The Effectiveness Biosorption of Durian (*Durio zibhetinus*) Rind Pectin on Handling Liquid Waste Containing Heavy Metal (Pb II)

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Abstract. Heavy metal is one of the most substances occur in water pollutants. It is harmful to humans and other living things. The biosorption of pectin from durian rind is used as a heavy metal binder. However, the type of pectin presented in organic waste is generally HMP (High Methoxyl Pectin), which previously should be demethylation. Durian rind used in this study are originated from Bogor West Java. This study aims to determine the effectiveness of pectin biosorbent in reducing the concentration of heavy metal (Pb II). Pectin extraction was carried out at 80 °C within a time variation of 1; 5; and 6 hours. The results showed that the most optimum pectin is with 6 hours of extraction time where the methoxyl content is 3.46%; weight equivalent 3860 % galacturonate content; the degree of esterification 20.29%; and lead (Pb II) uptake 97%. While durian seeds do not contain pectin.

1 Introduction

The mining industry in Indonesia like any other country produces heavy metals which sufficiently to the fulfillment of infra structure. The worrying consequences are led to metal contamination on surface water if managed inappropriately. The health problems and other environmental degradation can be impacted to the quality of life. Efforts of handling heavy metal pollution can actually be done by using chemical processes which expensive and tends to cause new problems [1], the process produces high toxic [2]. Another alternative is using biological materials namely biosorption, with low cost, high efficiency, minimization of mud formation, and ease of regeneration process [3]. Pectin is an ionic plant cell [4] can be used as biosorbent [5]. The active group present in pectin will bind metals [6-7] and forms complex compounds [8].

Pectin is a polymer of 1-4 linked D-galacturonic acid where widely used in industries [9], can be used as biosorbent because of many active groups which are generally High Methoxyl Pectin (HMP) type. It must be demethylated to LMP to be applied to heavy metals. Citrus pectin absorbs metal Pb (II) to almost 90% in the amount of pectin 0.1 g/L and Pb concentration of 0.1 mm [10]. The purpose of this study is to determine the effectiveness of pectin biosorbent in reducing the concentration of heavy metal (Pb II).

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2 Experimental

2.1 Sample Preparation

The durian rind and seed are collected from local fruit stall in Bogor origin, West Java, Indonesia. The rind was washed and dried with oven for 3 hours. The fine durian rind and seed samples were added aquadest with the ratio 1:10 (gr/mL) and HCL 2 N until it reached pH 2. The samples were heated in an oven at 80 °C for 1; 5; and 6 hours. Strain and wash with 96% ethanol solution. Put in the oven with temperature 40ºC until the sample is dry.

Pectin is dissolved in aquadest until it reaches a concentration of 1.5%. Add 3N NaOH solution to show pH 10. Then incubated with 55 ºC for 1 hour. Cooled, then add HCL 3N solution to reach pH 3 and allowed to stay overnight. It was precipitated with 96% ethanol. Filter the pectin residue and washed with acetone. Dried in the oven. Blend until smooth and sifted with Mesh 60.

2.2 Qualitative Identification

The pectin yield is the amount of pectin in grams resulting from durian rind and its seed extraction, at various treatment times of extraction (1, 5, and 6 hours).

$$\text{Yield} = \frac{Pectin\ (mgr)}{\text{Weight of dry sample (gram)}}$$

The equivalent weight was determined to 0.5 grams of pectin samples which inserted into 250 mL Erlenmeyer, add 2 mL of 96% ethanol, dissolve it with 1 gr of NaCl solution in 100 mL aquadest, then add 6 drops of Phenolphthalein indicator. Perform titration with a standard 0.1 N NaOH, and calculates the equivalent weight using the formula:

$$\text{Equivalent Weight} = \frac{Pectin\ (mgr)}{\text{V NaOH x N NaOH}} \quad (1)$$

The neutral solution of the equivalent weight determination plus 25 ml of 0.2 N NaOH solution. Then added 25 mL of 0.2 N HCl solution and 5 dropped of phenolphthalein, titrated with 0.1 N NaOH solution until it turns pink.

