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# Bananas Muli as a product fruit leather through using microwave and oven dryers

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**Abstract.** Post-harvest processing of bananas Muli local Karawang – Loji area became a research study on a breakthrough the kind of food products. Previously, this fruit only sold to consumers in the roadside, and the rest was thrown away or not utilized. Users prefer to consume directly and fresh. After that, its medium size with a diameter 3 to 4 cm caused this raw material did not display to be a selling outcome such as "sale" or chips. Bananas Muli has never received further food processing compared to other types of bananas (such as bananas Kepok, bananas Raja, bananas Tanduk, bananas Ambon, and others). The term of fruit leather gave the development and novelty for product fruit categories in the form of sheets. Furthermore, the process that occurred was decreasing water content used microwave and oven dryers, then temperature range between 60-80$^{o}$C with constant sample thickness in three suitable stabilizers. Utilization of oven dryers to produce banana leather products without stabilizers was more likely to choose a temperature of 70$^{o}$C as the best condition for decreasing water content in the ingredients. Meanwhile, the use of microwaves was able to produce electromagnetic waves and caused collisions between molecules owned by the sample. The results indicated a positive effect. Carrageenan and starch were more capable of binding the water molecules. This way helped the process of reducing water content much faster from the surface (free water) to the area in the sample (water bound to the equilibrium water content). This research resulted in a decrease in water content in the example by 10,5701-12,8639% within 3 hours of the drying process at the optimum conditions.

## 1. Introduction

Every day, people make fruit as a dessert dish. Generally, they consume them directly. Other than, they also provide additional treatment processes to produce other products such as boiled, steamed, fried, or crushed to be combined with other food ingredients. The other hand, the maturity level criteria become the random variable of the buyer. Levels 5 and 6 are the categories of banana that are ready for consumption in yellow and green to yellow stem whole as a delicious fruit to eat. The 7$^{th}$ stage (final) has the characteristics of yellow to slightly brown spots (taste, aroma, and the best nutrition).

The Loji area of Kabupaten Karawang has some potentials from one type of banana, namely banana Muli. But unfortunately, the system that carried out post-harvest is to sell it when the banana is at the first level of maturity with a fresh green color at a low price (Rp. 2000 - 4000,-/kilogram). Often residents in the area sell it in groups on the roadside. Most of the time, the banana decays and thrown away. This thing makes the challenge to increase the usefulness of bananas Muli into food products. The aim is to increase the shelf life [1] and also the selling value of the bananas Muli.

Some researchers also carried out activities to extend the shelf life of food materials. Those of them gave a drying process for seaweed [2], and other methods for beverages such as syrup and jelly drink [3]. Then, processing shrimp Rebon into local shrimp paste of Karawang the products as a form of product expansion and shelf life of abundant yields through reduced product water content [4], [5]. The increased shelf life of processed coconut was into dodol Betawi products by maintaining ancestral recipes [6].

One of the innovative issues carried out by some previous researchers is fruit leather, both from the involvement of the fruit itself such as apple [7], [8], mango [9], pomegranate [10], pineapple [11] and the mixture of various fruits [12] with the appearance of sheet-shaped products. Provision of hot air is to be a medium for reducing the water content of the sample.

The initial breakthrough carried out in this study was without the involvement of the molecular weight enhancing agent of the banana Muli pulp (as a sample) to the drying rate. stabilizing materials were starch, maltodextrin, and also carrageenan. Pulp bananas have a a low weight of puree bananas and desired end product is a reliable product for increasing molecule weight such as utilize wheat flour [10], maltodextrin and glucose [13], cassava starch [9], mixed sucrose and polydextrose powder [8]. Then, the drying temperature used is 60-80$^{o}$C in oven equipment and also compared with microwave dryer. From another research has been announced that optimum temperature, if the hot air of the sample was 50-80$^{o}$C [10]. The need for drying time and water content of SNI-regulated products would become the essential points if the product is continued to the product-ready stage.

## 2. Material and Method

Bananas Muli found in the traditional market of Karawang, which was the result of Loji residents' gardens. Raw materials purchased in the afternoon with a maturity level number 3. The next morning, the content reached level 5 because it stored in plastic. Meanwhile, the sequence of raw material preparation activities presented in Figure 1 below.

The involvement of lemon water was one form of prevention of the yellowing of the fruit pulp to brown. The time used was 1 minute during the mixing process - dozing until some the time later, then the sample put into the drying chamber. Meanwhile, the ratio of banana Muli to lemon water was 2: 1, the contribution of the thickening agent was 5%; 5,5 cm as the sample diameter 14 grams as the thickness of the sample.

