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The Study of Functional Properties of *Nypa fruticans* Flour

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Abstract. *Nypafruticans* or known as nypa produces considerable amount of fruit with high content of carbohydrate. The mesocarp of the mature fruit is a potential source of energy but underutilised. This research was conducted to study the production of flour from mesocarp of mature nypa fruit and to determine the functional properties of nypa flour. This research used the fruit from mangrove area in Jambi Province. The highest rendemenof flour in ratio to mesocarp weight was 20.00±5.24%. Mesocarp processing produced flour with low fat content (1.45%) and high crude fibre content (17.68%), color parameter L^* 83.13±4.04, a^* -0.67±0.90, and b^* 4.80±0.80. OAC nypa flour was 1.20±0.20 and its WAC was 2.84±0.24. Nypaflour exhibited low swelling power and solubility. The highest swelling power and solubility were achieved at 85°C with value of 4.5g/g and 10.56% respectively.

INTRODUCTION

Nypa fruticans is classified as palm. It is a native plant of Asia.According to report from FAO [1],native distribution and habitat ofnypa are the South and Southeast Asia, in tropical rain forest at brackish water swamps of tidal rivers. Furthermore, FAO has declared nypa fruticans as non-threatened palm in South East Asia hence available in considerable amount to be utilised. Nypa thrives in mangroves areas in Jambi Province but underutilised. Several parts of nypa tree have been utilised such as leaves for thatching or roofing and nypa sap for making sugar. The other parts such as the the frond and the fruits have not been utilised yet. The fruit itself consist of husk, shell and the mesocarp. While the husk and shell are promising biomass resource for biofuel and chemical [2], the mesocarp is promising to be exploited as food [3].

Mesocarp of nypa palm contains different amount of carbohydrate, protein, fat and ash depend on the growth location and the maturity of the fruit [4]. Young fruit contains high amount of water (up to 80%) and this decreases as maturity of fruit increases. The mature fruit contains considerable amount of carbohydrate (51.89%) and very low fat content (0.48% to 1.16%) and low protein content (0.7% to 2.4%). The chemical composition of nypa mesocarp offers the potential of nypa mesocarp to be processed into flour. The flour of nypa mesocarp has previously been used for extender in board processing [5]. Nypa flour has also been used for human consumption [6], in which it is used for biscuits. The biscuit was produced using 37.5% nypa flour and 62.5% wheat flour was compared well in nutritive value with 100% wheat biscuit. However the use of nypa flour can be extended to countless products if the functional properties of the flour is known. This research was conducted to study the production of flour from mesocarp of mature nypa fruit obtained in mangrove area in Jambi Province and to determine its functional properties.

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MATERIALS AND METHODS

Material

The Fruits of *Nypa fruticans*were collected or harvested from mangrove area inWest Tanjung Jabung. Only mesocarp from mature fruits as shown in Figure 1 were used for this research. There werethree kinds of mature fruit used for the experiment with reducing degree of freshness: freshly harvested Nypa fruit, fallen Nypa fruit and sprouted Nypa fruit respectively.Both fallen and sprouted Nypa fruit were collected on the ground when water subsided.

FIGURE 1. Nypa trees and the fruits (a), bunches of mature nypa fruit (b), sprouted fruit (c), cross section of nypa fruit (d).

Methods

The mesocarp were ground into flour using the method described by Sari[5] with slight modification. The epidemis of mesocarps were removed using knives and mesocarp was washed. The clean mesocarp was divided into 12 portion, each was blanched using steam blanching at 100°C for 0, 0,5, 5 and 15 minutes. There were 3 repetition for each length of blanching. Blanched mesocarp were cut into small pieces and dried in the air oven at 60°C for 6 hours. Dried mesocarp were ground using grinder, sieved using 60 mesh sieve, sealed packaged and kept at room temperature until further used.On the other experiment, to increase the starch content of the flour, starch extractionwas applied using water and continued with sieving with 100 mesh sieve.

Chemical composition of flour was done on proximate analysis with by difference carbohydrate content, crude fibre content, starch content, and phospor content. Color parameter L^*, a^* dan b^* were determined using simple digital imaging method [7,8]. Oil absorption capacity (OAC) and water absorption capacity (WAC) were measured following method described by Falade and Christopher [9] and expressed as gram of oil or water absorbed by one gram of sample. Swelling power and solubility were measured using method described by Mir & Don Bosco [10].

