

## Dryer Cabinet Modification with Heating Element

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### ABSTRACT (9 pt)

**Keywords:**

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*The modification of a gas-powered drying machine into an electric-powered drying machine in the Food Technology laboratory of the Family Welfare Education Department Faculty of Engineering Surabaya state of University aims to make the use of tools more effective, efficient and improve the work function of the tools. Gas dryers are more energy intensive and less practical to use. Apart from that, the distribution of hot air from gas dryers is less even. Electric powered dryers use electric heating elements as heat producers and are more environmentally friendly because they do not produce gas emissions. The electric heating element used is a tubular type heating element equipped with a ceramic insulator as safety. Hot air is distributed in the drying machine by a blower placed close to the heating source. Even distribution of hot air and a stable temperature are the keys to speed in drying. This research is research and development research. The expected result of this research is that the tool can function optimally, effectively and efficiently. Drying carried out on bay leaves with a capacity of 500 gr using an electric heating temperature of 60-70 C can dry the material in less than 5 hours.*

### INTRODUCTION

Drying is a method of preserving food ingredients by reducing the liquid content through evaporation with the help of heat (Asiah and Djaeni., 2021). There are various methods of drying. The natural method of drying is using direct sunlight. The food to be dried is cut or placed in such a way on a tray or base and placed in an open area under direct sunlight. During the drying process, the outside air around the material will rise due to radiant heat from the sun which then comes into contact with the wet material (Osman, 2018). Initially the temperature of the material will increase and cause the water to evaporate until the material becomes drier (Apriandi et al., 2022). This phenomenon is the basis for the development of drying technology, where parameters (flow rate, temperature and humidity) are controlled to obtain dry material with the desired moisture content. Another method of drying, namely the artificial drying method, is drying with the help of drying equipment (Purnamasari et al., 2019). There are several drying equipment, namely solar dryers, cabinet dryers, tunnel dryers and so on. This drying equipment can help the drying process using gas or electricity and even sunlight energy. Each tool certainly has advantages and disadvantages, so development of the tool's working methods is needed to minimize deficiencies so that the drying process is more effective and efficient (Arhamsyah et al., 2018). The food technology laboratory in the Culinary Study Program, Family Welfare Education Department, Faculty of Engineering, Surabaya State of University has several cabinet type drying equipment. The dryer cabinet uses gas fuel. Gas-powered cabinet dryers have several disadvantages, including uneven drying temperatures, less environmental friendliness, high equipment maintenance costs and complicated work methods. Thus, it is necessary to improve the performance of the tool so that its use is more effective and efficient. Modification is generally defined as an attempt to change or adapt. However, specifically modification

is an effort made to create and display something new, unique and interesting (Saputra, 2015). The modifications referred to in this research are changes to unit components that support tool performance with the aim of optimizing tool performance so that it can produce higher quality products effectively and efficiently. Modification of the dryer cabinet by changing the unit type from a gas-powered dryer cabinet to a dryer cabinet using an electric heating element. The aim of this research is to modify a cabinet type dryer to improve the performance of the tool so as to create a more effective and efficient artificial dryer that saves energy, short drying time, is safe and has a simpler working method.

## **RESEARCH METHOD**

The research method used is the research and development (R&D) method. Research and development methods are research methods used to produce certain products, and test the effectiveness of these products (Okpatrioka, 2023). Development research is a process or steps to develop a new product or improve an existing product (Hakim et al., 2017). The following are the research procedures.

### *Potential and Problems*

This research begins with a potential or problem. High frequency of tool use and suboptimal tool maintenance result in decreased tool performance. The gas flow in the dryer cabinet is not smooth due to a clogged burner nozzle so that the lighter does not work and the tool cannot be used. Apart from that, there are problems with the unstable temperature control system. This obstacle can certainly hamper laboratory activities. Procurement of equipment every year has also not been realized so a development of tool working methods is needed to improve tool performance.

### *Data Collection*

Literature studies can be used as material for planning certain products that are expected to overcome problems. Through literature studies, the scope of a product will be studied, the breadth of use, supporting conditions so that the product can be used or implemented optimally, as well as its advantages and limitations. Literature studies are also needed to find out the most appropriate steps in developing the product.

### *Product Design*

The final result of this activity is a new product design complete with specifications. This design is still hypothetical because its effectiveness has not been proven, and will be known after going through tests. The product design must be realized in pictures or charts, so that it can be used as a guide for assessing and making it, and will make it easier for other parties to understand it.

- 2.3.1 Hardware design is the initial activity in dryer cabinet modification product design. Hardware design includes preparing tools and materials, designing designs, measuring and assembling electric heating elements, assembling boxes for placing wiring and electronic modules, assembling fans, timers and temperature sensors.

2.3.2 Software design includes the process of setting the temperature sensor system, setting the timer system, setting the electric heating element and setting the blower.

*Design Validation*

Validate the design of the product by experts or food technology lecturers, electrical lecturers and culinary lecturers to determine the effectiveness of the dryer cabinet product.

