ADVANCES IN AGRICULTURAL AND FOOD RESEARCH JOURNAL

Original Research Article

Effect of Different Cooking Temperature and Time of Glutinous Rice Flakes

Mohd Dom, Zanariah.[1]*, Noordin, Mohd Ikram.[1], Shamsudin, Rosnah.[1], Hashim, Norhashila.[2]

1Department of Process and Food Engineering, Faculty of Engineering, Universiti Putra Malaysia, 43400 Serdang, Selangor Darul Ehsan, Malaysia; nana@upm.edu.my; mohdikramnoordin@gmail.com; rosnahs@upm.edu.my

2Department of Biosystem and Agricultural Engineering, Faculty of Engineering, Universiti Putra Malaysia, 43400 Serdang, Selangor Darul Ehsan, Malaysia; norhashila@upm.edu.my

*Corresponding author: Zanariah Mohd Dom, Department of Process and Food Engineering, Faculty of Engineering, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor Darul Ehsan, Malaysia; nana@upm.edu.my

Abstract: The immature stage of glutinous paddy or *Oryza sativa var. glutinosa* is one of the most popular cultivars known as waxy or sticky. Glutinous rice flake is a flattened carbohydrate-rich edible food obtained from the processing of immature glutinous paddy. Since glutinous rice flake is a traditional food, the farmers are more comfortable producing it by conventional cooking. Still, it will take longer and require more labor energy. Hence, this study aims to determine a new cooking method for glutinous rice flake using a microwave oven at different temperatures (230°C, 240°C, 250°C) and ranging taken (3.3min, 4.0min, 4.3min, 5.0min, 5.3min). From the study, the suitable cooking parameter is at a temperature of 250°C, from 4.3min to 5.0min. The glutinous paddy can maintain its stickiness and is easy to flatten. Furthermore, the husks are easily removed and separated from the paddy grains during the flattened process. Lower temperatures and shorter time taken will make the paddy not fully cooked. However, higher temperatures and longer time will make the paddy pop and easily break. In short, this study successfully identifies the new cooking parameter of rice flake by implementing microwave heat treatment. The physical, frictional and chemical properties of rice flake through microwave heat treatment can be considered for further study.

Keywords: glutinous rice flake; glutinous paddy; temperature; time

Received: 18th March 2022

Received in revised form: 26th October 2022

Available Online: 15th November 2022

Published: 28th November 2023

Citation: Mohd Dom, Z., Noordin, I., Shamsudin, R., *et al*. Effect of Different Cooking Temperature and Time of Glutinous Rice Flakes. *Adv Agri Food Res J* 2023; 4(2): a0000374. https://doi.org/10.36877/aafrj.a0000374

1. Introduction

Glutinous paddy, also known as *Oryza sativa var. glutinosa*, is a bowl of cultivated rice with long-standing cultural values in Asia. Glutinous paddy has a characteristic such as being waxy, opaque, and sticky, and the size of the grain cultivar is small compared with other paddy cultivar (Zainal & Shamsudin, 2021). There are several types of glutinous paddy in Malaysia, such as *Susu, Siding* and *Gantung Alu*. It is also an essential cereal grain and a staple food in many parts of the world (Stanley, n.d.).

Figure 1. *Ringgi* (Source: pentasarbanji.wordpress.com)

Figure 2. Glutinous Rice flake

The study conducted by Dahare *et al.* (2019) stated that rice flake basically undergoes a traditional cooking method. The first step is we need to cut the half-ripe paddy stalk. The paddy stalks are cut and then tied in a bundle. The bundle of glutinous paddy consists of paddy that is green or yellow. Then, the selected paddy is separated from the paddy stalks by hand. Another study by Amrinola *et al.* (2022) stated that glutinous rice flake is made from glutinous paddy grain pre-roasted and then flattened. The separated grains will be put into a wok and dried without any oil for a particular time until the popping sound is produced. Then, the cooked glutinous paddy was immediately flattened using a wooden pestle and mortar or

"*lesung hindik*" (Figure 3). Traditionally, two or three peoples are needed during the flattened process to pound and smash the "*lesung hindik*" until the glutinous paddy turn a flattened shape, and the husks are removed. After the flattened process, the glutinous paddy was put into "*nyiru buluh*" (Figure 4) to remove and separate the husk from the glutinous rice flake during the sieving process. The glutinous rice is heavier than the husk, so the husk will be separated easily. After separating the husk, glutinous rice flake is ready to eat and looks like oatmeal flakes.

