF DIFFERENT PREPARATION METHODS OF BEESWAX
COATING AT DIFFERENT STORAGE TEMPERATURE
ON SABA BANANA**

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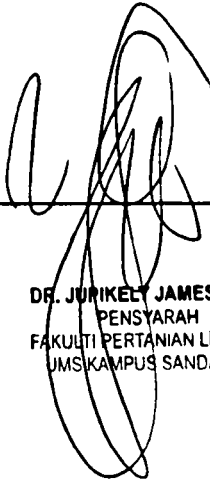
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ABSTRACT

Saba banana is highly perishable and has short shelf life. Thus, coating application is an alternative solution to this problem. The objectives were to examine whether the application of beeswax coating would influence the shelf life of saba banana and the most suitable preparation of beeswax coating to lengthen its shelf life. For this research, the experimental design was RCBD and each finger of saba banana had been tested on different preparation of beeswax coating (mixed with sunflower oil and coconut oil or corn oil) and with a control (no coating). Each treatment had 3 replicates and was observed under three different storage temperature ($13\pm 2^{\circ}\text{C}$, $26\pm 2^{\circ}\text{C}$ and $30\pm 2^{\circ}\text{C}$) on week 0 (day zero), 1 (day seventh), 2 (day fourteenth), and 3 (day twenty first). Parameters examined were visual appearance, weight loss, colour, firmness, total soluble solid, pH and titratable acidity. The results were analysed using ANOVA. From the results, both preparation of beeswax coating were similarly effective in extending shelf life of saba banana which no coating application was not capable of. The result was even better when the samples were stored under refrigerated condition ($13\pm 2^{\circ}\text{C}$).

KESAN PELBAGAI JENIS CARA PENYEDIAAN SALUTAN LILIN LEBAH DALAM SUHU SIMPANAN BERBEZA PADA SABA BANANA

ABSTRAK

Pisang saba merupakan buah yang mudah rosak dan mempunyai jangka hayat yang pendek. Oleh itu, kaedah salutan lilin adalah satu penyelesaian alternatif untuk masalah ini. Tujuan-tujuan adalah untuk mengkaji sama ada kaedah salutan lilin lebah akan mempengaruhi jangka hayat pisang saba dan cara penyediaan lilin lebah yang paling sesuai untuk memanjangkan jangka hayat buah tersebut. Bagi kajian ini, reka bentuk eksperimen ialah RCBD dan setiap buah pisang saba akan dikaji dengan penyediaan lilin lebah yang berlainan serta pemalar (tiada salutan). Setiap rawatan ada 3 replikat dan akan diperhati di bawah tiga suhu simpanan yang berlainan ($13\pm 2^{\circ}\text{C}$, $26\pm 2^{\circ}\text{C}$ and $30\pm 2^{\circ}\text{C}$) pada minggu 0 (hari zero), 1 (hari ke-tujuh), 2 (hari ke-empatbelas), dan 3 (hari ke-dua puluh satu). Parameter yang dikaji termasuk penampilan visual, penurunan berat buah, kekerasan isi, jumlah kadar pepejal larut, pH, dan tertitrat keasidan. Keputusan dianalisis dengan menggunakan ANOVA. Daripada keputusan-keputusan yang diperolehi, kedua-dua penyediaan lilin lebah sama-sama efektif dalam memanjangkan jangka hayat pisang saba yang tidak dapat dicapai oleh tiada salutan. Keputusannya lebih bagus apabila sampel-sampel disimpan di dalam peti sejuk.

