MATURITY INDICES AND HARVESTING PRACTICE OF "ARUMANIS" MANGO RELATED TO THE TARGET MARKET

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Abstract

Mango as a climacteric fruit is frequently harvested when less than fully ripe. This is often necessary to obtain optimal eating quality at the time of consumption where markets are a considerable distance from the place of harvest.

In this study the age of fruit was calculated, based on the time of flowering. The orchard selected for the trials was located in northern part of Bali, Indonesia. The laboratory analyses were carried out at Udayana University.

The results showed that optimal maturity of 'Arumanis' mango for best consumption is when the fruit is harvested 13-14 weeks after flowering. Fruit age has a close relationship with total soluble solids (TSS), total acidity and pH content. This study found that'Arumanis'mango is best for consumption when the TSS content of the fruit is not less than 16.8'Brix, total acidity 0. 18%, pH 4.8, flesh colour rating 6-6.5, and taste score 5.

Mangoes can be classified into two groups based on their ability to reproduce from seed: monoembryonic and polyernbryonic types. The major commercial cultivars in Indonesia, the Philippines and Thailand are of the polyembryonic type, while in Malaysia and Singapore, a mixture of polyembryonic and monoemhryoilic seeds are extensively grown (Kusumo et al. 1984). 'Aruinanis' mango, which is classified as poly embryonic, is considered to have much commercial potential.

The definition of maturity as 'the stage of development giving minimum acceptable quality to the ultimate consumer' implies a need for objective measures of maturity. Indication of maturity is of considerable importance during the marketing chain (Reid 1985). Mango growers harvest fruit using their judgement based on the appearance of the fruit. Consequentiy, fruit harvested by conventional criteria may exhibit significant variations in both ripening rate and fruit quality (Kosiyachinda et al. 1984). Therefore, there is a need to find objective measures which can be used to determine fruit maturity in order to determine optimal harvesting time.

Mango fruit traded commercially are commonly harvested green. Various methods for determining maturity in mango have been proposed, namely, softness of cheeks, peel colour, development of shoulder, specific gravity, and starch content. However, these methods have found limited commercial application since they are mainly applicable to fruit that have reached an advanced degree of ripeness. The objective of this trial was to study the maturity indices and harvesting practice of

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fresh 'Arumanis' mango fruit related to the target market.

MATERIALS AND METHODS

Fruit were obtained from local farmers in the northern part of Bali island, and the analyses were carried out at the Analytical Laboratory, Udayana University, Denpasar. Fruit were harvested at six stages of maturity at one-week intervals: PI = harvested 1 1 weeks after fruit set; P2 = harvested 12 weeks after fruit set; P3 = harvested 13 weeks after fruit set; P4 harvested 14 weeks after fruit set; P5 harvested 15 weeks after fruit set: and P6 = harvested 16 weeks after fruit set,

On arrival at the laboratory, the samples of fruit were selected on the basis of good condition and even maturity. Fruit of uniform size were selected. Each fruit was carefully sorted according to visual assessment of its size, freshness and level of damage. After sorting, the fruit were washed, dipped in a fungicide solution, and dried until the skin was dry. The sample units were then randomly allocated to each treatment. A randomised block design was used which consisted of six treatments and four replicates. An analysis of variance of data from the experiment was carried out and where significance was shown, the data were further analysed using Duncan's multiple range test (Gomez and Gomez 1976) to deteitnine the significance between individual treatments.

Observations were made on weight loss, fruit firmness, total soluble solids, total acidity, vitamin C content, pH, and organoleptic evaluation (colour and taste). Observations on fruit freshness were carried out daily to calculate the storage life.

RESULTS AND DISCUSSION

Weight loss and moisture content

Weight loss decreased with the onset of fruit maturation. The highest weight loss was observed in fruit harvested at 1 1 weeks after fruit set (9.28%), and sig- nificantly decreased in fruit harvested at 13, 14, 1;1 and 16 weeks after full bloom. The lowest value for weight loss was observed in fruit harvested at it weeks after fruit set (4.92%), but was not significant different to fruit harvested at 15 weeks after full bloom (Figure 1).

