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Combination Treatment Effect Of Ammonium Sulphate, Ph And Optimal Temperature On Fermentation Efficiency

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ABSTRACT

This study aims to examine whether there is an effect of combined treatment of Ammonium Sulphate, pH and optimal temperature on the yield of ethanol, CO2 and fermentation efficiency. The study was conducted in laboratory scale, using local sugar aren sap in Tomohon North Sulawesi. The result showed that under optimal conditions when ammonium sulfate was 2:25 gr, pH was 5.00 and temperature was 35˚C, they produced 92.54% average efficiency value (still range between 90-93%). It is claimed that there is a positive impact on the provision of ammonium sulfate with pH and optimal temperature.

KEYWORDS: Ammonium Sulfate, Ethanol, Fermentation, Efficiency

INTRODUCTION

The world's energy crisis made people look for opportunities to produce and provide alternative energy. This is very relevant to the global community's vision to achieve sustainable development. Today's experts said that the world's energy needs increase significantly [3, 10, 1,4].

80% of the world's energy needs are supplied by fossil fuels. Many countries rely heavily on fossil energy, including Indonesia [6]. The World Bank reported that the consumption of fossil energy in Indonesia is considered high (ca 65.57%) in 1999. The experts assume and estimate that the average fuel consumption growth during 2006-2020 was 4.6%. Unfortunately, the increase in energy consumption is not accompanied by adequate energy production. In addition to limited resources, the intensive use of energy from fossil fuels has been identified as contributing negatively to the environment. Significantly, global consumption of fossil fuels has resulted CO2 gas which triggers global warming. Currently, the increase in CO2 in the atmosphere and the phenomenon of global warming become a crucial issue in the world [14,11].

The transfer of energy sources from fossil fuels to alternative fuels has become intensive discussion and developed bio-ethanol from biomass which is a real obtained solution. Bio-ethanol is a potential alternative energy source that is produced from the fermentation process. The use of bio-ethanol, in both industrial and domestic, has many advantages because it is considered as an environmentally friendly energy and one of the renewable energy sources [9].

Arenga pinnata is a potential resource in the production of bio-ethanol. This species is native from Indonesia and abundant in many places. This species is not used to the daily diet, therefore, it provides an opportunity to process and produce bio-ethanol. This plant grows in all regions in Indonesia from the plains to the mountains [5]. The nature of this palm is hapaxanthik (flowering once and then die) and have male and

female flowers, but generally sap tapped from male flowers [13]. Arenga sugar content in the sap is about 6-16% [7]. This fact shows that the sap of A. pinnata can be considered as one potential source for the production of bio-ethanol.

Tomohon, North Sulawesi is one of the population center of A.pinnata and according to Pontoh [12], the sugar content of palm sap in Tomohon can reach 11 to 16%, and according to Bassham [2] the sugar content can still be improved by manipulating through various technologies against external factors (temperature, light intensity, carbon dioxide, water, minerals) and internal factors (chlorophyll, enzymes that regulate photosynthesis and transportation products and control hormonal on all systems), which means that this species may be potential raw material of bio-ethanol production.

Lantemona et al, [15] stated the addition of 2:25 gram Ammonium Sulphate produce 92.84% fermentation efficiency, pH 5 resulted in 92.84% fermentation efficiency and a temperature of 35˚ C gets 88.13% fermentation efficiency.

Based on the, this study was conducted to examine whether there was an effect of combined treatment of Ammonium Sulphate, pH and temperature on the fermentation efficiency.

MATERIALS AND METHODS

Materials:

The sap *Arenga pinnata* (locally called *Nira Aren,* Aren sap) was collected from Several *A. pinnata* orchards in Tomohon, North Sulawesi. The mature individual of *A. pinnata* was selected from Several traditional orchards in Tomohon. The process of tapping was carried out by cutting the blossom's spadix of the mature *A. pinnata,* and liquid sap was collected in the sterilized 10-liter bottle. The tapping was carried out at 6 pm to 6 am. The collection of palm sap was done with the help of local inhabitants. The sap which was collected in bottles then transferred to laboratory for next experiment steps.

Method:

First of all the sap was heated (sterilized) until the sugar content was 20% as measured by Brix meter and then cooled. After the prepared bottles and gallon fully charged water along with a hose that has been designed for the fermentation process, then the yeast Saccharomyces cerevisiae (locally called yeast) weighed 2.5 grams using digital scale as much as 5 replicates, then weighed Ammonium Sulphate, which gave optimum results. The next stage Nira aren was prepared in each bottle of 300 ml, then added 2.5 g yeast, ammonium sulfate. Then set the optimal pH and temperature as much as 5 replicates. After that it was sealed with a cover that has been designed so that it can be connected with a hose to the gallon. Next Connecting the bottle that contained the sample and a gallon then calculated CO2 produced by observing the number (L) of water coming down every 4 hours to 32 hours and the fermentation was stopped.

