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COMPARISON RESOLUTION RICE FLOUR USING DESIGN OF EXPERIMENT

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ABSTRACT

This research interests in the development of pin mill rice grinders and the use of the design of the experiment analysed by a statistical program. There were 2 factors in the study: 1. Rice types consisted of jasmine rice, glutinous rice, riceberry rice, and brown rice, and 2. The sieve hole sizes consisted of 1.0 mm and 0.4 mm sieve holes. The dependent variable is the weight of the residual rice flour on the sieve, indicating the granularity/finesse of the rice flour obtained by grinding. The results of the analysis showed that the mean values of each type of rice flour that were left on the sieve were not significantly different. As for the factor of sieve hole sizes, it was found that by using a 1 mm sieve hole, the mean value of the rice flour left on the sieve was 49.466 g. While using a 0.4 mm sieve hole, the average value of the rice flour left on the sieve was 45.529 grams. Both sieve hole sizes had a significant effect on the amount of rice flour left on the sieve.

Keywords: *Rice Mill Machine, Rice Flour, Sieve*

1. INTRODUCTION

Thai rice exports in the past three years have decreased more and more each year. In 2017, 2018, and 2019, Thai rice exports were at 11.67, 11.23, and 7.5 million tons, respectively, and it was projected that, in 2020, Thai rice export volume is likely to decline (Thai Rice Exporters Association, 2020). As a result of this particular problem, there is an economic solution to increasing the value of rice by increasing the variety of rice products, or by processing rice into rice flour and using it to create other products that need rice as an ingredient (Kongseree, 2004). But the machines used in the production of rice flour are usually large and high in price, so they are not suitable for farmers or small businesses. Therefore, using a small rice grinder is a popular choice for small businesses. Pin mill rice grinders are now very popular and used to grind spices and grind rice that does not need to be very fine. This research, then, developed a commercially available pin mill grinder to be capable of producing high-resolution powder. The results of this research were able to obtain the fineness value of each type of rice that was ground from a developed mill. This will benefit farmers and small businesses to get better starch suitable for products that need fine rice flour as an ingredient.

2. EXPERIMENT

2.1 Experiment apparatus

Originally, a small pin mill rice grinder was widely commercially available in the size of 750x400x1070 mm and the sieve hole inside the rice grinder was 1.0 mm, as shown in Figure 1. The rice flour obtained from using this type of grinder cannot be used for baking or cooking due to its rough and bumpy texture. Its particles are also quite big in size. Therefore, it was improved by changing the sieve hole in the rice grinder to be smaller. The smallest sieve available in Thailand has a hole size of 0.4 mm, as shown in Figure 2, which could help obtain rice flour with a similar finesse to the rice flour sold in the market. In this experiment, four types of rice were used, namely jasmine rice, glutinous rice, riceberry rice, and brown rice to compare the fineness of each type of rice.

Figure 1 1 mm sieve in a rice grinder

Figure 2 0.4 mm sieve in a rice grinde

After each type of rice is ground with a pin mill rice grinder two separated times using different sizes of sieve, each rice flour was thoroughly tested by shaking with a sieve shaker using a 140-mesh sieve. The reason for using this particular sieve is that the fineness of the rice flour should not be coarser or rougher than 140 mesh to suitably be used in baking or cooking (Ravangsamrong, 2017). The researcher used 50 grams of rice flour to measure the amount of rice that remained on the sieve. The data, then, was analysed for any variances.

3. ANALYSIS

3.1 Governing Equations

The design of this experiment was 2 Factors Factorial Design (Montgomery and Douglas, 2014) with two factors: factor 1, the type of rice consisting of jasmine rice, glutinous rice, riceberry rice, and brown rice. The 2nd factor was the sieve hole size inside the rice grinder, consisting of a 1.0 mm sieve hole and a 0.4 mm sieve hole. The response was the weight of the rice flour remaining on the sieve in the Sieve Shaker. The experiment was conducted two times and data was collected twice in the same manner.

In the research hypothesis test, the significance level was set at 0.05 and the hypothesis was set as follows.

1. H0: The types of rice had no effect on the fineness of rice flour obtained by grinding.

H1: The types of rice affect the fineness of the rice flour obtained by grinding.

2. H0: The sizes of the sieve hole do not affect the fineness of the rice flour obtained by grinding.

H1: The sieve hole sizes affect the fineness of the rice flour obtained by grinding.

3. H0: The interaction between rice types and sieve hole sizes does not affect the fineness of rice flour obtained from grinding.

H1: The interaction between rice types and sieve hole sizes affects the fineness of the rice flour obtained by grinding.

