



Optimisation of Rice Flour Traits for the Production of Indigenous Rice Recipes

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Abstract

The study aimed to optimize the rice flour characteristics using different rice varieties and milling methods and its effects on the flour traits. Seven varieties of rice, five non-waxy and two waxy types were obtained from Philrice and made into flour using two milling methods (wet and dry) and type of equipment. For the dry milling method, the disc attrition mill (DM) Quadrumat roller mill (QDM) were used. On the other hand, the wet milling method used plain water and (WM) alkali washing (AW). The flours produced were compared with the commercial rice flour from Thailand in terms of proximate composition, physicochemical characteristics, photomicroscopy and sensory evaluation. Results obtained had notable difference in the parameters of % moisture, crude fat, ash, protein, apparent amylose content, gel consistency and starch damage. The five non-waxy varieties comprise the different rice classification according to amylose content and gel consistency type. The commercial non-waxy Thai flour was found to be high amylose type rice variety with a soft gel consistency. Photomicrographs of different treatments showed that dry milled flours are bigger in size, irregular in shape and are clumped together while the wet milled and alkali washed flours have smaller appearance, circular in shape and are not clustered together but rather distinct from each particle. Two product models were done such as rice cake for the non-waxy flour while “*palitao*” for the waxy type flour. Sensory evaluation of rice cakes from non-waxy varieties showed that optimizing the water level of the flours brought satisfactory results for all treated flours. On the other hand, sensory evaluation of palitao on the waxy type variety were observed to have no noteworthy difference between the wet milled, alkali-washed flours and the commercial grade Thai flour in almost all sensory attributes evaluated.



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Introduction

The staple food of about half of the world's population especially in the low income- fast growing countries like the Philippines is *Oryza sativa* L. or Rice.¹ Rice production in the global scenario were observed to largely support the domestic needs and only seven percent (7%) was allotted for rice trading internationally with five leading exporting countries like India, Thailand, Vietnam, Pakistan and the US for they comprise about eighty percent (80%) of the total rice exports beginning 2014.² This scenario only implies that global rice market is in danger and will affect food security around the globe even at the slightest change.³

Rice consumption in Asia is between 40 to 46 percent (40-46%) of which comes from irrigated cropland from the 90 percent (90%) world's total rice production.^{4,5} It remains as one of the most important staple food of the Philippines with superfluity of varieties and gastronomic use.⁶

It is further consumed mostly as cooked grains and is processed to puff rice,^{6,7} flour and starch which can be made into various products.⁵ However, to successfully use the rice flour into different products, properties like product quality and consistency should be analyzed to have good acceptability and satisfaction from consumers.⁸

Rice flour is usually used as the chief ingredient in numerous traditional foods due to absence of gluten, low calcium and allergenic proteins.¹¹ Some of the factors which are known to affect the nutritional value of rice are genotype, agronomic and cultivation condition, storage and processing.^{9,10,11} Furthermore, rice flour is a very good substitute for imported wheat flour in the bakery industry, although it cannot be used directly in bakery products without alterations and modifications since rice flour lacks gluten protein.¹²

Although this crop is rich in nutrients, consumption of rice leads to some disadvantage because some nutrients are lacking which is required for normal growth and development of the body. This is due to fairly weak functional characteristics of the proteins in rice since it has eighty percent (80%) glutelin which is insoluble in neutral water solutions.^{12,13} Rice

flour, the finely ground powdery meal of rice kernel has a fairly good market for use as a food ingredient. The flour from rice usually comes from brown or white of a whole or broken grain which is processed by dry or wet milling. Its principal value is connected with the starch component, which consists of very small granules, about 8 to 10 microns in the largest dimension.¹³ Different rice varieties have different starch properties as reflected in the characteristics of rice flour. Most rice flour is ground. The good product may be used as it comes from the grinder or it may be sifted to obtain fractions with specific particle size distribution.