Table 1: Efficiency in the best conditions, compliance with ideal conditions of 90-93%, and the efficiency of fermented (ethanol from the sap) as an renewable energy source

Treatment	Optimal results	Result		
		Ethanol (%)	CO_2 (lt)	Efficiency (%)
ammonium Sulfate				
pH				
Temperature				

Result of CO2, ethanol and efficiency of the combined treatment $(NH_4)_2SO_4$, pH and temperature above, were analyzed using Analysis of Variance (ANOVA).

RESULTS AND DISCUSSION

Description of the ethanol yield, CO_2 and efficiencies gained in the five treatments was compared with five treatments and control, as in the description of Table 2.

Table 2: Comparison of Results of Ethanol, CO_2, and Efficiency In Treatment, Combined Treatment and Control

Treatment	Optimal value	Obtained Result		
		ethanol	Gas CO_2	Efficiency
ammonium Sulfate	2:25 gr	12.64%	13:58 lt	92.84%
pH	5:00	12.64%	12:18 lt	92.84%
Temperature	35˚C	12:00%	12.98 lt	88.13%
Control		11.74%	10.83 lt	86.13%
combined treatment		12.60	10.6 7 lt	92.54%

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1. Comparison of Ethanol in Treatment, Treatment and Control:

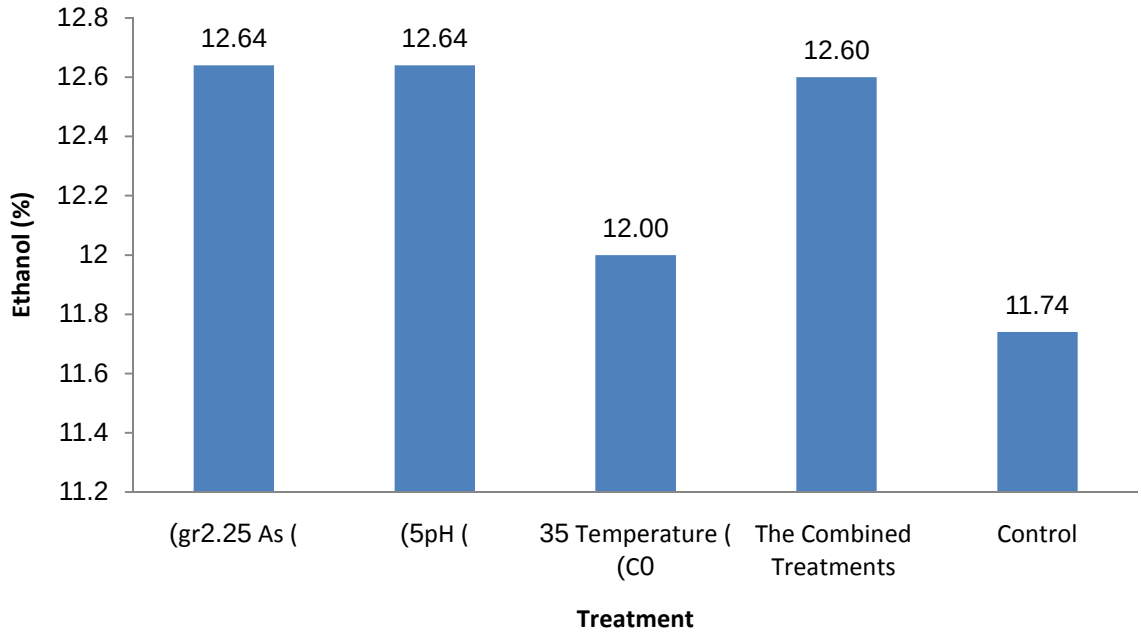

Fig. 1: Ethanol in Treatment, combined Treatment and Control

2. Comparative Results of CO2 in Treatment Combined Treatment and Control:

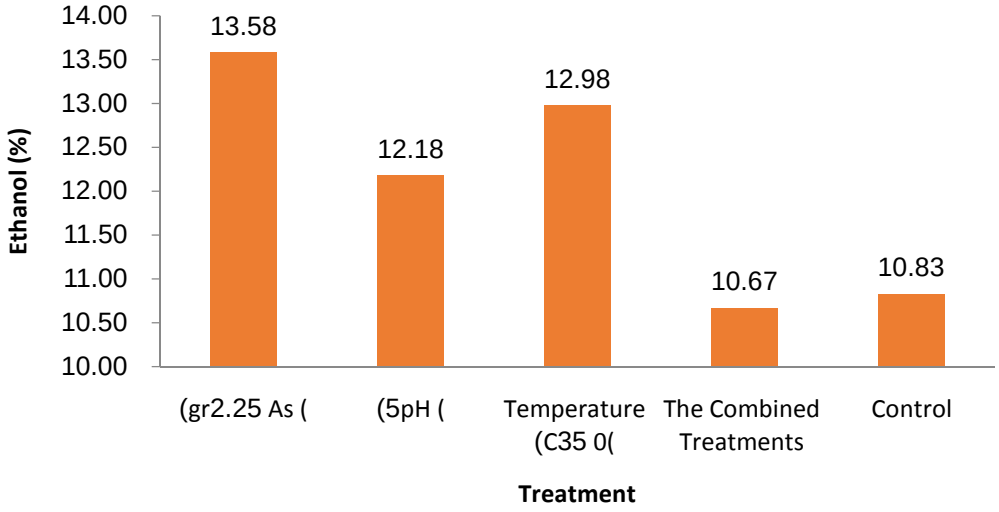

Fig. 2: Comparative Results of CO2 in Treatment, Combined Treatment and Control

3. Comparison of Results Efficiency in Treatment Combined Treatment and Control:

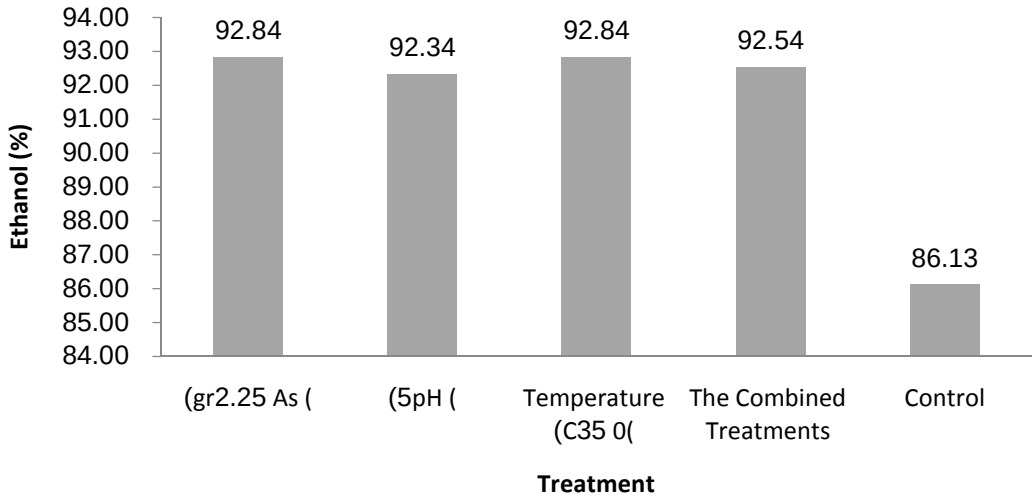