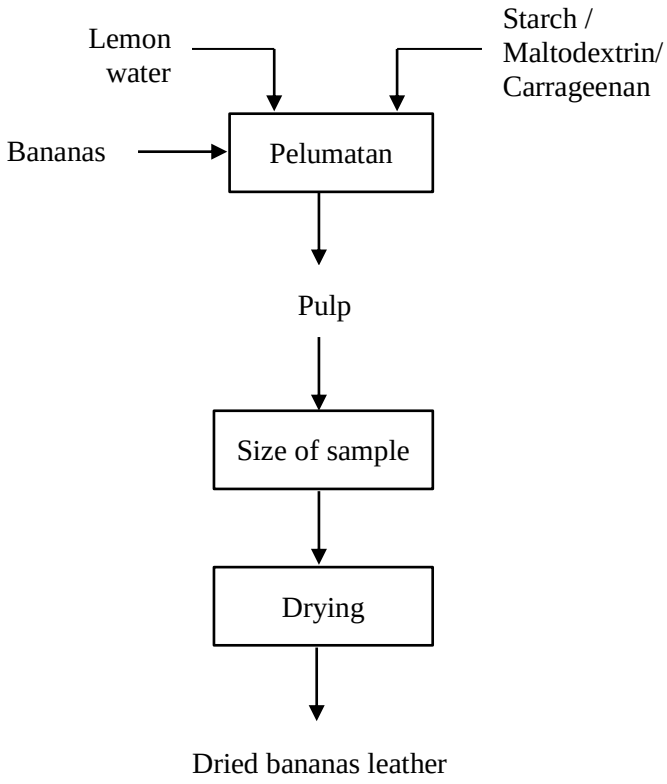


**Figure 1.** The process of making bananas Muli as a fruit leather product

## 3. Result and Discussion

Data on the decrease in water content in the ingredients recorded per 10 minutes for 3 hours. Then, the sample was dried until it reached equilibrium water content. The drying process used two types of equipment, oven, and microwave. Removal of the amount of water in the material presented in Figures 2 - 3 below.