*Design Revision*

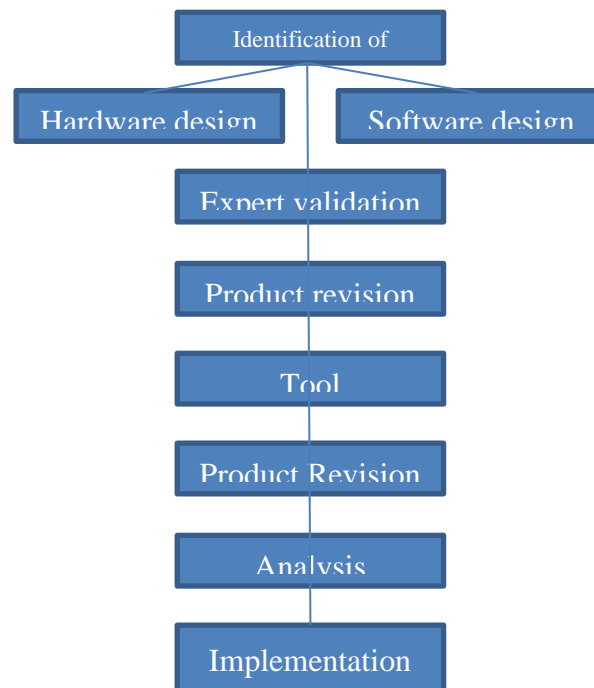
This activity is based on input from experts regarding the shortcomings of the product design. Researchers are tasked with improving product designs based on directions from experts.

*Product Testing*

Product testing in this research is by testing the function of tool components including testing the timer function compared to a stopwatch to determine the precision or accuracy of time measurements. Apart from that, tests were carried out on the temperature sensor function compared to a mercury temperature thermometer as well as product function tests for drying.

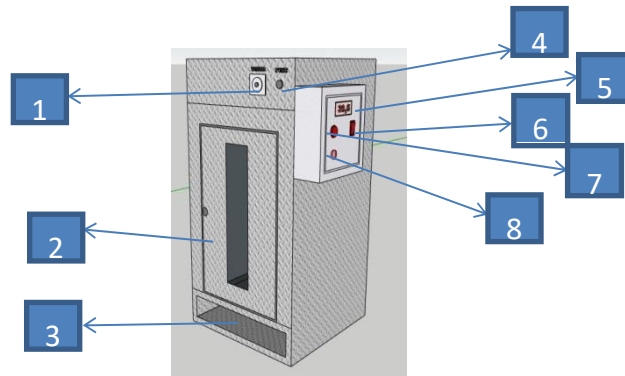
*Product Implementation*

After passing the trial use phase, the dryer cabinet can be implemented in student practicum activities. Researchers continue to evaluate the performance of the tool during use. The following is a research design flow chart in Figure 1.



**Figure 1.** Research steps with bibliometric analysis

The research design is intended to provide direction for researchers regarding procedures for carrying out R and D research. The following is a picture of the design of a dryer cabinet with heating elements.



**Figure 2.** Dryer Cabinet with Heating Element

Information :

1. Timer
2. Heating Elemen
3. Fan
4. Fuse
5. Temperature control
6. Power
7. Indicator lamp

## RESULTS AND DISCUSSION

The result of this research is a prototype dryer cabinet with heating elements. Based on research by Jesika, Amnur and Luqman, ovens should use low power heaters to save more electricity (Osman, 2018). The heating element used is the finned heater type, namely a heating element with finned pipes. The Finned heater is straight in shape with a tube length of 50 cm with a diameter of 11 mm and a voltage of 220 volts 250 watts. The fins on the heating element pipe function to collect the heat produced and then radiate the heat to the air medium. According to research by Meriadi, Selamat and Muhammad, [9]to meet the requirements for work safety due to electricity, the heating element must last a long time at the desired temperature, have strong construction, a small expansion coefficient and a small temperature coefficient so that the working current is constant. When installing the heating element, it is equipped with a ceramic insulator to protect it from electrical currents. This is in accordance with Meriadi's research (2018) that heat protection materials are mainly ceramic insulating materials. Finned heaters are installed vertically on the right and left sides of the dryer cabinet (Meriadi et al., 2018). The dryer cabinet is equipped with a blower to remove hot air inside the cabinet in an effort to speed up the reduction in air temperature and also evenly distribute the hot air throughout the

area inside the cabinet. This is in accordance with Jesika, Amnur and Luqman's research (2018) that the heating element (heater) produces hot air which will be distributed into the air with the help of a fan or blower. The heat will spread evenly with the help of the blower. There is a timer to set the drying time and also a temperature sensor to regulate the temperature required for drying. In the tool performance test, the timer system ran normally. The times shown are compared with the appropriate stopwatch. Likewise with temperature sensor trials compared with mercury thermometers. In testing the performance of the tool for drying bay leaves, the time needed to dry 500 gr of bay leaves was 5 hours at a temperature of 60°C. Drying is even on all shelves because the heating elements are located vertically on the right and left sides of the cabinet and are assisted by a fan or blower in evenly distributing the hot air. Meanwhile, based on Andika and Eka's research (2022) drying machines with gas stove heaters produce different heat temperatures on each shelf or uneven heat and quite high drying costs (Bakara and Daryanto, 2022). Based on Antu's research (2021), conventional drying using solar heat is faster and more effective than drying using a dryer (Khasanah et al., 2021).

## CONCLUSION

Modified dryer cabinets with heating elements are more effective than dryer cabinets with stove heating. In terms of energy use, a cabinet dryer with heating elements consumes 250 watts of electrical energy for 5-8 hours of use. Cabinet dryer with stove heating consumes 3 kg of gas resources in 2 days of use for 5-8 hours. So energy consumption by a dryer cabinet with a heating element is more efficient compared to a dryer cabinet with a gas stove heater. Another advantage is that dryer cabinets with heating elements do not produce fuel emissions like stove heaters, so they are more environmentally friendly. The working procedure for a cabinet dryer with a heating element is simpler and safer. There is a button to turn on the unit then the blower will automatically rotate to adjust the temperature settings which can be adjusted according to needs and a timer system to set the drying time if needed. Maintenance of dryer cabinets with heating elements is cheaper and easier.

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