4. RESULTS AND DISCUSSION

The results obtained according to Table 1. It can be seen that the weight of the rice flour left on the sieve when using 1.0 mm and 0.4 mm sieve holes are similar. The results type of rice flour ground with a pin mill rice grinder as shown in Table 2 and Table 3.

Table 1 Weight of the flour left on the sieve in the Sieve Shaker

Rice Types	Weight of rice flour left on the sieve (g)					
	1.0 mm Sieve hole size			0.4 mm Sieve hole size		
	1	2	Mean	1	2	Mean
jasmine rice	49.84	49.48	49.66	43.84	43.82	43.83
glutinous rice	48.43	49.28	48.86	43.10	42.78	42.84
riceberry rice	49.77	49.42	49.60	47.19	49.17	48.18
brown rice	49.96	49.59	49.78	46.75	47.58	47.17

Table 2 Rice flour type obtained by grinding using a 1.0 mm sieve hole.

Rice Types	The results rice flour grinding using a 1.0 mm sieve hole.
jasmine rice	
glutinous rice	

Table 2 Rice flour type obtained by grinding using a 1.0 mm sieve hole (Continued)

Rice Types	The results rice flour grinding using a 1.0 mm sieve hole.
riceberry rice	
brown rice	

Table 3 Rice flour type obtained by grinding using a 0.4 mm sieve hole.

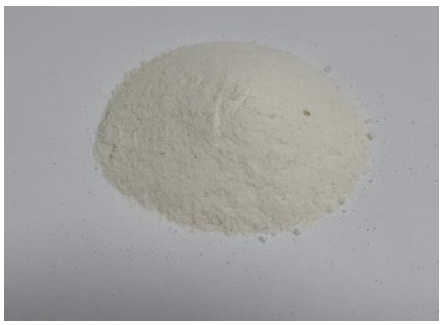
Rice Types	The results rice flour grinding using a 0.4 mm sieve hole.
jasmine rice	
glutinous rice	

Table 3 Rice flour type obtained by grinding using a 0.4 mm sieve hole (Continued)

Rice Types	The results rice flour grinding using a 0.4 mm sieve hole.
riceberry rice	
brown rice	

When the obtained data were analyzed to find the distribution using the statistical analysis software, as shown in Figure 3, it was found that the data tended to be in a normal distribution.

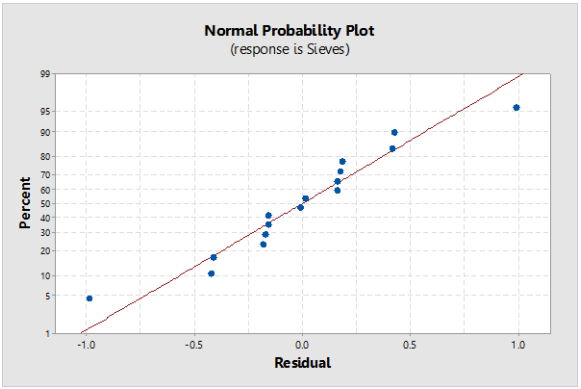


Figure 3 The graph shows the normal distribution

From the ANOVA table, it was found that the P-value of Interaction between rice type and sieve hole size was 0.001 <0.05 as shown in Table 4.

Table 4 The Analysis of variance table

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Typ Of Rice	3	24.077	8.0257	22.15	0.000
Typ of Sieves	1	62.016	62.0156	171.18	0.000
Typ Of Rice*Typ of Sieves	3	15.542	5.1807	14.30	0.001
Error	8	2.898	0.3623		
Total	15	104.533			

The results from the comparison of the mean weight of each type of rice flour that remained on the sieve by the Tukey Test method showed that the mean obtained was not different. However, when comparing the mean weight of rice flour through the two sieve sizes, it was found that the mean was different. The 0.4 mm hole of the sieve had the mean of the weight of rice flour left on the resolution measuring sieve equal to 45.529 g. As for the 1.0 mm sieve hole, the mean weight of the rice flour left on the sieve was 49.466 g. This means that the sieve hole size in the rice grinder affects the fineness of the rice flour.

5. CONCLUSIONS

From the results of the experiment, it can be concluded that the types of rice had no effect on the resolution of the rice flour. It was shown that the improved rice mill could grind all four types of rice to similar resolutions. The difference lied in the sieve hole size inside the grinder which affected the fineness value of the rice flour. The 0.4 mm sieve holes produced finer rice flour than the 1.0 mm sieve holes.

ACKNOWLEDGMENT

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NOMENCLATURE

(if necessary, it is included.)

a : Weight [g]

b : Width [mm]

PHOTOS AND INFORMATION

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