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Some Physical Properties of Mature Green Nipah and Nangka Banana Fruit

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Abstract
Physical properties of fruits and vegetables are important as it is used as a grading measurement for packaging and safe transportation. The postharvest losses of fruits are mainly due to its mechanical damage during transport and handling. Banana for example, has various varieties with different shapes and sizes. Therefore this study was conducted to assess some physical properties of mature green Nipah and Nangka banana fruit. Properties obtained were weight of whole fruit, peel and pulp, dimensions, surface area and projected area. The average weight, length and diameter of Nangka is higher than that of Nipah ($p<0.05$). Peel thickness of Nipah is higher than Nangka. The volume (Vellip), projected area (Pellip) and surface area (Sellip), Nangka possess higher value than Nipah.

Keywords: Physical, banana, nangka, nipah

Introduction

Physical properties of fruits are important data for grading operation. Different countries have different standard grading specifications. Most of it are based on maturity, shape, size, colour, degree of blemishes and taste. Besides it can also be used in the design and operation of machines for fruits processing.

Many studies were made on the physical properties of fruits such as pomegranate (Radunić et al. 2015), apricot (Haciseferoğullari et al. 2007), okro (Owolarafe and Shotonde 2004) and mango (Wanitchang et al. 2011). Radunić et al. (2015) evaluated the physical and chemical properties of seven pomegranate cultivars. The physical dimension obtained shows high variability in fruit weight and size, calyx and peel properties. Haciseferoğullari et al. (2007) evaluated the physical and chemical characteristics apricot and attribute to the processing equipment. Wanitchang et al. (2011) measured the physical and mechanical properties and used it for classification of maturity of mango.

Among fruits, banana have the second largest production are in Malaysia and 5th in its export revenue (Department of Statistics 2011). Exportation of fruits requires proper handling and packaging as it is one of the main reason of postharvest losses (Wasala et al. 2015).

This paper aims to determine the physical properties of two varieties of mature green bananas which are Nipah and Nangka. The properties which will be measured are weight of peel, pulp and whole fruit as well as diameter. While, geometric mean diameter (Dg), sphericity (φ) and radius of curvature (R), estimated volume (Vellip), projected area (Pellip) and surface area (Sellip) will be obtained by using specific equations with the measured data.

Materials and methods

Banana fruits of Nipah and Nangka variety is harvested from a small farm in Kampung Sungai Lang, Banting. The banana fruits were transported and stored in a room temperature of 25oC. The samples were made sure to have a ripening index 1 and were randomly selected from the bunch.

The external and internal length of banana (Lo, Li) was measured by a flexible ruler as in Figure 1. The diameters were measured by a digital Vernier caliper as in Figure 2. The mass of both banana varieties was measured using an electronic weighing scale (Model SB12001, Switzerland). The measurement was replicated three times and is averaged out. For measurement of geometric mean diameter (Dg), sphericity (φ) and radius of curvature (R), estimated volume (Vellip), projected area (Pellip) and surface area (Sellip) the following equations are used (Sharifi et al. 2007).

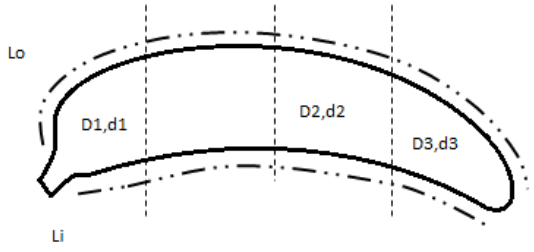

Figure 1: Longitudinal section of banana

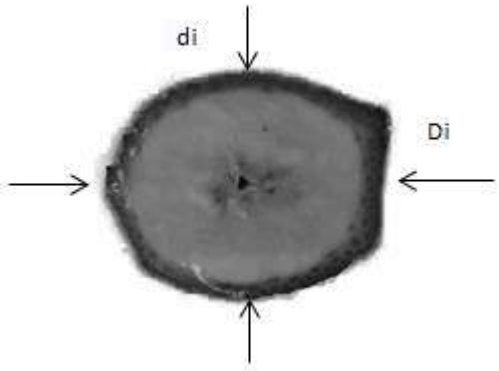

Figure 2: Cross sectional plane on longitudinal axis

Geometric Mean Diameter (D_g)

D_g = (L average x D average x d average) $^{0.333}$

where:

$$L_{average} = \frac{L_o + L_i}{2}$$

$$D_{average} = \frac{D2 + D3}{2}$$

$$d_{average} = = \frac{d2 + d3}{2}$$

Shpericity (φ)

$$(\varphi) = \frac{D_g}{L\ average}$$

The intermediate section of banana is estimated to be in circular shape thus the radius of curvature (R) was measured as

$$R = \frac{L_i}{\Delta L} D_{average}$$

where

$\Delta L = L_o - L_i$

The estimated volume (Vellip), projected area (P ellip) and surface area (S ellip) is treated as an ellipsoidal shape with following formula.

$$V_{ellip} = \frac{\pi}{6\ x\ 1000} L_{average} \text{ x } D_{average} \text{ x } d_{average}$$

$$S_{ellip} = \pi D_g^{\ 2}$$

$$P_{ellip} = \frac{\pi}{600} L_{average} \text{ x } D_{average}$$

Results and discussion

Weighting properties of both Nipah and Nangka banana fruits are presented in Table 1. The average weight of whole fruit for Nipah is seen lower than that of Nangka with 31% differences. While study by Kachru et al. (1995) obtained 89.69g for Dwarf Scavendish and 126.16g for Nendran variety. The average pulp to peel ratio for Nipah and Nangka banana variety was found to be 1.45±0.25 and 1.5+0.06 respectively. Which means that Nipah have thicker peel than Nangka variety.

