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Characterization of Raw and Ripen of Banana Peel wastes and It's Oils extraction using Soxhlet Method

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***Abstract*—In this present studies, characterization of raw and ripen of banana peels waste of Musa aluminata balbisiana (MBS), Musa acuminata Cavendish subgroup (MCS) and Musa acuminata Colla (MES) were performed using proximate analysis. The results shows that the peel waste of MCS is contained the higher moisture content (87.58%) followed by MBS and MES with the percentage of 86.57% and 82.97% respectively. However, the volatile content was showed that MES was exhibited the higher percentage with the values of 4.18%, meanwhile, followed by MBS and MCS with the values of 0.57% and 0.18 % respectively. At the optimum condition of soxhlet extraction method, the extraction recovery of MBS, MCS and MES were 39.53 %, 62.42 % and 39.53 % respectively and oil obtained were 3.6 ml, 5.3 mL and 3.0 mL respectively. Morphological study revealed that there are existed a bundle of follicular gel which contribute to the presence of oil in banana peel wastes.**

Keywords—banana peel; proximate analysis; soxhlet method

I. INTRODUCTION

Banana, which is scientifically known as *Musa sapientum* is a herbaceous plant of the family *Musaceae*. It is known to have originated from the tropical regions of Southern Asia. The *Musa sapientum* grows up to height of about 2-8 metre with leaves of about 3.5 metre in length. The stem also known as pseudo stem produces a single bunch of banana before dying and replace by new pseudostem. The fruits is grows in hanging cluster, which 20 fruits to a tier and 3-20 tiers to a bunch. The fruit is protected by its peel, which is discarded as a waste after the inner fleshy portion is eaten [1].

Soxhlet extraction method is a common and efficient technique in producing oil for biodiesel production [2]. *Soxhlet* extraction or known as solid liquid extraction, sometimes called leaching, involves the transfer of a soluble fraction from a solid material to a liquid solvent. The solute diffuses from the solid into the surrounding solvent. Normally, solid liquid extraction is dependent on the nature of the solvent and oil, reaction time between solvent and seeds, temperature of the process, particle size of the meal and the ratio of solvent to the meal [2].

The present work is therefore aimed to study the volatile and moisture content of raw and ripen peel waste of MBS, MCS and MES. Besides, oil extraction processes of the peel wastes were carried out using *soxhlet* extraction method and to investigate the morphological of follicular gel which contributing in oil extractions.

II. MATERIALS AND METHOD

A. Chemical and Instrumentation

Analytical grade hexane was purchased from Polyscientific Enterprise Sdn.Bhd (Melaka, Malaysia) and was used as solvent An electrical grinder was used at its fine grind setting to grind the dried banana peel wastes. An electrical oven (Memmert, UM200, Germany) was used to dry the samples and measure the moisture content. A universal soxhlet extraction system (B-811/B-811LSV, Buchi ,Switzerland) was used extract the oil from the banana peel wastes. Rotary vacuum evaporator (N - 10004 - W, Eyela, USA) was used to dry the samples.

B. Raw Materials Preparation

Banana peel wastes of MBS, MCS and MES were collected at the pisang goreng stall in Klebang Area, Melaka Malaysia. The samples were then identified by Botanist from Pejabat Pertanian Cawangan Melaka Tengah, Melaka Malaysia. All the samples then were crushed into a smaller sizes before oven dried. The well dried samples were ground using an electrical blender prior to extraction.

C. Experimental Procedures

i. Determination of Moisture Content

Approximately 30 g of the cleaned banana peel was taken in a crucible and dried in an oven at a temperature of 105°C for 6 hours and the weight was taken after every 2 hours. The procedure was repeated until a constant weight was obtained. After each 2 hours, the sample was removed from the oven and cooled in desiccators for 30 minutes. It was then removed and re-weighed [3]. The percentage loss of weight gave the percentage of moisture in the sample. The percentage of moisture content is computed as :

$$\%Mc = \frac{(Wto - Wtd)}{Wto} x100\% \quad (1)$$

Where Wt_o is the original weight of the sample taken and Wt_d is the weight of the sample after drying.

ii. Determination of volatile matter

The dried sample after moisture removal was taken in a crucible and placed in electrically heated oven at a temperature of 920°C for 10 minutes and then it was cooled in desiccators for 30 minutes. It was then removed and re-weighed. The percentage of weight loss gave the volatile matter content. The percentage of volatile matter is computed as:

$$\%Vm = \frac{(Wtd - Wt2)}{Wtd} 100\% \quad (2)$$

Where Wt_2 is the original weight of the due to the removal of volatile matter.

iii. Extraction Process

A standard weight of crushed banana peel wastes were placed in a 5 L three neck flask. Hexane was used as solvent to extract oil. The volume of hexane needed was determined by the ratio of 6:1. A reflux condenser was fitted and the mixture was heated at 40, 68 and 80°C and stirred for about 3, 7, 10 and 13 h. The resulting oil and solvent mixture were filtered to remove the suspended solids. Then, the mixture was placed in a rotary vacuum evaporator to evaporate the solvent and to obtain oil. The percentage of extraction recovery was calculated. Each extraction cycle was repeated twice.

iv. Scanning Electron Microscope (SEM) Analysis

The morphology of the raw and ripen banana peel waste of MBS, MCS and MES were examined by scanning electron microscopy (SEM).