Fig. 3: Comparison of the Efficiency Result on the Treatment, Combined Treatment and Control

Overall optimal conditions obtained when ammonium sulfate was 2:25 gr, pH was 5.00 and at temperature of 35˚C. They would produce ethanol values in the range from12:00 to 12.64%, CO2 from 11.83 to 12.98 lt, and efficiency from 88.13 to 92.84%.

Before conducting the test, it was performed a calculation of correlation between ethanol, CO2 and efficiency resulting in optimum condition as follows

Table 3: The correlation between ethanol, CO_2, and Efficiency

Correlation	Correlation coefficient	Sig
Ethanol with CO_2	0. 773	0. 126
Ethanol Efficiency	1. 000	0000
CO_2 with Efficiency	0. 762	0. 134

Source: Primary Data Processed, 2016

Correlation analysis of the test results in the above table can be concluded as follows:

1) The correlation between ethanol with CO2 generated correlation values for 0773 and the Sig (p-value) for 0126 Due to the Sig> 0.05 (error rate of 5%), indicating that there is no link between Ethanol is produced with CO2 gas resulting from.

2) The correlation between the efficiency of ethanol produced, obtained by the correlation value of 1, 000 and the Sig (p-value) of 0000 because the value of Sig> 0.05 (5% error rate), indicating that there is a link between Ethanol is produced with efficiency generated.

3) The correlation between the efficiency of CO2 produced correlation values of 0. 762 and the Sig (p-value) of 0. 134 because the value of Sig> 0.05 (5% error rate), indicating that there is no link between efficiency generated by CO_2 produced.

