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HORIZONTAL COFFEE ROASTER DESIGN WITH TEMPERATURE AND TIME CONTROL

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Abstract. National coffee have bean production reaches 600,000 tons for a year, only 20% that can be processed and marketed in to secondary products by roasted coffee, ground coffee, fast food coffee, and several types of secondary products derived from its derivatives and processing. The factors need to be considered when roasting, including temperature, time, expertise, and roasting techniques with a tool that is designed has dimension length 50 cm width 45 cm and height 110 cm. Coffee beans are roasted using a teflon griddle without a 25 cm cover diameter and Teflon griddle with a 16 cm cover diameter. The treatments studied were temperatures around 180 to 215°C with 12 minutes roasting time. The temperature treatment and roasting time affect the changes in mechanical physical properties of the coffee, namely a faster decrease in water content, increased fragility and accelerate changes in the color of darkness. Roaster machine based on microcontroller using gas fuel is made only 3 settings of coffee profile results, namely light, medium and dark with a light time of 12.8 minutes, medium 17 minutes and dark 25 minutes with a temperature setting of 245 degrees Celsius. The price of "roaster" is still very high because all the roasted tools in Indonesia are mostly imported so that they are not affordable by the household industry scale in relatively low income. A prototype of the horizontal roaster model has been created while emphasizing the traditional method of temperature and time control. Temperature and time control can be used to obtain the desired coffee profile quality to reproduce creations roasted results. The dimensions are also small with a height of 60 cm, a width of 50 cm and a length of 60 cm and a frying pan diameter of 30 cm to hold 2 kg of coffee. This tool is designed with stainless steel and other parts used easily found on the market with the aim of facilitating maintenance and the main point is the application of appropriate technology with to increasing economic value. The results of testing the tool with a robusta coffee sample of 2 kilograms obtained the conclusion that the temperature and roasting time affect the profile of coffee produced and the roasting process can reduce the moisture content of coffee beans produced to improve quality of coffee profile.

Keywords : coffe roaster, temperature, time control

1. INTRODUCTION

Coffee is a commodity plantation found in Bali. Coffee that develops in Bali is robusta type, the word robusta comes from the word "robust" which means strong. This is consistent with the description of the body or a strong level of thickness. This coffee is a derivative from coffea canephora species. Robusta can grow in the lowlands, but the best location to cultivate this plant at an altitude of 400-800 meters above sea level. The optimal temperature of robusta coffee growth ranges from 24-30°C with 2000-3000 mm of rainfall a year. The roasting of traditional coffee beans is still done using traditional tools usually made of clay or steel of pan and stirrer, as well as a furnace and firewood, before roasting the wet process is carried out for coffee fruit.

National coffee bean production reaches 600,000 tons a year, only 20% that can be processed and marketed in secondary products include roasted coffee, ground coffee, fast food coffee, and several types of secondary products derived from its derivatives and processing [1]. Roasting is very important to result of coffee (steeping coffee). The factors need to be considered when roasting include a roasting machine system, a roasting tube plate material, the stability of the roasting tube fire source, and the type of coffee raw material and its characteristics. In addition rooster factor, other important aspects are temperature, time, expertise, and roasting technique with the designed tool having a dimmer length 50 cm width 45 cm and height 110 cm [2].

Coffee beans roasted using a teflon griddle without a 25 cm cover diameter and teflon griddle with a 16 cm cover diameter. This treatments studied were temperatures around 180 to 215ºC with 12 minutes roasting time. The results showed that roasting process using conduction heat with a covered roaster caused the heat to spread evenly so that roasting process runs faster. The temperature treatment and roasting time affect the changes in mechanical physical properties of the coffee, namely a faster decrease in water content, increased fragility and accelerate changes in the color of darkness [3]. The studies stated that the quality of roasted coffee beans is determined in terms of roasting method and temperature and time, but the equipment used still has quite large dimensions and relatively high prices where the frying pan uses teflon material.

This automatic roaster and grinder uses a microcontroller as an electric controller. To roasting process, dried coffee beans are inserted into roasting tube then set the temperature and press the start button then the heating element and the stirrer will rotate to the desired temperature. When the roasting process is finished this tool will turn on the buzzer as a sign to start the grinding process. The grinder rotates according to the desired timer set [4]. Roaster machine based on microcontroller using gas fuel is made only 3 settings of coffee profile results, namely light, medium and dark with light time 12.8 minutes, medium 17 minutes and dark 25 minutes with a temperature setting of 245 degrees Celsius [5]. This research has applied an automatic system which is limited to the microcontroller so that the desired profile quality can be determined. However, the weaknes of tools made with this technology are felt to be inappropriate applied into home industry because maintenance costs will be higher and can only create three types of coffee profiles while the needs of consumers now determine and create their own desired of coffee profiles.

