

Drying of fish crackers from NARATHIWAT province by microwave oven

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Abstract. Transferring an electric power to the microwave power was studied. Dried fish crackers were measured in various topics such as mass and moisture content at various times, and moisture absorption. The results revealed that an electric power equal 304.7 and 503.8 W transferred to be the microwave power equal 44.58 and 206.21 W, respectively. The time of fish crackers drying was shown to have an effect on the mass of fish cracker by equation $m=1.62 \times 10^{-3}t^2-3.70 \times 10^{-2}t+2.68$ for 304.7 W of electric power and $m=2 \times 10^{-6}t^2-1 \times 10^{-3}t+2.74$ for 503.8 W of electric power. The dried fish crackers at center of glass plate showed a lower moisture content and a higher moisture absorb value than the dried fish crackers at edge of glass plate. The fish crackers dried at 503.8 W of electric power had a higher moisture absorb value than the fish crackers dried at 304.7 W of electric power.

1. Introduction

Fish cracker, is a mixture of fish and ingredients, which is a popular food in the south of Thailand. The main ingredient of fish cracker is tapioca flour or sago flour and the secondary ingredient is sugar, garlic, pepper, salt and MSG. Fish cracker is made from crushing a fish and ingredients until it became a uniform mass. This mass is put into a cylindrical mold before slicing to be a thin fish cracker sheet. Most commonly oil is used to cook these thin fish cracker sheets. It is mean that when the consumers eat the fish cracker, they will intake oil.

Microwave ovens are widely used in many households for cooking and warming food. The advantage of cooking by using microwave oven is the without oil cooking food. Therefore, drying of fish cracker using microwave oven will help consumers reduce to intake oil from food.

In this study, we are interested in studying an electric power transferred to the microwave power in fish cracker drying process. Dried fish crackers were measured in various topics such as, mass and moisture content at various times, and moisture absorption.

2. Method and Experiment setup

2.1. Electric power measurement

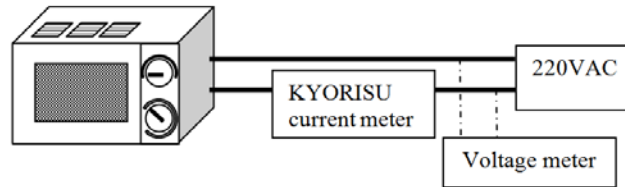


Figure 1. An electric power measurement setup.

An electric power measurement setup is shown in figure 1. The current and voltage will be measured. These values will be used to calculate an electric power by equation:

$$P_{av} = \frac{\int d(I \cdot V)}{t} \quad (1)$$

2.2. Calculate Microwave Power

In order to measure an energy transferring from the microwave oven to the fish cracker, the water in a beaker will be used to an energy receiver. In this experiment, 500 ml of water in a beaker that will be set at center or edge of glass plate. Then the microwave power was turned on for 1 minute as shown in figure 2. The microwave power is calculated from changing of water temperature (ΔT) by equation:

$$P = \frac{E}{t} = \frac{m_w c_w \Delta T + m_b c_b \Delta T}{t} \quad (2)$$

When P is the average microwave power (W), E is microwave power (J), t is experiment time (s), m_w is mass of water (kg), c_w is specific heat capacity of water = 4.18 kJ/kg.K., m_b is mass of Pyrex glass (kg). c_b is specific heat capacity of Pyrex glass is 0.55 kJ/kg.K. And ΔT is temperature changing (K)



Figure 2. 500 ml of Water in beaker (Pyrex Glass) in Microwave oven in microwave power measurement

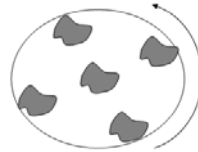


Figure 3. The layout of position the fish crackers on glass plate in microwave oven.

2.3. Moisture content (dry base) and moisture absorption measurement

To determine the moisture content of dried fish cracker, the mass of dried fish cracker in each of 30 sec will measure to be wet mass, while dry mass is the lowest mass of dried fish cracker. The difference in mass changing is equal to the amount of water that evaporated. This was calculated as follows:

$$MC = \frac{m_w - m_d}{m_d} \times 100 \quad (3)$$

when m_w = wet mass and m_d = dry mass.

The layout of position the fish crackers on glass plate in microwave oven is shown in figure 3. The moisture absorption experiment, fish crackers were put in the box for 24 hr. The moisture in this box was controlled at 90% humidity value. After 24 hr, the mass of fish cracker were weighed. The % moisture absorption of fish cracker is determined by equation:

$$\% \text{ moisture absorption} = \frac{m_f - m_i}{m_i} \times 100 \quad (4)$$

when m_i = mass of fish cracker before moisture absorption
and m_f = mass of fish cracker after moisture absorption.

