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Changes in Tannin and Pectic Substances at Different Positions within a Bunch of Cavendish Banana (*Musa cavendishii* L. var. Montel) during Development and Maturation

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ABSTRAK

Kajian telah dijalankan ke atas perubahan kandungan tanin, pepejal taklarut alkohol (AIS) dan pecahan pektin (air, ammonia oksalat dan natrium hidroksida larut) bagi pisang Cavendish varieti Montel pada kedudukan yang berlainan dalam satu tandan semasa kematangan dan kemasakan. Terdapat penurunan yang bererti ($P<0.01$) dalam kandungan tanin di antara kedudukan sikat yang berlainan (atas, tengah dan bawah) dalam satu tandan dan juga di antara buah (atas dan bawah) dalam satu sikat semasa kematangan. Kandungan AIS meningkat pada peringkat awal, tetapi menurun dengan bererti ($P<0.05$) apabila mencapai peringkat kematangan (minggu 12) bagi buah-buah yang masak. Bahan-bahan pektik juga menunjukkan perbezaan bererti ($P<0.05$) pada kedudukan-kedudukan yang berlainan (sikat dalam satu tandan dan buah dalam satu sikat) bagi setiap tandan semasa kematangan. Pektin meningkat pada peringkat awal sehingga ke peringkat maksimum pada minggu 12 dan kemudian menurun secara perlahan-lahan. Pada peringkat akhir kematangan, bahan-bahan pektik mulai meningkat dengan perlahan sehingga ke peringkat kemasakan. Terdapat juga perbezaan bererti ($P<0.05$) di antara kedudukan sikat dan buah yang berlainan bagi kandungan tanin , AIS dan bahan-bahan pektik semasa kematangan. Walau bagaimanapun, terdapat perbezaan yang bererti ($P<0.05$) di antara kedudukan-kedudukan sikat-sikat dan buah-buah yang berlainan dalam satu tandan di mana kedudukan sikat atas dan kedudukan buah atas dalam sikat memberikan nilai yang tinggi bagi kandungan-kandungan tanin, AIS dan bahan-bahan pektik berbanding dengan kedudukan-kedudukan sikat tengah dan bawah dalam satu tandan dan kedudukan buah bawah dalam sikat masing-masing.

ABSTRACT

Studies were carried out on changes in the tannin content, alcohol insoluble solids (AIS) and pectin fractions (water, ammonium oxalate and sodium hydroxide solubles) of Cavendish banana variety Montel at different positions within a bunch during maturation and ripening. There was a significant decrease ($P<0.01$) in the tannin content between the different portions of hands within a bunch and between different fingers within a hand during maturity. AIS increased at the early stages, but it decreased significantly ($P<0.05$) in the ripe fruits (week 12). There was a significant difference ($P<0.05$) in the pectic substances at different positions within a bunch during maturity. The pectins increased at the early stages, reaching a maximum at week 12 and then slowly decreased. At the end of maturation, the pectic substances started to increase slowly until ripening. There were also significant differences ($P<0.05$) in the tannin content, AIS and pectic substances during maturity between different portions of hands and fingers. However, significant differences ($P<0.05$) were observed between portions of hands within a bunch and between fingers within a hand during maturity stage; the top hands and upper fingers were higher in tannin, AIS and pectic substances contents than the middle and bottom hands within a bunch and lower fingers within a hand respectively.

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INTRODUCTION

Pectic substances play a significant role in maturation, softening and textural changes in some fruits (Pilnik and Voragen 1970). Ripening and maturation in fruit involve the breakdown of these compounds to sugars and acids (Doesburg 1973). In the USA, commercial pectin is mainly produced from citrus peel and apple pomace (Rouse 1967) with other fruits such as guava (Verma and Srivastava 1966), purple passion fruit (Pruthi 1965) and banana (Von Loesecke 1930) also good sources. During the ripening of many edible fruits (Goldstein and Swain 1963), both tannins and astringency are reduced and the changes in astringency are a reflection of changes in the molecular size of the tannins. Effects of tannin on browning in fruit and fruit products (Swain 1962) and cloudiness in many fruit juices (Cash *et al.* 1976) have long been recognized. Tannins have also been associated with astringency in many fruits, especially less ripe ones (Swain 1962; Joslyn and Goldstein 1964; Ismail and Mamat 1984). Goldstein and Swain (1963) believed that the physiology of the astringency sensation was due to the interaction of these polyphenols with salivary proteins and glycoproteins in the mouth. The objective of this study was to determine the changes in pectic substances and tannin content of 'Montel' banana (*Musa cavendishii* L.) from different hand positions (top, middle and bottom) and different finger positions (upper and lower) within a hand in a bunch.

MATERIALS AND METHODS

Fruit Source

One hundred banana plants (cv. Montel) were tagged randomly during flower emergence at the experimental plot, Universiti Pertanian Malaysia (UPM), Serdang, Selangor. Fruit growth was observed weekly. Banana bunches were harvested each week from week 3 to week 15 (fruit started to ripen). Observations were done in triplicates with one bunch per replicate. The harvested fruits were immediately transported to the laboratory of the Faculty of Food Science and Biotechnology, UPM for further evaluation.