Rice is also noted for its non-allergenic properties hence, it is the first cereal recommended for infants.¹⁴ Other unique functional properties of rice flour are their flavor carrying capability, hypo-allergenicity and bland flavor, which make them desirable for use in value-adding products. Besides being consumed as a staple food, rice is a major ingredient in manufacturing value added food products such as puffed rice, noodles, rice flakes, extruded snack foods, fillers for food processed meats, low fat sauces, salad dressing and preparation of traditional rice products like rice cake (*puto*), *kutsinta*, *espasol*, *tikoy*, *bibingka*, *palitaw* and many other indigenous recipes. Hence, this study was conceptualized to investigate the rice flour traits of local varieties as affected by processing, equipment use and milling methods used.

Materials and Methods

Seven rice varieties composed of five non-waxy types and two waxy (glutinous) types with different physicochemical properties has been utilized as raw materials for rice flour production in this study. The non-waxy rice varieties also represent the three major classes of rice based on amylose classification. The non-waxy rice varieties are PSB Rc 52 (low amylose), PSB Rc 72, 18, & 82 (intermediate amylose), and PSB Rc 74 (high amylose). The waxy varieties on the other hand are IMS 5 and IR 65. All of rice varieties came from PhilRice and milling treatment used were dry milling, wet milling and alkali washing.

Dry milling was done using a disc attrition mill and quadromat roller mill designated as DM & QDM respectively. For the wet milling and alkali washing

treatment, the milling equipment used was also the disc attrition mill designated as WM and AW. These are from both types of rice varieties (waxy and non-waxy).

Flour preparation for the Dry Milling and Quadromat Roller Milling Method (DM & QDM).

All rice varieties of about 1 kilogram each were milled using the disc attrition mill (DM) and Quadromat Roller Mill (QDM). Flour samples were sieved in a 100-mesh sieve and was packaged using Polypropylene plastic bags and stored in a desiccator until further analysis and use.

Flour Preparation

For the WM & AW treatment, all of the seven rice varieties used in this study were prepared according to the scheme presented in Figure 1.

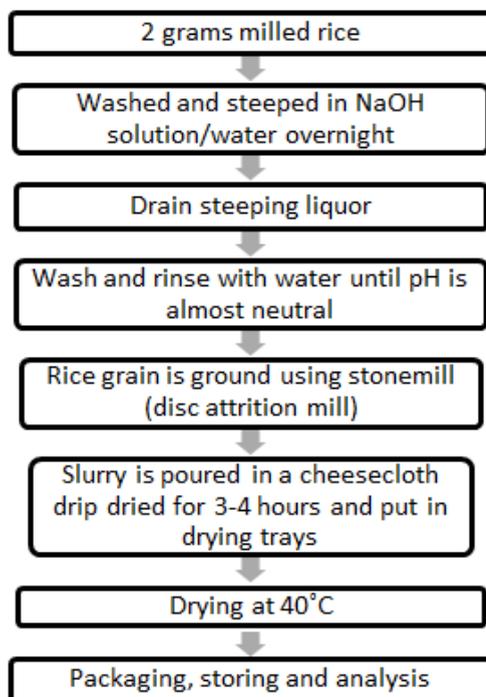


Fig.1: Schematic diagram of the flour preparation from different rice varieties

Proximate Analysis

All of the flours were analyzed for moisture, protein, crude fat and ash adopting the Association of the Official Analytical Chemists standard method.¹⁶

Physicochemical Characteristics

The physicochemical characteristics of the 7 rice flour varieties consisted of amylose content, gel consistency and starch damage.

