Determination of Ethanol in a Distillate Sample of *Arenga pinnata* by UV-Visible Spectrophotometry

Y Febriani*, E A Ihsan
Universitas Hamzanwadi, Lombok, Indonesia
*yuyunfebriani89@hamzanwadi.ac.id

Abstract. This research aimed to determine ethanol in a distillate sample of *Arenga pinnata*. We have determined, by the means of spectrophotometer UV/VIS, ethanol contained by the distillation process of a series of samples. The results of these researches will analyse the ethanol contained in a distillate sample, qualitatively. Experiment method with 12 samples of *Arenga pinnata* series has been done. The samples found by varying day of the fermentation process and continued with the distillation process. Further, a distillate sample has been measured by UV-VIS Spectrophotometry. Wavelength 277 nm found as maximum wavelength with absorbance range (0.1 A-0.5 A). Samples in day 2nd to day 17th have these data. This means that a sample in day 2nd to day 17th of samples contained ethanol. Furthermore, the percentage of ethanol in a series of samples and the pharmacology effect of palm sugar as hypoglycaemic are still investigating in this research.

Keywords: *Arenga pinnata*, ethanol, distillation process, UV-Visible Spectrophotometry

1. Introduction

*Arenga pinnata* is one species of Arecaceae family and become one of the wide resources of sugar alcohol. Sugar alcohol is a noncyclic hydrogenated carbohydrate with reduced the hydroxyl group in aldehyde or ketone in sugars. They are most widely found in fruits and vegetables which have a fermentation process of microorganisms. They have health-promoting benefits as sugar substitutes regarding not only a wide range of sweetness and cooling effect, but also the non-cariogenic and less calorigenic properties. So they are used widely in the food and pharmaceutical industries [1]–[3].

*Arenga pinnata* produced a liquid which has a higher percentage of sugar and fibres which composed of cellulose (66.49%)[4]. Palm sugar, in a market known as red sugar and brown sugar, is the most famous sugar produced from a liquid of *Arenga pinnata* with the heating process. In Lombok, fresh liquid of this sample became one of the traditional drinks. In several areas of Lombok, the activity of drinks this liquid became a habit. But it might be not safe for a long time, because of the fermentation process. The fermentation process change sugar becomes alcohol and also change not only flavour but also taste[5]. So if this liquid saved for a certain time, this drink is still safe to consume.

Coconut water has the same family of *Arenga pinnata*, contains several biologically active compounds and possess cardioprotective, hepatoprotective, hypolipidemic, and antihypertensive properties in experimental animals [6], hypoglycaemic and antioxidant activities in rats induced diabetes has shown by mature coconut water[7], and mature coconut water has significant beneficial effect in diabetic rats comparable to glibenclamide, a well-known antidiabetic drug[8]. Groups of plants in one family may have almost the same content and efficacy and any medicinal plants contain phytochemical
substituents which important for human diet[9], [10]. Based on these researches, the opportunity of Arenga pinnata liquid as hypoglycaemic becomes very large.

One type of non-infectious diseases is diabetes mellitus. It becomes a serious and increasing global health burden and high prevalence. In developing countries, type 2 diabetes constitutes about 85% to 95% of all diabetes. Deaths due to non-infectious diseases increasing and becoming a major burden of the disease since 2000 and most of these factors are caused by humans [11]–[13]. This disease affects many people in Indonesia, generally and in Lombok West Nusa Tenggara in particular. For West Nusa Tenggara, the risk factors and non-infectious diseases reported by districts/cities are hypertension, obesity, and cervical and breast cancer examination. Obesity is one of the triggers for the emergence of diabetes. Therefore the possibility of increasing the disease data will continue along with changes in people's lifestyles[14].

