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Original Paper

The Analysis of Alcohol Content in Cassava (*Tape*) Fermentation Process

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Abstrak: The fermentation process in making cassava *tape* (Manihot esulenta) worked on the alcohol content. The alcohol content differed during the fermentation process. The objective of this research was analyzing the alcohol content produced in the fermentation process of cassava *tape* (Manihot esculenta). Data interpretation method was experimented in this research. Three samples of *tape* were treated with ELF magnetic field exposure involving the intensity of 200μT with 15-minute exposure and the intensity of 300μT with 15-minute exposure. The tools used in this research were a thermometer to measure room temperature and a portable alcohol brix ATC meter refractometer to measure alcohol content. The results showed the average alcohol content on the first day was 8-10%; it increased on the following day by 25% and on the third day, it reached 36-38%. Thus, the longer the fermentation process, the higher the alcohol content would be; it can be concluded that the samples treated with ELF magnetic field at the intensity of 300uT obtained the highest alcohol content.

Keywords: Alcohol; Fermentation; Cassava; Intensity; Magnetic field

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INTRODUCTION

The majority of Indonesia consumed cassava-based *tape*. Some people argued that the fermentation process brought the different taste until the *tape* is well-fermented. This is due to the different alcohol content during the fermentation process. It depends on the duration of fermentation, the air, and the temperature of the *tape*. The average air temperature should be around 25.70°C and its maximum point should be 26.77°C during the lowest fermentation process. Furthermore, the most optimum temperature of the yeast was 25-30°C (Abdillah et al, 2014). Saccharomyces cerevisiae produced both zimase and invertase enzymes to break down the glucose into fructose and glucose into bioethanol (Nasrun, 2015).

Muflihah and Maisyaroh, (2018) said that analyzed the measurement of alcohol content through distillation process which was then measured by using an alcoholmeter. Thus, the research showed that the no-name yeast had higher alcohol content than the drum yeast. The fermentation process brought a major effect on the alcohol content produced. As much as 30% bioethanol was produced at 10-day fermentation process, while the 50% bioethanol was obtained at 15-day fermentation. The water content found in 30% bioethanol was higher that the 50% one as it influenced by the higher temperature density the 30% had (Firdaus et al, 2020).

Tape is a traditional food in Indonesia. The length of fermentation process was the indicatior of *tape* quality. The longer the fermentation process, the better quality tape would be. This *tape* spread delightful aroma, good texture; in which its quality got better. Utami (2017) claimed that the fermentation process of *kapok* banana *tape* also had an impact to its alcohol content. The longer the fermentation process, the

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more glucose would be converted into alcohol; which raised it more. In average, the gas produced in the fermentation process was 35% by volume, the ethanol content was 8-10%, and the alcohol content was 95% while the others were used in the other distillation process (Utami, 2017).

Very low-frequency magnetic fields have low frequencies so that they have an impact on tissue cells and can destroy microbes on cell membranes and microbes in organelles (Liu et al, 2017). Magnetic fields have a very low frequency in food, which is non-invasive (Minano et al, 2020). Very low-frequency magnetic fields have low frequencies so that they have an impact on tissue cells and can destroy microbes on cell membranes and microbes in organelles (Liu et al, 2017). Magnetic fields have a very low frequency in food, which is non-invasive (Minano et al, 2020). According to sadidah et al, 2015 Energy from magnetic fields can be transferred through ions of acid-forming bacterial cells. Then formed the flow rate of an ion that can pass through the cell membrane which can increase and cell proteins. Damaged cell proteins can interfere with metabolic processes and cause cell death. Meanwhile, according to Sudarti et al, 2020 extremely low frequency magnetic fields can be able to overcome and inhibit the invasion process because exposure to the magnetic field itself is able to inhibit the proliferation of bacteria.

METHOD

The alcohol content in the fermentation process of cassava *tape* was analyzed at the ELF physics education laboratory, the faculty of teacher training and education at the University of Jember by using several tools including; a portable alcohol brix ATC meter refractometer to measure alcohol content and thermometer to measure room temperature.