Modern coffee processing methods use modern tools or what is commonly referred to as "roasters" have been highly developed, but the prices it is still very high because all the roasted tools in Indonesia are mostly imported so that they are not affordable by the household industry in relatively low income. A prototype of a horizontal roaster model has been created while still emphasizing traditional methods equipped with temperature and time control. Temperature and time control here can be used to obtain the desired coffee profile quality to reproduce creations from roasted. The planned dimensions are also small with a height of 60 cm, a width of 50 cm and a length of 60 cm and a 30 cm diameter skillet to hold 2 kg of coffee. This tool is designed with stainless steel and other parts are used easily found on the market with the aim of facilitating maintenance and the main point is the application of appropriate technology. Applying appropriate technology for handling post-harvest being to increasing economic value.

2. RESEARCH METHOD

2.1. Design

To make coffee powder there are several stages, namely: roasting coffee beans traditionally using traditional tools usually made of clay or steel in frying pan and stirrer, as well as a furnace and firewood, before roasting, a wet process is carried out to remove the skin before being dried by the sun, after being dried is stored for fermentation process, after that the coffee beans are roasted using a constant fire and stirred evenly so that the beans are not charred.

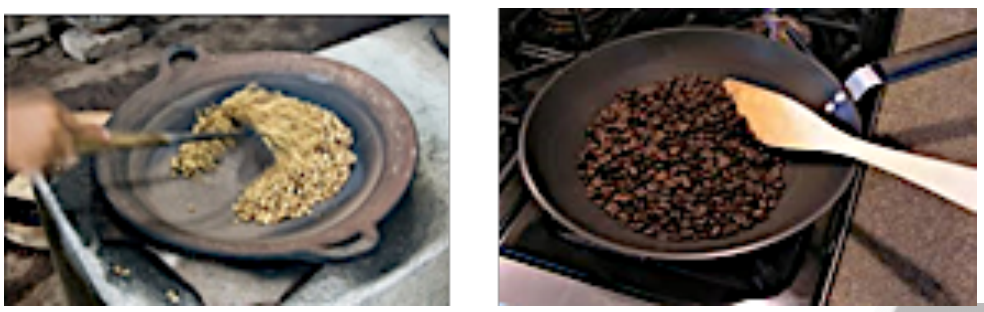


Figure 1. Traditional coffee roasters in Pupuan-Tabanan

The problems occur where the roaster that is sold relatively high, even though the equipment has temperature control, it is not affordable by the home industry. Terdapat banyak model roaster, salah satunya adalah model

roaster horizontal [6,7]. A horizontal roaster model with a capacity of 2 kg was designed can be applied to village communities.

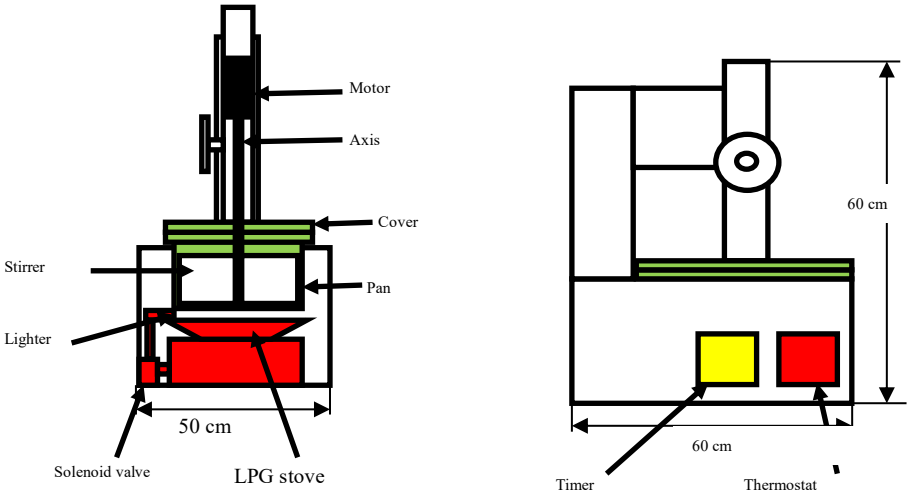


Figure 2. Design of a horizontal coffee roaster

2.2. Methods

The flow of research can be explained as follows.

