Jurnal Reaksi (Journal of Science and Technology)
Jurusan Teknik Kimia Politeknik Negeri Lhokseumawe
Vol. 21 No.01, Juni 2023 ISSN 1693-248X

DESIGN AND REALIZATION OF A DRYER SYSTEM WITH THE ADDITION OF A BLOWER

Abdul Haris Salam[1*],Teuku Rihayat[1], Sariadi[1], Awanis Ilmi[1], Rika Annisa[2], Lianti[2], Rusydi[2]
[1]Department of Chemical Engineering, Politeknik Negeri Lhokseumawe, Jl. Banda Aceh-Medan Km. 280,3, Buketrata, Mesjid Punteut, Blang Mangat, Lhokseumawe, Aceh 24301, Indonesia
[2]Commerce Deparment, Politeknik Negeri Lhokseumawe, Jl. Banda Aceh-Medan Km. 280,3, Buketrata, Mesjid Punteut, Blang Mangat, Lhokseumawe, Aceh 24301, Indonesia

*E-mail: abdulharissalampnl@gmail.com

ABSTRACT

Drying Blower Oven technology by testing the feasibility to be seen with tests such as nutrient content test, ash content test, water content test, organoleptic test to marketing test. Testing of the Drying Blower Oven is carried out by testing the raw material of the product, such as red chili. Drying using Drying Blower Oven at a temperature of 32.2˚C to 54.2˚C with a wind speed of 12 m/s until the water content is below 8% - 10%. This study aims to determine the drying characteristics of red chili with Multioven Cabinet Type changes in temperature, relative humidity, material weight loss, air flow rate, air volume rate, material moisture content against time, drying rate against time, and drying rate against moisture content. This study uses a descriptive method of drying temperature used below 65˚C repeated 3 (three) times until it reaches a moisture content of 8-10 %wk. The results of the observations showed that the drying process recorded Rh outside the drying apparatus between 83.28%-89.50%. Also the Rh in the Drying apparatus was observed and was observed to be between 86.58%-97.91%. The red chili content during the drying process decreased from 38.75% down to an average of 18.05% with details in rooms one and two reaching 17.4%, rooms three and four 16.95% and spaces five and six 16, 6%. With an observation time of 4 hours.
Keywords: *Drying Blower Oven, Technology, Instant Seasoning*

1. INTRODUCTION

Spices are a type of plant that has a strong taste and aroma and functions as a seasoning and flavor enhancer for food. Besides being used in cooking, spices can also be used as medicine and raw materials for herbal medicine. Taking into account the benefits, it is not surprising that spices are one of the commodities that have high economic value. In fact, during the colonial era, the main reason why colonists, especially from several countries on the European continent, explored other continents was to look for spice-producing countries. This was done because of the high economic value of spices in Europe at that time and the potential income that could be generated (Berita Daerah, 2014). Commodities included in the spice category include: pepper, nutmeg, vanilla, cinnamon, cloves and ginger.

Indonesia is a world producer of spices so that colonialists, especially from the Netherlands, Portugal and England, came in droves to Indonesia. According to data released by the Food and Agriculture Organization (FAO), Indonesia ranks first in the world's vanilla and clove producers and ranks second in the world's pepper and nutmeg producers in 2014 (FAOStat, 2016).

Culinary is one of the cultural products that is closely related to the people of Indonesia, where the country is known to have a variety of ethnic and cultural differences from each region. Because apart from the main function of food ingredients as fulfilling basic needs, culinary also has historical and even philosophical values. Authentic culinary is one type of community creativity in processing food ingredients and adding value to traditional culinary culture.

One of them is the people of Aceh who have culinary that is very attached to the hearts of consumers, both domestic and foreign, namely Mie Aceh. The Aceh noodle seasoning can be easily obtained at the local local market, however, for consumers who are outside Aceh, it is difficult to process and make Aceh noodles with flavors that don't disappear from the cooking. There are several supermarkets or local markets outside Aceh that have opened branches in making Acehnese noodles themselves. However, there is a lack of flavor, so special processing is needed in processing the Aceh noodle seasoning into Aceh noodle seasoning in a practical condition to use and easy to serve and can be easily carried anywhere.

