Performance Evaluation of Rotary Dryer for Drying of Ginger

I Ketut Suherman, S. Sudirman, Achmad Wibolo, I Wayan Suma Wibawa and
I Made Anom Adiaksa
Politeknik Negeri Bali, Kampus Bukit, Jimbaran, Bali, Indonesia

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Abstract: Drying is a suitable alternative for post-harvest management, especially in countries such as Indonesia, which have poor distribution and post-harvest handling facilities. More than 20% of spoiled or spoiled crop yields are preserved by drying to increase shelf life. This is the oldest and most effective method of lowering moisture content to slow down spoilage by microorganisms. This research will make a special drying machine to dry ginger. Where the type of drying machine is rotary drying type. The design of the machine to be designed, emphasizes more on the control system and the time it will take to dry fresh ginger. The experimental results show that this machine with a drying time of 5 hours with 1 kg of fresh ginger produces an average of 0.19 kg of dry ginger. with a water content of 9.68%.

1 INTRODUCTION

Indonesia is known as an agricultural country because most of the Indonesian population has a livelihood in agriculture or farming. Various types of plants are produced by Indonesian farmers. One of the most abundant in Indonesia are medicinal plants, including ginger. Commodities belonging to the plantation sub-sector that have good development prospects are ginger (Zingiber Offilcinale). Data from the Ministry of Trade of the Republic of Indonesia shows that ginger export volume has increased from year to year. During the period 2010 - 2015, the average export volume of ginger increased by 7.55% per year (Kementrian Pertanian, 2015).

Indonesian ginger cultivation is spread across 34 provinces with ginger production growth in 2014-2015 of 5.22%. In 2015 the production growth of Bali Province was 197.47%, which was the highest growth in Indonesia in 2014-2015. The Central Bureau of Statistics of Bali Province shows that ginger production in Bali in 2015 was 5,735,658 kg, of which Gianyar Regency contributed 51.36% of the total production in Bali. The second largest production is Karangasem Regency, which is 1,056,342 kg or 18.41% and the rest is spread in Badung, Bangli, and Jembrana Regencies Tabanan, Klungkung, Buleleng, and Denpasar regencies do not produce ginger because the agro-climate of the area is not suitable for ginger cultivation (BPS Provinsi Bali, 2021).

Drying is a suitable alternative for post-harvest management especially in countries such as Indonesia, where distribution and post-harvest handling facilities are not very good. It should be noted that more than 20% of damaged or rotting crop yields are preserved by drying for increase shelf life (Singham Pragati and Birwal Preeti, 2014). It is the oldest and most effective method of lowering water content to slow down spoilage by microorganisms (Jayashree, et al, 2017).

Ginger (Zingiber officinale) is an herbal plant. Fresh ginger root is usually consumed as a spice in tropical countries and dried ginger is used as a medicinal plant internationally. Dried ginger is usually used as a spice or medicine. Quality specifications for export as medicinal herbs are required to be properly cut, well dried and properly stored (Osueke, et al, 2015).

The drying process plays an important role in preserving agricultural products because it is energy efficient. Drying has been used since ancient times. Hot air drying is most commonly used in dehydration operations in the food and chemical industries. The wide variety of preserved foods, currently available to consumers and attracting attention to meet quality specifications and energy conservation, emphasizes the need for a thorough understanding of the drying process (Desmukh, et al, 2015).

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Drying machine models and drying types have developed so rapidly in the industry. Therefore, the Bali State Polytechnic which has aspirations as a center for applied technology needs to develop appropriate technology such as these machines.

The stages of processing fresh ginger rhizomes into ginger simplicia are carried out through several stages, namely the process of sorting, washing, chopping or cutting, drying, final sorting, packaging and storage (Sembiring, et al, 2012). Inappropriate harvesting can cause the rhizomes to easily experience physiological damage so that it can reduce the quality, therefore further handling needs to be done, one of which is the drying process (Ananingsih, et al, 2017). One of the goals of drying is not only to increase the selling value but also to overcome the occurrence of excess supply during the harvest season (Sunil , 2017).

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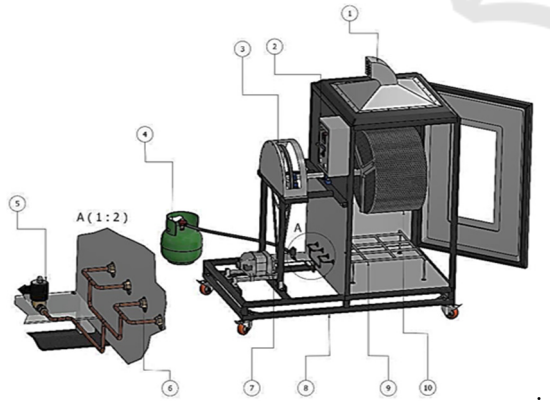
2 MATERIAL AND METHODS

