

## MATURITY INDICES OF BANANA (*MUSA SAPIENTUM* CV. BERANGAN)

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*Keywords:* Maturity indices, Berangan banana, Physico-chemical characteristics, Ability to ripen.

### RINGKASAN

Satu kajian indeks kematangan pisang Berangan yang diperolehi dari Sabak Bernam, Selangor telah dijalankan. Buah yang berusia di antara enam hingga 14 minggu selepas pengeluaran jantung telah dikaji. Proses kematangan buah didapati bermula pada minggu kesepuluh berdasarkan maklumat-maklumat asas rupa bentuk, sifat-sifat fizik, kandungan kimia dan kualiti organoleptik buah selepas masak. Kandungan kanji, pH pulpa dan nisbah ukuran panjang : garispusat jejari buah didapati mempunyai perkaitan yang rapat dengan kematangan. Nilai-nilai nisbah berat isi : kulit, jumlah keasidan tertitrat dan kandungan gula buah tidak disyorkan sebagai indeks kematangan untuk pisang Berangan.

### INTRODUCTION

Maturity index is considered as one of the most important influential quality determination factors in postharvest handling of horticultural produce. It serves as a guidance in estimating the right maturity stage for harvesting. The criteria for maturity, which differ among varieties and species, have been discussed in detail by PANTASTICO, SUBRAMANYAM, BHATTI, ALI and AKAMINE (1975). Despite the importance of such factors, information on Malaysian fruits is still lacking. The inadequacy may pose problems in developing an effective post-harvest handling system, especially in our effort to introduce local fruits for specific markets.

The work on maturity indices of two local banana cultivars, Mas and Embun had been reported by ANON. (1979) and ABDULLAH, ROHAYA and ZAIPUN (1985) respectively. Physical and chemical changes during maturation were used as parameters in formulating the maturity indices for both cultivars. However, such work has not been done on another local popular cultivar, Berangan. In the Philippines, Berangan is widely grown in some banana plantations for export, which clearly shows its great market potential (PESSOA, *pers. comm.*, 1985). The maturity indices for Berangan are reported in this paper.

### MATERIALS AND METHODS

#### Fruit

Eighty banana (Berangan cultivar) plants were tagged randomly during flower emergence from March to May 1983 in a private farm at Sabak Bernam, Selangor. The fruit were harvested weekly starting from six weeks after tagging. The harvested fruit were immediately transported to the laboratory of the Food Technology Division in Serdang, Selangor. During transportation, the fruit were cushioned by a layer of five-centimetre thick sponge to reduce physical injuries.

#### Sampling

Each fruit bunch was divided into three portions, namely upper, middle and lower portions. The upper portion refers to the bigger cut end of the bunch stalk. The peel colour development, the nature of stylar ends and shape of the fruit of the first, middle and last hands of the bunch were observed and recorded.

#### Physical Properties, Chemical Analysis and Sensory Evaluation

Observations on the physical properties, chemical analysis and sensory evaluations of fruit were done according to

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Table 1. General characteristics of Berangan banana harvested at different maturity stages

Maturity stage (week)	Portion of bunch	Peel colour <sup>+</sup>	Stylar ends <sup>++</sup>	General appearance of fruit
6 & 7	Upper	1	1	Immature, small and very angular. Unable to ripen.
	Middle	1	1	
	Lower	1	1	
8 & 9	Upper	1	1	Immature, small and very angular. Unable to ripen satisfactorily.
	Middle	1	1	
	Lower	1	1	
10	Upper	2	2	Formation of rust-like spots. Fruit of upper portion of bunch slightly mature. Ripened satisfactorily.
	Middle	1	1	
	Lower	1	1	
11	Upper	2	2	Slightly mature and angular. Formation of rust-like spots. Ripened satisfactorily.
	Middle	2	2	
	Lower	1	1	
12	Upper	2	3	Fruit from upper and middle portions of bunch were round and full with less visible angles except the lower portion. Formation of rust-like spots. Ripened satisfactorily.
	Middle	2	3	
	Lower	2	3	
13	Upper	2	3	Round and full. Severe formation of rust-like spots. Ripened satisfactorily.
	Middle	2	3	
	Lower	2	3	
14	Upper	2	3	Round and full. Severe formation of rust-like spots. Some fruit at upper portion of bunch ripened before harvesting.
	Middle	2	3	
	Lower	2	3	

<sup>+</sup>Peel colour : 1 = Light green; 2 = Dark green.

