Proceeding of the International Research Symposium on Postharvest Technology

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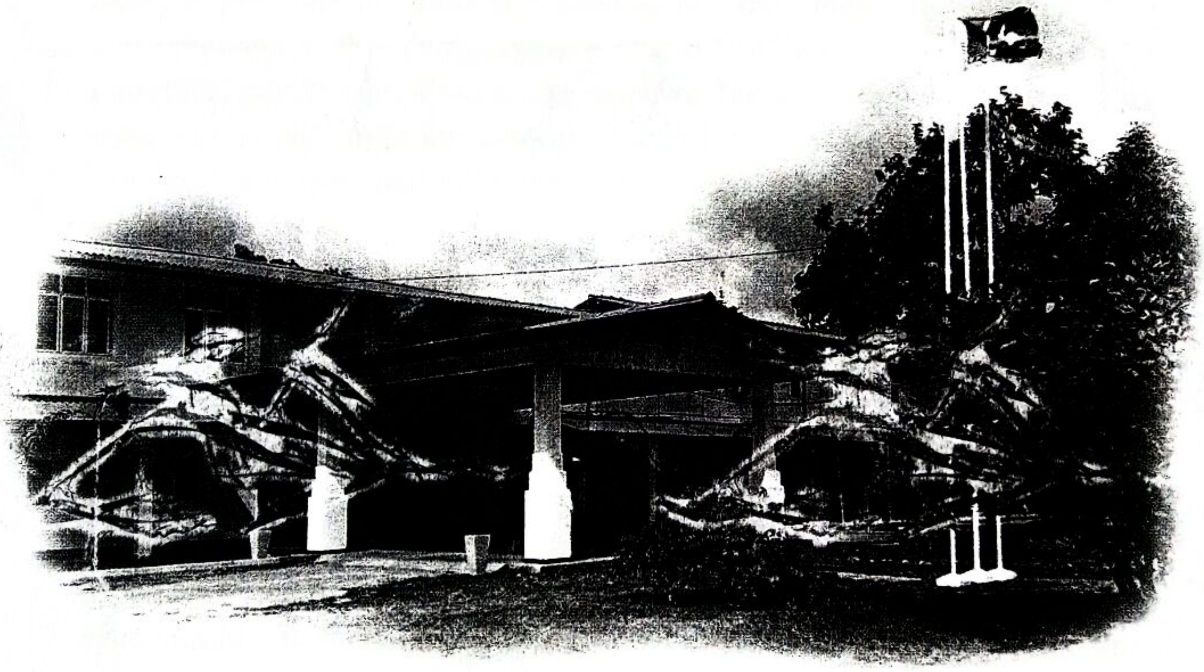

19th October 2018

NATIONAL INSTITUTE OF POST HARVEST MANAGEMENT

Ministry of Agriculture

Research and Development Center, Jayanthi Mawatha,

Anuradhapura , Sri Lanka

Quality of string-hopper prepared from high and low amylose rice fl

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ABSTRACT

Physico-chemical properties of rice flour obtained from high and low amylos varieties, BG 360 and AT 405, were tested in this study. Physical properties sı moisture content, moisture evaporation and cohesiveness of string-hoppers prє from both rice flours were tested. Physico-chemical characteristics, such as an content (%), damaged starch (%), swelling power (g/g), water absorption ca; (%) and sedimentation volume (ml) were tested for both high and low amylos flours.

String-hopper prepared from high amylose rice flour showed lower moisture cı and cohesiveness than string-hopper prepared from low amylose rice flour. An content of rice flour showed strong negative Pearson's correlation (>-0.9) wi cohesiveness and moisture content of string-hopper. In contrast to that an content of rice flour showed strong positive Pearson's correlation (>0.9) with r moisture evaporation from string-hopper. In spite of damaged starch of rice showed positive correlation (0.9-0.8) with cohesiveness and moisture contє string-hopper, damaged starch showed negative Pearson's correlation (>-0.9) rate of moisture evaporation from the string-hopper.

String-hopper made from high amylose rice flour BG 360 undergoes early gradation than string-hopper made from low amylose (AT 405) rice flour. Hov string-hoppers made from high amylose rice flour showed better physica textural properties than low amylose rice flour. High amylose BG 360 rice flou more suitable for string-hopper production than low amylose (AT 405) rice flou

Keywords: amylose, damaged starch, rice flour, string-hopper

INTRODUCTION

In Sri Lanka, rice is the staple food with a per-capita consumption of 114 kg per year in (Department of census and Statistics, 2017). It plays a major role in nutritional status of the population in Sri Lanka. Rice has the great potential to be utilized by the food industries in Sri Lanka. Most of the rice varieties in Sri Lanka can be categorized as high amylose rice, while some varieties as low amylose rice (Prasantha *et al.* 2014). As an example, BG 360 and AT 405 are considered as high and low amylose rice varieties, respectively. According to the study of Darandakumbura *et al.* (2013) amylose content of BG 360 was 31.9±0.8% and amylose content of AT 405 was 14.9±1.3%.

