Dry Matter, Moisture, Ash and Crude Fibre Content in Distinct Segments of 'Durian Kampung' Husk

Norhanim Nordin, Rosnah Shamsudin, Azrina Azlan, Mohammad Effendy Ya'acob

***Abstract*—**An environmental friendly approach for disposal of voluminous durian husk waste could be implemented by substituting them into various valuable commodities, such as healthcare and biofuel products. Thus, the study of composition value in each segment of durian husk was very crucial to determine the suitable proportions of nutrients that need to be added and mixed in the product. A total of 12 'Durian Kampung' fruits from Sg Ruan, Pahang were selected and each fruit husk was divided into four segments and labelled as P-L (thin neck area of white inner husk), P-B (thick bottom area of white inner husk), H (green and thorny outer husk) and W (whole combination of P-B and H). Four experiments have been carried out to determine the dry matter, moisture, ash and crude fibre content. The results show that the H segment has the highest dry matter content (30.47%), while the P-B segment has the highest percentage in moisture (81.83%) and ash (6.95%) content. It was calculated that the ash content of the P-B segment has a higher rate of moisture level which causes the ash content to increase about 2.89% from the P-L segment. These data have proven that each segment of durian husk has a significant difference in terms of composition value, which might be useful information to fully utilize every part of the durian husk in the future.

***Keywords*—**Durian husk; crude fibre content; dry matter content; moisture content.

I. Introduction

DURIAN (*Durio zibethinus)* is a famous seasonal tropical fruit prevalent throughout Southeast Asia, particularly Malaysia, Thailand, Philippines and Indonesia due to its unique taste and aroma; it has a pungent odour and is locally known as the 'King of Fruits' [1]. The average weight of durian is 2 kg to 4.5 kg and it ovoid to nearly round-shaped depending on the variety [2]. In Malaysia, the peak season for the durian is mid-year between June and August. The durian fruit begins to ripen during rainy the seasons which are April to September for the southwest monsoon and October to March for the north-east monsoon. The fruit takes around 96-130 days to develop into a fully formed durian; generally, farmers will use cross-pollination-type durian because pure breed-type durian has a higher rate of self-incompatibility from 20-25%.

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Durian fruit is composed of 20-35% flesh (aril), 5-15% seeds and 55-66% husk [3]; it has a high nutritional value and is rich in dietary fibres, minerals, trace metal, sugar, vitamin C, potassium, as well as being a good source of carbohydrates, proteins and fats. Durian husk contributes to the biggest compartment in the whole durian and claims to have numerous health benefits towards human body system. Durian has green to brownish, thick and sharp hexagonal spines on its outer husk with white and loamy inner husk. Each durian husk has four or five locules that holds maximum of three pockets of creamy yellow flesh, which are edible and tasty. It is made up of 18.6% of pectin and 73.45% of cellulose, which is further divided into α-cellulose and hemicellulose. The physicochemical properties of durian husk have been carried out and the results show that it has 11.27% moisture content, 4.84% ash content, 39.3% carbon content and 53.74% oxygen content [4]. The study by Manickam et al. [5] has shown that among the three varieties of durian, which are 'Durian Kampung', 'Durian Kacing Baju' and 'Durian D2', 'Durian Kampung' has the highest moisture and ash content, which indicates that that the husk contains much water and minerals, while it also has a better adsorption capacity due to its lowest volatile matter value compared to the other two varieties that might have a higher chance of pores blockage for adsorption purposes. In addition, an equation has been developed by computing the higher heating value (HV) obtained from proximate analysis of 17 types of biomass samples including durian husk. The results conclude that durian husk is mainly composed of 80% volatile matter, approximately four-fifths of the sample and a small amount of ash content which might contribute as an alternative source of biomass fuel [6].

Durian husk is also believed to comprise features such as wound healing properties, a non-toxic effect towards internal organ, as well as being a source of lots of other nutritional benefits [7]. Previous studies have proven that the synthesis of activated carbon from durian husk exhibit toxic adsorbent properties by removing toluene [8], lead ions [9] and chromium [10] in aqueous solution. Studies conducted relating to diabetes mellitus reveal that the content of bioactive compounds such as polyphenols and flavonoids in durian husk exhibit both antioxidant [11], [12] and antiproliferative [13] properties by inhibiting the elevation of plasma lipids (mainly fatty acids and cholesterols) and plasma antioxidant activity on in vivo tests conducted on Wistar rats [14]. The purpose of this project was to study the composition and nutritional properties such as dry matter content, moisture content, ash content and crude fibre content in different segments of durian husk.