Statistical Analysis

Analysis of variance was conducted to determine the effect of freshness and length of blanching on the functional properties of flour. Duncan was used to determine the mean difference. Data analysis was performed using SPSSv 16.

RESULT AND DISCUSSION

Mature nypa fruit for flour production was characterised by its skin colour which turned dark brownish in colour. The rendemen for mesocarp was in the range 20-24% in ratio to fruit weight including the husk and the shell. Mature nypa fruit has very hard mesocarp that 15 minutes blanching at 100^{o}C could not soften the mesocarp.

Chemical Composistion

Nypa flour contains considerable amount of starch which increase in their content as the freshness decreased (Table 1). Sprouted nypa fruit still can be processed into flour and contain 39% starch. The lowest fat content of flour was produced from fresh nypa fruit. The fat content of flour was increased as the freshness of fruit was decreased. In addition to its low fat content, flour from fresh nypa fruit also contains very high amount of crude fibre (17,68%). This allow the use of nypa flour for production of low calorie food.

The high content of fibre and low starch content in nypa flour may affect the ability of flour to exhibitpreferable functional properties.Extraction of starch using 100 mesh sieve has increased the starch content from 32.73% to 35.66%, however the rendemen for flour after extraction was extremely low, only12.9% of the original weight of flour. Therefore, although the starch content was increased, the extraction is not recommended to produce nypa flour.

TABLE 1. Chemical composition of nypa flour

Component	Flour A	Flour B	Flour C	Flour D
Water(%)	7,79±0,22	7,01±0,42	7.30±0.02	5.64±0.00
Ash (%)	2,73±0,36	1,26±0,28	2.52±0.01	3.34±0.01
Protein (%)	2,66±1,73	2,90±1,36	5.98±0.01	8.17±0.04
Fat (%)	12,25±2,13	11,95±2,07	1.45±0.01	1.46±0.00
Crude fibre(%)	0,18±0,05	0,32±0,11	17.68±0.05	-
Carbohydrate (%)	74,57	76,88	82.75	81.39
Starch (%)	39,05±6,72	37,58±5,93	32.73±0.05	35.66±0.08

Flour A was from sprouted nypa fruit, Flour B was from fallen nypa fruit, Flour C was from fresh nypa fruit, and Flour D was from 100 mesh extracted Flour

Colour Parameter of Nypa Flour

Nypa flours were produced from three kinds of mature fruit with reducing degree of freshness: freshly harvested Nypa fruit, fallen Nypa fruit and sproutedNypa fruit respectively. These Nypa fruits could be processed into flour (Figure 2) without any significant different in amount of rendemen but had different colour parameters (Table 2). Reducing the freshness of the fruit decreased the value of L^* and increased the value of b^*. No effect of freshness of the fruit was found on the value of a^*. However, length of blanching did not affect the rendemennor the colour parameter of flour (Table 3).The value of L^* (lightness)is a parameter for degree of whiteness. The higher whiteness of the sample, the higher value of L^* up to 100. The values of L^* obtained for Nypa flours were in the range 73.35 to 87.6 which were in the range of flour lightness such as68.5-74.8 in taro flour [11], 84.73 -85.44 for rye flour [12], and 87.44-88.9 for barley flour [12], 86.59 for wheat flour [13], and 83.42 – 85.74 in Bamboo culm flours [14].The value of a^* (green-redness) is a parameter for degree of green to red and the value of b^* (blue-yellowness) is a parameter for degree of blue to yellow.Normally value of both$a^*$and $b^*$are in the range -128 to 127. The lower (negative) the valuethe more concentrate the green or blue and the higher the value (positive) the more concentrate the redness or yellowness.The result on spectrum L^*, a^*, and b^* showed that freshness of the fruit had generally a significant impact on the color characteristics of Nypa flour. The changing of colour values might have resulted from the changing in chemical composition of the fruit after falling (and followed by soaking in saline water) and sprouting. Carbohydrate and protein content plays important role in non enzymatic browning reaction affecting color properties of the flour. Yet, no reports is found on the presence of some enzymes which may be responsible for browning on the Nypa flour.