$$\text{Methoxyl Content (\%)} = \frac{mL\ NaOH\ x\ N\ NaOH\ x\ 31}{\text{Pectin (mgram)}} x100 \quad (2)$$

The Galacturonate levels are calculated from the milliequivalent (mEq) of NaOH obtained from the determination of equivalent weight and methoxyl content. The value 176 is obtained from the lowest equivalent weight of pectic acid. The calculation using the formula:

$$\text{Galacturonate Content (\%)} = \frac{(mEq\ Wt + mEq\ methoxyl) x\ 176}{\text{Pectin (mgram)}} x100 \quad (3)$$

The degree of esterification is calculated from the methoxyl and galacturonate acid levels obtained.

$$\text{Degree of Esterification (\%)} = \frac{176\ x\ \%\ methoxyl}{\text{31 x galacturonate}} x100 \quad (4)$$

2.3 Capacity the capacity Lead (Pb II).

Pectin samples from various treatments of 1 g were fed into a measuring flask each contain of 50 mL $Pb(NO_3)_2$ 10 mmol /L solution. The solution was centrifuged at 3000 rpm for 5 min. The supernatant was taken and the concentration of lead (Pb II) measured by Atomic Absorption Spectrum (AAS) at 283.3 nm wavelength [5].

3 Results and Discussion

3.1 Qualitative Identification of Durian Rind Pectin and Durian Seed.

The pectin of modified durian rind by treatment of different extraction times has yielded a positive response. The durian seed does not form anything during the qualitative test, it can be concluded it does not contain pectin. The hypothesis to this result, durian seed pectin powder is only a sap of durian seed and is not a pectin so no further research on durian seed pectin.

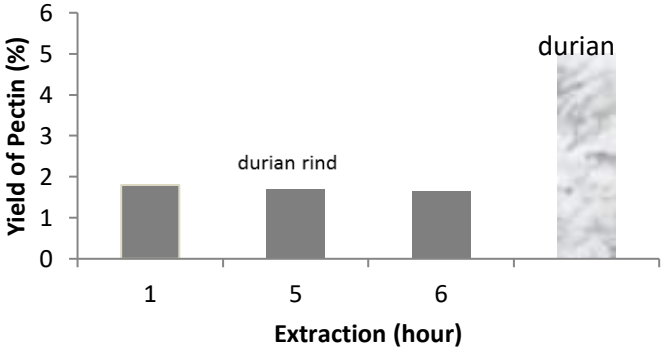

Fig 1. The Yield of Pectin in an average of Modified Durian rind and Durian Seed

The pectin yield is the amount of modified pectin in grams resulting from rind extraction at various times of extraction; 1; 5; and 6 hours and the durian seed the result then compared to dry powder. The yield of modified durian rind pectin with an hour extraction time shows the value of 1.80%; the yield of 5 hour extraction time has shown the value of 1.59%, and the yield of 6-hour of extraction is 1.49%. In the modified durian rind pectin the yield value decreases as the time of extraction take longer. The durian seeds show the value of 5%, this could be other substances than pectin that took part in the solid as seen in Fig 1.

The equivalent weight is the content of free un-esterified galacturonate acid consist of methyl ester group which are not esterified. The lower the pectin level causes the lower equivalent weight [11]. The highest equivalent weight in average is 5022 gr/eq within 1 hour of extraction. The equivalent weight of 5 hours and 6 hours of extraction of durian rind are respectively 4179 gr/ eq and 3860 gr/eq. This means a modified durian rind pectin within 6 hour extraction time has the most pectin compared to extracted for 1 or 5 hours.

