Prototype of Kempelang Fish Dryers Reviewed from Energy of H_2O that is Evaporated to Air

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ABSTRACT
Kempelang is a typical food of Palembang City. The hallmark of ths food lies in the prominent taste of fish. The use of fish will affect the distinctive taste and price of this food. Kempelang crackers are one of the small industry products that are quite popular in the community. In order for kempelang crackers to last a long time and have a crunchy taste after frying, it is necessary to reduce the cracker content (moisture) in fish kempelang. To do this, one of them is the drying process. One effort made to facilitate the making of this kempelang in order to become a better product is to design an automatic fogging system in an enclosed space with dual blower curing system configuration and natural material smoke filter to produce clean and continuos air. In the drying machne prototype, the constant variables are the mass of pempek kempelang, operating temperature, and fuel supply, while the variables that are changed are operating time 30 minutes, 45 minutes, 60 minutes, 75 minutes, 90 minutes, 105 minutes and 120 minutes, are the rate of the supply air is 6,3 m/s, 7,3 m/s and 8,3 m/s. Based on the results of the research, the finela water content of pempek kempelang fish which was obtained was 5,702%, it met the standard SNI 2713.1:2009 with the most optimum time of 120 minutes, and the air flow velocity of 8,3 m/s produced the greatest heat of evaporation of water which was 2797,29 kJ.

Keywords: *Kempelang, Dryer, Energy, Prototype.*

1. INTRODUCTION

Kempelang is one of the snacks that are popular and favoured by the people of Indonesia, especially the people of Southern Sumatra. Kempelang raw materials are all types of fresh fish that can be processed into products. Types of raw materials that are generally used as raw materials for kempelang are mackerel, snakehead fish, snapper, carp, and tilapia [1]. Kempelang is widely known among the public, easy to obtain in various places, both in stalls, in supermarkets, and in restaurants of five-star hotels. How to make kempelang is quite simple, namely the white fish meat is ground, mixed with a little water, salt and spices, then stirred until smooth. The resulting dough is then shaped like pempek, steamed, dried in the sun. It is dried in the sun to reduce its moisture content until it is dry and then baked or fried [2]. Handling kempelang requires a drying process. Drying is one way to remove some of the moisture content of a material by evaporating water using heat energy. There are two drying methods commonly used in foodstuffs, namely drying by means of a dryer. Drying is the process of removing water from an agricultural/ fisher product until the water content is balanced with the surrounding air or up to a water level which will result in the quality of agricultural, plantation or fishery products being protected from fungal attack and insect activity [3]. Drying kempelang using direct sunlight will take up to two days if the weather is sunny, but it will take up to four to five days in less sunny weather conditions. One of the ways that the people of South Sumatera, especially in the districts, are Palembang in the process of processing Kempelang is by drying the kempelang naturally (drying in the sun).

The natural drying process has many disadvantages, including long drying time, requires a large area, the quality of kempelang decreases due to dust exposure, and is prone to animal disturbances such as flies, chickens, cats and dogs. Another problem that then arises in the utilization of solar energy is the weather conditions. The dryng process can be done if the weather is sunny, and if the weather is not sunny, it will take a longer time int the drying process. In the rainy season, drying is very slow. The results obtained from drying are not optimal, and the amount of production produced is not as expected. This imperpect drying can even cause the product to

mushroom and the rot so that the selling price drops [4]. The main problem with drying with natural sunlight is that it depends on good weather and the temperature cannot be controlled, therefore in the wet tropics conditions some additional energy sources are needed to add heat of vaporization to the drying process. Therefore, the performance test of this kempelang dryer needs to be done by looking at the effect of time and ar flow velocity on the water content in the process of drying fish kempelang with an air circulation system.

2. MATERIALS AND EQUIPMENTS

The materials used are pempek kempelang fish and the equipment used are prototype of kempelang fish dryers.

3. METHODS

3.1. Making Pempek Kempelang [2]

Fresh fish after being peeled is weighed 1 kg, ground until smooth and then given a salt solution, stir until smooth/ chewy. The dough is smooth, plus 300 grams of sago, stir until smooth and then formed into a long circle with a diameter of 6 cm and a length of 20 cm. The dough that has been formed is boiled in boiling water, until the pempek is cooked or floats on the cooking water, then remove and drain. Slice pempek with a thickness of ±0,6 cm so that it becomes kempelang pieces.

3.2. Kempelang Dryers

3.2.1. Product analysis from effect of airflow velocity and time on moisture content.

Weigh the kempelang pieces, this is initial weight of the kempelang before drying. Dry the kempelang in the oven for 30 minutes at a temperature of 100℃ untik it contains no water, cool and weigh, this is the weigt of dry kempelang. The difference between the weight of the inital kempelang and the weight of the dry kempelang is the initial moisture content of the kempelang to be dried. Prepare the dryer, turn on the blower and heater from the coconut shell biomass and set the temperature regulator to 60℃. Record the dry bulb temperature and the wet bulb temperature of the hot air entering the drying chamber. Determine the relative humidity, absolute humidity, and the volume of the drying air humidity using a humidity chart at 15 minute intervals for 120 minutes. Put the kempelang into the oven as many as 50 peces. After 15 minutes take one piece of kempelang and wegh it. Repeat procedure 5 to 7 for each time interval of 15 minutes up to 120 minutes operating time.