3. Results

3.1. Electric power management

There are two settings in the current and voltage measurement: low and med setting. These setting were assigned by limitation of drying that can ripe and no burn. The current and the voltage and the electric power signal showed 30 s of cycle that can be separated in two parts: active and non-active part. At low setting, there were 18 s of active part and 12 s of non-active part. The current and voltage value in active part was 4.83 A and 203 V, respectively. The current and voltage value in non-active part was 0.17 A and 215 V, respectively. At med setting, there were 16 s of active part and 14 s of non-active part. The current and voltage value in active part was 5.01 A and 210 V, respectively. The current and voltage value in non-active part was 0.21 A and 219 V, respectively. To calculate the average value of electric power from equation (1) is shown in table 1. The average value of electric power at low and med setting was 304.7 and 503.8 W, respectively.

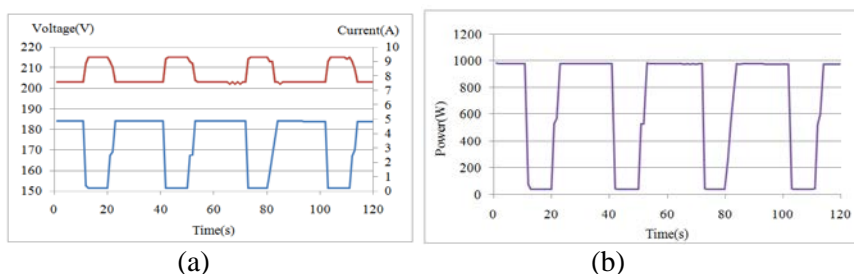


Figure 4. Signal of (a) voltage (above line) and current (below line) (b) Electric power of microwave oven at 304.7 W

3.2. Microwave Power

To calculate, the water temperature was estimated equal the temperature of the container. According to equation 2, the microwave powers were calculated in both low and med setting. The results of microwave power are displayed in Table 1.

Table 1 Electric power and Microwave power

	Electric Power (W)	Microwave Power (W)	
		At center	At edge
Low	304.7±3.1	44.58±1.30	38.32±1.41
MED	503.8±2.2	206.21±1.25	197.45±2.32

3.3. Moisture Content (dry base) and moisture absorption measurement

First, the crackers were placed in the center of the microwave glass plate and then at the edge of the glass plate as shown in Figure 3. The wet mass wet and dry mass was measured to find mass changing. The moisture content values were calculated by following eq. (3). Fish cracker was dried at 304.7 W

showed 1.1% of humidity absorption, while Fish cracker was dried at 503.8 W showed 1.7% of humidity absorption.

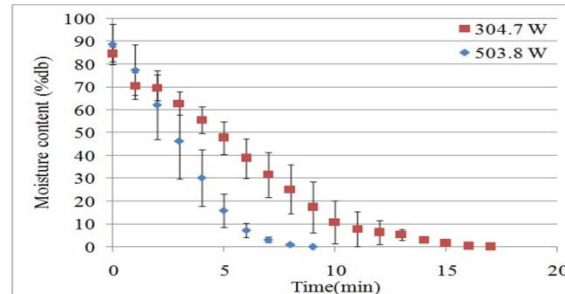


Figure 5. Moisture content of fish cracker drying.

4. Conclusions

An electric power equal 304.7 and 503.8 W transferred to be microwave power equal 44.58 and 206.21, respectively. At the center of the plate had more microwave power than at the edge of the plate. At the center of plate and 503.8 W electric power is good condition for using in fish cracker drying.

The time of fish crackers drying was shown to have an effect on the mass of fish cracker by equation $m=1.62 \times 10^{-3}t^2-3.70 \times 10^{-2}t+2.68$ for 304.7 W of electric power and $m=2 \times 10^{-6}t^2-1 \times 10^{-3}t+2.74$ for 503.8 W of electric power. The dried fish crackers at center of glass plate showed lower moisture content and higher absorb humidity value than the dried fish crackers at edge of glass plate. The fish crackers dried at 503.8 W of electric power had a higher absorb humidity value than the fish crackers dried at 304.7 W of electric power.

Dried fish cracker at the center of glass plate showed quicker ripe than dried fish cracker at the edge of glass plate due to the energy transferring at the center of glass plate is quite stable. An energy transferring at edge of glass plate is not stable due to rotation of glass plate and the edge of glass plate will be turned close to and far away from the magnetron head.

5. Acknowledgement

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6. References

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