Figure 3. *Lesung hindik*

Figure 4. *Nyiru buluh*

On the other hand, the disposal of by-products leads to a loss in potential revenues and a rise in the disposal cost of these products (Jayathilakan *et al.*, 2012). During the paddy harvesting season, the immature paddy is not selected for rice processing since the paddy grain is not entirely and will be disposed of. Instead of disposing of it, farmers can use the immature paddy grain to process and produce a cereal-like rice flake.

According to Rahul Dahare *et al*. (2019), the farmers are more comfortable producing glutinous rice flakes by traditional cooking methods. However, this method has some

disadvantages: it will take longer and require more labor than the microwave oven. In addition, the young generations are not interested in commercializing this traditional product. So, this study can help young generations be involved in this particular product and commercialize it with modern cooking.

This study aims to determine the effect of different cooking temperatures (230°C, 240°C, 250°C) and time (3.3 min, 4.0 min, 4.3 min, 5.0 min, 5.3 min) of rice flake production to reduce cooking time, requires less labor energy and space.

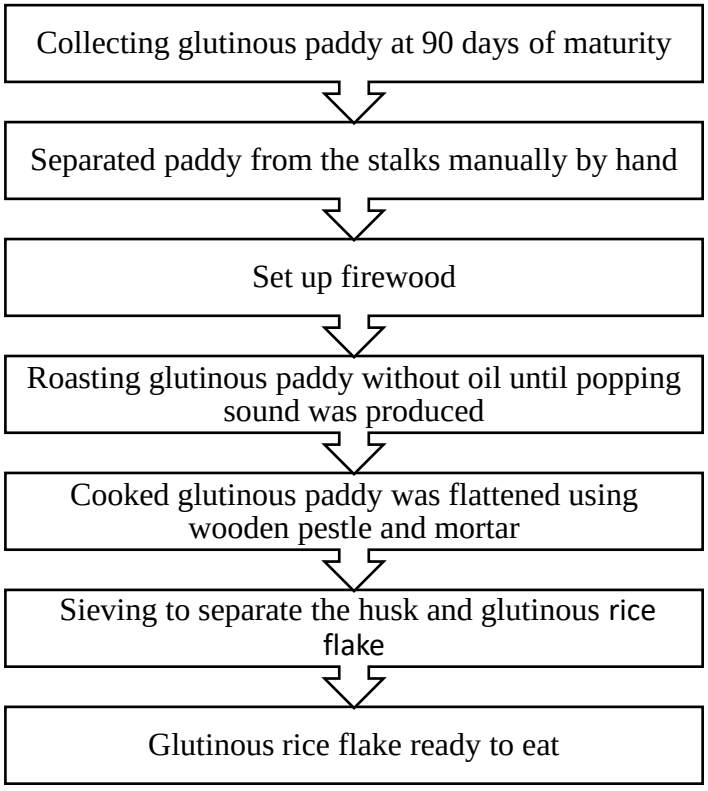

Figure 5. Process chart of making glutinous rice flake by traditional cooking method

2. Materials and Methods

2.1 Materials

The immature glutinous paddy (*Siding*) stage was collected from Berkat Padi Sdn. Bhd. Sungai Besar, Selangor. The maturity of paddy is 90 days. A bundle of paddy was randomly picked from paddy stalks. A microwave oven convection type (Panasonic, model NN-J993, Japan), wooden pestle and mortar and "*nyiru buluh*" were also used during the experiment.

2.2 Microwave Oven Cooking Method

First, we need to cut the half-ripe of glutinous paddy stalk at 90 days of paddy maturity. Then, the selected paddy is separated from the paddy stalks by hand. Next, the paddy grains will be put in the microwave oven without oil. The cooking parameter for different temperatures and times taken is shown in Table 1. The cooking parameter is the temperature (230^{o}C, 240^{o}C, 250^{o}C) and ranging time (3.3 min, 4.0 min, 4.3 min, 5.0 min, 5.3 min). To measure the temperature of microwave heating, the glutinous paddy was started to cook at a lower temperature of 230^{o}C. Then, try the temperature at 240^{o}C and the highest temperature for the microwave oven, 250^{o}C. The time taken for each temperature is 3.3 min, 4.0 min, 4.3 min, 5.0 min, and 5.3 min. The popping sound of glutinous paddy during the cooking process indicates that the grains are already cooked. The cooked paddy was then immediately flattened using a wooden pestle and mortar. Glutinous rice flake is successfully produced when the paddy's structure is flattened.