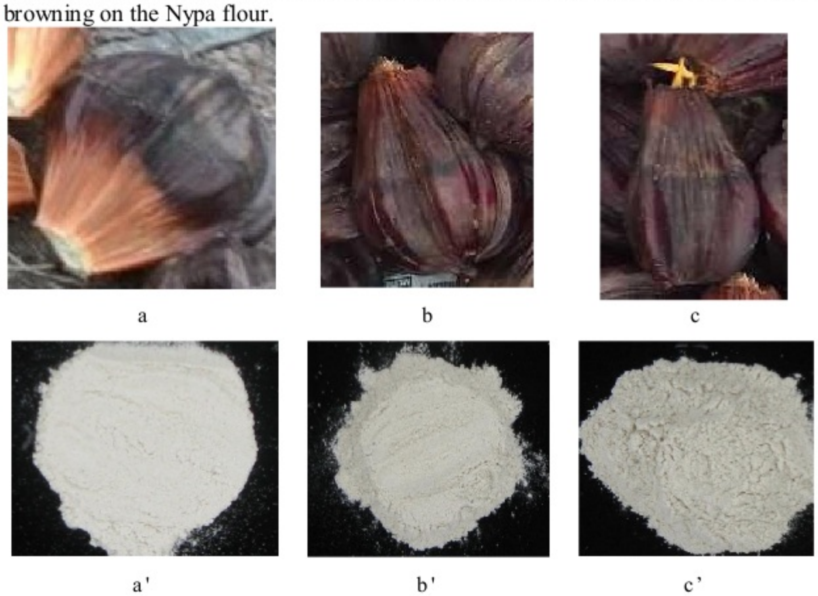

FIGURE 2. Fresh fruit (a), fallen fruit (b), sprouted fruit of *Nypa fruticans* and their corresponding flour (a', b', and c')

TABLE 2. Rendemen and colour parameter of flour produced from several fruit criteria

Fruit Criteria	Rendemen	L*	a*	b*
Sprouted fruit*	17.19±9,21%^{a}	73.35±2,45^b	-0.25±1,00^a	7.55±0,60^a
Fallen fruit*	12.58±2,77%^{a}	75.70±2,09^b	-3.20±2,59^a	6.00±0,59^b
Fresh fruit**	20.00±5,24%^{a}	83.13±4,04^a	-0.67±0.90^a	4.80±0,80^c

*Numbers presented are the average of seven readings and the deviations
**Numbers presented are the average of two readings and the deviations
Means with the same superscript in the same column were not significantly different (p>0.05)

TABLE 3. Rendemen and colour parameter of flour produced from fresh nypa fruit at different length of blanching

Length of Blanching (minutes)	Rendemen	L*	a*	b*
0	20.00±5,24%^{a}	83.1±4.0^a	-0.7±0.9^a	4.8±0.8^a
0,5	18,35±2,38%^{a}	86.6±1.0^a	-0.3±0.4^a	3.4±0.5^a
1	17.12±1,50%^{a}	87.6±1.6^a	-0.1±0.4^a	4.3±1.1^a
5	18.69±1,82%^{a}	87.3±2.4^a	-0.4±0.3^a	3.3±1.0^a
15	19.11±0,40%^{a}	85.6±1.1^a	-0.9±0.7^a	3.9±1.8^a

Numbers presented are the average of three readings and the deviations
Means with the same superscript in the same column were not significantly different (p>0.05)

Water and Oil Absorption Capacity

Water absorption capacity (WAC) of flour may indicate the function of protein in the flour and the present of some molecules with high affinity for water such as simple sugar. At this study, the WAC of Nypa flour were 1.91 – 3.09g/g which is comparable to WAC of young Bamboo culm flours 3.68-4.73 g/g [14]. These values are higher than WAC of Rice flour 1.2-1.4 g/g [9], Rye flour 1.49 g/g [12], Barley flour 0.95 g/g [12], and whole Wheat flour 0.85 g/g [13]. As shown in Table 4, the freshness of Nypa fruit significantly affect WAC of the flour ($p<0.05$). Fallen and sprouted fruit of nypa might have absorbed water and salt, which may penetrate into the mesocarp. The present of salt must be confirmed as it may affect the function of protein in the flour and caused the WAC to decrease.

