

The influence of coconut sap heating temperature on the content of alcohol elements in arak distillation process

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Abstract. The process of making wine by distilling coconut sap through the process of condensation of steam that is heated so that it becomes alcoholic wine. Prototype distillation of coconut juice by heating using a gas stove. The results of the study showed that there was an effect of heating duration on alcohol content in coconut juice, at 85 Degree Celsius, 90 Degree Celsius and 95 Degree Celsius, the time taken was 0 minutes, 10 minutes, 20 minutes and 30 minutes. The average alcohol content at 85 Degree Celsius, 0 minutes with 72 percent, 10 minutes with 69 percent, 20 minutes with 66 percent, and 30 minutes with 63 percent. For a temperature of 90 Degree Celsius, 0 minutes are 56 percent, 10 minutes are 54 percent, 20 minutes are 51 percent and 30 minutes are 49 percent. While the temperature of 95 Degree Celsius, 0 minutes by 34 percent, 10 minutes by 32 percent, 20 minutes by 29 percent and 30 minutes by 22 percent. Significance probability value is 0.00. Greater than 0.05 then the hypothesis is rejected, meaning there is a significant difference in the heating time to the alcohol content for 0 minutes to 30 minutes.

1. Introduction

Arak Bali is one of the two favorite types of traditional Balinese beverages that are popular with young and old people. Besides drinking wine, it is also commonly used as a means of offering in Hindu religious ceremonies in Bali. Arak is a type of fermented liquor containing 37-60% alcohol (ethyl alcohol) which has been known in Bali since ancient times. Arak is generally made from palm wine by distillation. Arak can also be made from rice or glutinous rice through a fermentation process, then squeezed. The liquid is fermented and continues to be distilled [1].

Based on information from the Karangasem Industry Office, the number of traditional arak farmers in Karangasem as much as 7,600 people. The number is spread in four districts namely Manggis, Sidemen, Kubu and Abang. Arak Production in Karangasem Reaches 2.65 Million bottles per year [2].

Tri Eka Buana Village, Sidemen Subdistrict is one of the centers for the home industry of arrack makers. The distillation tool for coconut sap into arrack still used the traditional method. Coconut sap refining is now able to produce arak, however still used firewood as a heater and required a relatively long time to produce arak. Arak is divided into several grade levels of alcohol. For class one, alcohol content ranges from 35 to 40 percent, class two alcohol content is 30 percent, whereas for class 3 alcohol content is 25 percent [3].



In the heating process, the optimum temperature used at a 70°C because it is possible for the activities of various kinds of microorganisms that caused alcohol levels. If it is heated at a temperature of more than 80°C it is feared that it will quickly evaporate and decrease because it is the boiling point of alcohol [4]. Through research by developing a arak distillation tool it is expected to be one of the innovations in the development of appropriate technology in supporting the home industry especially distillation of arak [5].

2. Research Methods

This research is an experimental research through prototype testing of distillation devices with heat from LPG stoves. Before conducting the test (distillation process), coconut sap was given a treatment or preparation of sample material [6]. The treatment was fermentation for 6-12 hours, filtering roomie with a sieve. The purpose is to treat the sample raw material to be tested, including a good quality of sap. Furthermore, the tests conducted on distilled arak include testing alcohol content using an alcohol meter [7]. The observation and sampling of the results of the distillation test on the independent variable is the heating time. The duration of heating of the coconut sap was carried out at a temperature of 85°C, 90°C and 95°C and the heating time is 0 minutes, 10 minutes, 20, minutes and 30 minutes. The dependent variable was the alcohol content contained in the coconut sap expressed in (%) and determined using an alcohol meter. The test results were analyzed using the ANOVA statistical program.

3. Results and discussion

3.1. Prototype of arak distillation tool

The results design distillation device was made according to the needs of coconut sap farmers, with the dimension aspect referring to the planned capacity of the furnace volume of 50 liters [8]. in Figure 1.