The moisture content of fruit flesh increased slightly with the increase in fruit maturation. Fruit halted 11 weeks after full bloom showed the lowest mioisture content (8.74%), and the highest was in fruit harvested at 15 weeks after fruit set (Figure 1).

Fruit firmness

'Arumanis' mango does not lose its green even when fully ripe (Yuniarti 1980). The absence of a quick visual index of ripeness in 'Arumanis' mango makes it difficult to ascertain the degree of fru ripeness without the use of destructive analytical procedures, although it is possible that firmness could be used as an index.

Fruit firmness was highest in fruit harvested weeks after full bloom (1.73 kg/CM^2) and deteriorated significantly as time to harvest after fruit set increased. The lowest value was observed in fruit harvested at 16 weeks after fruit set (Figure 2), but was not significantly different to fruit harvested 13, 14 and 15 weeks after full bloom. Fruit harvested at 13 and 14 weeks after fruit set had fruit firmness value of 0.79 and 0.63 kg/cm^2, respectively.

According to Pantastico et al. (1984), comprehensive studies on 'Carabao' mango showed that fruit firmness decreased abruptly early in the ripening period, but continued to decrease with further ripening, Softening changes in ripening mango have been previously attributed to the activity of enzymes that degrade pectic substances. In Malaysian 'Arumanis' mango, the activities

of pectin methylesterase and polygalacturonase were low in immature fruit, and Increased with increasing physiological age. When harvested fruit were allowed to ripen under ambient conditions, pectic enzyme activity initially decreased bat ilien markedly increased in ripening fruit.

Total soluble solids

Total soluble solids (TSS) increased with the onset ot' fruit maturation. However, the highest TSS was observed in fruit harvested at 14 weeks after fruit set (16,96^{o} Brix), and was significantly different to fruit harvested, it 11 and 12 weeks after flowering. The value of TSS observed was of fruit harvested at 11 weeks after full bloom (1 1.72^{o} Brix) (Figure 2).

Panstatico et al. (1984) reported that total sugars and soluble solids increased as the 'Carabao' mango fruit ripened. with the most marked increases occurring early in the ripening process. Mendoza et al. (1972) also found that the soluble solids content of mango increased with the onset o f maturation, however at 10-15 weeks after fruit set, the change in soluble solids did not show a consistent trend.

Figure 1. Weight loss and moisture content of "Arumanis" mangoes harvested at one-week intervals after fruit set. Points marked with different letters are significantly different at the 5% level

Figure 2. Total soluble solids and fruit firmness of "Arumanis" mangoes harvested at one-week intervals after fruit set. Points marked with different letters are significantly different at the 5% level

Figure 3. Vitamin C content and total acidity of "Arumanis" mangoes harvested at on-week intervals after fruit set. Points marked with different letters are significantly different at the 5% level.

Figure 4. pH, flesh colour score and taste score of "Arumanis" mangoes harvested at on-week intervals after fruit set. Points marked with different letters are significantly different at the 5% level.

Total acidity

Total acidity decreased with the onset of fruit maturation. The highest value was in fruit harvested at 11 weeks after fruit set (0.98%), and significantly decreased in fruit harvested at 12, 13, 14, 15 and 16 weeks after fruit set. The lowest value for total acidity was observed in fruit harvested at 16 weeks after full bloom (0.13%), but this value was not significantly different to fruit harvested at 13, 14 and 15 weeks after full bloom (Figure 3). Kosiyachinda et al. (1984) stated that titratable acidity decreases with the onset of maturation, however no common value for the maximum titratable acidity exists that could be used to determine the earliest acceptable picking time.