The test results above shows that the correlation was only in Ethanol with efficiency, not the CO_2 that was produced. The correlation coefficient between Ethanol and efficiency was positive (+1000) that indicates the higher Ethanol is produced, the higher the efficiency generated. Thus at the next test results only include efficiency as a representative measurement of the test results in optimum condition. In some literatures stated that the ideal level of efficiency is between 90-93%, while the level of efficiency less than 90% is less than ideal conditions. From the results of this test showed that under optimum conditions, ie p existing at 2:25 gr ammonium sulfate, pH of 5.00 and a temperature of 35˚C, efficiency value will be generated by an average of 92. 54%, with a confidence level (confidence interval) ranged from 90.75% to 92.55%. This indicates that the value of efficiency to be obtained is in the range from 90.75% to 92.55% under ideal conditions (they ranged between 90-93%).

The efficiency of fermentation in the production of alcohol obtained from the comparison of actual production with the theoretical production multiplied by 100%. According to [8], in the industrial world, the value of ideal efficiency is 90-93%. The application of fermentation technology of ethanol on an industrial scale, since World War II has been no fundamental change. Batch fermentation process using a system with an incubation period ranging from 50 hours and solely rely on yeast strains that have been elected significantly high productivity. The ideal conditions, the fermentation efficiency reach 90-93%, indicating that the positive effect the provision of ammonium sulfate, as well as variations in temperature and pH optimum.

Conclusion:

The result of the research of the effect of the addition of (NH4) 2SO4, pH and temperature on the yield of ethanol, CO_2 and fermentation efficiency showed that the process of combined treatments produced optimum fermentation efficiency in 92. 54% which means it is in ideal condition.

REFERENCES

[1] Alhajji, A.F., J.L. Williams, 2003. Measures of petroleum dependence and vulnerability in OECD countries. Middle East Economic Survey, 46(16): 21-28.
[2] Bassham, J.A., 2016. Photosynthesis, Botany. Encyclopaedia Britanica Online. http://www.britannica.com/science/photosynthesis.Downloaded March 2016.
[3] Chew, T.L and S. Bhatia, 2008. Catalytic processes towards the production of biofuels in a palm oil and oil palm biomass-based biorefinery. Bioresource Technology, 99: 7911-7922.
[4] Dincer, I., 2000. Renewable energy and sustainable development: a crucial review. Renewable and Sustainable Energy Reviews, 4(2): 157-175.
[5] Effendi, D.S., 2010. Prospek Pengembangan Tanaman Aren (Arenga pinnata MERR) Mendukung Kebutuhan Bioetanol di Indonesia. Perspekti, 9(1): 36-46.
[6] Gosan, M., M. Samsuri, F. Siti, P. Bambang, M. Nasikin, 2007, *Sakarifikasi dan Fermentasi Bagas Menjadi Ethanol Menggunakan Ensim Selulase dan Enzim Sellubiase*, JURNAL TEKNOLOGI, Edisi 21 (3): 209-215. Jakarta.
[7] Imamkhasani, S., J. Kantasubrata and S. Sumartini, 1989. Analysis of Mono and Disaccharides in Indonesian Palm Sugars by a High-Performance Liguid Chromatographic Method. J ChromatogrSc, 27: 676-679.
[8] Jacques, K.A., T.P. Lyon and D.R. Kelsall, 1999. Alcohol Textbook. Third Edition. *A reference for the beverage, fuel and industrial alcohol industries*. Nottingham University Press, Nottingham, UK.
[9] Jeon, J.Y., S.J. Kim, D.H. Kim, B.K. Na, D.H. Park, H.T. Tran, R. Zhang and D.H. Ahn, 2007. Development of a Serial Bio-reaktor System for Direct Ethanol Production from Starch Using Aspergilus niger and Saccharomyces cereviceae. Biotechnol Bioprocess Eng., 12: 566-573.
[10] Naik, S.N., V.V. Goud, P.K. Rout and A.K. Dalai, 2010. Production of first and second generation biofuels: a comprehensive review. Renew SustEnerg Rev., 14(2): 578-97.
[11] Norton Roses Group, 2010. *Indonesia Energy Report*. A Norton Rose Group Guide.
[12] Pontoh, J., 2009. PotensiNira aren. LaporanHasilPenelitianYayasanMasarang, Tomohon, Sulawesi Utara.
[13] Pontoh, J and W.T.M. Smits, 2015. Some aspects of carbohydrate physiology in sugar palm (Arenga pinnata Merr). IOSR Journal of Agricultural and Veterinary Science, 8-II: 13-20.
[14] USAID., 2007. Indonesia Country Report: from ideas to action: *clean energy solution from Asia to address climate changes*. USAID- Annex 3, Bangkok, Thailand.
[15] Lantemona, H., A.L. Abadi, A. Rachmansyah, J. Pontoh, 2013. The Effect of Ammonium Sulphate, Calcium Chloride, Magnesium Chloride, pH and Temperature on Ethanol, Carbon Dioxide and Fermentation from Aren Sap. Journal of Basic and Applied Scientific Research, 3: 359-364.