Technological innovation based on biomass waste with controlled features for cassava drying agrotechnology

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Abstract. Indonesia is the largest cassava producer in the world. In 2020, cassava production will be 18.3 million tons. The aim of this research is to find an innovation in the field of cassava processing using environmentally friendly biomass energy. The method used is to design an innovative biomass energy-based cassava drying technology tool using a controlled system. The tool is tested in the laboratory using experimental methods to produce a prototype. tools that can be directly applied in the field. The results of the research showed that the time used during the drying process with variations in the coconut shell mass of 400 grams for 136 minutes, then continued with a mass of 600 grams for 109 minutes had succeeded in obtaining dry cassava products, with an average temperature during drying. room 40 to 60 °C with minimum humidity ranging from 24 to 49 percent. All observation data can be displayed on an LCD screen or computer with controlled features. Conclusion: In the end, this research has applications in the cassava processing industry in every region, both in Indonesia and in any region, offering an innovative approach to biomass energy-based cassava processing technology with controlled features.

1 Introduction

Indonesia is the largest cassava producer in the world. In 2020, cassava production will be 18.3 million tons. For this reason, many industries have grown up involved in the cassava processing business. The problem of global air pollution is a challenge for industrial businesses who process cassava using direct solar energy, because there will be contamination of the cassava product with air particles or dust [1-3]. This will have an impact on the health of people who consume processed cassava, in other words it can reduce the quality of processed cassava products [4]. The fundamental issue that is very necessary to overcome the problem of low quality of processed cassava products is by improving the

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management of cassava processing technology. Management of sustainable environmental technology is an important issue to realize civil society according to the vision of the Riau Government in line with the vision of the University of Riau, namely a Superior Research University with Dignity in the Field of Science and Technology in the Southeast Asia Region in 2035. The University of Riau's research strategic plan realizes post-harvest technology. There have been many studies on Drying for post-harvest processing of food grains [5]. Drying of apples depends on the output voltage [6]. Design of drying chamber with transparent walls [7]. Furthermore, Juandi from 2015 to 2019 discovered scientific concepts underlying future research developments. Utilization of biomass-based drying technology for drying cracker raw materials [8], application for drying other products [9], use of biomass stoves to help make crackers [10]. Biomass-based drying innovation with an alarm system [11]. Innovative model of biomass-based dryer with microcontroller automation system [12]. The development of previous researchers has given rise to innovations in the field of technology, especially in New Normal conditions (Covid 19) [13]. Juandi needs to carry out further research with the title post-harvest technology innovation based on biomass waste energy with an internet of things telecontrol system. The aim of this research is to improve the work system with controlled features using the internet of things system and to conduct an economic feasibility analysis for post-harvest technological innovation products with an internet of things controlled system. Stages of the research method to achieve the goal of designing and improving tool performance with a controlled system of the internet of things and applying it to the field, analyzing the economic feasibility model of the results of post-harvest technological innovation with a controlled system ready for production.

2 Method

The method used for this research is an experimental method, by designing a dryer with controlled features for cassava drying agrotechnology. This research consists of 4 main stages, namely, designing post-harvest technology designs, designing work systems with controlled features for cassava drying agrotechnology, data collection, and data analysis. The design of a biomass energy-based drying technology tool can be seen in Figure 1 below: The first step in reading the Internet of Things data communication flow is treating the sample created as an environment [14,15]. The data that has been provided can be read by sensors in the drying room. The sensor in this dryer **works** using an Arduino Uno which can send reading data from the sensor via the NodeMcu which functions as a WiFi Router module that uses the Mobile Hostpot network, so that the data obtained is connected or entered on the HTTP Server which can be monitored or viewed using a remote system. and displayed in the web browser by the user. The data that has been obtained will be stored in database form and will be managed in Ms. Excel. The description of each letter symbol in Figure 1 can be explained in Table 1.

Table 1. Description and function of innovation tool design.

Symbol	Information	Function
A	Internet of Things series	To send data when conducting research
B	Laptops	To observe the characteristics of research data results
C	Air Circulation Room	As air circulation in the drying rack during research
D	Power Supplies	As a voltage source for the mini digital thermocouple
E	Combustion chamber	As a place to burn coconut shell biomass
F	Drying Rack	As a place to place materials
G	Mini Digital Thermocouple	As a measure and detect the temperature on the outer surface of the drum

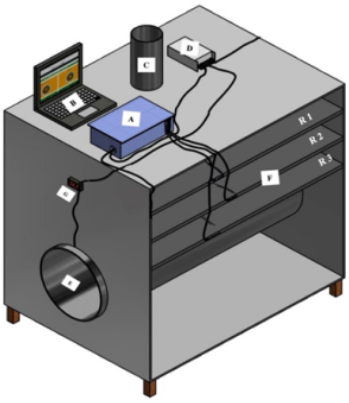

Fig. 1. Design of innovation tools [16].