2. METHOD AND CHARACTERIZATION

2.1 Method

This study used a drying blower oven with a Type Multioven Cabinet measuring 140 x 90 x 170 cm. The heat source is obtained from the electricity. Oven temperature ranges from 50-80℃. The number of trays is 30 with a distance between trays of 7.3 cm with a capacity of ± 10-20 kg depending on the material to be dried. The ingredients used are red chilies, shallots, garlic, sunti tamarind, candlenut, coriander, cardamom, and pepper.

Picture 1. Drying Blower Oven

Blower drying oven is an upgraded version of oven. An oven is a set of drying machines as a substitute for sunlight in drying a product. The working system of this drying oven machine is to dry the product at the desired temperature (the temperature can be set constantly)[4]. The drying system of this machine uses hot air flow at high speed, with the help of a saturated air blower which is sucked in and flows out. This drying system with a drying machine is called artificial drying.

Drying with artificial heating has several types of devices where heat transfer occurs by conduction or convection, although some can be done by radiation. Dryers with convection heat transfer generally use flowing hot air, so that the heat energy is evenly distributed throughout the material. Dryers with heat transfer by conduction generally use a solid surface as a heat conductor. One of the material drying equipment that is often used on an industrial scale is an electric oven. The working principle of this tool is to reduce the water content in the material by transferring heat from the element (which converts electrical energy into caloric energy) with air as the medium. On a commercial scale for the food industry, electric ovens are set at a speed of 2.45 x 10 rps [4]. Heating is obtained from the movement of particles caused by alternating current (AC current), besides that electric ovens are often used as dryers for laboratory purposes because they can be used for moisture research methods of several different materials. Therefore, electric ovens are categorized as cabinet dryers.

Drying is done mechanically, namely by using an artificial dryer (artificial drying) to facilitate controlling the factors in the drying process. Air temperature regulation, for example, can produce a much more homogeneous and orderly product when the drying air temperature is adjusted according to the properties of the material and the desired result. This blower drying oven is designed using food grade stainless steel material. So, it is safe to use for food. This blower drying oven is designed with 6 chambers, 6 blower fans and 30 drying trays for a capacity of 10-20 kg of raw material.

2.2 Characterization

2.2.1 Moisture Content

The grain drying process aims to reduce the water content to a certain limit, so that no damage occurs due to metabolic activity by microorganisms (3). Reducing water reduces weight and reduces food volume, thereby reducing transportation and storage costs. Drying also facilitates handling, packaging, transport and consumption (2). Testing the moisture content begins with washing all the ingredients. The water content of the samples was measured at the beginning and at the end of the study. Next, weigh the total weight of the ingredients in each tray. Each ingredient is put into a tray weighing 100 grams with a total of 5 kg per spice ingredient. After that, put the tray containing the red chilies, shallots, garlic, tamarind sunti, candlenuts, coriander, cardamom, and pepper into the drying blower oven. This research was conducted by trying to dry spices at 3 temperatures, namely T1 60°C, T2 70°C, and T3 80°C. The reduction in material weight was analyzed by weighing the initial sample weight and the final sample weight. This observation is carried out every 2-3 hours by checking once an hour for each spice.

a. Moisture Content Test Variable

Table 1. Capacity of high water content experiment results

Herbs and spices	Weight (kg)	Drying time (hours)	Temperature (oC)
Red chili pepper	5	2,3	60, 70, 80
Garlic	5	2,3	60, 70, 80
Sunti acid	5	2,3	60, 70, 80

Table 2. The capacity of the results of the low water content experiment

Herbs and spices	Weight (kg)	Drying time (hours)	Temperature (oC)
Candlenut	5	2,3	60, 70, 80
Coriander	5	2,3	60, 70, 80
Cardamom	5	2,3	60, 70, 80
Pepper	5	2,3	60, 70, 80