2.1 Equipment

Ginger (Zingiber officinale) is an important edible spice widely grown throughout the world. It is believed to be a native economic crop of Southeast Asia. India is the largest ginger producing country in the world. Ginger has many medicinal properties and thus is widely used in Ayurveda and cooking applications. Ginger is mainly composed of fibrous content, volatile oil and non-volatile ether extract. It is consumed as green ginger, dried ginger and in powder form. Drying ginger is an important practice for the enhancement and preservation of self-life and is therefore often dried through traditional methods such as open sun drying. Drying in the open sun is a cheap and easy drying method, but this technique suffers from various obstacles such as poor drying quality, longer drying time and drying products are susceptible to environmental dirt, rain, animals, etc. (Jayashree , et al, 2014).

The schematic of the rotary dryer with drying using LPG gas made for this test is as illustrated Figure 1



Description
1. Ducting
2. Control Panel
3. Pulleys
4. Gas LPG
5. Solenoid valve
6. Nozzle
7. Electrical Motor
8. Frame
9. Burner
10. Dryer Drum

Figure 1: Rotary dryer for drying of ginger.

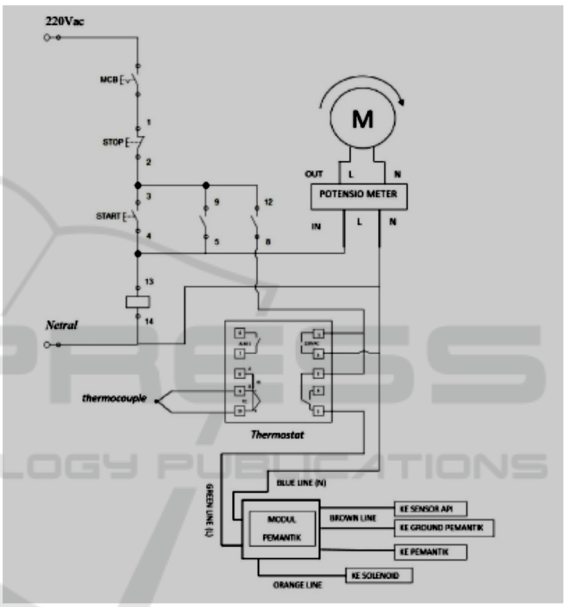


Figure 2: Smart control of rotary dryer for drying of ginger.

This dryer is planned to dry ginger with a capacity of 5 kg. Fresh ginger to be dried is put into the dryer drum. The rotating drum dryer utilizes an electric motor and a stove that can turn on and off automatically so that energy consumption such as electricity and gas is not too large. The rotation speed of the dryer drum can be adjusted according to the needs of the drying process. In addition to the use of energy that is not too large, this tool is also equipped with several safety systems, both from electric motors and flames.

The lighter will light up simultaneously with the electric motor when the on button is pressed, the lighter will turn on for 10 seconds if for 10 seconds no gas is detected, the lighter will signal the solenoid to close and the alarm will sound. This tool can be said to use a semi-automatic control system.

The data obtained from the measurement of ginger weight were used to study the drying kinetics of ginger in terms of moisture removal rate. The rate of moisture removal is stated at dry time. Therefore, the initial moisture removal rate based on dry percentage can be calculated using Eq.

$$M_{initial} = \frac{W_w - W_d}{W_d} \times 100 \quad (1)$$

$M_{initial}$ = Initial moisture removing rate, % dry basis
W_w = Weight of wet ginger, g
W_d = Weight of dry ginger, g

2.2 ProcedureExperiment

The experimental material was local ginger which after washing was cut into thin slices, with an average thickness of 1 mm. The chopped ginger is then put into the drying drum.

When the push button start is pressed, the electric current from the MCB will flow towards the push button stop because the normal position of the push button stop is NC (Normally Closed) then terminals 1 and 2 are connected. The output from the push button stop goes to the push button start input at terminal 3 and terminal 9 and terminal 12 get current as common. Terminals 3 and 4 on the push button start are connected because they are pressed, will cause terminals 13 and 14 (solenoid) to be connected because they get phase or neutral. The solenoid works which will cause terminal 9 and terminal 5 to be connected or become NC (Normally Closed) as well as terminal 12 and terminal 8 on the relay. So that the driving motor will rotate and the thermostat will work. At the input the lighter is connected to terminal no 5 on the thermostat as NO. The goal is that the lighter turns on from the initial temperature and turns off at the temperature that has been set on the thermostat, and turns on again when the temperature starts to get low and so on. The experiment was carried out for 5 times, the ginger to be put into the drying drum was weighed 1 Kg per experiment. The test was carried out for 5 hours/experiment, by measuring the water content of ginger in the drum every hour the experiment was running. The drying setting temperature is 50 degrees Celsius. After the end of the experiment, the weight and moisture content of the dried ginger will be measured.