Table 1: Weight properties of Mature Green Nipah and Nangka banana variety

Properties	Nipah	Nangka
Weight of Fruit (g)	85.67±1.25[a]	124.67±1.70[b]
Weight of peel (g)	49.33±3.30[*]	48.67±1.70[*]
Weight of pulp (g)	34.67±3.40[*]	73±0.82[*]
Pulp/peel ratio	1.45±0.25[a]	1.5+0.06[b]

In each row, means followed by same letter are not significantly different (P<0.05)

The dimensional properties of Nipah and Nangka banana fruits are presented in Table 2. Nangka banana is bigger compared to Nipah as it possesses higher average outer length with 209.00±0.22mm. This result may vary to other places as fruit size may fluctuate depends on climatic conditions and also the plantation practices (Lopez et al. 2007). As for the diameter, D1 to D3 and d1 to d3 shows range of average diameter at various planes of cut of banana fruit with peel for both varieties tested. It can be seen that the diameter of the fruit is lowest at the bottom and highest at its top due to its curvature structure. The changes were as function of their position on banana and varied as a linear form. The Daverage and daverage were obtained for Nipah and Nangka which are 37.83±0.96mm and 25.33±0.62mm, 40.50±0.41mm and 30.50±0.00mm respectively.

Table 2: Dimensional properties of Mature Green Nipah and Nangka banana variety

Properties (mm)	Nipah	Nangka
L_o	148.33±0.24[a]	209.00±0.22[b]
L_i	123.33±0.24[a]	122.67±0.21[b]
L	135.83±0.24[a]	165.83±0.08[b]
ΔL	25.00±0.00[a]	86.33±3.90[a]
D1	41.00±0.82[a]	41.00±0.00[b]
D2	40.50±0.71[a]	40.00±0.82[b]
D3	34.67±1.18[a]	40.00±0.82[b]
d1	22.50±1.08[a]	29.83±0.62[b]
d2	28.33±0.24[a]	31.43±0.09[b]
d3	28.17±0.24[a]	31.17±0.62[a]
$D_{average}$	37.83±0.96[a]	40.50±0.41[b]
$d_{average}$	25.33±0.62[a]	30.50±0.00[b]

In each row, means followed by same letter are not significantly different (P<0.05)

Results of other estimated and calculated properties are presented in Table 3. The radius of curvature for Nipah and Nangka was measured at 186.64±3.60mm and 57.54±3.44mm respectively. This means that Nangka have a more curvy shape compared to Nipah. Besides, for average value of geometric mean diameter for Nipah was obtained lower that of Nangka banana while Nipah possess higher sphericity value. While for estimated volume (Vellip), projected area (Pellip) and surface area (Sellip), Nangka possess higher value than Nipah with value of 107.26±0.57mm3, 35.17±0.19mm3 and 10828.29±38.56 mm3 respectively.

Table 3: Physical Properties of Mature Green Nipah and Nangka banana variety

Properties	Nipah	Nangka
R (mm)	186.64±3.60[a]	57.54±3.44[b]
D_g (mm)	50.48±0.73[a]	58.71±0.10[b]
φ	0.37±0.01[a]	0.35±0.00[b]
V_{ellip} (mm^3)	68.17±2.96[a]	107.26±0.57[b]
P_{ellip} (mm^2)	29.88±26.91[a]	35.17±0.19[b]
S_{ellip} (mm^2)	8006.74±231.79[a]	10828.29±38.56[b]

In each row, means followed by same letter are not significantly different (P<0.05)

Conclusion:

Some physical properties of mature green Nipah and Nangka banana were determined. From the result, it can be concluded that Nangka banana is larger and heavier than Nipah. Peel of Nangka is thinner than Nipah. The sphericity of Nangka is lower as it have higher radius of curvature which result to a more curvature shape. Thus it can be concluded that the physical properties of bananas are dependent of its varieties.

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References:

Department of Statistics, Malaysia. 2011. "Supply and Utilization Accounts Selected Agricultural Commodities 2007-2011." : 2013–15.

Haciseferoğullari, Haydar, Ibrahim Gezer, Mehmet Musa Özcan, and Bayram MuratAsma. 2007. "Post-Harvest Chemical and Physical-Mechanical Properties of Some Apricot Varieties Cultivated in Turkey." *Journal of Food Engineering*.

Kachru, R P, Kotwaliwale Nachiket, and D Balasubramanian. 1995. "Physical and Mechanical Properties of Green Banana (Musa Paradisiaca) Fruit." *Journal of Food Engineering* 26(3): 369–78.

Lopez, Gerardo, R. Scott Johnson, and Theodore M. DeJong. 2007. "High Spring Temperatures Decrease Peach Fruit Size." *California Agriculture*.

Owolarafe, O. K., and H. O. Shotonde. 2004. "Some Physical Properties of Fresh Okro Fruit." *Journal of Food Engineering*.

Radunić, Mira et al. 2015. "Physical and Chemical Properties of Pomegranate Fruit Accessions from Croatia." *Food Chemistry* 177: 53–60.

Sharifi, M et al. 2007. "Some Physical Properties of Orange (Var. Tompson)." *Industrial Research*.

Wanitchang, Padungsak, Anupun Terdwongworakul, Jaitip Wanitchang, and Natrapee Nakawajana. 2011. "Non-Destructive Maturity Classification of Mango Based on Physical, Mechanical and Optical Properties." *Journal of Food Engineering*.

Wasala, W M C B, D A N Dharmasena, T M R Dissanayake, and B M K S Thilakarathne. 2015. "Physical and Mechanical Properties of Three Commercially Grown Banana (Musa Acuminata Colla) Cultivars in Sri Lanka." *Tropical Agricultural Research* 24(1): 42. https://tar.sljol.info/article/10.4038/tar.v24i1.7988/.