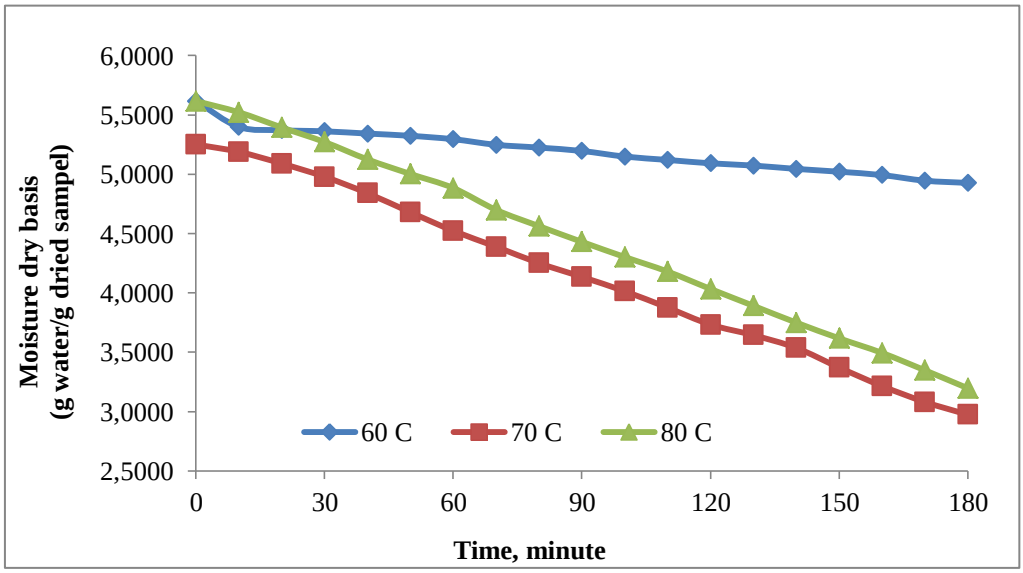


**Figure 2.** Drying of bananas Muli pulp using an oven without involving thickening agents

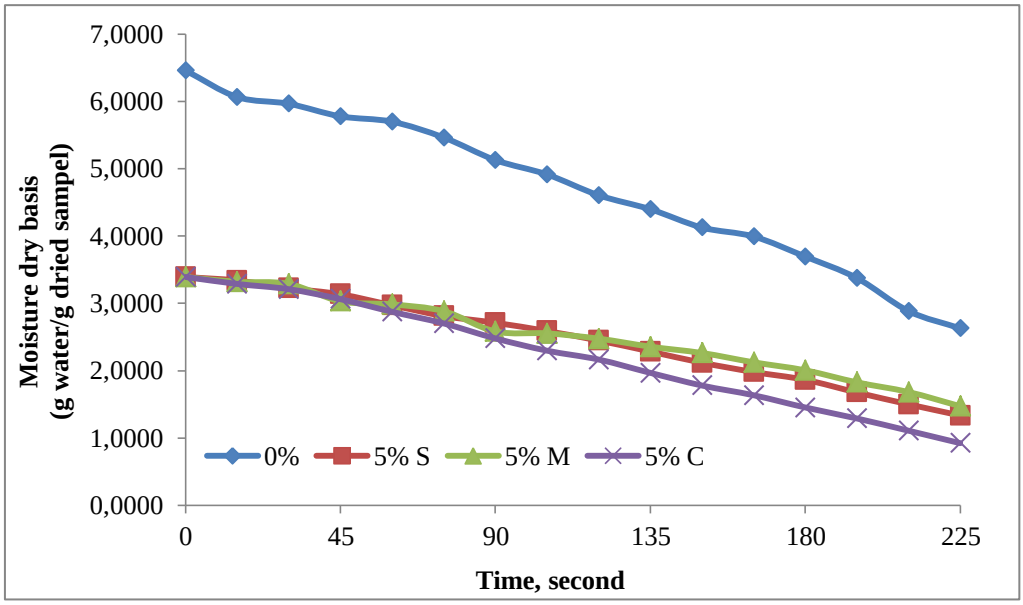


**Figure 3.** Drying of bananas Muli pulp using the microwave: 5% mass for starch - S, maltodextrin - M, and carrageenan - C

The initial moisture content of the samples ranged from 84,0025 – 86,5931%. The drying process used two types of dryers, namely oven, and microwave. These devices undergo the process of reducing free water content, bound until reaching equilibrium water content. The two pieces of equipment have different working principles. The temperature of the hot air in the oven could be set 60-80$^{o}$C. The reducing water period did the difussion process (from outside the surface to the inside of the sample).

The microwave utilized electromagnetic waves as a medium-hot air like in the oven). This method reduced the amount of material water from the inside to the outside surface of the sample. Radiation from these waves has a second chance in polarity. The right time setting was a step to anticipate the magnitude of microwaves generated from electric currents, and it was able to make the sample shape messy. This way certainly expected by the right timing. This study utilized a delta of time of 15 seconds (Figure 2) to measure the sample per time and at the same time as a form of handling the use of microwaves against collisions between molecules in the example.

Figure 2 showed that a decrease in free and bound water levels over time — meanwhile, the presence of equilibrium water content achieved by the microwave equipment presented in Figure 3. Then, variations in those agents have a low removal of water movement. This thing caused three materials bound a certain amount of water in the bananas pulp. In trend line Figure 3, the second binder tended to increase the molecular weight of the sample a little. Then, it followed by starch and ended by carrageenan. The viscosity behaviour of the sample also supports this before entering the drying process stage. Provision of carrageenan and starch gave higher viscosity (thicker) to puree bananas. The additional action of stirring manual was carried out to release the binding material which attached around the wall of the mixing equipment. This thing reinforced the necessary use of these types of materials that carrageenan and starch could increase the molecular weight of the bananas pulp. From one of the result, the study knew the addition of a stability agent was involved in handling the molecular weight of the fruit pulp. It also overcame the degree of stickiness of the sample during the drying process [14]. Besides, the hope with adding carrageenan into the pulp soursop could produce fruit leather which a great product [15].

Temperature regulation from 60-80$^{o}$C provided a rate of decrease in water content in materials that were not in tune with the increase in the study variable. The optimal condition for drying puree bananas samples as solid products were at 70$^{o}$C. While the 60$^{o}$C situation, the sample has more free water content, and it showed from Figure 3.1 that after 3 hours, the percentage of water reduction obtained in the sample between 0,9159 – 1,7596%. Meanwhile, temperatures of 70 and 80$^{o}$C were 10,5701 – 12,8639 and 8,7143 – 12,7641%, respectively.

## 4. Conclusion

Initial research to review fruit leather products from the raw material of bananas Muli has been carried out using two types of dryers: oven and microwave. Both of them have different working principles in reducing the water content of ingredients. The application of the first equipment gave the result of the tendency. The optimum temperature achieved by 70oC without using a molecular weight enhancing material for bananas pulp and using carrageenan caused drying kinetic faster than others.

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