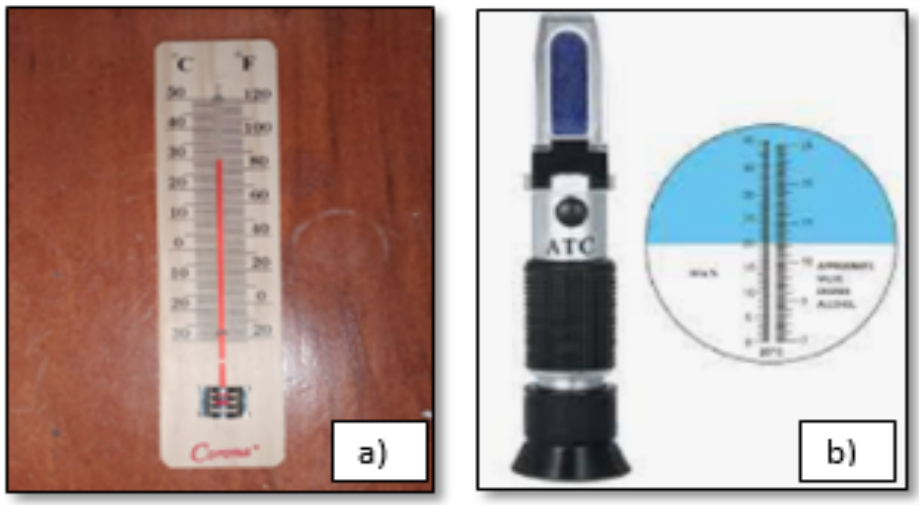

Figure 1. Research Tools, a). Room Thermometer, b) Alcohol Refractor

The research to collect data on alcohol content was done for 3 days, they were on October 23, 2021 to October 26, 2021. The research location was Elf's laboratory and a closed room to be precise in the classroom. The research was divided into three groups, namely without ELF magnetic field treatment, with 200uT and 300uT magnetic field treatment for 15 minutes. Measurement of each sample was conducted every 6 hours, namely at 09.00 WIB, 15.00 WIB, 21.00 WIB, and 03.00 WIB. Measurement of alcohol content was performed by dissolving the sample of cassava *tape* with distilled water by taking 25 grams of *tape* per sample dissolved in 30 ml of distilled water. Then, the dissolved solution is dropped into the alcohol reflector as much as three drops.

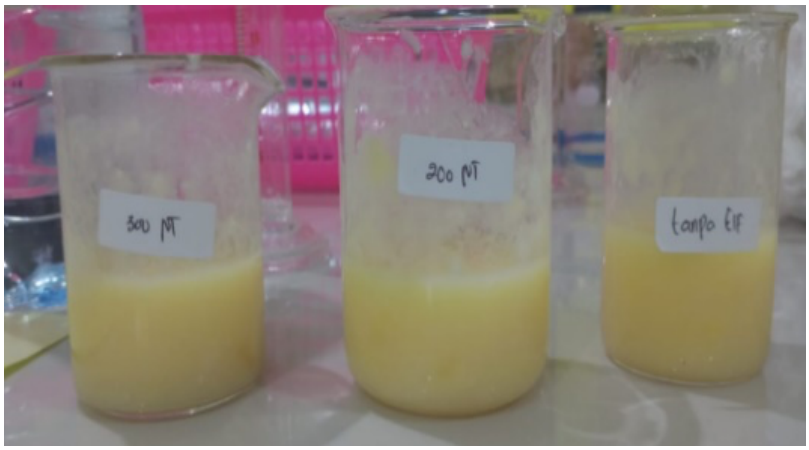

Figure 2. *Tape* Solution

The purpose of this research was to determine the value of alcohol content in the cassava *tape* fermentation process. From this research, it is known that there was a relationship between temperature and alcohol content produced in the fermentation process. This research has research variables, namely the independent variable that was changes in temperature, the control variable was time, and the dependent variable was the amount of alcohol produced. The method used for direct data collection research is presented in the chart below:

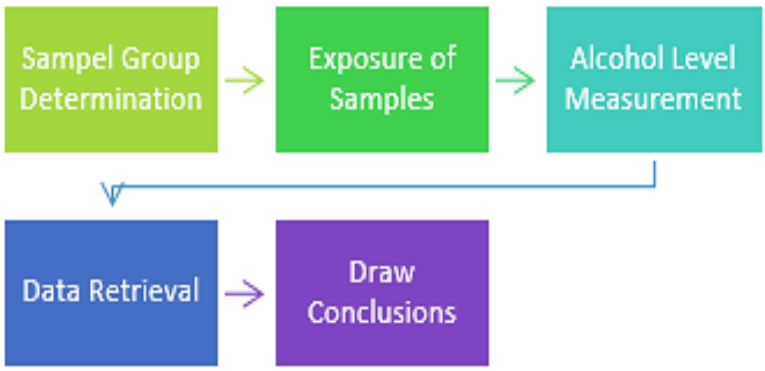

Figure 3. Alcohol Level Research Procedure

RESULT AND DISCUSSION

Based on the research data in Figure 4, the alcohol content on the first day in the control sample was 5%, in the sample treated with the 200uT ELF magnetic field for 15 minutes was 5%, in the sample with the 300uT ELF magnetic field treatment for 15 minutes was 7%. From the results of the first day of research, the percentage of alcohol content in the control and 200uT exposure samples was the same. Meanwhile, on the second day, the alcohol content in the control group without treatment increased to 10%, the sample with 200uT exposure was 10%, and the sample with 300uT exposure was 15%. On the second day, the control sample and the intensity of 200uT increased by 5% and on the intensity of 300uT it increased by 8%. On the third day, according to research data, the alcohol content on the *tape* reached more than 20% with the percentage in the sample without exposure of 20%, the intensity of 200uT 22%, and the intensity of 300uT being 27%. The third day of the research, samples exposed to the 200uT and 300uT experienced the same increase of 12%. On the fourth day the percentage of alcohol content of the control sample was 28%, the sample with 200uT exposure was 28%, and the sample with 300uT intensity was 30%. Meanwhile, on the last research day, the alcohol content reached a percentage of more than 30%, which were 32% in the untreated sample, 34% with 200uT exposure, and 38% on the 300uT intensity. On the fifth day, samples exposed to the 300uT ELF magnetic field showed the highest increase in alcohol content.