The initial step in this experimental stage is to provide a mass of 400 grams and 600 grams of coconut shell as a source of biomass energy that will be used during the drying process. Next, the coconut shell mass is put into a drum and burned. Data collection was carried out by observing the results of changes in temperature of the heat radiation source using the XH B310 K Type Thermocouple which is located on the outer surface of the drum and observing changes in temperature and humidity using the Internet of Things (IoT) system obtained on the website server which can be observed with a laptop.

3 Results and discussion

3.1 Tool work performance

Design and improve the work performance of tools with an internet of things controlled system and apply it in the field (Figure 2a). The sensor in this dryer works using an Arduino Uno which can send reading data from the sensor via NodeMcu which functions as a WiFi Router module that uses the Mobile Hostpot network, so that the data obtained is connected or entered on the HTTP Server which can be monitored or viewed using a remote system. and displayed in the web browser by the user. The data that has been obtained will be stored in database form as shown in Figure 2a.

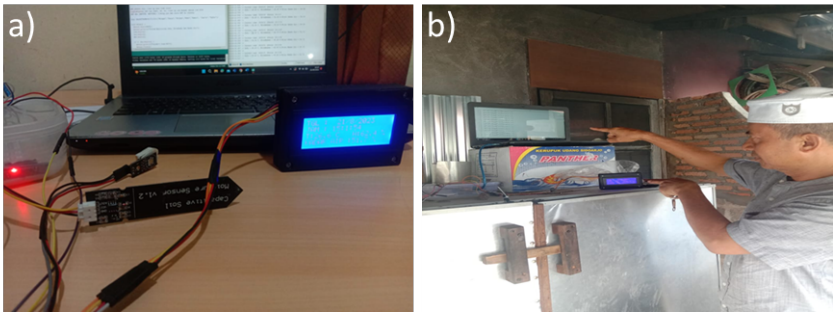

Fig. 2. (a) Design of a series of work performance tools with an internet of things system, and (b) Data obtained in database form can be seen on the laptop.

Figure 2b shows the results of the data obtained in the form of a database which will be processed using MS, Excel and SigmaPlot. In Figure 2b, data on the rate of change in temperature of the heat radiation source using a thermocouple on the outer surface of the drum is displayed and data on the rate of change in temperature and humidity using the Internet of Things (IoT) system as shown in Figure 2b can be seen on the laptop. One of the teams was observing the work performance of tools controlled by the internet of things and the results of the tool's work performance could be said to be several things, namely the efficiency aspect of drying time, the hygiene aspect, and the supervision management aspect related to the tool's work performance.

3.2 Economic feasibility model analysis

Based on the results of the economic feasibility model, the results of post-harvest technological innovation with a controlled system have economic feasibility both from the aspect of time efficiency and from the aspect of product quality [17]. The results of the economic analysis of the innovation tools that have been designed can become business operations that are carried out at any time, the organization involves one or two people, has standard operating procedures, and equipment maintenance and real time because it is based on IoT [18].

3.3 Analysis of tool implementation characteristics

Analysis of the relationship between observation time and temperature in the drying room with biomass-based dryers has been found in many research results [19]. This research uses energy sources from coconut shell waste with masses of 400 grams, 500 grams and 800 grams. Temperature data collection in the drying room uses a DHT22 sensor located in the middle of the drying room wall, where the sensor can send reading data via NodeMcu which functions as an IoT (Internet of Things) platform module that uses the Mobile Hostpot network, so that the data obtained is connected or enter the HTTP Server which can be monitored or viewed by a remote system and displayed in a web browser by the user. The data that has been obtained will be stored in the form of a database. Based on research, data was processed using the MS program. Excel and Sigmaplot to display comparative graphic results between temperature and time in 10 minute intervals for each observation. The graph obtained can be seen below along with an explanation.