Vitamin C content and pH

The highest vitamin C content was observed in fruit harvested at 16 weeks after full bloom (161.7 mg/100 g), and the lowest value was measured in fruit harvested at 12 weeks after full bloom (85.8 mg/100 g). The vitamin C content increased as the time before harvesting increased, except in fruit harvested at 15 weeks after fruit set where the value decreased slightly (1 23.2 mg/ 1 00 g) (Figure 3).

The pH of fruit flesh significantly increased with the onset of fruit maturation. Fruit harvested at 1 1 weeks after fruit set had the lowest pH (3.40), which was significantly different to fruit harvested at 13, 14, 15 and 16 weeks after fruit set. The highest pH was measured in fruit harvested at 16 weeks after fruit set (5.15) (Figure 4).

Flesh colour and fruit taste

Flesh colour wasjudged using a rating where: 1 = all white; 2 = white with slight yellow; 3 = whitest yellow; 4= yellowish white; 5=yellow with aslight white; 6= all yellow; and 7= yellowish red. The flesh colour score significantly increased with the increase in fruit maturation. The lowest colour score was observed in fruit harversted at the earliest time of harvesting (11 weeks after fruit set (7,0=yellowish red) (Figure. 4)

Fruit taste was judged using a rating where :; 1= dominant sour; 2=slightly sour; 3= balance of sweet and sour; 4 = slightly sweet; and 5= domait sweet. The tasye score significantly increased with the increase in fruit harvested at 11 weeks after flowering (3,05 = balance of sweet and sour) and the highest was in fruit harvested at 13, 14, 15 and 16 weeks after fruit set (5,0=dominant sweet) (Figure 4.)

Storage life

Fruit storage life significantly decreased with the increase in fruit maturity. Fruit harvested at 11 weeks after full bloon showed the longest shelf life (9 days) at room temperature (29±1°C), while the lowest was obeserved in fruit harvested at 15 and 16 weeks after fruit set (4 days) (Table 1.)

Table 1.
Storage life of 'Arumanis' mangoes harvested atone-week intervals after fruit set.

Treatment	Storage life	
	D a y s [a]	LSR 5 %
P1 (harvested 79 days afsb)	9.00 a	
P2 (harvested 86 days afs)	7.00 b	0.36
P3 (harvested 93 days afs)	6.50 c	0.38
P4 (harvested 100 days afs)	5.00 d	0.39
P5 (harvested 107 days afs)	4.00 c	0.40
P6 (harvested 1 14 days afs)	4.00 c	0.40
a Values with different letters are significantly different at the 5% level. b afs after fruit set		

CONCLUSION

The major chemical change in 'Arumanis' mango fruit during growth and maturation was a regular increase of the level of reducing sugars throughout the development period. It was expressed by a gradual increase in total soluble solids up to maturity, a continued decrease in fruit firmness, a decline in total acidity, and an increase in pH and vitaminnn C content.

The results of the trial showed that the optimal maturity of the fruit for consumption was reached when fruit was harvested at 13-14 weeks after fruit set, characterised by the values of 16.8-17.0° Brix total soluble solids, 0,18-0,22 % total acidiity, pH 4,8, flesh colour raating of 6-6,5, and a taste score 0f 5.

In the absence of adequate objective measures of maturity, visual indicators are often employed, such as the shape of the fruit, the appearance of powdery materials or bloom on the fruit surface, or the presence of plant sap at the fruit surface close to maturity.

Acknowledgments

The authors wish to thank the Association of South-East Asian Nations (ASEAN)-Australia Economic Cooperation Program III (AAECP-III) Quality Assurance Systems for ASEAN Fruit (QASAF) Project for financial support of financial support of this work, and the Australian Centre for International Agricultural research (ACIAR) for the presentation of this paper at 19th ASEAN/1st APEC Seminar on Postharvest Technology, Ho Chi Minh City, Vietnam. The authors also wish to thank Prof. John Janes and Dr Zora Singh (Curtin University of Technology Australia) for their helpful comments and Mr. I.B.K.G. Kertia who typed the manuscript.

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