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LIST OF SYMBOLS, UNITS AND ABBREVIATIONS

ANOVA	Analysis of Variance
°C	Degree Celcius
%	Percentage
g	Gram
mg	Milligram
w/v	Weight per Volume
SSA	School of Sustainable Agriculture
UMS	Universiti Malaysia Sabah



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CHAPTER 1

INTRODUCTION

1.1 Background

Saba banana, which its scientific name is *Musa paradisiaca* L., is a cooking banana, though it can be eaten raw. It has the largest and tallest stem, attaining a height of 4m. It may be the easiest to grow, very commonly grown in home backyard, hardy and resistant to drought. Saba banana bunches are big, a bunch with 8-16 combs having 12-20 fingers per comb. The fingers are angular with yellowish rind when ripe but greenish yellow angles. The thick rind peels off readily when ripe. The pulp is firm and contains seeds. The male bud, named as *puso*, is normally used as a vegetable. The fruit is also processed into flour and made into banana biscuit. It is also processed as an infant or diabetic food. Some use it to make banana chips. Besides, certain brand of catsup uses the fruit as its main component.

1.2 Problem Statement

The main problem for the harvesting of saba banana is the short storage life in which they have rapid metabolism and tend to release heat. However, there are not much postharvest technologies to solve this problem due to its low popularities.

1.3 Justification of Study

Saba banana has short storage life since it turns ripe in short period. Therefore, to deal with the problem, this experiment of beeswax coating aimed to determine whether it will bring any effect to saba banana since beeswax coating has been found effective in decreasing the degree of browning of fresh-cut apples.



1.4 Objective

This research aims to determine whether applying beeswax coating will bring any changes to saba banana. Besides, it also aims to determine the most suitable preparation of beeswax to coat on saba banana.

1.5 Hypotheses

H_0 : There was no significant difference between the effects of control and beeswax coating on saba banana.

H_A : There was at least one significant difference between the effects of control and beeswax coating on saba banana.

CHAPTER 2

LITERATURE REVIEW

2.1 Saba Banana

Musa paradisiaca L., commonly called Kaila in Pakistan, is traditionally used for the treatment of inflammation, rheumatism, gripe, diabetes, hypertension, cough, and bronchitis. Unripe bananas are astringent and their ashes are used to treat diarrhea. Plantain juice is used as an antidote for snake bite. In ethnoveterinary medicine, *Musa paradisiaca* L. is used to treat the hooves and injuries while its green fruit is used for the treatment of diarrhea. The young leaves of *Musa paradisiaca* L., locally named viniveh (guyud variety), are used to treat fever and headache by forehead external application with oil.

The antioxidant activity of banana peel extracts (*Musa x paradisiaca* L.) was studied using an experimental model of rats subjected to a normal diet compared to rats with a diet rich in fatty acids. Animals treated orally with banana peel extract showed significantly decreased concentrations of peroxidation products (MDA), hydroperoxides, and conjugated dienes. At the same time, the enzymatic activities of catalase and superoxide dismutase increased significantly in treated animals, as well as the concentration of reduced glutathione.

2.2 Postharvest Quality of Saba Banana

It is very important to concern the postharvest quality and apply respective postharvest technology to prolong the storage life and preserve the quality of saba banana.



2.2.1 Visual Appearances

Visual appearances are the most common and important means of quality assessments of food products. It is one of the key factors for consumers in purchasing fresh produce. Many aspects can be included and referred for the evaluation of visual appearance, including colour or glossiness and percentage decay.

Frequently, fruit ripening and vegetable yellowing involve the unmasking of yellow-to-orange xanthophylls and carotenes by the disappearance of chlorophyll (Chen and Ramaswamy, 2002). Thus, measurement of changes in pigments is important in understanding the physiology of ripening and senescence. In measuring changes in visual impact however, it is more important to detect physical changes in the appearance. In selecting colour-measuring equipment, careful attention must be paid to the specific applications desired and the range of commodities or products to be tested. In the experimental stage, sample orientation and light aperture are critical (Clydesdale, 1991). Although colour is related primarily to maturity or purchase quality, it may also contribute to consumption quality.

2.2.2 Weight Loss

Loss of postharvest fruit weight is related to water loss, especially from the fruit peel. Water loss in fruits indicates an increase in deformation and puncture pressure with resulting loss of firmness and turgidity. The fluctuation in temperature will bring rapid water loss from the stored fruits (Kong, 2012).