Amylose Content

The simplified method of Juliano (IRRI method)¹⁷ for determining amylose content was used. Around 75 mg ground rice (40 mesh) was transferred to a 75 mL volumetric flask. Two milliliters ethanol was added to each flask, and allowed to stand for at least two hours or preferably overnight at room temperature. After overnight standing, ethanol was decanted, (2 mL for non-de-fatted samples) ethanol was added to disperse sample. To each sample, 75 mL of 1 N sodium hydroxide (NaOH) was added and was set aside at ambient temperature for ten minutes. The samples were immersed for ten minutes using boiling water bath with gentle shaking. Cooling followed and the volume was adjusted using de-ionized distilled water. The sample was set aside at ambient temperature for thirty minutes (30 min) using a one hundred volumetric flask, fifty milliliter acetic acid solution and two milliliter iodine solution was incorporated to the mixture. Five milliliters of sample was pipetted into the second 100 mL volumetric flask and made up to volume with acetic acid solution. The color was allowed to develop for 20 minutes and the transmittance read at 620 nm. For the blank, (100% transmittance), 2 mL iodine solution was used and diluted to 100 mL with acetic acid solution. The percentage transmission was converted to % amylose by use of standard curve prepared as follows.

Seventy five milligram of pure amylose was weighed and placed in a 7.5 milliliter volumetric flask. Two milliliters ethanol and 7.5 ml of 1N sodium hydroxide (NaOH) was incorporated to the mixture and the volumetric flask was immersed in boiling water bath for ten minutes, cooled and diluted with distilled water until it reached seventy five milliliter. Standard concentration from 0.25-2.0 ml was prepared (1ml= 1 mg into one 100 ml volumetric flask) and diluted with distilled water until it reached one hundred milliliter. The mixture was allowed to stand for twenty minutes (20 min) with shaking. Absorbance of starch iodine complex was determined at 620 nm. Results were based on "as is (approximately 11% milled rice mixture content) basis.

Gel Consistency

Gel consistency test adopted from Cagampang *et al.*, (1973)¹⁸ was used in the study. Starch sample of about 0.1 g was weighed and placed in 13 x mm test tubes and 0.2 milliliter of ninety five percent ethanol with 0.025 percent thymol blue reagent was incorporated. The test tubes covered with glass marbles were refluxed and was allowed to cool at ambient temperature (26°C) for five (5) minutes. The mixture was placed in a water ice bath for fifteen (15) minutes. Subsequently, the test tubes were horizontally laid on a graphing scaled paper, and the length travelled by the gel was measured from the bottom of the test tube to the front of the gel after thirty to sixty (30-60) minutes.

Starch Damage

Five hundred mg sample was dispersed in 50 mL of 0.25 N hydrochloric acid (HCl) solution and shaken at 55°C for two hours. The sample was centrifuged soon after at 2000 rpm for 20 minutes. Damaged starch (% glucose) was determined as 0.25 N hydrochloric acid (HCl) soluble carbohydrate (CHO)/flour dry weight x 100. Percent glucose was determined by phenol-sulfuric acid method. One milliliter of 1/10 aliquot of sample was prepared, and one milliliter of 5% phenol and 1% concentrated H₂SO₄ acid were added. The sample was then added which reagents and sample was substituted with water. A standard solution of glucose was prepared using 20-80 µg/mL glucose.

Photo-Microscopy Analysis

The different treated flours were subjected to microscopic examination using a photomicroscope. A pinch of the flour was placed in a glass slide and a drop of glycerol was added as the mounting fluid. Then the slide was covered with a cover slip and then was observed in the photo-microscope under the high power objective magnification. Pictures were then taken to observe the appearance of the different flours.

Product Model to Test the Flour

The flour produced was tested using two product models. Rice cake or *puto* were made from the non-waxy varieties and *palitao* were from the waxy type varieties. Fifty grams of rice flour was soaked for half an hour in 80 mL water in a mixing bowl and mixed with an electric mixer at speed one for

five minutes. Thirty grams of sugar was added and the batter was mixed for two minutes at speed one. Double acting baking powder (2.3 g) was added and mixed again for one minute. The butter was poured into greased aluminum pans (40 mm bottom dia. X 67 top dia. X 25 mm height) and steamed immediately for 30 minutes.

Palitao on the other hand was prepared by mixing rice flour with 40 mL water. The mixture was mixed and soaked for about an hour before making small balls, which were flattened and were dropped into a boiling water bath until it floated. Roasted sesame seeds, sugar and grated coconut were placed on top of the cooked *palitao* before serving.