3.2.2. Product analysis determination of moisture content by oven method

Empty cup and lid are dried in the oven for 15 minutes. Cool in a desiccators for 10 minutes. The cup and lid were weighed 5 gr of the sample was weighed quickly and the sample was put into a cup and into the oven with a lid for 2 hours. The cup is put into a desiccators to be cooled, weighed again. The sample was dried again in the oven until a constant weight was obtained. The used formula : Sample weight (grams) = w1, sample weght after drying (grams) = w2, weight loss (grams) = w3

$$\text{Percent moisture content (dry basis)} = \frac{w3}{w2}x100 \quad (1)$$

$$\text{Percent moisture content (wet basis)} = \frac{w3}{w1}x100 \quad (2)$$

$$\text{Total solids (\%)} = \frac{w2}{w1}x100 \quad (3)$$

4. RESULT AND DISCUSSION

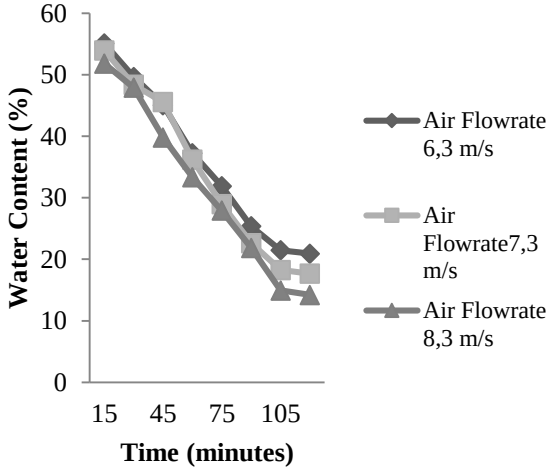

Figure 1 Graph of the relationship percent moisture content and processing time

The average decrease in water content takes place linearly. At the beginning of drying, the moisture content of the material is about 78% down to 40% at the end of drying. The standard value of the water content of kempelang fish based on SNI 2713.1:2009 is a maximum of 90 %. Fish kempelang product using this dryer has a moisture content that is in accordance with the standards determined by SNI 2713.1:2009. The water content is caused by the relatively long drying time, although the drying temperature fluctuates which causes the water evaporaton process to become unstable, but this does not cause the water content to be high. The long drying process causes a decrease in the water content, the highest amount of ingredients forms smoke on the surface of the fish kempelang, and the high temperature in the drying process acause anti- bacterial properties [2].

Different air flow speeds produce different drops in water content. This shows that the speed of air flow is one of the factors that affect the decrease in water content in the drying process. The presence of air flow serves to speed up drying but does not immediately scorch the dried material [4].

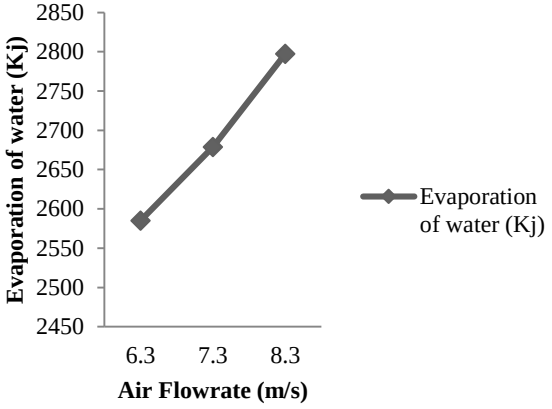

Figure 2 Graph of the relationship between the air flowrate and the heat of vaporization of water.

The effect of air flow velocity on the heat of evaporation of water from the research data shows that the heat of vaporization of water increases in air flow velocity. This is because the air rate in the oven will be faster, so the contact between the hot air and the material will be shorter, but because it is carried out continuously, the greater the mass of water transferred from the material to the air. So that the amount of heat from the H_2O carried by the air out of the smoker will also increase. The ability to evaporate water will increase with increasing the amount of hot air that enters.

5. CONCLUSIONS

1. From the research gets one unit of kempelang dryer with smoke circulasi that can produce fish kempelang with good quality and accordance that with the quality standard SNI 2713.1:2009.
2. The supply air flow rate and the length of operation time have an influence on the amount of water content in the kempelang product, where the greater the air flow rate, the lower the remaining water content in the kempelang final product, as well as the longer the operating time, the lower the water content remaining water content in kempelang products.
3. From the results of data processing, the optimum condition of the process using a kempelang dryer is a flow rate of 8,3 m/s and an operating time of 120 menit wit a % moisture content of kempelang product of 5,702% and the heat of evaporation of water is 2797,29 KJ.

AUTHORS' CONTRIBUTIONS

Ida Febriana conceived and planned the experiments. Ida Febriana and KA Ridwan carried out the experiments. Ida Febriana, KA Ridwan, Anerasari M, and Taufik jauhari contributed to sample preparation, took the lead in writing the manuscript, and all authors provided critical feedback and helped shape the research, analysis and manuscript.

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