2.2.3 Firmness

The firmness of a fruit is normally evaluated using a penetrometer. When the fruit becomes riper, it will turn soft to be touched. The firmness differs with the environment and the culture practice. More nitrogen can cause the fruit to be softer other than increased watering and more rainfall (Silip, 2014).

Fruit firmness can be estimated by determination of the permanent fruit deformation. As the fruit matures and becomes senescence, deformation increases. This

is highly correlated with the loss of fruit moisture which occurs predominantly from the peel. (Kong, 2012)

2.2.4 Titratable Acidity

When the fruit matures, percentage of acidity will naturally decrease though total acid increase. Acidity is measured by titrating 0.1N NaOH and indicated using phenolphthaline. The unit of measurement is ml NaOH / 100g fruit juice. The acidity varies with the places. It is found that cooler area produce fruits with higher content of acidity.

2.2.5 pH

pH carries the definition of the logarithm of the reciprocal of hydrogen ion concentration in gram per litre. Measure of the active acidity is important since it affects the flavour or palatability of a product and affects the processing requirements (Kong, 2012).

2.2.6 Total Soluble Solid

Total soluble solid content of a solution is determined by the index of refraction which is measured using hydrometer or refractometer, and is referred to as degrees Brix ($^{\circ}$ Brix). $^{\circ}$ Brix is a measure of soluble solids of a solution only in the case of pure sucrose solution. It is widely used during fruit processing to determine the concentration of sugar in the products. When the fruit matures and becomes soft, total soluble solid will increase. (Kong, 2012)

Concomitant with the decline of ethanol fraction and starch is an increase in ascorbic acid, total soluble solids, total soluble sugars, and total titratable acidity. Total soluble solids increase to about 16 $^{\circ}$ Brix. The total sugars begin increasing 1–2 days from harvest at the same time as the increase in respiration. Ethanol-soluble sugars increase rapidly as ripening progresses. Glucose and fructose reach a maximum concentration 5 days after harvest. (Sawant and Dongre, 2014)

2.3 Factors Effecting Postharvest Quality of Saba Banana

2.3.1 Effect of Edible Wax Coating to Postharvest Life of Harvest Produce

The technique of application of edible films and coatings is especially suitable for the preservation of fresh and minimally processed foods, compared to techniques such as modified atmosphere packing and antimicrobial packaging, since it offers a unique possibility of incorporation of biologically active substances in the film or coating, such as the vitamins or natural antimicrobial agents.

The fresh fruits and vegetables are food products that are fragile and especially prone to fast decay and deterioration. The minimal processing technique is particularly suitable for this class of food products since they are rich in biologically active compounds that are easily degradable if using some harsh preservation techniques, such as the thermal processing. The edible films and coatings are being extensively used nowadays for the preservation of fruits and vegetables.

2.3.2 Beeswax Coating

There are not many studies regarding the incorporation of natural biologically active compounds in beeswax coating, separately or as a component of some natural product.

According to Hagenmaier (1998), beeswax emulsions with low turbidity could only be made by mixing the beeswax with other waxes. Beeswax emulsions were difficult to make by the water-to-wax method due to its very high viscosity before inversion. Formulations with more than 50% beeswax had 20-30% cream and very high turbidity. Beeswax coatings also tended to have low gloss.

In the study by Ruzaina *et al.* (2013), the beeswax was melted first at 65°C in an oven prior to use and diluted with distilled water in the ratio of 6:4 (beeswax: distilled water) with ten percent of soy lecithin added into beeswax as an emulsifier. Beeswax had SMP high at 48°C due to high percentage of palmitate which is around 70% (Monedero *et al.*, 2009).