<sup>++</sup>Stylar ends : 1 = Attached firmly; 2 = Attached loosely, brittle; 3 = Attached very loosely, very dry.

the methods described by ABDULLAH *et al.* (1985).

## RESULTS AND DISCUSSION

### General Characteristics

Table 1 summarizes the general characteristics of Berangan banana harvested between six and 14 weeks after flower emergence. The peel colour changed gradually from light green to dark green while the stylar ends became brittle and loosely attached to the fruit as maturation progressed after ten weeks. The fruit changed from angular to round and full notably with less visible angles as the stage of maturation progressed. Rust-like spots on the peel started to form and multiply after nine weeks. Complete changes in maturation were observed after 12 weeks. The fruit started to ripen on the plant at the 14th week.

The suitable maturity stage for harvesting Embun banana was reported (ABDULLAH *et al.*, 1985) to be 12 weeks after flower emergence, *i.e.*, two weeks later than Berangan. Contrary to Embun, the peel colour of Berangan changed from light green to dark green, a distinctive characteristic of this cultivar. In addition, rust-like spots were formed on the peel. However, these spots cannot be used as maturity index as they are suspected to be a form of pathological infection.

### Fruit Length to Diameter Ratio

The changes in the fruit length to diameter ratio (L:D ratio) of Berangan at different maturity stages are shown in Figure 1. The L:D ratio for the fruit from the upper portion of the bunch decreased significantly from the sixth to the seventh week. The ratios for fruit of middle portion,

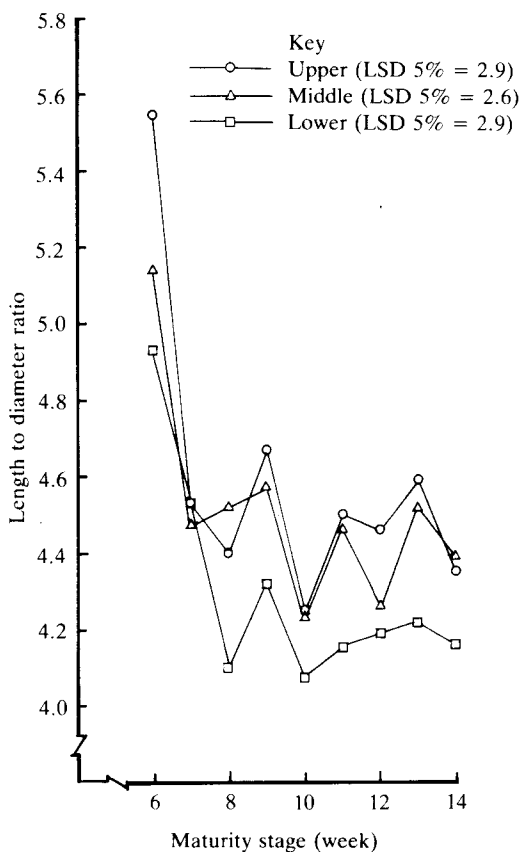


Figure 1. The changes in fruit length to diameter ratio of Berangan banana from different portions of bunch harvested at different stages of maturity.

harvested at sixth and seventh week, were not significantly different. However, ratio of similar trend was also observed from sixth to eighth week as compared with the upper and lower portions. There was a significant decrease in the L:D ratio for fruit obtained from the upper and middle portions at ninth to tenth week. However, no significant difference was observed in fruit of the lower portion harvested between eighth and 14th week. As the fruit in the upper and middle portions were reasonably mature at ten week, the significant reduction in the L:D ratio at the ninth week compared with that of the tenth week could also serve as a good index of assessing the maturity of Berangan banana.