Sensory evaluation was conducted using a scorecard with a seven-point quality scoring sensory parameters, which includes the following attributes: aroma/odor, taste flavor, off-flavor, texture, color, cohesiveness and general acceptability. A panel of fifteen judges was employed to evaluate the product.

Statistical Analysis

The data gathered from the study were analyzed for significant differences among varieties method of flour preparation or treatment and milling equipment by Analysis of Variance (ANOVA) and Duncan's Multiple Range Test (DMRT).¹²

Result and Discussion

Proximate Analysis of the Rice Flour

Table 1 summarizes the proximate properties and characteristics of the flour from different rice varieties and milling treatments. The moisture content of the rice flour samples ranges from 5.8-12.2%. The alkali washed flour having the lowest moisture content and highest was 12.2% from the disc attrition mill (dry milling). The moisture content of the dried milled samples is within the standard acceptable range for effective flour storage which is 10-13%.^{8,20}

The moisture content of the flour is significantly different from each other as affected by the milling treatments. Other studies about rice flour^{21,22} have higher values observed for the moisture content (8.0-9.61). On the other hand, another study²³ observed that milling method, processing procedure and temperature can affect the moisture content of rice flour. It further reiterates that if the moisture

content is above 20%. Microbial growth is accelerated hence the moisture content should be below the 20% limit to have a longer shelf life.

The fat content of rice flour ranges from 0.22-2.10% (Table 1). The lowest value was observed in the Thai non waxy flour (0.22%) while the highest fat content was noted in the waxy dry milled (2.10%) rice flour. Statistical analysis showed that crude fat content of the two rice varieties is significantly different from each other depending on the milling treatments applied. Several authors^{20,24,25} have observed in their studies that the fat content of rice flour of different rice varieties varies and the reason why the values are variable may be due to varietal differences, environmental factors, sample processing, and milling methods.^{25,26,27}

Further, well milled rice flours have lower fat content values than dry milled rice flours because washing

alone could remove 25-65% of crude fat in milled rice hence the lowest values were observed from the wet milled, alkali washed and Thai rice flour which is also processed by wet milling.⁸

Ash Content

The ash content of the rice flour using two rice varieties and subjected to different milling treatments ranges from 0.14 (waxy, alkali washed) – 0.81% (non-waxy). The standard ash content value of milled rice ranges from 0.30-0.80% while for rough rice is 2.9-5.2%.²³ The ash reflects the mineral content of the sample. Major properties of the fat, fiber, ash and vitamins of cereal grains are often removed with the bran during milling and pretreatment has a profound effect on the rice composition.²⁸ Similarly, it was also observed that variations in ash content of rice flour are due to varietal differences, source and milling methods.²⁵ Moreover, wet milled flour contains lower ash content due to washing process.^{8,23,24}

Table 1: Proximate analysis of rice flour sample

Proximate composition	Rice Type	Treatment/Rice Type				
		DM	QDM	WM	AW	Thai
% Moisture	Non waxy	11.75+0.05 ^a	11.21+0.01 ^a	6.75+0.03 ^c	5.80+0.02 ^d	8.30+0.04 ^b
	Waxy	12.20+0.07 ^a	11.06+0.02 ^a	6.77+0.01 ^c	6.15+0.03 ^d	8.56+0.02 ^b
% Fat	Non waxy	2.01+0.01 ^a	1.63+0.01 ^b	0.35+0.03 ^d	0.60+0.02 ^d	0.22+0.01 ^d
	Waxy	2.10+0.04 ^a	0.82+0.03 ^c	0.53+0.02 ^c	0.89+0.03 ^c	1.41+0.02 ^b
% Ash	Non waxy	0.52+0.02 ^b	0.46+0.04 ^c	0.81+0.01 ^a	0.26+0.05 ^d	0.39+0.03 ^c
	Waxy	0.56+0.03 ^b	0.68+0.02 ^a	0.18+0.03 ^d	0.14+0.05 ^d	0.33+0.02 ^c
% Protein	Non waxy	6.70+0.02 ^b	7.29+0.03 ^a	7.25+0.04 ^a	6.57+0.02 ^b	6.40+0.03 ^b
	Waxy	7.64+0.05 ^a	6.24+0.01 ^c	6.75+0.02 ^b	6.65+0.01 ^b	6.00+0.02 ^c
% Carbohydrates	Non waxy	79.0+0.02 ^b	79.41+0.03 ^b	84.84+0.02 ^a	86.77+0.01 ^a	84.09+0.03 ^a
	Waxy	77.71+0.04 ^b	81.20+0.02 ^b	85.77+0.02 ^a	86.17+0.02 ^a	83.83+0.03 ^a