Rice is mainly consumed as cooked grains, as well as processed to flour and starch that can be formulated into different products. There is a growing market for rice flour with many diverse food applications in Sri Lanka. Many factors such as rice genotype, amylose content, protein content and milling method influences the physico-chemical properties of rice flour and rice-based food products (Varavinit *et al.* 2003).

In Sri Lanka food processors mix all the rice varieties during processing of rice flour, irrespective of their amylose content. But, quality of the food product made of rice flour, varies with amylose content. Understanding the relationship between amounts of amylose with the quality of food product will be beneficial to increase the use of rice flour as a food ingredient. This study was aimed to investigate the impact of high and low amylose rice flour, obtained by dry milling method, on physico-chemical and pasting properties of string-hopper preparation. The objectives of this study were to analyze the physico-chemical characteristics of rice flour obtain from high amylose and low amylose rice varieties and also to identify the effect of physico-chemical characteristics of rice flour on string hopper preparation.

MATERIALS AND METHOD

Preparation of rice flour

Rice samples with high amylose (BG 360) and low amylose (AT 405) were collected from Ambalantota Rice Research Institute. Dry- milling method was used to obtain flour from both high amylose and low amylose rice. Milled rice grains were grounded, separately using a pin mill (Alpine, Augsburg, Germany).

Analysis of physico-chemical properties of rice flour

Amylose content

Amylose content was measured according to procedure reported by Juliano (1971). Absorbance was measured at 620 nm using an UV-VIS spectrophotometer. Amylose concentration was determined from already established graph for absorbance value and potato amylose concentration.

Damaged starch

About 0.50 g flour was weighed into a dry 100 ml conical flask and 20 ml extractant preheated to 30±2 °C was added to each flask. The absorbance was measured at 600 nm using an UV-VIS spectrophotometer (UV 1601, Shimadzu, Japan). The damaged starch was predicted, by subtracting the already measured amylose content of the sample from total amylose.

Swelling power

Swelling power was determined following method described by Leach *et al.*, (1959). The swelling power was calculated on wet basis using the equation (1).

$$\text{Swelling power } (g/g) = \frac{m_1}{m_0} \quad \text{........................ (1)}$$

where,

m_0 = Initial weight of sample (g)

m_1= Sediment weight after centrifuge (g)

Water absorption capacity

One gram sample was weighed into 25 ml graduated centrifuge tube and about 10 ml water was added. The suspension was centrifuged at 2000 × g for 30 minutes. Water absorption capacity was calculated based on wet basis using following equation (2).

$$\text{Water absorption capacity (w.b \%)} = \frac{m_1 - m_0}{m_0} \times 100 \quad \text{.................. (2)}$$

where,

m_0 = Initial weight of sample (g)

m_1= Sediment weight after centrifuge (g)

Sedimentation test

Flour sample of 5 g was placed in a 100 ml graduated cylinder, and 50 ml of 0.2% lactic acid was added. The cylinder was inverted five times and placed in a 35 °C water bath. Readings of the sediment volume was taken at 5, 30 and 60 min (Akatsu, 1954).

Preparation of string-hopper

Rice flour paste was extruded using simple manual extruder (string-hopper mould) on the string-hopper mats and steamed about 15 min., until get gelatinized.

Moisture content

String-hopper of 5 g was measured in moisture can and it was oven dried at 105 °C for 4 h in a forced air oven until a constant weight was obtained (AOAC, 2005). Moisture Content was calculated as a percentage on wet basis using the equation (3).

$$\text{Moisture Content (w.b \%)} = \frac{m_1 - m_2}{m_1 - m_0} \times 100 \quad \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

where,

m_0 = mass of the empty moisture can (g)

m_1 = mass of the moisture can with sample (g)

m_2 = mass of the moisture can with dried sample (g)

Moisture evaporation

Evaporation from string-hopper of about 5 g was measured under control condition in a desiccator. Weight of the sample was measured after keeping in the desiccator for 12 h. Evaporation was calculated using equation (4).

$$\text{Evaporation (\%)} = \frac{m_1 - m_2}{m_1 - m_0} \times 100 \quad \ldots\ldots\ldots\ldots\ldots (4)$$

where,

m_0 = mass of the empty moisture can (g)

m_1 = mass of the moisture can with sample (g)

m_2 = mass of the moisture can with sample after evaporation for 12 h (g)

Cohesiveness of string-hopper

Cohesiveness of string-hopper was measured using the newly developed apparatus. Three strands of 3 cm cooked string-hopper piece were pressed in between two glass slides. The force required for separate the two glass slide were taken as reading.

Statistical analysis

Values were stated as mean with standard deviation of triplicate determinations. Data was analyzed by simple T-test and correlation coefficient using Minitab-17 packaging software.

