

Production of Free Fatty Acid from Hydrolysis of Waste Coconut Milk from Waste Water Pond Using Hydrochloric Acid



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Abstract

Free fatty acid was yield from waste coconut milk by hydrolysis technique. Hydrolysis of waste coconut milk had been studied two parameters which they were the amount of hydrochloric acid and temperature. The optimum condition was achieved at the amount of hydrochloric acid 5% (v/w) at 100 °C of temperature. Free fatty acid and cake obtained from this condition were further analyzed for physical and chemical properties. The hydrolysis reaction of this waste is the innovation method for high value products from waste water pond of coconut milk factory.

Introduction:

Fatty acid is the important raw material especially in oleochemical industrials such as biodiesel, soap, cosmetics and pharmaceutical industrials. Existing methods for production of fatty acid are base on chemical and physical methods. The existing industrial process hydrolyzes oils to fatty acid and glycerol at high pressure and temperature, respectively within two hours to achieve 96-99% conversion. Physical refining involves subjecting the oil to stem distillation under high temperature and vacuum for removal of the free fatty acids. Both hydrolysis and subsequent distillation of fatty acids to produce pure products are energy intensive process [1]. Coconut milk is food product that obtains by pressing the coconut kernel. A problem of one Thai factory which produces coconut milk is the coconut milk leak from the process into waste water pond. This coconut milk will accumulate together to make solid fat that float over the waste water in waste water pond. The factory has to remove this solid fat for landfill before making biogas form waste water. The problem of landfill is smell and uses high area. So, the factory try to avoid landfill and find the way to make value adds material from this solid fat.

Methodology:



Fatty acid composition in free fatty acid product obtained from acid hydrolysis

Free fatty acid product was further analyzed fatty acid composition by gas chromatography. The result of chromatogram showed in figure 1 and the amount in percentage area of each fatty acid was showed in table 3.

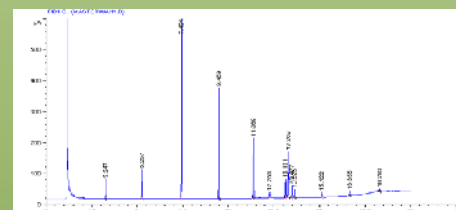


Figure 1 Chromatogram of fatty acids in free fatty acid product

Table 3 The percentage area of fatty acid in free fatty acid product

| Fatty Acids component | Chemical structure | Retention time (min) | Area (%) |
|-----------------------|--------------------|----------------------|----------|
| Decanoic acid | (C10:0) | 5.257 | 4.24 |
| Lauric acid | (C12:0) | 7.035 | 39.23 |
| Myristic acid | (C14:0) | 9.050 | 17.79 |
| Palmitic acid | (C16:0) | 11.369 | 15.93 |
| Stearic acid | (C18:0) | 13.131 | 3.88 |
| Oleic acid | (C18:1) | 13.268 | 11.73 |
| Unknown acid | - | 3.247 | 4.58 |

Results and Discussion :

Effect of acid concentration on acid hydrolysis

The results of oil content, yield of cake, free fatty acid content were experimented with different concentration of HCl to follow in table 1.

Table 1 Effect of acid concentration (Conc.) on the hydrolysis of waste coconut milk.

| Conc. of HCl (%v/w) | Oil content (%) | Yield of cake (%) | FFA (%) |
|---------------------|-----------------|-------------------|---------|
| 0 | 51.06 | 30.71 | 75.38 |
| 1 | 55.55 | 27.62 | 77.86 |
| 2 | 66.62 | 25.93 | 79.63 |
| 3 | 70.25 | 23.38 | 82.67 |
| 4 | 70.65 | 21.75 | 83.60 |
| 5 | 71.25 | 21.79 | 84.48 |
| 6 | 71.38 | 21.57 | 84.58 |
| 8 | 71.42 | 20.77 | 84.40 |
| 10 | 71.65 | 20.33 | 85.00 |

In table 1, the results show that the concentration of hydrochloric acid from 5-10% gave the nearly amount of oil content (71.25-71.65%), yield of cake (21.33-21.75%) and FFA content (84.48-85.00%). In this experiment, the optimum concentration of HCl was 5 % (v/w) because this concentration of acid hydrolysis used less concentration when compare with 6-10 % (v/w) of HCl concentration.

Effect of temperature on acid hydrolysis

The results of temperature from room temperature (30°C) to 90 °C and room temperature (30°C) to 100 °C were show in table 2. Both temperature conditions were experiment at 500 rpm of agitation rate and 5% (v/w) of HCl concentration.

Table 2 Effect of temperature on the hydrolysis of waste coconut milk.

| Conc. of HCl (%v/w) | Oil content (%) | Yield of cake (%) | FFA (%) |
|---------------------|-----------------|-------------------|---------|
| 0 | 71.25 | 21.79 | 84.48 |
| 100 | 74.86 | 14.38 | 95.88 |

The result from table 2 showed that the temperature at 100°C gave higher oil content and free fatty acid content than temperature at 90°C (95.88 % of FFA at 100°C of acid hydrolysis). It means that free fatty acid content increased when the temperature of acid hydrolysis increased, too.

From figure 1 and table 3 showed the fatty acids composition in free fatty acid product, the highest value to least value were lauric acid, myristic acid, palmitic acid, oleic acid, decanoic acid, stearic acid and Unknown acid, respectively. So, the free fatty acid product was saturated fatty acid.

Conclusion :

Waste coconut milk from waste water pond of Thai coconut milk factory can be a feedstock for production of free fatty acid oil product for the hydrolysis of waste coconut milk from waste water pond, it was found that the optimum condition was 5% (v/w) HCl concentration, and 100 °C of temperature. This condition give product with 95.88% of free fatty acid content and lauric acid is the major acid in this product. Right now the result from this experiment is upscale at factory to produce free fatty acid product as raw material for biodiesel production.

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Reference :

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