*Values are average of three trials

Standard deviation +

DM (Disc attrition milling)

QDM (Quadrumat Roller Mill)

WM (Wet Milling)

AW (Alkali Washing)

Mean values with different letters are significantly different from each other (P<0.05)

Protein Content

Results of the protein determination of rice flour using waxy and non-waxy rice varieties (Table 1) ranges from 6.00 (waxy control Thai) – 7.64 (waxy dry milled). Statistical significance was also observed within treatments. Standard rice flour protein content ranges from 5-9%. The present results of the protein content coincides with the values observed with other several studies.^{21,22,25,26} These authors furthermore observed in their studies that variation of protein within varieties is usually influenced by the method of milling, as protein is mostly found in embryo tissue or aleurone layer which is removed during milling.²⁹

Carbohydrate Content

Milled rice is rich in starch followed by protein.³⁰ Results of the carbohydrate content ranges from 77.71 (DM, Waxy) – 86.77% (AW, NW). Statistical treatment also showed that significant differences were observed between rice type and milling treatment used. Observations of data showed that higher carbohydrate content was noted for wet milled rice treated flours than dry milled rice. Similarly, a study on wet milled rice flour showed lower protein and ash contents but higher carbohydrate content in the nine rice varieties studied.⁸ Thus, the results of the proximate composition of rice flours are indeed influenced by rice variety, milling treatments or methods as well as processing treatments.

Physicochemical Properties

The physic-chemical characteristics of rice flour using waxy and non-waxy rice types and subjected to different milling methods (dry, wet, alkali washed) are presented in Table 2.

Amylose Content

Rice could be classified according to its amylose content. These classifications are 1) high amylose content which is greater than twenty-five percent, 2) very low which is two to ten percent, 3) non-waxy amylose content which is greater than two percent and 4) waxy which is one to two percent amylose content.³¹ The amylose content of grains is usually determined by the degree of translucency of the endosperm or waxiness. Moreover, cooking, eating qualities and industrial properties of the extracted starch are often affected by the amylose content of the grains.³²

The amylose content of rice has a big role in the cooking characteristics of rice.³³ Varieties of rice with high amylose content have harder texture during cooking compared to those having low amylose content.³⁴

Similarly, rice containing high amylose has longer chains compared to rice with low amylose content.³³

Based on the results presented in Table 2 under the amylose content, non-waxy varieties of rice ranges from 16.3-22.4 (under the wet milled treatment while the highest was 25.27 (Thai samples) and with a high amylose characteristics since it has the highest amylose among the other treatments. On the other hand, waxy varieties with a standard amylose content 1-2% ranges from 1.4 (waxy) – 5.92 (under DM milling method) with a very low amylose. The amylose content of the samples of rice flour in this study was observed to be within the amylose classification which was very low amylose (VLA) and Thai flour (25.27) having a high amylose content (HA).