RESULTS AND DISCUSSION

Amylose content (31.09±0.32%) of BG 360 rice flour was significantly higher ($P<0.05$) than the amylose content (14.46±0.25%) of AT 405 rice flour (Table 1). According to the study of Darandakumbura *et al.* (2013) amylose content of BG 360 was 31.9±0.8% and amylose content of AT 405 was 14.9±1.3%. Wickramasinghe and Noda (2008) have reported 16% amylose content in AT 405. The amylose content of rice flour affects the quality of bakery products including its shape and hardness (Araki *et al.* 2016). This finding shows the importance of amylose content for production of quality food products from cereal flour such as wheat, rice etc.

Table 1. Physico-chemical properties of rice flour

Rice flour	Physico-chemical properties(±S.D)			
	Amylose content (%)	Damaged starch (%)	Swelling power (g/g)	Water absorption capacity (%)
Bg 360	31.09±0.32**	2.64±0.18*	6.27±0.07*	196.80±2.49**
At 405	14.45±0.14**	4.17±0.61*	6.75±0.05*	248.53±4.22**

*Mean± S.D value within same column are significantly different at ($P<0.05$)
** Mean± S.D within same column are significantly different at ($P<0.0$)

Water absorption capacity of AT 405 was higher than the water absorption capacity of BG 360 (Table 1). Low amylose rice flour AT 405 may consist of higher amount of amylopectin which consist of branched chain, hence it form more hydrogen bond with water molecules. Sedimentation volume of AT 405 rice flour at equal time interval was significantly higher ($P<0.05$) than the sedimentation volume of BG 360 rice flour. According to Kruger and Hatcher, (1995) sedimentation test results were influenced by the flour mill extraction rate and the type of mill. Even though the same mill was used with same extraction rate there was difference it may be due to the difference in protein content. Crude protein content of At 405 rice flour was 9.91±0.1 (Somaratne *et al.* 2017) and BG 360 was 7.0±0.1 (Prasantha, 2014).

According to the results there was a significant difference ($P<0.05$) between the string-hopper prepared from BG 360 and AT 405. String-hopper made from AT 405 rice flour had higher moisture content than the string-hopper from BG 360 (Table 2). This may be due to the amount of amylose content, which affects the moisture content of final food. Moisture content has negative correlation with amylose content while positive correlation with damaged starch, swelling power, water absorption capacity and cohesiveness (Table 2).

Table 2. Correlation between physico-chemical characteristics of rice flour and physical properties of string-hopper

	Amylose content (%)	Damaged starch (%)	Swelling power (g/g)	Water absorption capacity (%)	Cohesiveness of string-hopper (g)	Moisture content of string-hopper
Amylose content (%)	1					
Damaged starch (%)	-0.909*	1				
Swelling power(g/g)	-0.979*	0.935*	1			
Water absorption capacity (%)	-0.995**	0.910*	0.987*	1		
Cohesiveness of string-hopper (g)	-0.993**	0.874*	0.971*	0.992**	1	
Moisture content of string-hopper	-0.999**	0.911*	0.972*	0.991**	0.990**	1
Evaporation from string-hopper (%)	0.970*	-0.901*	-0.967*	-0.979*	-0.951*	-0.965*

*Correlation between the parameters are significantly different ($P<0.05$)

** Correlation between the parameters are significantly different ($P<0.01$)

Significant difference ($P<0.05$) was observed in terms of cohesiveness between the string-hopper made from BG360 and AT 405 (Table 5). String-hopper made from AT 405 showed higher cohesiveness than the string-hopper made from BG 360.

It may be due to higher water absorption by amylopectin structure and higher amou of damaged starch in AT 405 rice flour.

Table 3. Physical properties of string-hopper

String-hopper	Physical properties		
	Moisture content (%)	Evaporation (%)	Cohesivenes
Bg 360	54.06±0.14**	18.03±0.73**	213.3±20
At 405	65.58±0.37**	14.11±0.46**	625.3±33

** mean± S.D value within same column are significantly different at (P<0.01)

Study of Kurasawa (1972) reported that cooked rice from rice varieties with higl amylose had lesser stickiness. String-hopper from BG 360 showed higl evaporation than the string-hopper made from AT 405 (Table 3). Evaporation fr string-hopper showed positive correlation with amylose content in the rice fl while negative correlation with damaged starch, water absorption capacity a swelling power of rice flour. Evaporation from string-hopper also showed negat correlation with moisture content and cohesiveness of string-hopper (Table 2).

CONCLUSION

Rice flour obtained from high amylose rice BG 360 and low amylose rice AT 4 showed significant difference (P<0.05) in physico-chemical properties. Stri hopper made from high amylose rice flour can undergo retrogradation earlier tl string-hopper made from low amylose rice flour. However, string-hopper made from high amylose rice flour showed better physical and textural properties tl string-hopper made from low amylose rice flour. High amylose BG 360 rice flou more suitable for string-hopper preparation than low amylose rice flour. Accord to these physico-chemical properties of rice flour, they can be utilized for differ applications in food industries.

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