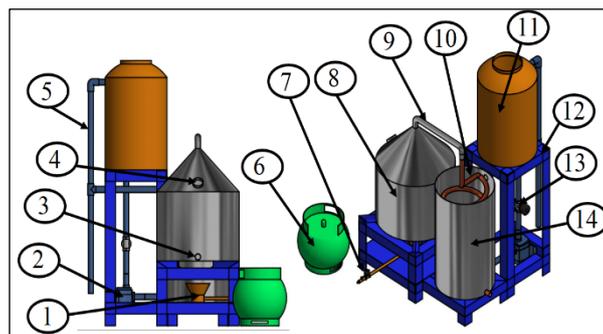


Figure 1. Distillation tool design.

Legend:

1. Burner	6. Gas cylinders	11. Water Tubes
2. Pump	7. Solenoid Valve Gas	12. Order
3. Drain	8. Reactor Tubes	13. Solenoid valve Air
4. Material Inlet	9. Pipeline	14. Condenser Tube
5. Sewerage	10. Condenser Pipe	

3.2. Basic Concept of Distillation

Distillation equipment has the principle of working to separate some substances through heating and cooling. The basic ingredients of the arak will be heated, heating is carried out with a certain temperature causing evaporation, this happens because of the differenced in the density of sap. As the heating circulation occurrd, the density of the sap that cannot evaporate will accumulate below and the light

specific gravity will go up so that it occurs fogging and undergoes a cooling process to change the phase from hot steam to liquid [9].

3.3. Distillation construction

Distillation or distillation of wine has important parts which are very influential on its performance [10], namely:

- Heater
This tool used to heat water in the evaporator tube, where the sap is drained in copper pipes in the evaporator tube.
- Digital Thermostats
The tool used to set the desired heating temperature and cut off the electric current to the heater automatically
- Evaporator Tube
This tube made from glass in order to be able to see the phenomena that occurs in the tube, in addition the high temperature used in this glass material so that the glass will not melt in the heating process.
- Condenser Tube
This tube made from mica in order to be able to see the phenomenon of phase change from steam to liquid in the process of distillation of Balinese arrack that occurs in the tube.
- Pump
This pump is used to drain sap material into the evaporator tube.
- Flow meter
Flow meter is used to determine how much output the sap material pumped into the evaporator tube.
- Thermometer
The thermometer is used to determine the hot temperature of the steam after heating the evaporating sap and the results of the distillation of arak.

3.4 Discussion

The examination of alcohol content on coconut juice with a duration of 0 minutes, 10 minutes, 20 minutes and 30 minutes with a temperature of 85°C, 90°C and 95°C to determine the alcohol content using an alcohol meter are shown in Table 1-3.

Table 1. Results of checking alcohol content at 85°C.

Sample	Alcohol content in percent%				
	85°C	0 minute	10 minute	20 minute	30 minute
1		72	70	67	65
2		74	71	64	66
3		71	68	66	63
4		72	69	69	60
5		73	70	65	62
6		71	68	64	60
Total		433	416	395	376
Average		72	69	66	63

Alcohol content in coconut juice with no heating 0 minutes obtained the lowest alcohol content of 71%, the largest 73%, with heating for 10 minutes obtained the lowest alcohol content 68% the largest 71%, with heating for 20 minutes obtained the smallest alcohol content 64% the largest 69% while heating for 30 minutes the lowest alcohol content is 60% and the largest is 66%.

Tabel 2. Results of checking alcohol content at 90°C.

Sample 90°C	Alcohol content in percent%			
	0 minute	10 minute	20 minute	30 minute
1	57	55	52	52
2	56	54	54	50
3	56	52	50	48
4	57	56	51	50
5	54	53	49	47
6	55	54	48	48
Total	335	324	304	295
Average	56	54	51	49

Alcohol content in coconut juice with no heating 0 minutes obtained the lowest alcohol content of 54%, the largest 57%, with heating for 10 minutes obtained the lowest alcohol content 52% largest 56%, with heating for 20 minutes obtained the lowest alcohol content 48% the largest 54% while heating for 30 minutes the lowest alcohol content was 47% and the largest was 52%.

Tabel 3. Results of checking alcohol content at 95°C.

Sample 95°C	Alcohol content in percent %			
	0 minute	10 minute	20 minute	30 minute
1	34	33	29	24
2	35	30	28	21
3	33	32	29	25
4	34	29	31	20
5	35	34	30	23
6	32	31	29	21
Total	203	189	176	134
Average	34	32	29	22

Alcohol content in coconut juice with no heating 0 minutes obtained the lowest alcohol content of 32%, the largest 35%, with heating for 10 minutes obtained the lowest alcohol content 29% largest 34%, with heating for 20 minutes obtained the lowest alcohol content 28% the largest 31% while heating for 30 minutes the smallest alcohol content is 20% and the biggest is 25%.