CHAPTER 3

METHODOLOGY

3.1 Preparation of Materials

216 fingers of saba banana, which were uniform in colour, shape and size other than free from diseases and defects, from the second until the fourth comb from the bunches were bought from the farm located near the campus of Faculty of Sustainable Agriculture, Universiti Malaysia Sabah and were transported immediately to the Postharvest Laboratory for carrying out experiments.

Beeswax was collected from Gombizau Honey Bee Farm located in Matunggong, Sabah. For the first treatment, 25g of beeswax, 60mL of coconut oil and 50mL of sunflower oil were mixed and stirred on a low flame to obtain a homogenous mass that would become vicious upon cooling. For the second treatment, 25g of beeswax, 60mL of corn oil and 50mL of sunflower oil were mixed and stirred on a low flame to obtain a homogenous mass that would become vicious upon cooling.

3.2 Postharvest Quality Analysis

The parameters examined were classified into physical and chemical measure. Physical measurements included visual appearance, firmness and weight loss whereas chemical measurement consisted of titratable acidity, pH, and total soluble solid. 18 replicates for each treatment were removed from storage for analysis purposes.



3.2.1 Visual Appearance

A subjective hedonic score for visual appearance was evaluated according to Cantwell *et al.* (2001); Mercado-Silva *et al.* (1998); and Cantwell *et al.* (1992). The evaluation was based on a scale of 9 to 1 where:

9: 0% defects

7: up to 25% defects

5: 50% defects

3: 75% defects

1: 100% defects

A score of 6 (37.5% defects) was considered to be the limit of acceptable visual appearance.

3.2.2 Weight Loss

Initial weight of each sample was measured using electronic balance before storage to get initial weight. The percentage of weight loss was calculated according to the formula:

$$\% \text{ Weight loss} = (W_1 - W_2) / (W_1) \times 100\% \quad (3.1)$$

Where:

W_1 = fruit weight at initial period

W_2 = fruit weight at sampling period

3.2.3 Firmness

Firmness of saba banana was measured using a penetrometer. The saba banana was sliced into halves. A force was applied to the pulp of the fruit, allowing the probe of the penetrometer to penetrate into the fruit flesh. The reading was given according to the firmness shown on the penetrometer. The reading of saba banana firmness was taken in unit kilogram force (kgf) and converted to N, in which 1kgf equals to 9.80665N)

3.2.4 Titratable Acidity

0.1N sodium hydroxide was prepared by weighing 4g of sodium hydroxide and dissolve in 1L of distilled water. Next, phenolphthalein which acted as indicator was prepared. Then 30g of sample was blended with 90mL of distilled water for 2 minutes. The mixture was then filtered by using cotton filter.

Then, 10mL of titrate was transferred into 125mL conical flask. Three drops of phenolphthalein indicator was added and stirred. The titrate was then titrated with 0.1N of sodium hydroxide until it changed to pink colour. The results were expressed as % of malic acid in fresh pulp weight by using the formula:

$$\text{Percentage of titratable acidity} = \frac{\text{Titre (mL)} \times \text{Normality of NaOH (0.1N)} \times \text{Volume made up} \times 64\text{g} \times 100}{\text{Sample volume (10mL)} \times \text{Sample weight} \times 100} \quad (3.2)$$

3.2.5 pH

The pH value was taken by measuring the titrate with pH meter.

3.2.6 Total Soluble Solid

The total soluble solid (TSS) was measured by using Refractometer. Three drops of the filtrate had been prepared was placed on the prism of the refractometer. The refractometer was then pointed towards a light source to get the accurate reading of the percentage of TSS in Brix unit.

3.3 Experimental Design and Statistical Analysis

The samples were further divided to be stored under three different storage temperature ($13\pm 2^\circ\text{C}$, $26\pm 2^\circ\text{C}$ and $30\pm 2^\circ\text{C}$) and were left for observation on week 0 (day zero), 1 (day seventh), 2 (day fourteenth), and 3 (day twenty first).

The data collected from the research were analysed with Analysis of Variance (ANOVA). The means were subjected with Tukey at significance level of 0.05.

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