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# GRAIN SHAPE, PROTEIN CONTENT AND COOKING QUALITIES OF SOME ADVANCED RICE GENOTYPE

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**ABSTRACT**

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Rice is the leading cereal crop in Bangladesh. More than half of the world's population relies on rice as the major daily source of calories. Ten advanced rice genotypes were selected to study their grain shape, nutritional property and cooking qualities. Results revealed that amylose content ranged 21.53-23.83 mg, amylopectin 76.17-78.47 mg and protein 5.02-7.20% in the rice genotypes. The highest amylopectin was found in PNR166 followed by MK-35 and Y 12(8-1). The genotype EM-2 had the highest protein% followed by RM-16-N-10 and EM-3. The lowest kernel length was found in IR-64. The genotype Y-12(8-1) produced the highest kernel breadth followed by EM-4. The highest L/B ratio was found in MK-35. Volume expansion ratio, kernel elongation ratio and 1000-grain weight of the rice genotypes did not show significant difference.

***Key words**: rice, grain shape, amylose, protein, cooking quality*

## INTRODUCTION

Rice is the most important cereal and staple food which serve as major carbohydrate for more than half of the world population. Half of the world's population is suffering from one or more vitamin and/or mineral deficiency (World Food Program, 2015). Increase in literacy percentage and awareness of diet, people tend to be more health conscious and interested to have nutritionally enriched food. The quality of rice is an important character to determine the economic value in the export market and consumer acceptance. Protein energy malnutrition affects 25% of children where their dietary intake is mainly on rice and staple crops have low levels of essential amino acids (Gearing 2015). The amount of PC in rice is relatively low (8.5%) as compared to other cereals like wheat (12.3%), barley (12.8%) and Millet (13.4%) and an average of PC in milled rice is about 7 and 8% in brown rice. Rice supplies about 40% of the protein to human through diet in developing countries and quality of PC in rice is high, due to rich in lysine (3.8%) (Shobha Rani *et al*. 2006). Therefore, improvement of PC in rice grain is a major target for the plant breeders and biotechnologists. So far, by classical breeding effort, very limited success has been achieved because of the complex inheritance nature and the large effect of environment on protein content (Coffman and Juliano, 1987). According to Iqbal *et al*. (2006), more than 170 million children and nourishing mothers suffered from Protein-calorie malnutrition (PCM) in developing Afro-Asian countries. In comparison with meat, plant proteins are much less expensive and nutritionally imbalanced because of their deficiency in certain essential amino acids (EAAs). More than half of the world population is suffering from bio available nutrient deficiencies particularly in developing countries (Seshadri 1997; Shahzad *et al*. 2014). The main reason of these deficiency occurred due to consumption of polished cereal based food crops as rice, wheat and maize (Pfeiffer and McClafferty, 2007). Rice is the staple food and leading cereal crop in Bangladesh which is cooked and consumed as whole grain. Rice is the synonym for food in Bangladesh and had been the traditional source of carbohydrates and proteins since the prehistoric days (Shozib *et al*. 2017). Grain quality of rice is determined the factors such as grain appearance, nutritional value, cooking and eating quality (Juliano *et al*. 1990). The cooking qualities are amylose content, alkali spreading value, water uptake, volume expansion ratio and kernel elongation ratio. The gelatization temperature, gel consistency and amylose content are major traits, which are directly related to eating and cooking quality (Little *et al*. 1958). On the other hand, amylase content amylopectin structure and protein composition explained the difference in cooking quality of rice (Lisle *et al*. 2000). Coking quality is directly related to the physical and chemical characteristics of the starch in the endosperm. In this study, we have evaluated some cooking quality characters of ten advanced rice genotypes to help breeders for development of better quality rice for consumers. Grain size and shape (length-width ratio) is a very stable varietal property that can be used to measure the varietal purity of a sample. The nutritional status and grain quality of rice is becoming more important. So, this study was undertaken to know grain shape, nutritional character and cooking qualities of some advanced rice genotypes.