Sampling

The hands from each bunch were divided into top (1st hand from the top), middle (5th hand from the top) and bottom (2nd hand from the bottom) portions. The fingers from each hand of the bunch were divided into upper and lower portions. Observations of chemical parameters were made on composite samples of six fruits. Experiments were done in triplicate.

Determination of Tannin Content

Five grams of homogenized fruit material was used for tannin analysis according to the AOAC (1980) method. The sample was boiled for 30 min with 400 ml of distilled water, then transferred to a 500-ml volumetric flask and filtered. The standard tannic acid solutions of 0-10 ml aliquots were prepared. The absorbance of standard and samples was determined at 760 nm after 30 min of mixing against experimental blank adjusted to 0 absorbency using UV-Vis Spectrophotometer model Shimadzu.

Determination of Pectic Substances

The alcohol insoluble solids (AIS) obtained after extraction of sugars were used to measure pectin. The residue was washed in acetone and dried at 60 °C to a constant weight. The dry residue was ground finely and weighed. The sample was recorded as the alcohol insoluble solids (AIS) fraction and later used for pectin estimation. The AIS preparation was separated into three types of pectic substances by successive extraction with distilled water, 0.75% ammonium oxalate and 0.05 N sodium hydroxide (Roe and Bruemmer 1981). Each pectin fraction was then analysed colorimetrically after reaction between carbazole and anhydrogalacturonic acids of the pectin as described by Rouse and Atkins (1955).

Statistical Analysis

For data analyses, the SAS programme (Statistical Analysis System) was used. The values obtained were subjected to analyses of variance and tested using the Duncan's multiple range test (DUNCAN).

RESULTS AND DISCUSSION

The tannin content of 'Montel' banana from different positions was significantly different at all the different stages of maturity (*Fig. 1*). Tannin content of fruits from all positions decreased rapidly at the early stages and then slowly increased, for fruits from the top lower, middle upper and bottom lower positions, after week 9.

From week 12 onwards, the tannin content of fruits from all positions decreased rapidly during ripening (*Fig. 1*). When green and in the early stages of ripening, the banana fruit is astringent (Barnell and Barnell 1945). These results supported those of Von Loesecke (1949) who noted that green bananas have soluble tannin, the content of which decreases during ripening. The decrease in astringency of banana was correlated with the decrease in tannin content (Slocum 1933). Tannin is one of the sources from the polyphenol group which cause the astringent taste in fruits (Goldstein and Swain 1963; Ranganna 1977). Goldstein and Swain (1963) found that the tannin content and astringency of banana decreases rapidly during ripening.

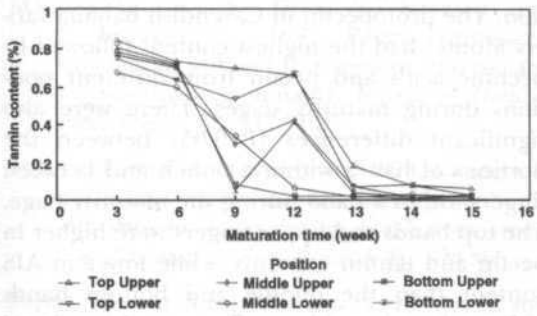

Fig 1. Effect of different positions of 'Montel' banana on tannin content during development and maturation

Pectin is a polysaccharide found in plant tissues (Kertesz 1951). There was a significant difference ($P<0.01$) in the total pectin, which is the sum of protopectin (NaOH soluble fraction), pectin (water soluble fraction, and pectinic acids (oxalate soluble fraction), of 'Montel' banana from different positions, indicating at different stages of maturity of the bunch (*Figs. 2-5*). There was also a significant difference ($P<0.01$) in the AIS content during maturity (*Fig. 6*). The AIS content exhibited an irregular pattern, decreasing rapidly at the early stages and then slowly increasing. At week 12, the AIS content (21.82%) started to decrease rapidly during ripening from 20.77% at week 12 to 18.12 and 12.56% at weeks 14 and 15 respectively (*Fig. 6*). These results support those of Subramanyam *et al.* (1972) and Roe and Bruemmer (1981) who reported that the AIS content decreased markedly during ripening. In spite of AIS content, the total pectin increased rapidly at the early stages until week

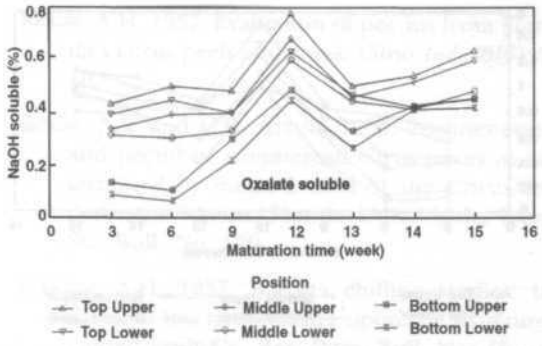

Fig 2. Effect of different positions of 'Montel' banana on NaOH soluble pectin fraction during development and maturation