III. RESULTS AND DISCUSSION

The proximate analysis of raw banana peel of MBS, MCS and MES was tabulated in table 1. The analysis shows that MCS contains a higher moisture content which is values of 87.58%, compared to MBS and MES with the values of 86.57 % and 82.97 % respectively. Previous studies shown that, the moisture content of banana peel of *Cavendish species* was about 85%, which is much lower as compared to the obtained result [4]. For volatile content, MES was exhibetd the high volatile content as compared to MBS and MCS with the percentage of 4.18, 0.57 and 0.18% respectively. Previous study suggest that moisture content give a direct correlation with the yields of oil in extraction processes]5]. Figure 1 show the relationship between moisture content and the oil extracted for MBS, MCS and MES. Based on Figure 1, MCS was show to exhibit high yiled of oil obtained (5.3 mL) followed by MBS and MES with the amount of oil of 3.61 and 3.0 mL repectively. Figure 2 below show a relationship between moisture content and the oil extracted for MBS, MCS and MES at optimum condition. Previous study stated that moisture content play a role in percentage of oil extracted from sunflower, cotton and soybean seeds [5]. In addition, the study also indicates that an increasing of moisture content from 5 to 9 %, the extraction yield increased from 25.82% to 31.32%. They also suggested that seed containing moisture content could be easily extracted since the water content affects the attractions between the seed and the oils. The dried seeds cannot be squeezed very effeiciently while seed containing high moisture are diificults to be extracted [5].

Table1: The Proximate analysis of banana peel waste

Type of Peel Wastes	Moisture Content(%)	Volatile Content (%)
MBS	86.57	0.57
MCS	87.58	0.18
MES	82.97	4.18

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Figure 1: Amount of oil extracted from the *Soxhlet* Extraction Method at the temperatures of 68°C and 7 hours or extraction time

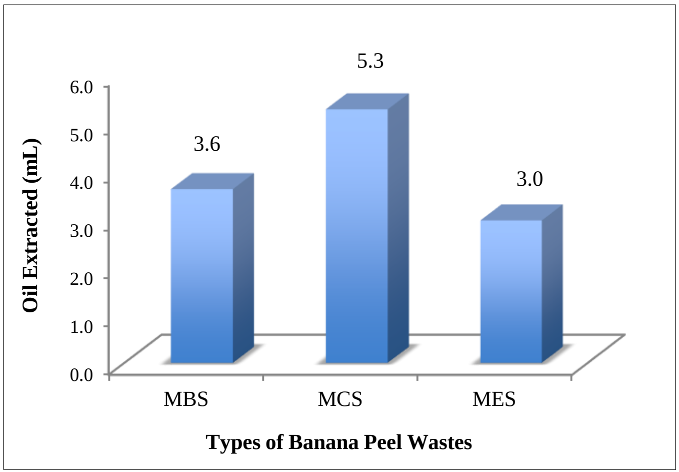
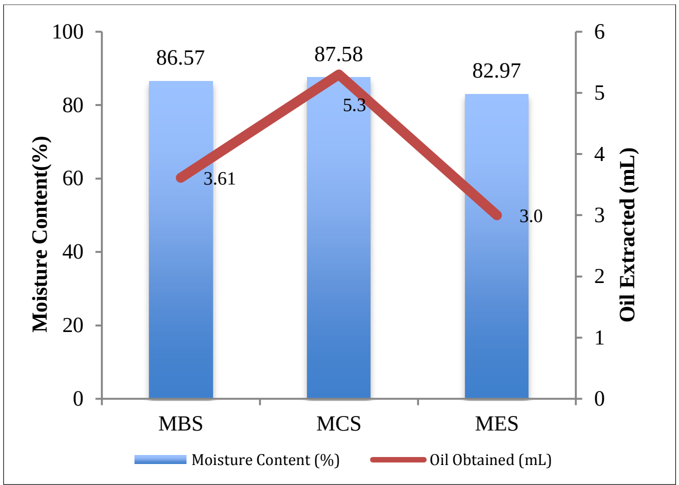