Gel Consistency

A standard assay usually used for rice cultivars and breeding lines of high amylose content for either soft or firmed texture when rice is cooked is the gel consistency^{6,19,35} Gel consistency is classified as soft when consistency measurement ranges from sixty one to one hundred millimeters (61-100 mm), medium when measurement ranges from forty one to sixty millimeters (41-60mm) and hard consistency when consistency measurement is between twenty six to forty millimeters (26-40mm).^{1,34,35}

From the results, it was observed that gel consistency was altered and affected by the milling treatment since the medium gel consistency varieties used in the study like PSB Rc 52, 72 and 74 exhibited a soft gel consistency after applying different milling treatments except for sample of rice using disc attrition mill which retained a medium gel consistency of 58.0 mm. Gel consistency³⁷ is a measurement of the cold paste viscosity of cooked milled rice flour. It is also the index in distinguishing cooked rice texture with high amylose rice varieties.³⁷

The lowest gel consistency reading (58-68 mm) was observed in the dry milled rice flour using

the disc attrition mill which was considered as having a medium gel consistency while the highest gel consistency value was observed in the wet milled rice flour (78.74 – 85.67mm) having a soft

gel consistency composition. Rice with soft gel consistency has a higher preference of acceptability among consumers³⁷ hence; most breeders tend to develop rice genotypes with soft gel consistency.^{38,39}

Table 2: Physicochemical properties of rice flour

Properties	Standard Values	Disc Attrition mill (DM)	Quadrant Roller Mill (QDM)	Wet Milled (WM)	Alkali Washed (AW)	Thai (Commercial)
Amylose %	2.30-30.0 NW 1-2 W	19.3-24.2 ± 0.06 5.92±0.04 ^a (VLA)	18.43-24.13 ± 0.05 3.7± 0.05 ^b (VLA)	16.3-22.4 ± 0.02 2.0 ± 0.02 ^c W	20.43-24.27 ± 0.04 3.74 ± 0.04 ^b (VLA)	25.57 ± 0.05 (HA) 1.40 ± 0.02 ^c (W)
Gel consistency (mm)	26-40(H) 41-60(M) 61-100(S)	68.13 ±0.04 ^a (S) 58.0 ± 0.04 ^b (M)	74.87 ±0.004 ^a (S) 85.17 ± 0.02 ^a (S)	78.74 ± 0.02 ^a (S) 85.67 ± 0.04 ^a (S)	67.2 ± 0.02 ^a (S) 83.50 ± 0.04 ^a (S)	64.67 ±0.04 ^a (S) 79.67± 0.06 ^a (S)
Starch damage (%)	NW W	18.10±0.03 ^a 30.74±0.02 ^a	5.23±0.02 ^c 5.24±0.03 ^d	2.75±0.03 ^d 5.26±0.02 ^d	15.0±0.02 ^b 14.83±0.04 ^b	2.09±0.02 ^d 10.52±0.03 ^c
Standard deviation + DM (Disc Attrition Mill) QDM (Quadrant Roller Mill) WM (Wet Milling) AW (Alkali Washing); Thai (commercial rice flour) HA (High amylose) (>25%)						VLA (Very low amylose (2-10%) NW (Non waxy) (>2%) W (Waxy amylose (1-2%) Gel consistency Hard (26-40); Medium (41-60); Soft (61-100)

Mean values with different letters are significantly different from each other (P<0.05)

Starch Damage

Starch damage of the rice flour samples produced through different milling treatments are shown in Table 2. Results showed that for the non-waxy rice varieties the highest starch damage was observed in the disc attrition mill (DM) dry milled rice flour (18.10%) followed by the alkali washed rice flour samples using the same mill (15.0%). On the other hand, the lowest starch damage noted is the commercial Thai samples followed by the wet milled (WM) rice flour samples (2.75%). Moreover, for the waxy rice varieties, the same trend was observed wherein the dry milled flour has the highest starch damage while the wet milled flour has the lowest starch damage.

Studies have shown that milling processes produce different levels of damage to starch granules in the flour produced which are usually due to mechanical forces enforced on the grain during milling.¹⁹ The milling equipment used has an effect on the rice grains. The mill equipment pressed the rice against the abrasive ring at high rotating speed to break the grain structure. Moreover, heat exposure of milled rice during grinding is presumed to contribute mechanical damage to starch granules.²⁰ This is expected especially with the kind of milling equipment which operates through the impact of the rotating hammer blades on the grain particles.