Management of treating DM always starts with a non-pharmacological approach rather than pharmacological therapy (administration of oral hypoglycaemic drugs and insulin injection). Oral medications can use alternative medicines derived from natural resources, one of which is the sugar of Arenga pinnata liquid. For this research purposes, it will be analysed of ethanol contained in a series of samples of Arenga pinnata. The current research was aimed at answering the following questions:

1. How the ethanol contained in a series of samples of Arenga pinnata, qualitatively?
2. How the percentage of ethanol a series of samples of Arenga pinnata, quantitatively?
3. How the pharmacology effect and doses of a series of samples of Arenga pinnata as hypoglycaemic?

2. Methode

The material or sample of this research is samples of Arenga pinnata. This liquid is produced by Arenga pinnata, located in Kebon Tatar Selong, East Lombok. For this research need 10 Litter, approximately.

For solving the proposed research questions, the data of the study were collected by experiment treatment, including preliminary condition, distillation process, and UV-Visible spectrophotometry measurement. The preliminary condition was done by identifying the shape, colour, smell, and taste of each sample. The distillation process was done by simple distillation set and UV-Vis Spectrophotometry (Shimadzu 1880 series) for analytical measurement. This research was done in Analytical Pharmacy Laboratory, Universitas Hamzanwadi. Samples of Arenga pinnata as a sample is varied by the day, derived from 12 samples. Each sample contains 300 mL of liquid of Arenga pinnata and gets the distillation process. The distillate of each process will measure by UV-Vis Spectrophotometry. The standard of this experimental treatment was ethanol (96%). The data collected from the experimental result was analysed by qualitatively and quantitatively measurement. For qualitatively was analysed by preliminary condition, and wavelength and absorbance maximum conducted by UV-Vis Spectrophotometry. Next, for quantitatively was analysed by absorption measurement using linear regression of Lambert-Beer Law.

Here is the equation to analyse the percentage of ethanol using linear regression of lambert-Beer Law[15], [16].

3. Results and Discussion

3.1. Preliminary Condition

For qualitatively purposes on qualitatively analysis, preliminary condition can be used. Preliminary conditions include shape, colour, smell, and taste[17]. The sample was divided into 12 samples. Every sample has varied by the day or hours. Sample Day 0 (directly take from the tree) to Day 1st (48 hours keep on room temperature) show: shape liquid with white colour. The smell is a special smell of Arenga pinnata and sweet taste. Sample Day 2nd to 3rd have different preliminary conditions. They have pure white liquid with special smell of fermentation process, foaming, and sweet-a little sour taste. And for the other samples, they have the same preliminary conditions, including pure white
liquid with special smell of fermentation process and ethanol-containing, foaming, stinky smell, and very sour taste.

For qualitatively result, the fermentation process was starting on day 2nd and continuing for days after. This is identified by the preliminary condition of samples in these days. The high fermentation process was shown in sample in day 4th. The stinky smell has identified and very sours taste. So, based on this preliminary condition, samples of *Arenga pinnata* should be better consumption for 48 hours (two days) after harvesting from the tree, directly.

3.2. Distillation Process

There are many methods for separating alcohol as a result of the fermentation process. One of them is distillation. In this research, we used a simple distillation process for separating alcohol, in this case, is ethanol as a result of the fermentation process in samples of *Arenga pinnata*[18], [19]. Simple distillation (see Figure below) is a distillation process that does not involve a fractionation column or a process which is usually separating one liquid component from non-volatile substances or other liquids whose boiling point difference is at least 75°C. The condensate will have the same liquid mole ratio as the boiling vapour phase of the liquid phase. Simple distillation is not effective for separating components in mixtures where the boiling point difference is not too large[20].