II. Materials and Methods

A. Durian Husk Properties

Durians fruit (*Durio zibethinus*) cultivar ‘Durian Kampung’ used in this study were obtained from durian stall nearby Sri Rampai, Kuala Lumpur; the fruits were grown at a durian orchard in Sungai Ruan, Pahang, Malaysia in early-November 2016. A total of 12 fruits were selected for the study based on colour, uniformity of size (with the average weight 0.4 +/- 0.2 kg per fruit) and being free of defects.

Durians were cut open along the carpel suture at the middle of each locule using a sharp knife. The arils and seeds were manually removed from the husk. Later, each locule of durian husk was cut into small pieces (1-2 cm) and separated into four different segments which are:

i) H: Green and thorny outer husk
ii) P-L: Thin neck area of white inner husk
iii) P-B: Thick bottom area of white inner husk
iv) W: Whole combination of thick bottom white inner husk (P-B) and green thorny outer husk (H)

The label and indication of segments of durian husk are shown in Fig. 1. Then, the fruit specimens were packed into sealable plastic bags and stored at -18°C in a freezer (HVF-301S, Hesstar Corporation Sdn. Bhd.) for further analysis.

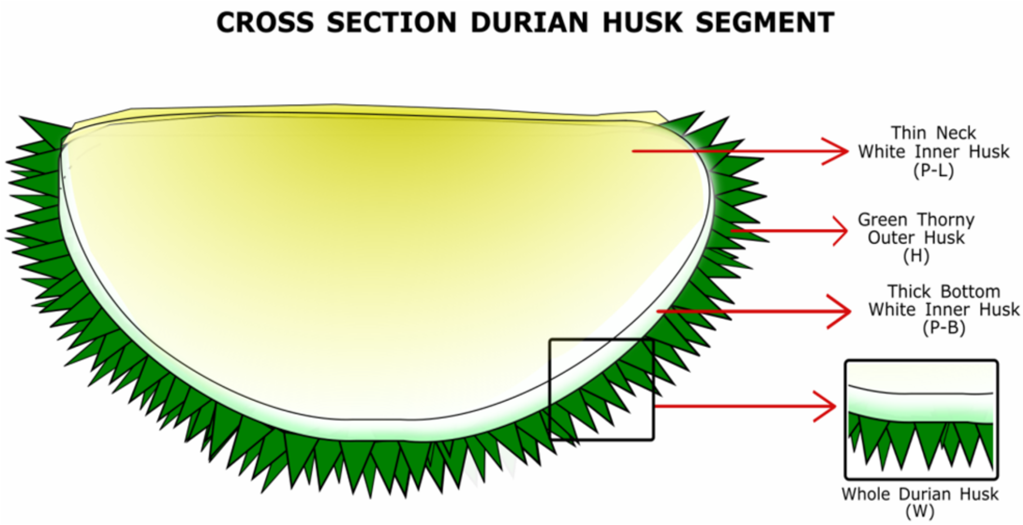

Fig. 1 Locule of Durian Husk and its Differential Segments

B. Dry Matter Content

About 1.0 g of sample was weighed and placed in the aluminium foil crucible. Then, it was dried for 24h in an oven (ON-02G, Jeio Tech; Korea) until the sample reached a constant weight. The final weight of sample and crucible was recorded. Percentage of dry matter content was calculated from (1):

$$Dry\ Matter\ Content = \left(\frac{Dry\ Weight}{Total\ Weight}\right) x\ 100 \quad (1)$$

C. Moisture Content

Aluminium foil was used as the crucible in this experiment. The initial weight of aluminium foil was recorded using a weighing balance and labelled as D_1. Then, 1.0 g of fresh weight durian samples from each segment were placed in the crucible and weighed as D_2. The set of samples and crucible were later placed in an oven and dried at 70°C for 24 h. Each sample was then further dried at 105 °C for 3 h until it has achieved stable weight. The final weights of the samples were recorded and labelled as D_3. The calculation of moisture content is performed from (2):

$$Moisture\ Content = \left(\frac{D2-D3}{D2-D1}\right) x\ 100 \quad (2)$$

D. Ash Content

The porcelain crucibles were washed and dried in an oven for 1 h. Then, the crucibles were cooled in the desiccator. Later, about 1.0 g of dried durian husk samples were placed in the crucible and their weights were recorded. They were carbonized at 550°C for 6 h in an ashing muffle furnace (KSL-1700X, MTI Corporation; USA) until ash was obtained. The ash was cooled in the desiccator and weighed. The calculation for the percentage of ash content is performed using (3):

$$Ash\ Content = \left(\frac{Weight\ of\ ash}{Weight\ of\ sample}\right) x\ 100 \quad (3)$$