Figure 3 is based on the table in Appendix 5 which explains the comparison of temperature in the drying chamber versus time for cassava chips using coconut shell biomass which has various mass variations. Coconut shells have a high flame, little smoke, so this causes the combustion process to dry a product more quickly. Figure 3 parts of a coconut

shell with a mass of 400 grams with a total time of 136 minutes explains that the temperature behavior in the drying room is quite stable at 40 to 60 degrees Celsius, this is because the biomass burning process occurs with stable fire conditions and the biomass energy works to transfer heat to the room dry well [19]. Based on the results a and b above, it can be said that the tool has worked well even though the mass of the coconut shell is only 400 grams, so that the biomass material is cost effective.

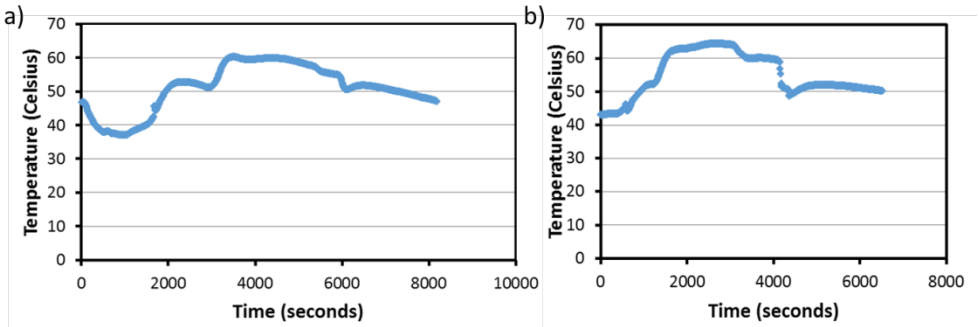

Fig. 3. Comparison of internal temperature versus time in cassava chips (a). coconut shell with a mass of 400 grams, and (b) coconut shell with a mass of 600 grams.

Figure 4 parts of a coconut shell with a mass of 400 grams for 109 minutes explains that there is a relationship between the temperature in the drying room and is stable from 40 to 60 degrees Celsius to room humidity values ranging from 24 to 49 percent. The results of this data have a faster time compared to a mass of 600 grams. Based on the results a and b above, it can be said that the tool has worked well even though the mass of the coconut shell is only 400 grams, so biomass material is cost-effective if used as an energy source for drying and is Eco-friendly drying techniques [20]. Figure 4 shows that the graph of the relationship between temperature (°C) and room humidity produced in the drying room against the observation time fulfills the equation as produced by the graph.

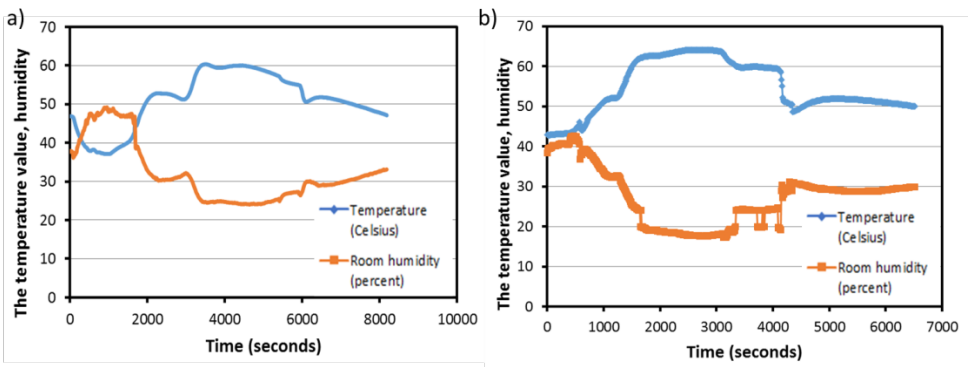

Fig. 4. Comparison of temperature and humidity in space versus time in cassava chips coconut shell with a mass of 400 grams (b) coconut shell with a mass of 600 grams.

4 Conclusion

Based on the results of the work performance of the biomass waste-based cassava drying technology innovation tool with controlled features using IoT, it was found that the cassava

drying results were going well with indoor temperature control parameters of 40 to 60 degrees Celsius and humidity in the drying room of 24 to 49 percent. The test used was with 400 grams and 600 grams of coconut shell waste, showing that the more coconut shell waste used, the faster the cassava drying process occurred. The contribution of the tool that has been designed can then be applied to all industrial activities engaged in cassava processing both in Indonesia and in other regions for efficient and environmentally friendly drying of cassava.

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