![Figure 1: Distillation Process of Samples of *Arenga pinnata*](image)

Samples of *Arenga pinnata* as a sample is varied by the days, derived from 12 samples. Each sample contains 300 mL of liquid of *Arenga pinnata* and gets the distillation process. The distillate of each process will measure by UV-Vis Spectrophotometry. The standard of this experimental treatment was ethanol (96%). The result of this treatment shows in the following table:

| Sample | Distillation Result (Distillate, mL) | Wavelength Maximum (nm) | Absorbance Maximum (A) |
|--------|-------------------------------------|-------------------------|------------------------|
| Day 0  | 2.0                                 | 331.4                   | 0.108                  |
| Day 1st| 2.8                                 | 258.0                   | 0.510                  |
| Day 2nd| 4.2                                 | 276.6                   | 0.111                  |
| Day 3rd| 13.1                                | 254.8                   | 0.418                  |
| Day 4th| 39.85                               | 258.2                   | 0.804                  |
| Day 5th| 39.0                                | 279.0                   | 0.591                  |
3.3. UV-Visible Spectrophotometry Measurement

UV-Visible spectrophotometry is one of the analytical measurements which analysed compound by absorbance and wavelength. Every compound has a specified wavelength which differences them with others[21]. This method has used to measure ethanol in a distillate sample of *Arenga pinnata*. For a standard of alcohol compound, we used ethanol (96%) with 279.6 nm for wavelength and 0.831A for absorbance. From table 1 above, the results show a maximum wavelength of sample day 0 was 331.4 nm for wavelength and 0.108 A for absorbance. This wavelength is not accurate with ethanol wavelength. The wavelength of sample day 0 near the ethanol was 257.6 nm on -0.292 A for absorbance. The negative value was described that in sample day 0, ethanol contained in samples of *Arenga pinnata* was not identified. This result has shown in sample day 1st. The next day, in sample day 2nd absorbance value and wavelength maximum show the standard value, nearly. The day after, all of the samples show the same analysis. These data show the ethanol contained in samples of *Arenga pinnata* after day 2nd. The percentage of ethanol contained in every sample of samples of *Arenga pinnata* is still investigating. Standard ethanol (96%) show absorbance maximum was 0.831A with 279.6 nm. Based on the following table, the spectrum peak picks report of UV-Vis Spectrophotometry measurement in day 0 and day 1 show on the following figure below:

| Day   | Wavelength (nm) | Absorbance (A) |
|-------|-----------------|----------------|
| 6th   | 62.5            | 277.4          | 0.101          |
| 7th   | 42.2            | 267.0          | 0.493          |
| 8th   | 89.8            | 276.8          | 0.152          |
| 9th   | 84.0            | 277.2          | 0.178          |
| 16th  | 60.0            | 278.8          | 0.271          |
| 17th  | 69.0            | 277.6          | 0.509          |

*Figure 2: Spectrum peak pick report of UV-VIS spectrophotometry measurement*
For the next step of research, we still analyse the percentage of ethanol from the distillate of a series of samples. Hypoglycaemic of palm sugar is also still in investigating.

4. Conclusion
The current research investigated the ethanol contained samples of *Arenga pinnata* and give the information that samples of *Arenga pinnata* would be better consumption not more than two days (48 hours) after harvesting from the tree, based on ethanol contained data, qualitatively.