Loss of weight of the material is analyzed by weighing the weight of the sample material, the initial weight of the material is reduced until the material becomes dry, compiling the observation data in tabular form, then depicting it in graphic form and then discussing it. There are two methods for determining the moisture content of the material, namely based on dry weight (dry basis) and based on wet weight (wet basis). In this case there are two ways to determine the water content of a material, namely based on dry weight (dry base) and based on wet weight (wet basis). Water content based on bsaah can be determined by the following equation:

$$\mathrm{m} = \frac{Wm}{Wm+Wd} \times 100\%$$

Where:
m= Moisture content on a wet basis (%)
Wm= Weight of water in ingredients (gr)
Wd = Weight of absolute dry matter (gr)

a. Dry weight moisture content can be determined by the following equation:

$$M = \frac{Wm}{Wd} \times 100\%$$

Where:
M= Dry basis moisture content (%)
Wm= Weight of water in ingredients (gr)
Wd = Weight of absolute dry matter (gr)

2.2.2 Relative humidity of the ambient air and the dryer

Relative humidity data from ambient air and dryers are obtained by plotting dry bulb temperature data and wet bulb temperature data on a psychometric chart or you can also use Psychometric Calculation.

2.2.3 Organoleptict Test

Organoleptic testing is an assessment technique using the five senses as parameters and acts as an early detection in assessing quality to detect deviations and changes in the product (Kartika, et al., 1988). This study aims to find the best extraction method to obtain natural flavor powder products that have the preferred sensory properties based on organoleptic tests.

a. Organoleptic Test Variables

Score	**Color**	**Flavor**	**Smell**
1	Very Brown	Very Savory	Very Fragrant
2	Brown	Tasty	Fragrant
3	No Chocolate	Not Savory	Not Fragrant
4	Sangat Tidak Coklat	Very Unsavory	not unfragrant

2.2.4 Ash content

Ash is an inorganic substance left over from the combustion of a food ingredient. The ash content and composition depend on the type of material and the method of ashing. Most of the food, which is about 96%, consists of organic matter and water. The rest is inorganic material in the form of minerals called ash. According to Deman (1997), burning at a temperature of 600oC will destroy organic compounds and leave minerals in the samples tested for ash content, but if combustion is carried out at temperatures of more than 600oC it will remove nitrogen and sodium chloride in the material being analyzed. Analysis of ash content in food ingredients aims to determine the mineral content present in the tested material, determine whether a processing process is good or not, determine the type of material used, estimate the content of the main ingredients used in making a product, ash content is also used as a parameter of the nutritional value of food ingredients (Sudarmadji et al, 2007).

The implementation of the research begins with preparing all the materials and tools to be used. All materials are cleaned and washed. The water content of the samples was measured at the beginning and end of the study. Next, weigh the total weight of the ingredients in the bag – each tray. Each ingredient is put into a tray weighing 100 grams for a total of 5 kg per seasoning

a. Observational Variables

The things observed include:
1. Material weight reduction
2. Reducing the water content of the material
3. Relative humidity
4. Drying rate to water content
5. Organoleptic Test
6. Test the ash content

3. RESULTS AND DISCUSSION

3.1 Material Weight Reduction

Table 3. Results of changes in the weight of ingredients in spices with high water content

Herbs and spices	T(°C)	Time (Hours)	Initial Weight (kg)	Final Weight (kg)	Lost (kg)
Red Chili Peper	60	2	5	3,5	1,5
		3		3	2
	70	2	5	2	3
		3		1,5	3,5
	80	2	5	1	4
		3		0,9	4,1
Red Onion	60	2	5	3	2
		3		2,9	2,1
	70	2	5	2	3
		3		1,2	3,8
	80	2	5	1	4
		3		0,8	4,2
Garlic	60	2	5	3,4	1,6
		3		2,9	2,1
	70	2	5	2	3
		3		1,5	3,5
	80	2	5	1	4
		3		0,9	4,1
Sunti Acid	60	2	5	3,4	1,6
		3		2,9	2,1
	70	2	5	2	3
		3		1,6	3,4
	80	2	5	1	4
		3		0,7	4,3

Herbs and spices	T(°C)	Time (Hours)	Initial Weight (kg)	Final Weight (kg)	Lost (kg)
Kemiri	60	2	5	3,1	1,9
		3		2,8	2,2
	70	2	5	2	3
		3		1,5	3,5
	80	2	5	1	4
		3		0,8	4,2
Ketumbar	60	2	5	3,2	1,8
		3		2,9	2,1
	70	2	5	2,1	2,9
		3		1,6	3,4
	80	2	5	1	4
		3		0,9	4,1
Kapulaga	60	2	5	3	2
		3		2,5	2,5
	70	2	5	1,9	3,1
		3		1,3	3,7
	80	2	5	0,9	4,1
		3		0,7	4,5
Lada	60	2	5	3,3	1,7
		3		2,7	2,3
	70	2	5	2	3
		3		1,5	3,5
	80	2	5	1	4
		3		0,8	4,2