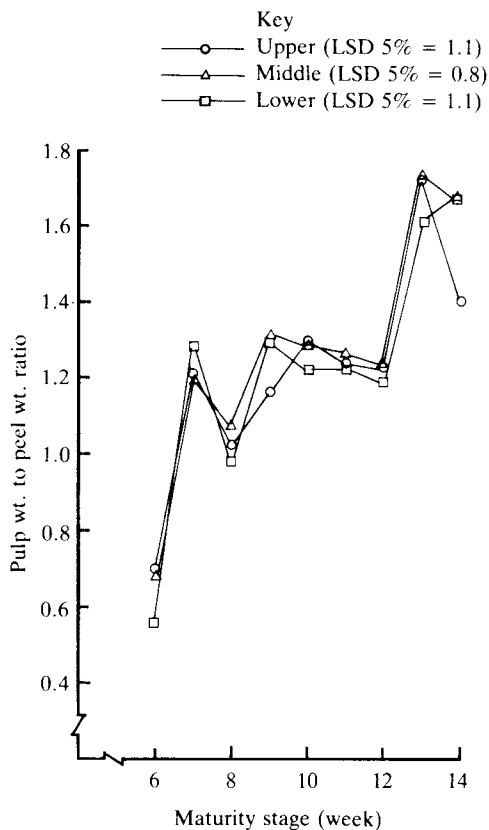


Figure 2. The changes in pulp weight to peel weight ratio of Berangan banana from different portions of bunch harvested at different stages of maturity.

### Pulp Weight to Peel Weight Ratio

Figure 2 shows the changes in the pulp weight to peel weight ratio (P:P ratio) of fruit from different portions at different maturity stages. Generally, the ratio increased as the fruit became more mature. However, the increase was not continuous as significant reductions were observed between the seventh and the eighth week in all portions of the bunch. For the upper portion, another significant reduction was observed after the 13th week, whereas it was between the ninth and the tenth week in the lower portion. For middle portion, the values were almost constant from the ninth to the 12th week.

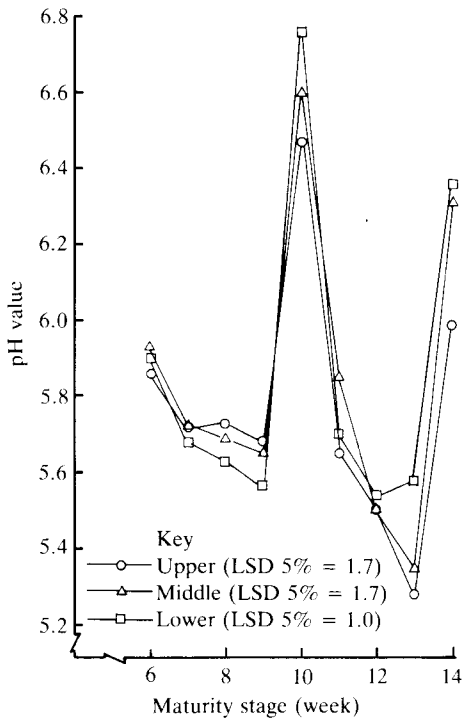


Figure 3. The pH changes in the pulp of Berangan banana harvested at different stages of maturity.

The P:P ratio of Berangan cannot be used as a maturity index as there was no clear difference in the changes between the tenth and the 14th week. This is not in agreement with Embun banana where the values increased continuously until ripening stage (ABDULLAH *et al.*, 1985).

