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Bioethanol production from durian shell wastes by saccharification and liquefaction processes

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Abstract
Durian shell wastes can serve as the main raw materials for advanced fermentation in bioethanol manufacture and can be used for wider applications to generate renewable fuels for industrial and rural communities in developing countries. This paper aims to study the process of bioethanol production and to look at the proper saccharification process for further fermentation which produces good bioethanol. The fermentation was observed for 48 hours. Enzyme α-amylase and glucoamylase are used in the process of saccharification and liquefaction to produce bioethanol. The results showed the fermentation of durian shell wastes was at pH 4.5 that became the maximum percentage of bioethanol production and was the highest ethanol content in water that is equal to 16,69%. The purity of bioethanol was analyzed using GC-MS and the highest peak of chromatogram reached 96.99% at 2,163 minutes which was detected as the first peak of bioethanol. The second peak of acetic acid reached 3.01% at 13,279 minutes. The purity of bioethanol that can be used for fuel should be 95% so this bioetahnol could replace premium. It is concluded the durian shells are very well used as an alternative fuel and the shells are renewable in nature as well as environmentally friendly for motor vehicles.

Keywords: durian shells, bioethanol, saccharification, liquefaction, and GC-MS

1. Introduction
Durian *(Durio zibethinus Murr)* is a climacteric fruit that has a short life of storage time. The storage temperature should not be lower than 15°C since the lower cold temperature can damage the fruit which is marked by the changes of the shells to become dark brown, by the loss of flesh fruit aroma, and by delayed fruit softening [1]. The wastes show to have a higher rate of production of ethylene from its flesh.

In the last decade, a significant increase in production, marketing and intake of tropical fruits, such as durian, interests local and international markets. This fruit is rich in essential micro and macro nutrients and contains high levels of minerals and vitamins, such A, C, and E [2]. Durian shell wastes can serve as the main raw materials for advanced fermentation in bioethanol manufacture and can also be used for wider applications to generate renewable fuels for industrial and rural communities in developing countries. The addition of enzymes through the process of saccharification and liquefaction would produce bioethanol and pure bioethanol can be obtained from distillation process using *a rotary evaporator*. Its purity is analyzed using a GC-MS tool.

Oil demand is expected to rise to a level of 57% from 2002 to 2030. As a result, bioethanol production can be considered as a substitute for fossil fuels. To produce bioethanol from durian shell wastes requires low cost due to the abundant availability of raw materials. Till today, the authors focus primarily on the extraction of the enzyme bromelain and the secondary use of the wastes as cheap raw materials for the production of phenolic antioxidants, organic acids, ethanol, biogas and fibers. In addition, the litter can also be a potential source for the production of vinegar as sugar found in fiber, which is the main raw material for fermentation [3].

2. Methods
Some tools used in the research are GC-MS, aluminum foillabu measuring, flask, beaker, pipette volume, pipette, digital scales, enzyme α-amylase materials, enzyme gluco amylase, *Saccharaomyces cerevisiae* (yeast *)*, durian shells, distilled water, phosphate buffer, sodium and NaOH buffer. There are some stages in collecting and selecting the durian shells, such as sample preparation from raw materials and their pre-treatment, removal of soil or other impurities in the shells, cleansing with aquadest, enumerating, spinning, drying, pulverization, grinding and sieving, and making durian shells flour; this flour helps to produce bioethanol. In case of fermentation the durian shells are fermented for 48 hours. In the process of saccharification and liquefaction to produce bioetahnol the enzyme α-amylase and glucoamylase are used.

Fig 1: Liquefaction and saccharification of durian shells into flour

3. Results and discussion

The durian shell wastes were dried into the oven at 60ºC with a reason that the higher temperature than 60ºC affects the enzymes of the shells [4]. Grinding the shells in blender was gradually carried out and the blended shells (or dough) were sieved with 100 mesh sieve so that the particle size of the dough had the same size so as to accelerate chemical reaction in the steps of bioethanol manufacturing process such as liquefaction and saccharification up to the fermentation.

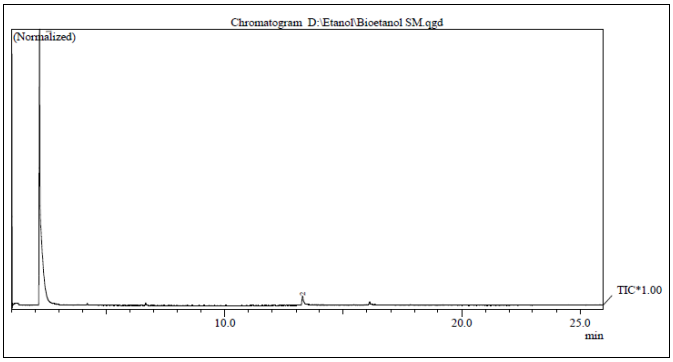

Fig 2: GCMS Chromatogram for durian shells bioethanol

From the sample of dough the fermentation pH was 4.5 which had the maximum percentage of bioethanol production and showed the highest ethanol content that was equal to 16,69%. The fermentation temperature was 35°C and the temperature could produce very good bioethanol because Dilapanga et.al. argued *Saccharomyces cerevisiae* grows in minimum temperature at 25-30ºC and in maximum temperature at 35-47ºC [5]. The fermented dough was then distilled using *a rotary evaporator*. The sample was heated at 65ºC to obtain pure bioethanol which had clear color. The purity of bioethanol was analyzed using GC-MS. The highest peak of chromatogram was in the percentage of 96.99% at 2,163 minutes which were detected at the first peak in bioethanol production. The second peak of acetic acid was at 3.01% recorded at 13,279 minutes. During the fermentation process, the formation of acids such as acetic acid, pyruvic and lactic acid which could decrese the pH of the liquid were found. From the GC-MS data, the percentage of bioethanol was 96.99% which posited above the normal purity of bioethanol, that is 95%. From this result it was known that bioethanol of durian shells is very good and can be used as an alternative fuel sources from fruits; it is also renewable and environmentally friendly for motor vehicles.

4. Conclusion

Bioetanol from durian shell wastes can be obtained from the optimum pH, namely pH 4.5 and from the temperature of 35°C. The percentage of bioethanol content of water is 16.69%. Bioethanol purity is distilled using *a rotary evaporator* and analyzed with GC-MS; it is obtained that the purity percentage is 96.99% and the percentage makes this bioethanol possible for fuel because ethanol percentage of purity is 95%.

5. References

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