E. Crude Fibre Content

This experiment was performed according to the method described by AOAC (1990). The crucible was washed and dried at 105°C for 1 h and cooled in the desiccator to prevent impurities. Then, the initial weight of crucible was recorded. Fibre analysis was conducted on a sample of about 1.0 g of durian husk and 1.0 g of filter agent using Celite 545 diatomaceous earth mixed in the crucible and later dissolved and boiled for 30 min in 200 mL of 0.25N sulphuric acid using a Fibertec™ machine (Foss Analytical; Denmark, 2010). The mixture was filtered and the residue was rinsed with acetone and distilled boiling water to remove the acid from the filtrate inside the crucible. A similar process was repeated with 200 mL of 0.313N sodium hydroxide (NaOH). After draining the mixture, the residue in the crucible was dried in an oven at 105 °C until stable weight was achieved. Then, the crucible was placed in the muffle furnace at 550°C for 6 h until it was burnt completely. Later, it was cooled in the desiccator and final weight was recorded. The percentage of crude fibre content was calculated using (4):

$$Crude\ Fibre\ Content = \left(\frac{Weight\ of\ residue\ without\ ash}{Weight\ of\ sample}\right) x\ 100 \quad (4)$$

III. Results and Discussion

A. Dry Matter Content

Diczbalis et al. [15] suggest that dry matter content could be useful in assessing fruit maturity, and it reflects the nutritional values that remain in the fruit after the removal of water. Fig. 2 depicts the dry matter content percentage of different segments of durian husk. The figure shows that the green thorny outer husk segment, labelled as H, contains the highest dry matter content percentage (30.47%) compared to other segments of white inner husk labelled as P-L (21.83%) and P-B (18.17%). According to Ho et al. [16], dry matter content is strongly linked to water and dry matter accumulation indicating that a higher amount of dry matter content, as in H segment of a durian husk, as in Fig. 1, contains an abundant of starch, protein and cell wall material acquired from photosynthetic activity and translocation in the phloem. P-B and P-L segments showing a slightly lower amount of dry matter content, reveals that they might have more water than dry matter since they are experience greater water loss during sample heating in an oven. Therefore, the H segment of a durian husk could be beneficial for livestock feed production, since these animals need to consume the proper amount of dry matter feed such as hay and grain for growth, maintenance and lactation [17].

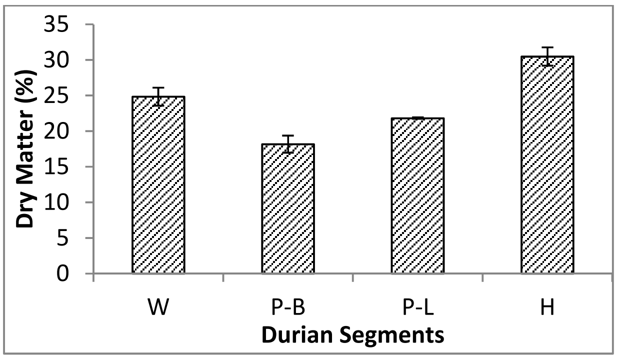

Fig. 2 Dry Matter Content Percentage of Segments of Durian Husk

B. Moisture Content

A moisture content study has been conducted to determine the rate of microbial activity in the fruit. Most fruits that can be easily damaged or rot have a high water content that makes them susceptible to microbial attack. For this experiment, wet-basis sample method has been used as the fresh wet sample was directly used instead of dried sample to calculate exact water loss in every segment of durian husk. Many researchers have been using the dry-basis method because the samples can be stored for a longer period than fresh samples due to the difference in the rate of moisture content, the samples first need to be oven-dried at 70 °C for 24 h before proceeding to further analysis [9], [18], [19]. Fig. 3 shows the graph of the percentage difference of moisture content in different segments of durian husk. The graph has shown that P-B segment of durian husk contributes to the highest percentage of moisture content (81.83%), indicating that the water concentration in thick bottom part of white inner husk is higher than in others, followed by P-L (78.17%), W (75.17%) and H (69.53%). It was reported that Shaiful et al. [20] tends to obtain a similar results for durian husk pulp for papermaking, which is 82% moisture content; while, the study by Ahmad [21] also has moisture content of 81.5% for a 25 mm cube-sized fresh durian husk sample that has been dried in air oven at 103°C for 24 h, which has the highest moisture content percentage in the experiment. Durian husk segment that has been used in the study by Ahmad is similar to the W segment used in this study as shown in Fig. 4 (a), while the durian husk used by Shaiful resembles that of the P-B and P-L segments, as in Figs. 4 (b) and (c), as only the white inner husk that is used in that study; thus, it shows that the inner white segment of durian husk is significant in controlling the water concentration of durian husk.