Table 4. Results of changes in the weight of ingredients in spices with low water content

In Table 3 and Table 4, it can be seen that the experimental capacity of the dryer with a weight of 5 kg of spices was dried for 2-3 hours. The working capacity of this dryer can be increased if the weight of the spices is added. The working capacity can be increased if the speed of rotation per minute is increased, because according to research results it is stated that the amount of power can affect the processing time and capacity of the processing equipment. In addition, spices can be added again when viewed from the length and diameter of the tray and this requires operator expertise to operate this tool.

In Table 3, yield loss occurs for spices that have a high water content. It can be seen that the yield loss was obtained at the best temperature of 70oC for 3 hours, with an average loss of water content of 70-75%. In Table 4, it can be seen that the spices that have a low water content obtained the best temperature in drying, namely 70oC at 2 hours, the average loss rate of water content was 60-65%, in addition, the drying process was too hot and long time can cause damage to spices that have low water content. Based on tables 3 and 4 above, the results of the analysis carried out to test the degree of loss of water content are appropriate according to SNI 01-2974-1996 for this instant seasoning product, the water content should not be more than 8-10%.

3.2 Relative Humidity of Ambient Air and Dryer Air

Observations showed that during the drying process the relative humidity outside the dryer was recorded in the range of 83.28% - 89.50%. Also the relative humidity inside the dryer was observed and recorded in the range of 86.58% - 97.91%. The results of this observation from both the wet and dry thermometers are plotted on the psychometric chart, the humidity data outside and the humidity inside the drying chamber is obtained, the difference between the humidity outside the dryer is an average of 86.11% and the humidity inside the dryer is an average of 88, 17%. This humidity occurs due to the process energy generated by the fully opened fan with an average air velocity of 12 m/s entering the dryer which is forcibly entered into the drying chamber to touch the material by convection in the drying chamber. The difference between the outside and inside humidity of the dryer creates space for the weight of the water to evaporate from the material and then transfer to the drying air.

3.3 Relationship of Moisture Content Against Time

The decrease in water content in red chili is relatively fast at the beginning of drying, then decreases slowly until it approaches the specified water content. Based on the research results, it was found that the minimum water content of red chilies in rooms one and two reached 17.4%, rooms three and four 16.95% and rooms five and six 16.6%. The decrease in the moisture content of the ingredients at the beginning of the study used the oven method, the results of the study obtained the initial moisture content data of 60–85% at harvest (Mikasari 2016). This water content is used as initial data for the decrease in the water content of the material as measured by the method of weighing the material after the drying process takes place, during the drying process the equilibrium moisture content continues to decrease, namely 8 - 10%. This decrease in water content is due to the drying process where the red chili material from agricultural products absorbs heat energy from the drying air, meaning that there is a convection heat transfer process from the drying air which is absorbed by materials containing water of 38.75%. Then the water evaporates slowly from the material to the drying air. This means that when the evaporation process occurs, the nutmeg for agricultural produce slowly loses its mass or in theory is called mass transfer. The water content in the material consists of 3 types of water, namely first the free water content, the second the water content bound to the material and the third the water content which is chemically bound in the material. This amount of water will evaporate after receiving or absorbing heat energy from the drying air. Initially, the water that evaporates is free water, followed by bound water, and finally, chemically bound water. The difference in water content occurs due to the position of the chamber, namely chambers one and two receive heat earlier, followed by chambers three and four and chambers four and five. In addition, there may be differences in the size of the material, there may even be differences in water content between one grain and another. Equally important is the difference between the position of the material and the air flow rate and the amount of energy present in the drying air so that the water content is different.

3.4 Organoleptic Test

Organoleptic testing of this spice aims to get an overview of the panelists' preference for the color, taste, and aroma produced.