### pH Value of Pulp

There was a distinct change in the pH of pulp of fruit from all portions of the bunch during maturation (Figure 3). The pH decreased continuously until the ninth week followed by a sudden increase at the tenth week. After this period, it decreased significantly but rose again at the 14th week. Similar trend was also observed in Embun banana, where the pH reached its maximum at the 12th week (ABDULLAH *et al.*, 1985). The results confirm the finding that pH changes simultaneously with fruit maturation and hence pH can be used as a good chemical maturity index.

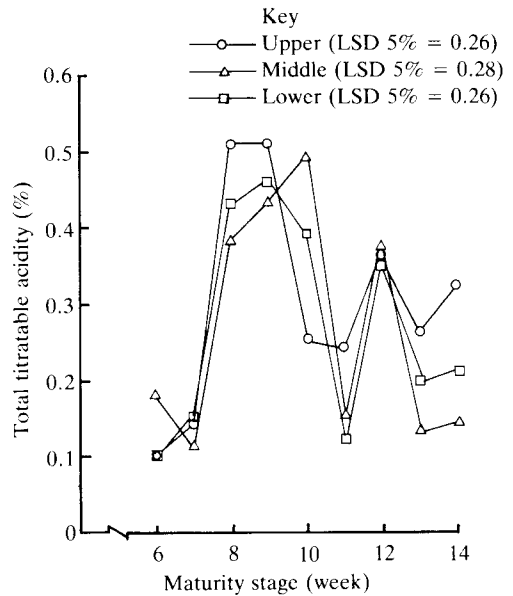


Figure 4. The total titratable acidity composition of Berangan banana harvested at different stages of maturity.

### Total Titratable Acidity

The total titratable acidity (TTA) increased significantly from the seventh to the eighth week in all portions of the bunch (Figure 4). The TTA of fruit from the upper portion remained high for another week. The fruit from the middle and the lower portions, however, maintained the high acidity levels for the next two weeks. This was followed by a significant decrease in the following week. Although the TTA value peaked again at 12th week in all the portions, this was not significantly different from the values of fruit harvested at the 11th, 13th and 14th week.

The change in TTA values of other local bananas during maturation has not been reported. A sudden decrease in the TTA value of the fruit at the upper portion occurred simultaneously with the sudden increase in pH (Figure 3). However, the sudden drop in TTA value of fruit from the middle and lower portions took place only after the attainment of maximum pH (Figure 3).

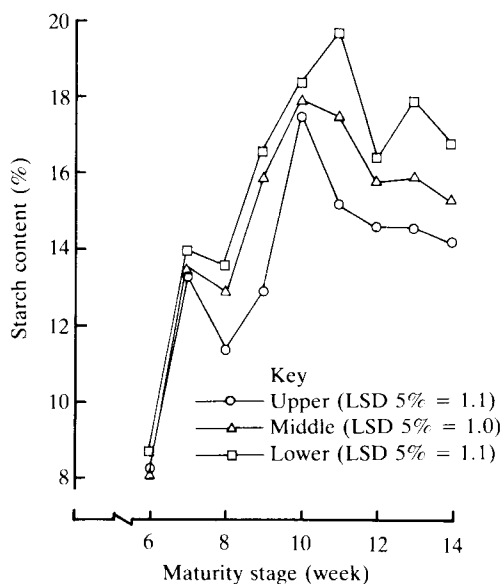


Figure 5. The starch content of Berangan banana harvested at different stages of maturity.

### Starch Content

The starch content of the pulp increased gradually until it reached its maximum peak (Figure 5). For the upper and middle portions, this peak was attained at the tenth week, whereas in the lower portion, it was attained a week later. This was followed by a gradual decrease in the starch content.

The maximum starch content was attained simultaneously with the change of peel colour (from light green to dark green) (Table 1) and the attainment of maximum pH (Figure 3). In Embun banana, maximum starch content was observed at the 14th week, two weeks after the fruit started to mature. The reasons for this phenomena have yet to be established (ABDULLAH *et al.*, 1985).