Furthermore, the husks are also easily removed and separated from the paddy grains during the flattened process. Lastly, sieving is done using "*nyiru buluh*" to remove and separate the husk from glutinous rice flake. After separating the husk, glutinous rice flake is ready to eat. Figure 6 shows the steps of cooking glutinous rice flakes using a microwave oven.

Table 1. Parameter to determine the best temperature and time

Temperature (^{o}C)	**Time (min)**				
230	3.3	4.0	4.3	5.0	5.3
240	3.3	4.0	4.3	5.0	5.3
250	3.3	4.0	4.3	5.0	5.3

Figure 6. Steps of cooking glutinous rice flake by using a microwave oven

3. Results

3.1. Temperature at 230°C

Figure 7. (a) 3.3 min; (b) 4.0 min; (c) 4.3 min; (d) 5.0 min; (e) 5.3 min.

3.2 Temperature at 240°C

Figure 8. (a) 3.3 min; (b) 4.0 min; (c) 4.3 min; (d) 5.0 min; (e) 5.3 min.

3.3 Temperature at 250°C

Figure 9. (a) 3.3 min; (b) 4.0 min; (c) 4.3 min; (d) 5.0 min; (e) 5.3 min.

4. Discussion

This study compared the glutinous rice flake from different heating temperatures and times via visual observation. Some characteristics must be observed to determine whether the glutinous rice flake was fully cooked. Firstly, the cooked paddy might produce a popping sound during microwave treatment. The paddy flattened after being pounded by a wooden pestle and mortar. Another study by Kumar and Prasad (2017) found that increased temperature or time of roasting results in the decreased hardness value of flaked rice. It will result in low moisture content and puffing of starch granules in the cooked paddy, thus easily flattened. The husk is also easily removed from the paddy. Lastly, the shape of the paddy is thinner than the raw paddy (Ghasemi, *et al*., 2007).

Figure 7 shows no significant effect on grain expansion at temperature 230°C, ranging from 3.3 min to 5.3 min. As a result, the glutinous paddy is not fully cooked as a lower temperature is exerted inside the microwave oven. After the flattened process, the husk also cannot be removed and separated from the paddy grains. Therefore, the temperature at 230°C with a ranging time of 3.3 min until 5.3 min is unsuitable to cook glutinous rice flake using a microwave oven.

Figure 8 shows the result at a temperature of 240 °C with the different times taken. There is no significant effect on grain expansion at the time taken: 3.3 min, 4.0 min, and 4.3 min. The lower temperature and shorter time taken during rice flake cooking will result in the glutinous paddy are not fully cooked. At 5.0 min and 5.3 min, only a few paddies can be flattened, but the rest are not entirely flattened. The paddy is not fully flattened when the structure of the paddy is not affected, and the husk is not removed after the flattened process.

Furthermore, Figure 9 shows the result of the temperature effect during glutinous rice flake cooking at 250°C with the different times taken. There is no significant effect on grain expansion at the time taken 3.3 min and 4.0 min. Even though the glutinous paddy was cooked at a higher temperature, a shorter time taken during glutinous rice flake cooking will result in

the grains are not fully cooked. Figure 9(c) shows that the best parameter to cook glutinous rice flake using a microwave oven is at a temperature of 250 ^{o}C and a time of 4.3 min. The glutinous paddy can maintain its stickiness and is easy to flatten. The stickiness of the grains was measured when the popping sound was produced during cooking. Wan (2021) stated that when cooked, glutinous paddy is immediately recognizable by its sticky and gluelike texture. Another study by Li et al. (2019) also found that amylopectin is a highly branched starch molecule responsible for making rice gelatinous and sticky. The swollen starch will expand and become pop during heating. Rice with a high amount of amylopectin will be very sticky once cooked. Because of its stickiness, the cooked paddy is easily flattened. However, at 5.0 minutes of cooking time, the glutinous paddy can also be flattened to become emping, resulting in a much-broken paddy. For 5. 3 minutes of cooking time, the glutinous paddy has already become pop rice and fully broken during the flattened process. Higher temperatures and longer time taken during glutinous rice flake cooking will affect the texture of the grains as it will result in the pop rice (Mohsenin, 2001). So, the suitable cooking parameter is at a temperature of 250 ^{o}C, ranging from 4.30 min to 5.0 min.