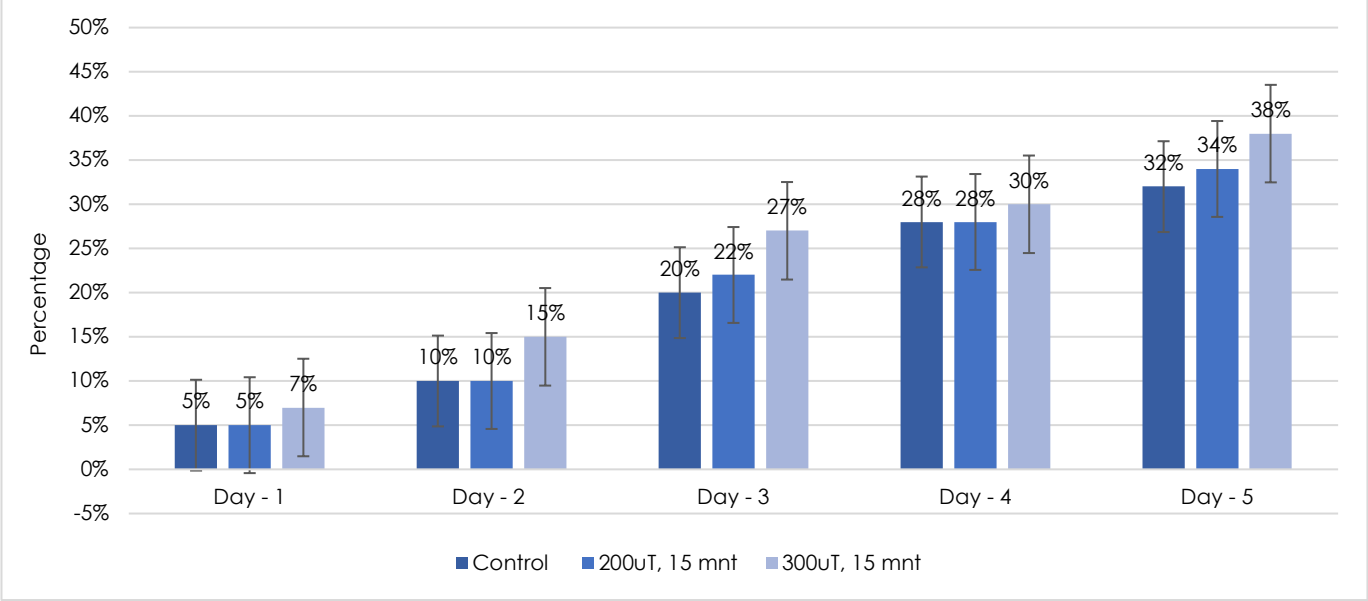

Figure 4. The Average alcohol content in the fermentation process

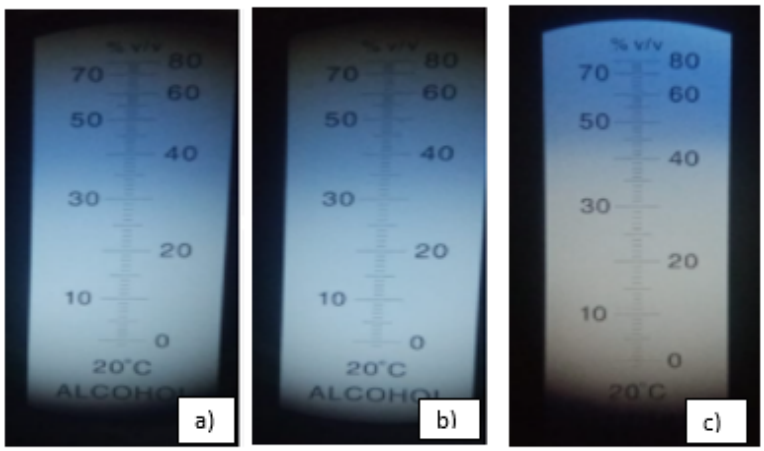

Figure 5. Percentage of alcohol content in each sample.
a) without ELF magnetic field treatment; b) 200uT intensity, 15 minutes; c) 300uT intensity, 15 minutes

The alcohol measurement in this research to analyze the alcohol level occurred in the cassava *tape* fermentation process. According to Rahman et al., (2017), the alcohol level measured in the third and sixth days in the process of cassava *tape* fermentation at the Boro market had a significant difference. It was due to during the fermentation, the starch turned out into glucose, and then later it turned out into alcohol after a few days. The alcohol level increased because of some factors such as temperature, room condition (open or close), and weather. Based on the interview with the product owner of Bondowoso *tape*, the temperature was the most influencing factor because if the temperature tended to be hot, the *tape* would quickly undergo the fermentation process so that the resulting alcohol content would be increasing as well. The alcohol level obtained from the sample without ELF magnetic field had a different percentage compared to those with ELF magnetic field exposure under 200uT and 300uT intensity for 15 minutes. The intensity also affected the increase of the alcohol level on *tape* because the exposure intensity below 500uT accelerated the fermentation process. Based on the research data, 300uT intensity caused the fastest fermentation process and thus produced the highest alcohol content compared to 200uT intensity.

The alcohol level measured every day indeed had percentage changes. The longer the fermentation, then the higher the alcohol level. The alcohol level on the first sample without ELF magnetic field treatment showed the highest percentage of 32%. In comparison, the second sample with ELF magnetic field treatment showed the highest percentage under the exposure intensity of 200uT was 34%, and 300uT was 38%. The percentage obtained from pure research results on the first and second samples had almost the

same alcohol content; however, the third and fifth days differed. While in 300uT intensity, it kept increasing significantly. This revealed that the intensity that could accelerate the fermentation process was 300uT. According to Hidayah & Basirun, (2021), different packaging affected the alcohol level, aroma, taste, and texture during the fermentation process. The *tape*, stored in a jar, had no alcoholic aroma. This research showed that *tape*, stored at woven bamboo basket (*besek*), resulted in *tape*'s unique aroma and taste. Moreover, it also affected the alcohol level as it gave a strong alcoholic smell.

CONCLUSION

Based on the results of this result, it can be concluded that the samples treated with an ELF magnetic field intensity of 300uT had the highest alcohol content. This was because the intensity accelerated the fermentation process and caused the alcohol content significantly increased.

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