According to Prtama et al (2012) the perception of the human senses of a product's properties.

- **Colour, Taste and Odor**

The color of food products is the first impression captured by the panelists before recognizing other stimuli. Color is a very important component to determine the quality or degree of acceptance of a food ingredient or food product. In addition, color can be used as an indication of chemical changes in food ingredients such as browning reactions and caramelization (Tahir et al., 2014).

Figure 1. Graph of color observations on high water content spice samples

The results of the observations in the graph above on the color, taste and smell of instant spices made from spices after being washed and dried in the drying blower oven at temperatures of 60oC, 6oC and 80oC for 3 hours drying time. Given to 15 panelists, the highest values for color, taste, and smell with a rating scale of 1-5 were found in the MA, BP, P, and KJ treatments at 70 oC with an average score of 4 (likes), and the lowest was in treatment A1, B1, C1, namely 2.3 (poor) for A2, B2, C2 with an average score of 3 (likes). The difference in organoleptic values on color testing did not show such a big difference. All treatments were liked by the panelists on average with the range of scores given being 2.5 – 4. The effect of color preference on instant seasonings made from spices is influenced by the presence of compounds present in these spices.

3.5 Ash Content Test

Determination of ash content has to do with the minerals of a food ingredient. Ash content is determined based on weight loss after combustion provided that the end point of combustion is stopped before the decomposition of the ash occurs (Tahar et al., 2017). The manufacture of instant seasonings made from spices begins with the preparation of powdered spices which is carried out by washing thoroughly and then drying using a drying blower oven for 2 hours at a heating temperature. The dry ingredients were crushed using a blender and sieved using a 60 mesh sieve. Based on SNI 01-3709-1995 the maximum permissible ash content is 7%.

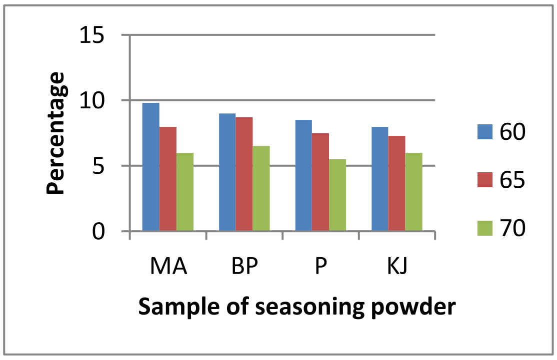
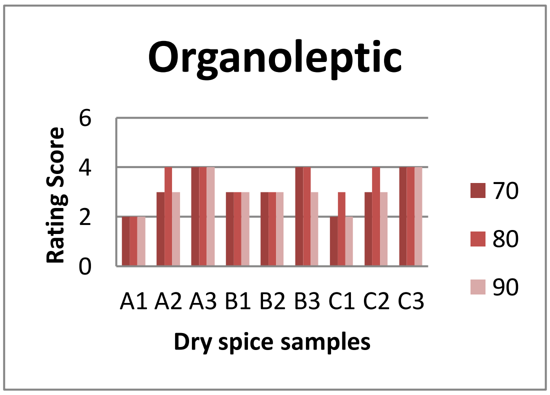


Figure 2. Graph of observations of ash content in instant seasoning samples



The test results for the ash content of instant seasonings made from spices show that the highest value is found at 70°C with an average ash content of 5.5% to 6.5% and these results are in accordance with SNI 01-3709-1995 standards for ash content. allowed a maximum of 7%. The results of the analysis of variance showed that the treatment had a very significant effect (α = 0.01) on the increase in the percentage of spice ash content. The increase in the percentage of ash content is inversely proportional to the increase in the percentage of water content in the seasoning. The lower the water content, the higher the ash content of the spices. This is in accordance with the opinion of Tambunan et al (2017) the higher the temperature in the processing, the percentage of ash content will increase. Because the water that comes out of the food will be bigger. According to Tapotubun et al (2010).

CONCLUSION

The results of observations of this drying blower oven dryer were experiments on spices that have high moisture content and low moisture content with an ingredient weight of 5 kg per spice which were tested at 75oC – 85oC for 2 - 3 hours.