5. References
[1] Y.-C. Park, E. J. Oh, J.-H. Jo, Y.-S. Jin, and J.-H. Seo, “Recent advances in biological production of sugar alcohols,” *Curr. Opin. Biotechnol.*, vol. 37, pp. 105–113, 2016.
[2] T. Ford, “A New Route To Sugar Alcohols,” 2017.
[3] T. B. Granström, K. Izumori, and M. Leisola, "A rare sugar xylitol. Part I: the biochemistry and biosynthesis of xylitol," pp. 277–281, 2007.
[4] M. L. Sanyang, S. M. Sapuan, M. Jawaid, M. R. Ishak, and J. Sahari, “Recent developments in sugar palm (*Arenga pinnata*) based biocomposites and their potential industrial applications: A review,” *Renew. Sustain. Energy Rev.*, vol. 54, pp. 533–549, 2016.
[5] C. A. Blanco, C. Andrés-Iglesias, and O. Montero, “Low-alcohol beers: Flavor compounds, defects, and improvement strategies,” *Crit. Rev. Food Sci. Nutr.*, vol. 56, no. 8, pp. 1379–1388, 2016.
[6] A. Prathapan and T. Rajamohan, “Antioxidant and antithrombotic activity of tender coconut water in experimental myocardial infarction,” *J. Food Biochem.*, vol. 35, no. 5, pp. 1501–1507, 2011.
[7] P. P. Preetha, V. G. Devi, and T. Rajamohan, “Hypoglycemic and antioxidant potential of coconut water in experimental diabetes,” *Food Funct.*, vol. 3, no. 7, pp. 753–757, 2012.
[8] P. P. Preetha, V. G. Devi, and T. Rajamohan, "Comparative effects of mature coconut water (Cocos nucifera) and glibenclamide on some biochemical parameters in alloxan-induced diabetic rats,” *Rev. Bras. Farmacogn.*, vol. 23, no. 3, pp. 481–487, 2013.
[9] N. R. Farnsworth, “Biological and phytochemical screening of plants,” *J. Pharm. Sci.*, vol. 55, no. 3, pp. 225–257, 1966.
[10] J. Ram, P. Moteriya, and S. Chanda, “Phytochemical screening and reported biological activities of some medicinal plants of Gujarat region,” *J. Pharmacogn. Phytochem.*, vol. 4, no. 2, 2015.
[11] L. Guariguata, D. R. Whiting, I. Hambleton, J. Beagley, U. Linnenkamp, and J. E. Shaw, “Global estimates of diabetes prevalence for 2013 and projections for 2035,” *Diabetes Res. Clin. Pract.*, vol. 103, no. 2, pp. 137–149, 2014.
[12] D. Atlas, “International diabetes federation,” *IDF Diabetes Atlas, 7th edition. Brussels, Belgium Int. Diabetes Fed.*, 2015.
[13] J. F. Lindahl and D. Grace, “The consequences of human actions on risks for infectious diseases: a review,” *Infect. Ecol. Epidemiol.*, vol. 5, no. 1, p. 30048, 2015.
[14] G. D. Kandou, B. T. Ratag, A. F. C. Kalesaran, and P. C. Kandou, “OBESITY AND LIFESTYLE FACTORS AS DETERMINANTS OF TYPE 2 DIABETES MELLITUS IN MANADO CITY, INDONESIA,” *Malaysian J. Public Heal. Med.*, vol. 19, no. 2, pp. 54–60, 2019.
[15] D. A. Skoog and D. M. West, “Principles of Instrumental Analysis, (Saunders golden sunburst series),” 1980.
[16] C. Andrea, “Quantitative Analysis of Alcoholic Drinks. Use of Calibration Curve Method to Determine the Alcoholic Degree of Samples of Paesanella, a Distillate of the Family of Grappa,” *World*, vol. 3, no. 3, pp. 70–73, 2015.
[17] S. Ghosh et al., “Isolation and Partial Evaluation of a Potential Indigenous Yeast Strain Pichia kudriavzevii from a Traditional Rice Beer—‘Gora’ Prepared by the Koloi Tribes of Tripura,” *Adv. Microbiol.*, vol. 9, no. 9, pp. 824–841, 2019.
[18] H. B. Aditiya, T. M. I. Mahlia, W. T. Chong, H. Nur, and A. H. Sebayang, "Second-generation bioethanol production: A critical review," *Renew. Sustain. energy Rev.*, vol. 66, pp. 631–653, 2016.

[19] S. Kumar, N. Singh, and R. Prasad, “Anhydrous ethanol: A renewable source of energy,” *Renew. Sustain. Energy Rev.*, vol. 14, no. 7, pp. 1830–1844, 2010.

[20] G. Shevla, "Vogel's Text Book of Macro and Semimicro Qualitative Inorganic Analysis, fifth edition." Longman: London, 1982.

[21] E. Smith and G. Dent, *Modern Raman spectroscopy: a practical approach*. Wiley, 2019.

**Acknowledgements**

This research was financially supported by Universitas Hamzanwadi. Also for the laboratory’s facilities of Department of Pharmacy, Universitas Hamzanwadi.