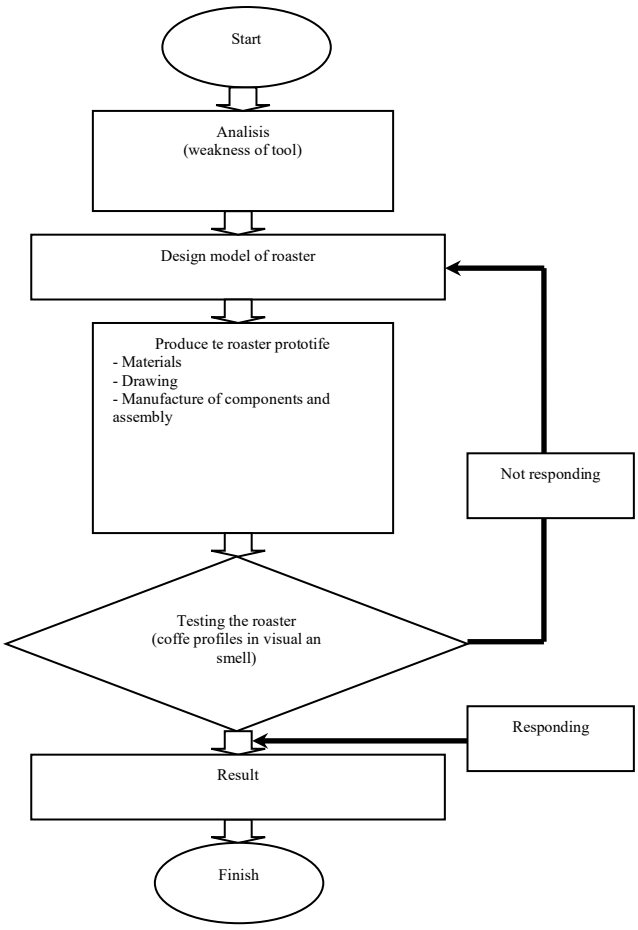


Figure 3. Research flow

Making and testing of tools is carried out at the Mechanical Workshop Department of Mechanical Engineering because all facilities support the process. Coffee samples are taken from the Pupuan area because later the tool will be applied in that area. The profile of roast results based on variable temperatures 80^0 C-220^0 C and the setting time of 15 minutes-30 minutes.

3. RESULTS

3.1. Roasting Tools

Roasting equipment is equipped with temperature and time control to regulate the temperature of the sangria room and the roasting time. The working principle of the tool uses rotation. The rotation is obtained from the electric motor to rotate the stirring blade. Roasting equipment is equipped with temperature and time control to regulate the temperature of the sangria room and the roasting time.

Figure 4. Roasting tools

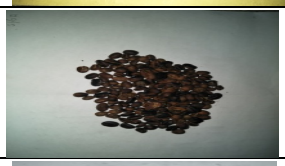
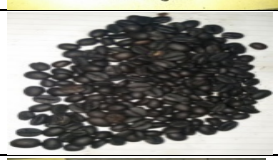
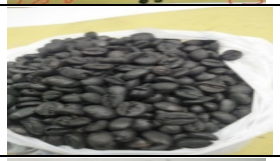
The working principle of the tool uses rotation. The rotation is obtained from the electric motor to rotate the stirring blade. The process of working the roaster is to turn on the burner and set the room temperature as needed. The roasted chamber is left empty for preheating so that the temperature is reached as needed. Room temperature will be maintained by the control. Entered the coffee when the temperature has been reached and pressing the start button to start the process. The start button will signal the electric motor to spin and start time as needed. Time control will stop all control systems to stop the roasting process.

3.2. Test result

After making and assembling the coffee roaster, it is tested with 2 kg of robusta coffee samples each time.

Tabel 1. Results of test roaster design

Temperature (^{0}C)	Time (minute)	Coffe profile	Visual	Coffee Weight (grams)	
				Before	After
80	15		-cinnamon -aroma kopi sedikit-cinnamon - a little coffee aroma	4,5	4
	30		- city -aroma kopi sedikit-cinnamon - a little coffee aroma	4,5	3,2

Temperature (^{0}C)	Time (minute)	Coffe profile	Visual	Coffee Weight (grams)	
				Before	After
100	15		-city coffee aroma began to smell	4,5	3,9
	30		- city coffee aroma began to smell	4,5	3
120	15		-city + coffee smellted coffee aroma	4,5	3,9
	30		-city + smellted coffee aroma	4,5	3,5
140	15		-vienna or full city ++ -aroma kopi tercium	4,5	3,6
	30		- vienna or full city ++ smellted coffee aroma	4,5	2,9
160	15		- Italian smellted coffee aroma	4,5	3,4
	30		-italian smellted coffee aroma	4,5	3
180	15		-french smellted coffee aroma	4,5	2,5
	30		-french smellted coffee aroma	4,5	2,2
220	15		-nearly black smellted coffee aroma	4,5	2

Compared using the journal results obtained during testing found that at temperatures (190 ℃ -195 ℃) roasted coffee beans can only be called light roast. Whereas the designer found / found that at the temperature (80 ℃ -100 ℃) the roasted coffee beans were already on the maturity of the light roast.

In accordance with coffee standards issued by: BSN, 2017 [8] that the water content can be measured from the initial weight loss and the final weight of a coffee process. In accordance with table 5.2, at a roasting temperature of 80 ° C within 15 minutes there was a decrease in weight of coffee beans by 11%. At a roasting temperature of 220 ° C with 15 minutes there was a significant decrease in weight of coffee beans by 55.56%. This proves that the heat process can reduce coffee weight.

4. CONCLUSION

After designing and testing the tool it can be concluded as follows:

1. Temperature and roasting time affect to the profile of coffee product.
2. The roasting process can reduce the moisture content of coffee beans produced to improve the quality of the coffee profile.

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