3.2 Methoxyl content

Pectin is comprised into two groups, namely low methoxyl pectin (LMP) and high methoxyl pectin (HMP) [12]. The lowest methoxyl content was in modified pectin with an hour extraction of 3.09%. While the highest is achieved in 6 hours of extraction time, is 3.46%. It can be concluded that modified pectin produced pectin with low methoxyl content as illustrated in fig 2. Galacturonate content produced in this study was 84.11% for 1-hour

extraction, 91.25% for 5 hours extraction, and 96.78% for 6 hours extraction. The minimum permissible galacturonate level according to International Pectin Producers' Association

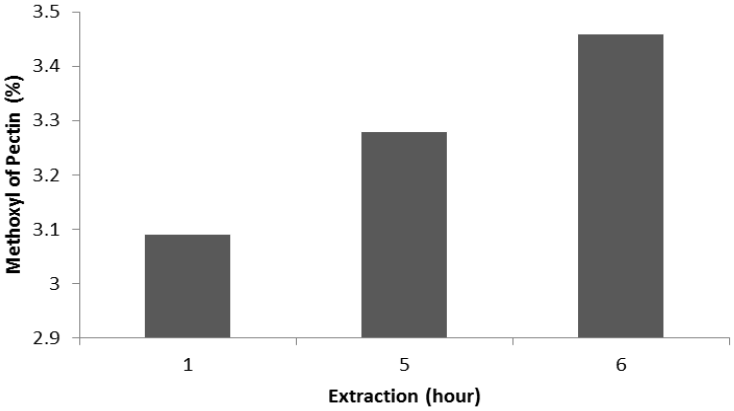

Fig 2. The Methoxyl content in an average of Modified Durian Rind Pectin

(IPPA) is 65%, so the resulting pectin has met the requirements of pectin quality. The lower the methoxyl pectin level, the low gel forming [13]. The degree of esterification of modified durian skin pectin for 1 hour is 20.83%, in 5 hours of extraction is 20.38%, the lowest is 6 hours of extraction time is 20.29 %. These are classified as low methoxyl pectin (LMP).

3.3 The capacity for Pb (II) Uptake

Pectin modification causes esterification to decrease, so increase the activity of the adsorption because of the lower the degree of pectin esterification the more active pectin

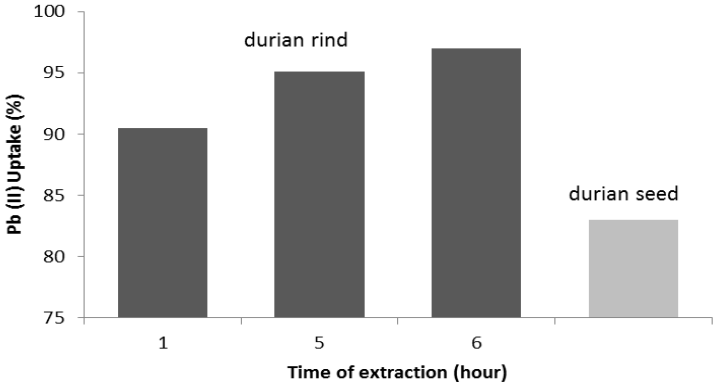

Fig 3. The Pb (II) uptake Capacity of Modified Pectin rind

group [5]. In durian rind pectin, for the time of extraction 1; 5; and 6 hours are respectively 90.46%; 95.1%; and 97%. The highest value is with 6 hours of extraction. So it is concluded that the longer the extraction time, the higher the absorption of Pb (II). Durian seeds do not show any response to various qualitative tests conducted, it is concluded that durian seeds do not contain pectin. Its absorbency shows a high enough value which is 83% as illustrated in Fig 3.

4 Conclusions

Durian waste can be used as raw material for making pectin. Modified durian skin pectin has a brownish yellow color. Optimum condition of pectin extraction results when viewed from the characteristics and absorption of lead metal was with 6 hours of extraction time. With a yield of 1.49%; weight of equivalent 3860.7 gr/eq; 3.46% methoxyl content; levels of 96.78% galacturonate acid; degree of esterification 20.29%; and 97 % of lead (II) uptake. While durian seed, throughout various of qualitative tests, was conducted does not give any responses, so it is concluded durian seeds do not contain pectin.

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