To compare the traditional cooking method and microwave treatment, it is indicated that a microwave oven will help us to cook glutinous rice flake at a higher temperature and take a shorter time. Thus, it will help the farmers increase the glutinous rice flake production. The temperature for the traditional cooking method measured by the infrared thermometer is around 190^{o}C to 214^{o}C lower than a microwave oven, which is 250^{o}C. According to another studythe condition of roasted paddy in a paddy roaster maintained a temperature of 270^{o}C to 280°C in a short time (29±1 s). Meanwhile, the traditional cooking method takes 8 to 9 minutes longer than the microwave oven, which only requires 4.3 min to 5.0 min. Implementing a microwave oven for cooking glutinous rice flake required less labor energy compared to traditional cooking methods. However, the conventional cooking method needs space to set up firewood to cook rice flake. In contrast, less space is required when using a microwave oven. A microwave oven cooking method gives more benefits, thus having up-scaling opportunities to be implemented by farmers in future.

5. Conclusions

In conclusion, the suitable cooking parameter in a microwave oven is at a temperature of 250^{o}C, time from 4.3 min to 5.0 min. A microwave oven has some benefits: it reduces cooking time and requires less labor, energy and space. In addition, implementing the new cooking method might assist farmers in increasing their production of glutinous rice flakes.

The evaluation of glutinous rice flake's physical, frictional and chemical properties through microwave oven cooking method can be done for further study.

Acknowledgments: This work was supported by the Transdisciplinary Research Grant Scheme, TRGS (Reference no: TRGS/1/2020/UPM/02/7), provided by The Ministry of Higher Education Malaysia. Deepest gratitude also to Berkat Padi Sdn. Bhd. for providing the sample of glutinous paddy (*Siding*) at 90 days of maturity.

Conflicts of Interest: The authors declare no conflict of interest.

References

Amrinola, W., Sitanggang, B. A., Kusnandar, F., *et al.* (2022). Characterization of pigmented and non-pigmented flakes glutinous rice (ampiang) on chemical compositions, free fatty acids compositions, amino acids compositions, dietary fiber content, and antioxidant properties. *Food Science and Technology*. https://doi.org/10.1590/fst.86621.

Dahare, R., Sahu, B., Patel, S. (2019). Effect on Physical, Chemical and Functional Characteristics During Transformation of Paddy To Flaked Rice: (POHA). *International Journal of Chemical Studies*, *7*(3): 73–80.

Ghasemi, M., Mobli, H., Jafari, A., *et al*. (2007). Some Physical Properties of Rough Rice (Oryza Sativa L.) Grain. *Journal of Cereal Science*, *47*: 496–501.

Jayathilakan, K., Sultana, K., Radhakrishna, K., *et al*. (2012). Utilization of by-products and waste materials in processing industries: A review. *Journal of Food Science and Technology, 49*(3): 278–293. https://doi.org/10.1007/s13197-011-0290-7.

Kumar, S. & Prasad, K. (2017). Optimization of Flaked Rice Dry Roasting in Common Salt and Studies on Associated Changes in Chemical, Nutritional, Optical, Physical, Rheological, and Texture Attributes. Asian Journal of Chemistry, 29(6): 1380–1392.

Li, H., Yang, J., Yan, S., *et al*. (2019). Molecular causes for the increased stickiness of cooked non-glutinous rice by enzymatic hydrolysis of the grain surface protein. *Carbohydrate Polymers*, *216*(1): 197–203. https://doi.org/10.1016/j.carbpol.2019.04.031.

Mohsenin, N. N. (2001). *Physical properties of plant and grain* (2nd ed.). New York (US): Gordon and Breach Science Publishers.

Stanley, M. (n.d.). *Food Staple*. National Geographic. Encyclopedic Entry. Retrieved from https://education.nationalgeographic.org/resource/food-staple

Wan, L. (2021). What is Sticky Rice? The Spruce Eat. Retrieved from: https://www.thespruceeats.com/what-is-sticky-rice-4106990

Zainal, N. & Shamsudin, R. (2021). Physical properties of different local glutinous rice cultivar (Susu and Siding) and commercial Thai cultivar (Susu). *Advances in Agricultural and Food Research Journal, 2*(1). https://doi.org/10.36877/aafrj.a0000178