From the data heating time 0 minutes to 30 minutes at a temperature of 85°C, 90°C and 95°C obtained an average value of alcohol content, so that the longer the heating of the coconut juice will be lower the alcohol content, the average alcohol content as shown in Figure 2.

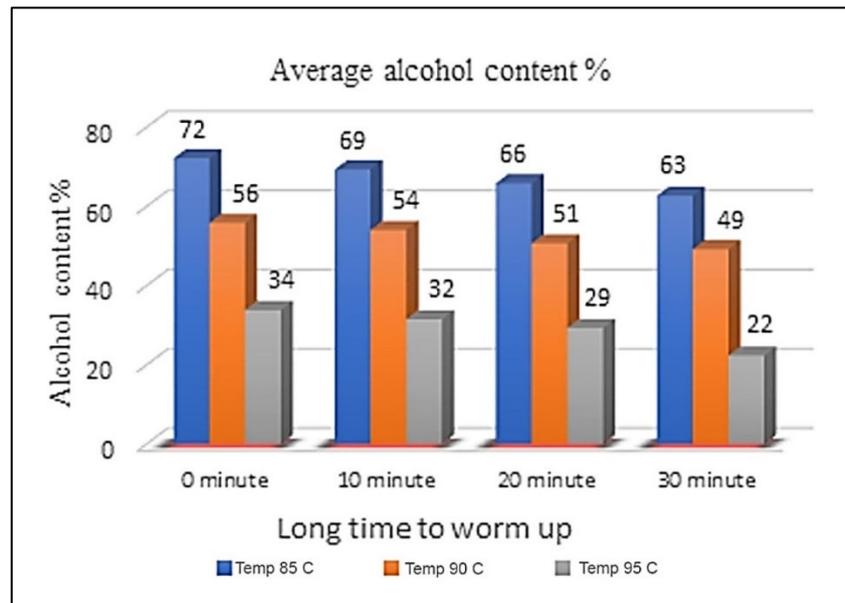


Figure 2. Graph of average alcohol content.

After getting the results of the examination of alcohol content on coconut juice, then the normal distribution test using the Kolmogorov test obtained significant $P = 0.200$ so that the data were normally distributed with a significant level of $p > 0.05$. The testing data with ANOVA test to get the final alcohol content. From the ANOVA test results obtained significant $p = 0.000$, therefore it can be concluded that H_0 is rejected or H_a was accepted, which means there was an influence of heating time on alcohol content for 0 minutes, 10 minutes, 20 minutes, and 30 minutes with significant $p = 0.000$ ($\alpha < 0.05$) therefore, an alternative H was accepted. This was indicated by the significant level below 0.05 (5%).

4. Conclusions

Based on the results of the study the effect of heating time on alcohol content in coconut sap, it can be concluded that, There was an influence of heating time on alcohol content on coconut was, with a temperature of 85°C, a temperature of 90°C and a temperature of 95°C, the length of time of sampling used 0 minutes, 10 minutes, 20 minutes and 30 minutes, indicated by a decrease in alcohol content.

The average alcoholic content of coconut sap at 85°C in 0 minutes was 72%, 10 minutes was 69%, 20 minutes was 66% and 30 minutes was 63%. For a temperature of 90°C, 0 minutes were 56%, 10 minutes were 54%, 20 minutes were 51% and 30 minutes were 49%. While the temperature of 95°C, 0 minutes by 34%, 10 minutes by 32%, 20 minutes by 29% and 30 minutes by 22%. Based on the ANOVA test output, a significance probability value of 0.000 can be obtained. Therefore, the significance value of $0.00 < 0.05$ then the hypothesis was rejected, which means there was a significant difference in the heating time to the alcohol content for 0 minutes, 10 minutes, 20 minutes and 30 minutes. The suggestion for arrack makers is to pay more attention to the way it is processed therefore, the alcohol content will not quickly become higher so then treat it immediately.

5. References

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