### Total Sugar Content

The banana pulp contained no sugar until the 12th week (Figure 6). Its presence in the fruit of upper portion of the bunch was first detected at the 13th week. At the 14th week, the sugar was detected in the whole bunch of fruit. The production of

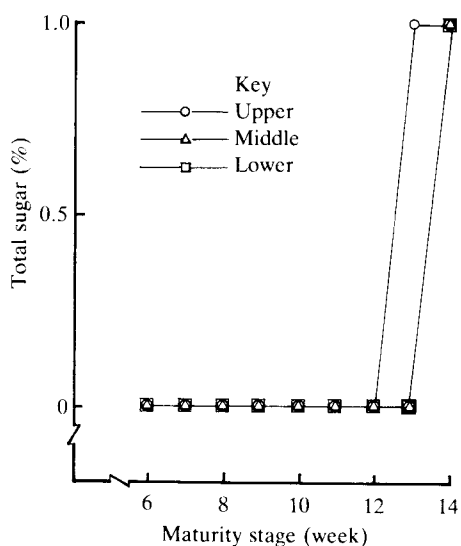


Figure 6. The total sugar content of Berangan banana harvested at different stages of maturity.

sugar in the banana fruit indicates the initiation of the ripening process as a result of starch hydrolysis (BARNELL, 1940; PALMER, 1981). The lag period between the maximum starch accumulation and the beginning of sugar production in Berangan banana was three weeks as compared with two weeks as has been found to occur in Embun cultivar (ABDULLAH *et al.*, 1985).

### Ability to Ripen

Fruit harvested between tenth and 14th week ripened satisfactorily (Table 1). Fruit harvested at the sixth and seventh week completely failed to ripen, and those harvested between the eighth and ninth week could ripen but were organoleptically poor. The best fruit were those harvested between the 12th and the 13th week after flower emergence (Table 2). At this stage, the fruit had good peel and pulp colour, peeling characteristics, pulp texture, taste, aroma and overall acceptability upon ripening. Harvesting at the 14th week produced fruit of almost the same quality. However, the peel colour was less attractive because of the presence of severe rust-like spots.

Table 2. Organoleptic properties of ripe Berangan banana harvested between 10 and 14 weeks after flower emergence

Organoleptic property	Maturity stage (weeks)				
	10	11	12	13	14
Peel colour	1	2	2	2	1
Pulp colour	2	2	2	2	2
Peeling characteristics	1	1	2	2	2
Pulp texture	1	1	2	2	2
Taste	1	1	2	2	2
Aroma	1	1	2	2	2
Overall acceptability	1	1	2	2	2

1 = Acceptable

2 = Highly acceptable

### CONCLUSION

Based on the physico-chemical changes including the organoleptic attributes after

ripening during the maturation process, the Berangan banana can be harvested between ten and 13 weeks after flower emergence. Gradual changes were observed in the general characteristics of the fruit, which included the peel colour, nature of stylar ends, shape of fruit and the formation of rust-like spots on the peel. The pH and starch content of the pulp, and the length to diameter ratio of fingers can be recommended as indices for assessing the maturity characteristics of Berangan banana.

### ACKNOWLEDGEMENTS

The authors wish to acknowledge Mr Talip Yaacob and Mr Zholkarnain Jaafar for their direct involvement in the research project. Sincere thanks are extended to Ms Hasnah Midon who assisted in the preparation of the paper.

### ABSTRACT

A study on the maturity indices of Berangan banana obtained from a farm at Sabak Bernam, Selangor was carried out. Fruit of six to 14 weeks old from the period of flower emergence were studied. Based on the general appearance, shape, physical properties, chemical analysis and organoleptic quality after ripening, the fruit started to mature after ten weeks. The starch content, pH values of the pulp and the fruit length to diameter ratio were found to be highly correlated with the maturation process, thus serve as a guide to assess maturity of Berangan. The pulp to peel weight ratio, total titratable acidity and total sugar contents were found to be poor maturity indicators.

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Accepted for publication on 25 October 1986

