The effect of temperatures and extraction time on bio oil extracted from banana peel wastes

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ABSTRACT – Bio oil extracted from various part of edible and non-edible plants offer several potential applications such as a biodegradable lubricant. In this study, banana peels which known as waste and often ignored was subjected to solven extraction via *soxhlet* method. Moreover, the extraction of oil from banana peels wastes of *Musa aluminata balbis*iana (MBS) was performed and optimized. The effects of temperatures and extraction time were investigated in order to optimize the extraction conditions for achieving maximum oil obtained. The optimum conditions using *n*-hexane as a solvent of extractor was found at the temperatures of 68°C and 7 hours of reaction times whereby the extraction recovery was 62.42% with 3.6 mL of oil obtained.

1. 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 which also known as pseudostem produces a single bunch of banana before dying and replace by new pseudo stem. 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].

Solvent extraction is the preferred method as it is cost- effective and requires no further purification of the product [2, 3, 4]. Solvent extraction is the ability of a solute to distribute itself between an aqueous solution and an immiscible organic solvent. The organic solvent separates and purifies the solutes by extracting into the organic phase, leaving undesirable substances in the aqueous phase [5]. Hexane is the most extensively used solvent for oil extraction because of its high stability, high ability to dissolve oil, low greasy residual effects as well as low boiling point and corrosiveness [6, 7]. The properties of the organic solvent require that the dissolved species be electrically neutral. Species that prefer the organic phase particularly organic compounds are lipophilic.

The objective of this study was to evaluate the oil recovery through solvent extraction process. The influence of various extraction parameters were investigated and optimized. These parameters includes extractions temperatures from temperatures of 40 to 80°C and extraction time ranges from 3-13 hours. The results provides basis for solvent extraction process from non-edible of banana peel waste.

2. METHODOLOGY

2.1 Chemical and instrumentations

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-811 LSV, 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.

2.2 Raw material preparation

A banana peel waste of MBS was collected at the pisang goreng stall in Klebang Area, Melaka Malaysia. Botanist from Pejabat Pertanian Cawangan Melaka Tengah, Melaka Malaysia, then identified the sample. The peel was cleaned and cut into a smaller size before subjected to dryness using universal oven. The dried peel was grinded prior to extraction process.

2.3 Oil extraction from banana peel waste of MBS.

A standard weight of crushed banana peel wastes was 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 desired temperatures and hours. 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.

2.4 *Effect of temperatures*

The experiments were conducted to determine the optimum temperatures for oil extraction from waste of banana peel. The temperatures were varied from 40 to 80 °C.

2.5 *Effect of extraction time*

Extraction was performed at various times ranging from 3 to 13 hours.

2.6 *Determination of oil extraction yield*

The oil from the solvent extraction was determined with respect to time fro various test. The oil extraction yields, Oy (% w/w) was calculated using equation 1 below:

$$Oy = 100(M_o / M_p) \quad (1)$$

Where M_o is mass of oil in grams, M_p is mass of banana peel wastes in grams.

3. RESULTS AND DISCUSSION

The effect of the extraction temperatures was investigated at different temperatures which were 40, 68 and 80 °C. The experiments were conducted in order to determine the optimum temperatures for oil from MBS. In this study, higher temperatures were not tested. It is obviously due to the solvent vaporization at high temperatures. Besides, the temperatures, which lower than atmospheric temperatures, were also not investigated as it was observed at ambient temperatures no oil is recovered [8]. The result obtained from the process is depicted in Figure 1.

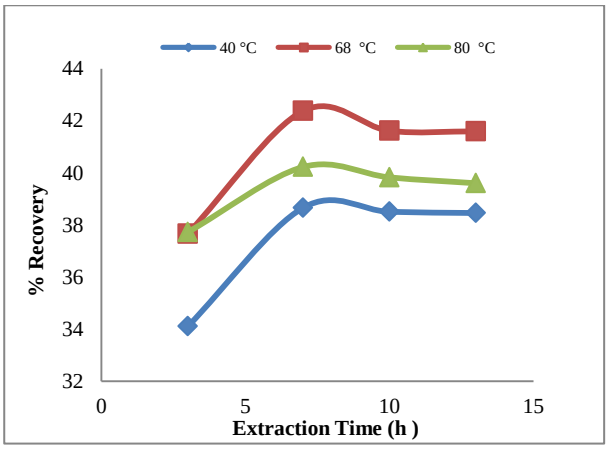

Figure 1 The Effect of Temperature on extraction recovery in *soxhlet* extraction method.

The Figure 2 shows that increasing the time for reaction do exhibit a signifcant increament in oil extraction from 3 to 7 hours at all the temperatures. However, there are no increament or decrement of oil yield after 10 to 13 hours of reaction time.

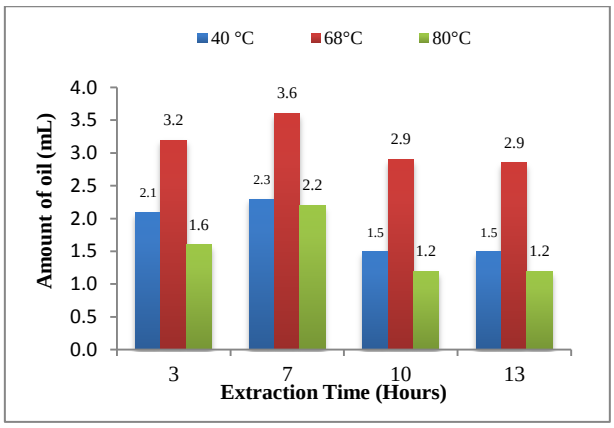

Figure 2 The effect of extraction time on oil extraction from peel waste of MBS by solvent extraction Operations

4. CONCLUSION

The results obtained in this study shows that an extraction time and extraction temperature affects the extraction recovery and oil obtained. The temperature of 68 °C and 7 hours of extraction was found to be an optimum condition for oil extraction process with 42.38% of extraction recovery and 3.6 mL of oil obtained.

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