1. The best results from drying spices which have a high water content are obtained at 70oC with a drying time of 3 hours. Then, the color, aroma, and taste of the spices produced are not damaged or changed. The levels during the drying process decreased from 38.75% down to an average of 16.98% with details in rooms one and two reaching 17.4%, rooms three and four 16.95% and rooms five and six 16.6% . With an observation time of 3 hours.

1. For spices that have a low water content, the best temperature is 70oC with a drying time of 2 hours. The spices that are obtained are not damaged, such as broken grains or too significant discoloration.

3. The relative humidity outside the dryer ranges from 83.26% - 86.50% with an average of 86.11%. Also the relative humidity inside the dryer was observed and recorded ranging from 86.58% - 97.91% with an average of 91.33%.

4. The increase in the percentage of ash content is inversely proportional to the increase in the percentage of water content in the seasoning. The lower the water content, the higher the ash content of the spices.

REFERENCE

[1] E. A. Parfiyanti, R. Budihastuti, and E. D. Hastuti, "The Effect of Different Drying Temperatures on the Quality of Cayenne Pepper (Capsicum frutescens L.) Indonesia is an agricultural country that has a diversity of plants which in the field of all fruits have a spicy taste from chilies. Capsaicinoids constitute and Pa," Biology, vol. 5, no. 1, pp. 82–92, 2016.

[2] BPS Sub-Directorate of Domestic Trade Statistics, Distribution Pattern of Red Chili Commodity Trade in 2019. 2019.

[3] F. B. Setiawan, M. Rizqiyanto, and J. U. M. Yiwa, "Microcontroller-Based Programmed Ovens," Widya Tek., vol. 21, no. 2, pp. 10–14, 2013.

[4] North U.S., North U.S., and North U.S., "Use of Type K Thermocouple in Baking Ovens as a Temperature Sensor Based on Atmega 328 Microcontroller," 2019.

[5] G. A. Putri, M. Sarosa, and L. D. Mustafa, "Implementation of the Internet of Things for Telecontrol Systems in Food Drying Ovens Using Android Applications," Jartel, vol. 9, no. 1, pp. 532–538, 2019, [Online].

[6] Syafriyudin and D. P. Purwanto, "Atmega 8535 Microcontroller-Based Drying Oven Using Heaters in the Home Industry," J. Teknol., vol. 2, no. 1, pp. 70–79, 2009.

[7] D. T. Papepabatha, "Design and Build of Arduino-Based Cassava Dryer," Semin. Has. Electrical S1 ITN Malang, 2019.

[8] T. I. Munandar and M. Kamal, "Temperature in Automatic Tuna Roasting Process Using Arduino Uno Atmega328," vol. 3, no. 2, pp. 75–80, 2019.

[9] E. L. Zaky, R. Hakim, and H. Hasan, "Design of a Convection Drying Machine for Agricultural Products with Arduino Uno

Microcontroller-Based Infrared Heater Elements with a Ds18B20 Sensor," J. Karya Ilm. Tech. Electro, vol. 2, no. 3, pp. 16–20, 2017.

[10] H. Priono et al., "Design of a Coconut Fiber Counter with a Motor Drive," 2019.

[11] A. R. Nugraha, A. Stirrer, A. A. P. Dough, and I. Introduction, "DC Motor Speed Control System in Dodol Dough Mixer Using PID Controller," no. DC, pp. 1–6.

[12] Rusliansyah, "Analysis of 2 Ampere Mcb at Kwh Meter 30 Houses in Jambat Balo Village, Kec. Pagaralam Selatan Kota Pagaralam," Foreign Aff., vol. 91, no. 5, pp. 1689–1699, 2016.

[13] Muchtadi, T. R., Sugiyono and F. Ayustaningwarno. 2010. Food Science. Bogor:

[14] Alfabeta Naidu, K. A. 2003. Vitamin C in Human Health and Disease is still a Mystery. An Overview, Nutrition Journal 2:7

[15] Pratiwi, S.T. 2008. Pharmaceutical Microbiology. Yogyakarta: Erlangga

[16] Rajput, J. C. and Y. R. Parulekar. 1998. Handbook of Vegetable Science and Technology: Production, Composition, Storage and Processing. Edited by D. K. Salunkhe and S. S. Kadam. New York: Marcel Decker