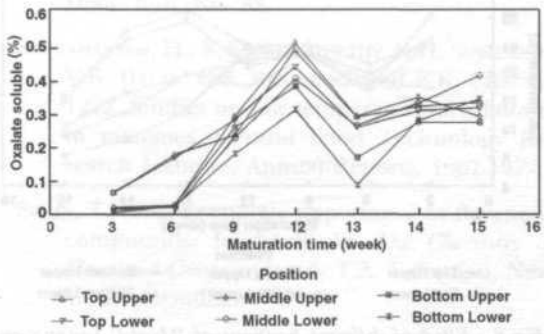

Fig 3. Effect of different positions of 'Montel' banana on oxalate soluble pectin during development and maturation

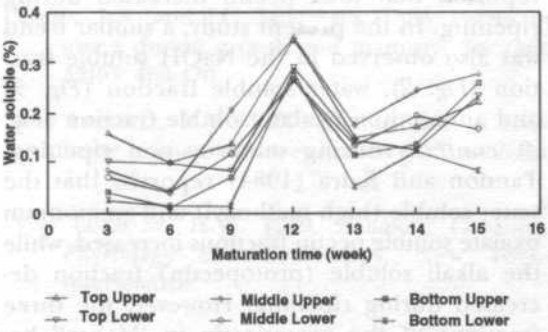

Fig 4. Effect of different positions of 'Montel' banana on water soluble pectin during development and maturation

12 (1.32%), which was the optimum period for harvesting (*Fig. 5*). It also exhibited an irregular pattern, decreasing slowly at week 13 (0.75%) and then increasing during ripening. According to Brady (1976), pectinesterase enzyme is involved in the changes in total pectin during ripening. This supported the findings of Stratton and Von Loesecke (1930) who

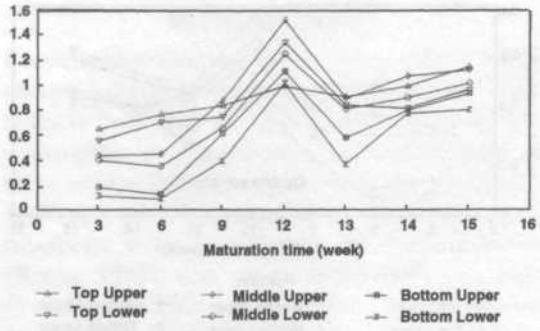

Fig 5. Effect of different positions of 'Montel' banana on total pectin during development and maturation

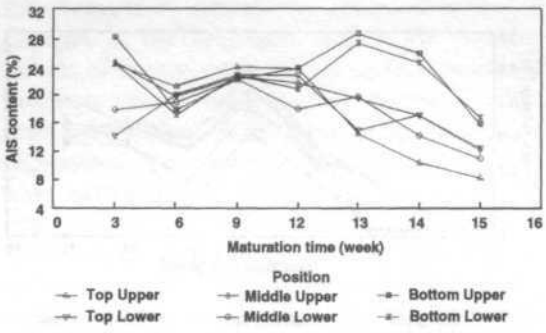

Fig 6. Effect of different positions of 'Montel' banana on AIS content during development and maturation

reported that total pectin increased during ripening. In the present study, a similar trend was also observed in the NaOH soluble fraction (*Fig. 2*), water soluble fraction (*Fig. 3*) and ammonium oxalate soluble fraction (*Fig. 4*) contents during maturity and ripening. Tandon and Kalra (1984) reported that the water soluble (high methoxyl) and ammonium oxalate soluble pectin fractions increased, while the alkali soluble (protopectin) fraction decreased during ripening. However, the three fractions of the protopectin in 'Montel' banana increased (*Fig. 2*). This supported the findings of Heimann (1980) who found that protopectin, upon hydrolysis, yields water soluble pectin and its content increases in ripe mango fruit (Mizuta and Subramanyam 1973). Recently, similar results were reported by Malisarad *et al.* (1983) in ripening tomato fruit. It seems that protopectin is an important pectin fraction which increases before physiological maturity and then decreases with fruit ripening and softening. Tandon and Kalra (1984) also noted that alkali soluble fraction increased again 70 days after fruit set but decreased thereafter. *Fig. 2* shows that the protopectin in 'Montel' banana had the highest content followed by pectinic acids and pectin from different positions during maturity stages.

CONCLUSION

From this study it was found that there is a highly significant difference ($P<0.01$) in tannin and pectin contents during maturity stages between the various portions of hands and fingers. The tannin content of Cavendish banana decreased rapidly, while the pectic substances increased during harvesting. There is a significant difference ($P<0.05$) in total pectin, tannin and AIS contents between the different portions of hands and fingers of the bunch during maturation. The protopectin in Cavendish banana variety Montel had the highest content followed by pectinic acids and pectin from different positions during maturity stages. There were also significant differences ($P<0.05$) between the portions of hands within a bunch and between fingers within a hand during the maturity stage. The top hands and upper fingers were higher in pectin and tannin contents, while lower in AIS content than the middle and bottom hands within a bunch and lower fingers within a hand respectively. The positional effects seen in the present study could possibly be due to the different physiological maturity of the fruit.

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