3 RESULTS AND DISCUSSION

3.1 Graph of Ginger Moisture Content with Drying Time

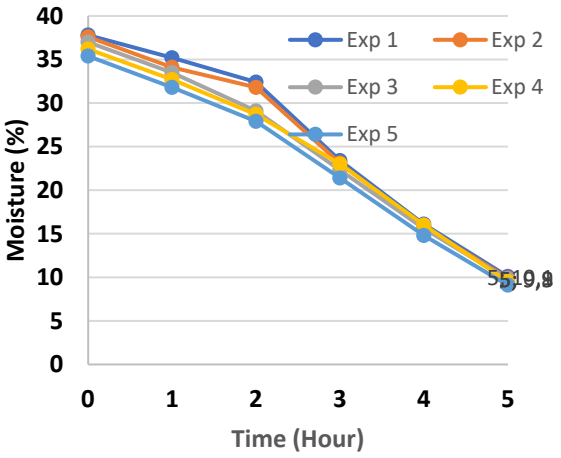


Figure 3: Graph of time with moisture every hour of testing.

The test was carried out 5 times, with the same weight and almost the same pieces of ginger, the results showed that every hour there was an almost same reduction in maoisture content.

3.2 Graph of Temperature in Drying Chamber

The drying chamber is heated by a stove whose fuel is LPG gas. With the smart control panel, the stove will automatically turn on and off at the desired condition. For the time being the control used is ON/OFF control. So there is a rather wide space for the desired temperature. The temperature that occurs in the drying chamber is between 55-65°C. During the 5-hour test, the stove as a heat source for the dryer was turned on and off 4 times, while it was off 4 times as well.

As in Figure 3, that the reduction in moisture in test 5 is the most in the reduction of moisture content, then the lowest weight of dried ginger is in test noumber 5. With a weight of 0.17 grams.

The average weight of dry ginger dried using a rotary drying machine is 0.9 grams.

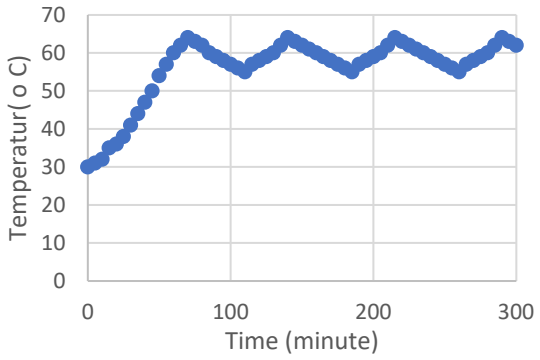


Figure 4: Graph of Temperature in drying chamber.

3.3 Graph of Dried Ginger Weight

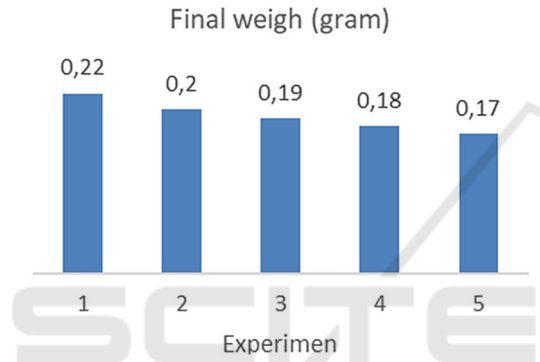


Figure 5: Ginger weight chart after drying by rotary ginger drying machine.

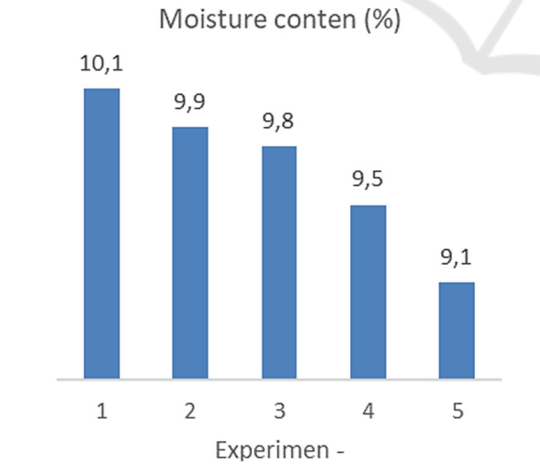


Figure 6: Graph of the moisture content of dried ginger.

3.4 Graph of the Moisture Content of Dried Ginger

Similar to the graphs of other test results, the lowest water content in this test is in test number 5. The water content is 9.1.

The average moisture content of the rotary dryer made is 9.68%.

4 CONCLUSIONS

The rotary type ginger drying machine made and the smart control made, can operate properly and automatically maintain the desired drying temperature. This machine also produces dry ginger with an average moisture content of below 10%, which is 9.68% with a weight of 0.9 grams.

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