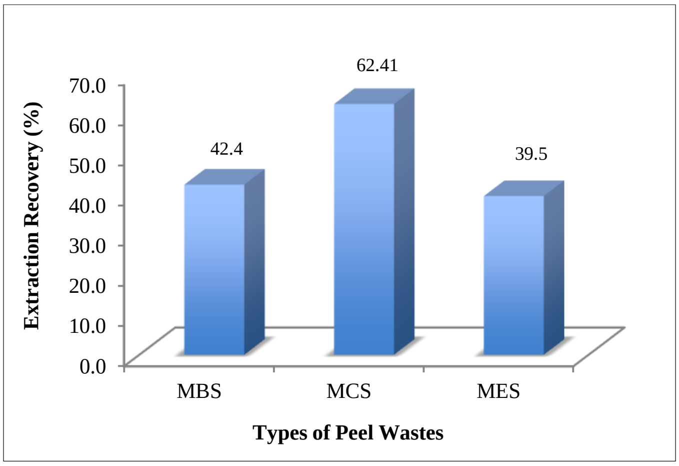
Figure 2: The Relationship between Moisture Content and the Oil Extracted for MBS, MCS and MES at Optimum Condition.



Soxhlet extraction process were carried by using *n*-hexane as solvent of extractor. It was chosen as it offered several advantages compared to other solvents. Hexane is extensively has a low vaporization temperature, high stability, low corrosiveness and low greasy residual effects [6]. In addition, Kpikpi [7] found that solvent extraction with *n*-hexane could produce about 41% yield by weight of oil per kg of the *jatropha* seed. However, Foidl and Eder [8] stated that the dry seed of *J. curcas* would yield about 30–38% of crude oil, however, in their study in Nicaragua 30.8% of crude oil by weight was extracted from 12,782 tons of dry weight of *J. curcas* using an engine driven-expeller.

In current study, the *soxhlet* extraction process were performed at 68°C at 7 hours of extraction time which said as optimum condition by the literatures [6]. The percentage extraction recovery of MCS (62.41%) is much higher compared to the previous reported. However, MCS and MES were shows about 42.4 % and 39.5% of their efficiency. The percentage of extraction recovery's profiles of oil from the peel waste of MBS, MCS and MES was depicted at Figure 3 below.

Figure 3: The profile of extraction recovery of oil from the peel waste of MBS, MCS and MES.



Micrograph from SEM, which were taken to determine the morphology of raw and ripen of banana peel waste of MBS, MCS and MES revealed that all the types of banana peel wastes contain a follicular gel as shown in Figure 4, 5 and 6. The large and clear structural of follicular gel appear in MCS suggested and support the reason of MCS having a high yield of oil obtained and better extraction recovery. Mabuchi *et al.*, [4] suggested that polysaccharide follicular gel do paly a dominant role in lubricating effect of banana skin after the crush and the change to homogenous solution. Moreover, Rosenthal *et al*., [8, 9] discussed that for plant materials, the oil constituents are trapped in the meshwork of proteins and cellulose/ hemicellulose or also known as polysaccharides which formed a bunch of follicular gel [10, 9,8] that related to polysaccharide follicular. Micrograph from SEM results indicated the reason of oil obtained in *soxhlet* extraction method of MCS showed the highest yield obtained compared to MBS and MES.

Figure 4: Scanning Electron Micrograph of raw and ripen banana peel waste of MBS at a) 30x, b) 50x and c) 100x

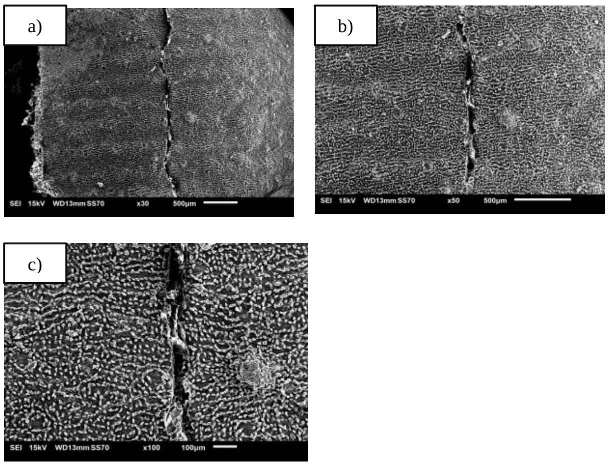


Figure 5: Scanning Electron Micrograph of raw and ripen banana peel waste of MCS at a) 30x, b) 45x and c) 100x