Oil absorption in the flour occurs as physical entrapment which highly depends on the shape and size of particle. The freshness of Nypa fruit nor length of blanching were found to have no effect on OAC of the flour (Table 4 and

Table 5). At this experiment Nypa flour exhibited low capacity to absorp oil with the values range 1.20-1.59g/g, comparable to OAC of whole Wheat flour 1.1g/g[13] and Barley flour 1.01g/g[12], but much lower than OAC of irradiated whole Wheat flour 1.91g/g [13].

TABLE 4.OAC and WAC of flour produced from different freshness of nypa fruit

Samples	OAC (g/g)	WAC (g/g)
Sprouted fruit*	1.58±0,38^a	1.91±0,59^b
Fallen fruit*	1.59±0,17^a	2.22±0,21^b
Fresh fruit**	1.20±0,20^a	2.84±0,24^a

*Numbers presented are the average of seven readings and the deviations

**Numbers presented are the average of two readings and the deviations

Means with the same superscript in the same column were not significantly different (p>0.05)

TABLE 5.OAC and WAC of flour produced from fresh nypa at different length of blanching

Length of Blanching (minutes)	OAC (g/g)	WAC (g/g)
0	1.20±0,20^a	2.84±0,24^a
0.5	1.22±0,06^a	2.55±0,16^a
1	1.28±0,09^a	2.31±0,63^a
5	1.35±0,16^a	3.09±0,02^a
15	1.27±0,00^a	3.05±0,39^a

Numbers presented are the average of two readings and the deviations

Means with the same superscript in the same column were not significantly different (p>0.05)

Swelling Power and Solubility

Swelling power (SP) of nypa flour is presented in Figure 3. SP is known to relate to amylose content, water holding capacity of starch molecules, hydrogen bond, and degree crystallinity of the starch granule. SP of the starches from present experiment was in the range 3.38 to 4.52 (g/g) with the highest SP was achieved at 85°C. This resultswere comparable to SP of rice starch (2.8 – 5.5 g/g) [9] but lower than *Dioscorea L* 3 to 17 (g/g) [16], 2.1 to 6.5 (g/g) for Bambara groundnut seed flour [17], 2.14 to 16.20 (g/g) for wheat starch[13]. The lower SP of *Nypa* flourmay indicate the inability of the flour to produce high viscosity upun low concentration.

Solubility (S) of nypa flour is presented in Figure 3. The result for solubility is similar to common solubility which increased as temperature increased to optimum and then decreased [15, 20,21]. Nypa flourfrom present study had the highest solubility 10.56% at 85°C which is comparable to solubility of *Dioscorea opposite*starch (10.25%). Solubility of a flour indicates the present of water solubility component in the floursuch as protein and amylose.

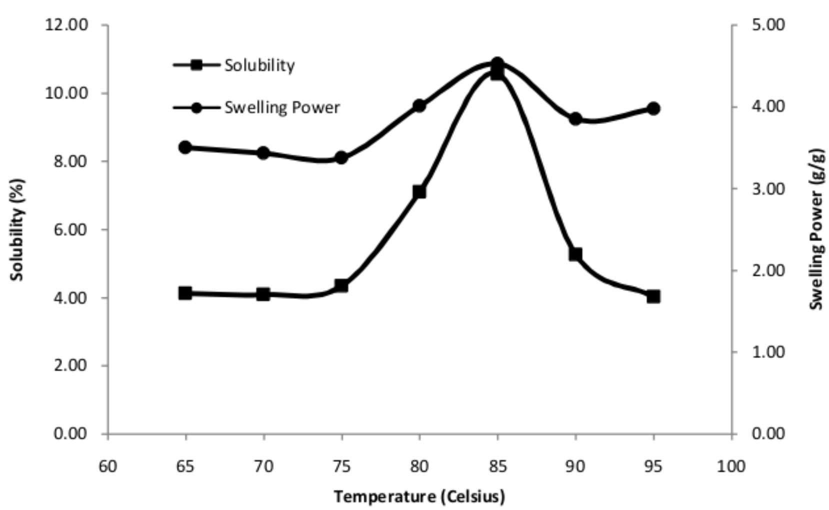

FIGURE 3. Swelling power and solubility of Nypa flour

CONCLUSION

The mesocarp of Nypa fruit can be processed into flour with rendemen 20,00±5,24%. The flour had low fat content and high crude fibre content. The flour had favourable color parameter, high WAC and low OAC . Nypaflour is a promising substitute for common flour such as wheat and rice especially for producing low calorie or high fibre food.

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