Studies have shown that milled flour have the highest percentage of damaged starch because of the lack of water which soften the rice grains and avoid abrasive pressure leading to high starch damage.²⁰

On the other hand, for the wet milled process, there is less damaged starch since the soaking process of rice grain during wet milling and alkali washing affected the rice kernels making it softer, easily broken and resulting in small particle granules during the milling process thus, starch damage is much lower. The results observed in this study is in consonance with the results obtained^{20,28} from other studies.

Photomicrographs of Rice Flour

Photomicrographs using HPO magnification (40X) was done to the different treated rice flour to compare their appearance and shape as affected by the different milling treatments used.

Results showed that DM and QDM samples, which are dry milled have bigger size, irregular in shape and are clumped together to the WM and AW flour samples, wherein starch particles are distinct from each other and usually circular in shape and are well separated from each other.

Product Model Test

The product prepared from non-waxy rice flour was rice cake (*puto*). Water level was adjusted to have an optimum result for the different milling treatments. Fifteen panelists composed of students, research assistants, instructors and professors from the Institute of Food Science and Technology evaluated the samples.

Results showed that the optimum water level for Disc attrition Mill flour (DM) is 75 mL/50g flour and for wet milled (WM) flour is 85 mL/50g and Thai flour needs 90 mL/50g flour. Results showed that wet milled (WM) flour and Thai commercial flour alkali washed (AW) flour samples got the highest scores, but the rice cakes were not significantly different in terms of texture, cohesiveness and general acceptability.

The product model used for waxy rice flour was palitaw. Results of the sensory evaluation showed that for odor and flavor, there was no significance noted between treatments made, but they were significantly different in terms of taste, texture, color, cohesiveness and general acceptability. The lowest scores were observed for the Disc attrition Mill and Quadrumat Roller Mill (QDM) samples and highest for wet milled (WM), Alkali washed (AW) and Thai commercial flour.

Conclusion

After the tests done, the flour found most similar to the commercial grade from Thailand for the non-waxy variety were PSB Rc 18, 82 and 74 and the treatments Quadrumat Roller Mill (QDM), wet milled (WM) and Alkali washed (AW). These varieties were found to be near the characteristics of the commercial flour, which our country is presently importing based on the physicochemical analysis and sensory evaluation tests done on the flours.

For the glutinous or waxy type, the Alkali washed (AW) and wet milled (WM) treatments were found comparable to the commercial grade Thai flour,

hence, this milling treatment could be used to prepare the flour. Furthermore, the rice variety used in the study can be used as well as the Alkali washed (AW) and wet milled (WM) milling treatment could be recommended to replace or substitute for the imported Thai glutinous flour.

In this study, it was found that for both rice types, physicochemical characteristics were affected by rice variety, type of milling and the milling method. The changes in the flour functional properties were greatly affected by the milling parameters used. Thus, the factors affecting the quality of rice flour are variety, milling methods and milling equipment used.⁵

Recommendations

The study has provided information on the rice flour's physicochemical behavior using different process of flour preparation and different rice flour varieties. However, there are still some unfinished tasks to do such as to have an in depth study of the rice flour characteristics as affected by other factors like the behavior of rice flour when different rice varieties are used or when two or more varieties with different physicochemical characteristics are mixed and made into flour. Another area for further study would be the behavior of rice flour in different food systems aside from the indigenous recipes locally produced in our country. Moreover, the shelf life of the flour

produced can be studied to be able to produce the flour in a bigger scale.

All these suggestion could offer a means to further improve our rice flour industry and someday provide our country high quality flour that is locally produced and readily available in the market that would benefit manufacturers and consumers.

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Conflict of Interest

There is no conflict of interest in the manuscript as well as in the project study.

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