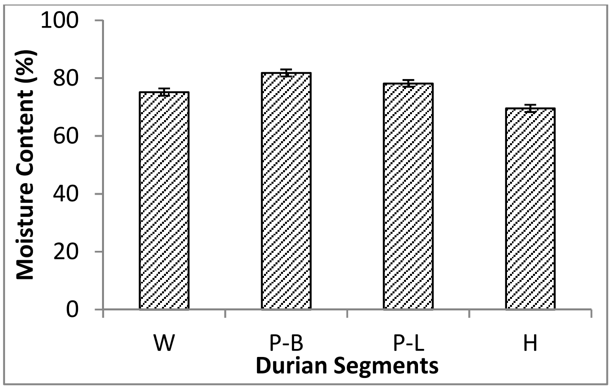

Fig. 3 Moisture Content Percentage of Segments of Durian Husk

Fig. 4 (a) Cross Section of Durian Husk [21]

Fig. 4 (b) Sliced Durian Husk

Fig. 4 (c) Durian Husk in Cubes [20]

C. Ash Content

The aim of the ash content experiment is to measure the total amount of minerals present in durian husk as inorganic residue that remains after the removal of water and organic matter through heating in an ashing muffle furnace. This process may impede the growth of microorganisms by burning away the organic content in the fruit. The effect of moisture content in four segments of durian husk was plotted in the graph as shown in Fig. 5. The result shows that P-B segment has the highest ash content (6.95%), followed by P-L (4.06%), W (3.57%) and H (3.32%). According to previous studies, ash content for random durian husk segments were obtained as 4.84% [4], 7.3% [5], 6.43% [6] and 4.22% [9]. Ash content for fresh fruits is usually lower than 5%, while the P-B segment is higher than 5%, which could indicate that the sample has a higher rate of moisture content that influenced its decreasing value of freshness within a shorter period compared to other segments, although all the samples were stored at the same temperature and location.

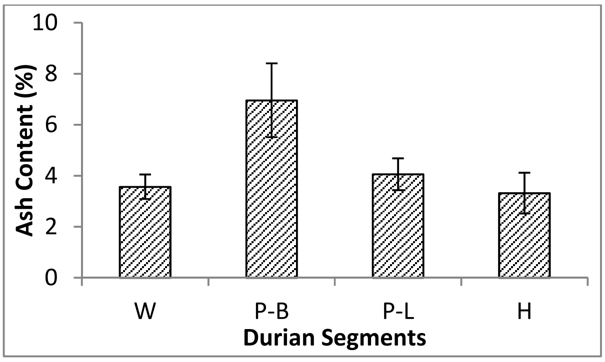

Fig. 5 Ash Content Percentage of Segments of Durian Husk

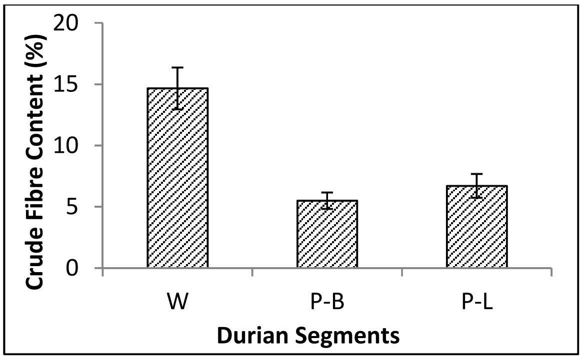

Fig. 6 Crude Fibre Content Percentage of Segments of Durian Husk

D. Crude Fibre Content

The crude fibre content experiment was developed to isolate the indigestible fraction in fruits by using successive acid and alkaline digestion method [22]. Fig. 6 presents the graph of crude fibre percentage of segments of durian husk, and shows that the W segment of durian husk has the highest percentage of crude fibre content (14.66%), followed by P-L (6.71%) and P-B (5.5%) segment. This experiment has been carried out to observe the presence of cellulose and lignin component in durian husk after soluble and insoluble fibre have been dissolved. However, a previous study shows a higher rate of crude fibre content which is 27.81% [19]. It is hypothesized that the H segment has higher crude fibre content compared to the W, P-B and P-L segments since the experiment is still running.

IV. Conclusion

This study showed that the H segment of durian husk has the highest percentage of dry matter content, which is 30.47%, while the highest moisture and ash content with percentages of 81.83% and 6.95%, respectively, was found in the P-B segment. The results obtained clearly show that each segment of durian husk has a significantly different composition value, and may contribute to the preparation of the proper amount of nutritional values that are contained in each segment needed for future commercialization approaches, especially in food production.

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