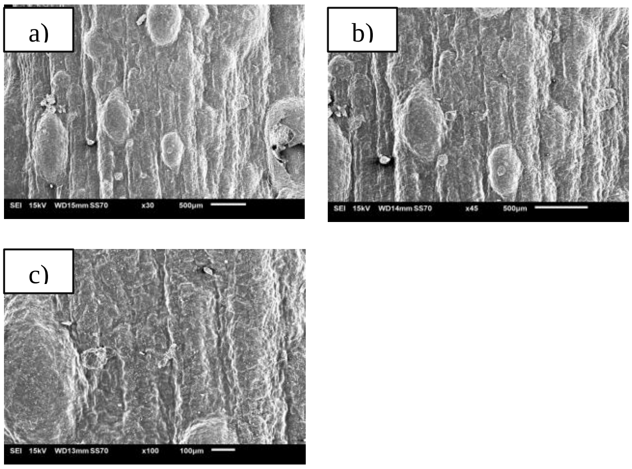
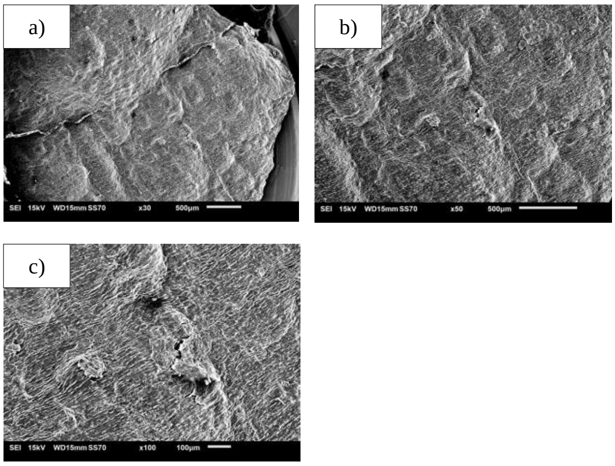


Figure 6: Scanning Electron Micrograph of raw and ripen banana peel waste of MES at a) 30x, b) 50x and c) 100x



IV. CONCLUSION

In the current study, proximate analysis, oil extraction using *soxhlet* method and morphological analysis were performed on three types of banana peel wasted of MBS, MCS and MES. For proximate analysis, MCS was show a higher moisture content, meanwhile for volatile content, MES was exhibited the higher values as compared to MBS and MCS. As per literatures, high moistures content was believed to contribute in increasing oil extracted which closed related with their extraction recovery. MCS do exhibit high moisture content, high % of extraction recovery and high amount of oil obtained as compared to MBS and MES. Morphological study revealed that the existence of follicular gel in the peel waste played a vital role in the formation of the oil.

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References

[1] Anhwange , B.A., 2008. Chemical Composition of *Musa sapientum* (Banana) Peels. *Journal of Food Technology, 6: 263-266.*

[2] Forson, F.K., E.K. Oduro and E. Hammond-Donkoh, 2004. Performance of jatropha oil blends in a diesel engine. *Renew. Energy*, 29: 1135-1145.

[3] Akpan, U.G., Jimoh, A. and Mohammed, A.D., 2006. Extraction, Characterization and Modification of Castor Seed Oil. *Leonardo Journal of Science* 5(8), 43-52.

[4] Mabuchi, K., Tanaka, K., Uchijima, U. and Sakai, R., 2012. Frictional Coefficient Under Banana Skin. *Tribology Online* 7 (3), 147-151.

[5] Muhamad, A.H.A.K. and Al Saa'di, D.A.A., 2010. Factor Affecting the Extraction Process of Oil-bearing Flakes of Sunflower, Cotton and Soybean Seedd. *Journal of Kerbala University* 8(3), 32-47.

[6] Seth, S., Agrawal, Y.C., Ghosh, P.K., Jayas, D.S., Singh, B.P.N. 2007. Oil extraction rates of soya bean using isopropyl alcohol as solvent. *Biosystems Engineering*, 97(2), 209-217.

[7] Kpikpi, W.M., 2002. Jatropha curcas as vegetable source of renewable energy. Paper presented at ANSTI sub-network meeting on Renewable energy.

[8] Foidl, N. and Eder, P. , 1997. Agroindustrial Exploitation of Jatropha curcus, In: Gubitz, G.M., MittelbachM, Trabi M. editors. Bio-fuels and industrial products from Jatropha curcas. Graz: Dbv-Verlag p. 88–91.

[9] Rosenthal, A., Pyle, D.L., Niranjan, K., 1996. Aqueous and enzymatic processes for edible oil extraction. *Enzyme Microb. Technol*. 19, 400, 120.

[10] Rosenthal, A., Pyle, D.L., Niranjan, K., Gilmour, S., Trinca, L., 2001. Combined effect of operational variables and enzyme activity in aqueous enzymatic extraction of oil and protein from soybean. *Enzyme Microb. Technol*. 28, 499-509.

[11] Shah, S., Sharma, A. and Gupta, M.N., 2004. Extraction of oil from Jatropha curcas L. seed kernels by enzyme assisted three phase partitioning. *Industrial Crops and Products 20,* 275-275