## MATERIALS AND METHODS

### Rice sample preparation

A total of 10 advanced rice genotypes (IR-64, EM-02, EM-03, EM-04, MV-40, MK-35, PNR-166, Y12(8-1), Kasalat80(C)-1 and RM-16-N-10) were collected from Bangladesh Institute of Nuclear Agriculture, Mymensingh, Bangladesh. The research was conducted in Crop Physiology Division, Bangladesh Institute of Nuclear Agriculture, Mymensingh and Department of Agricultural Chemistry, Department of Biochemistry, Bangladesh Agricultural University, Mymensingh during 2020-21.

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The samples were manually cleaned to remove cracks kernels and the husk of the paddy was removed to get rice. Rice grains were grinded for analyzing. For determining physical characteristics 1000 grains are clean, sun dried whole paddy seeds were randomly selected from the sample, counted carefully and weight measured by using electronic balance and expressed in gram (g).

**Determination of amylose content**

Amylose was determined following the method of Robyt and Whelan (1968). Accurately weighed 100 mg of powdered sample was taken and 1mlk of 95% ethanol and 9 ml of 1N NaOH were added and warmed for 5 min in water bath to gelatinize the starch. The content transferred in 100 ml volume with water cooled and brought to volume with water. 5 ml solution was taken into a 100 ml volumetric flask, 1 ml of acetic acid and 2 ml of iodine solution were added and made up to the volume with water, stirred and allowed to stand for 20 min before taking optical density at by spectrophotometer at 590 nm.

**Preparation of standard curve**

100 mg of anhydrous potato amylose was dissolved in 100 ml of alcoholic NaOH (10 ml ethyl alcohol and 90ml 1N NaOH). Portions containing 0.25, 0.50, 0.75, 1.00, 1.25, 1.50, 1.75 and 2 mg of amylose transferred to100ml flask. The solution was acidified with 1N acetic acid by adding 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5 and 4 ml respectively and color was developed using iodine solution. Optical density was taken at 590 nm in Spectrophotometer. The amylose content of the each sample was calculated from standard curve.

**Calculation of amylopectin content**

Amylopectin is a calculated value which is obtained from the value of total amylose. % of amylopectin = 100-% of amylose (Jane *et al*. 1999).

**Determination of kernel length and breadth**

Ten randomly selected whole kernels of rice in three sets were taken and length and breadth of each grain was measured by using a slide calipers. The average value for each observation was considered as final reading. The length and breadth of rice kernel were expressed in millimeter (mm).

**Determination of kernel length/breadth (L/B) ratio**

The L/B ratio was calculated by dividing the average length by the average breadth of kernel. L/B ratio=Average length of the rice (mm)/ average breadth of the rice (mm).

**Estimation of protein**

Micro-Kjeldahl method was used for the estimation of total nitrogen in rice grain. Then total nitrogen was multiplied by conversion factor to obtained protein content.

**Digestion:** Powdered rice samples (0.2 g) taken in a 75ml Kjeldahl flask and 5 ml of concentrated $H_2SO_4$, 1 gm of digestion mixture was added. The flask was placed on digestion chamber and boiled until the mixture content becomes clear. The flask was cooled and the digested sample was diluted with distilled water.

**Distillation:** 25 ml of diluted digested samples was taken and 25 ml of 40% NaOH was poured into the flask slowly holding the flask about 45.angle and connected to the distillation set. The distillate was collected in a conical flask containing 10 ml of 2% Boric acid solution and 2-3 drops of mixed indicator.

**Titration:** Total distillate was titrated with 0.1N HCL and titration value was recorded. Percentage of N was calculated by the following × formula: % of nitrogen= (Ts-Tb) × normality of acid×0.014×100/weight of samples (g), Where Ts= Titre value of the sample, Tb= Titre value of the blank 0.014= Milli equivalent weight of nitrogen% protein= % of nitrogen × C.F.C.F.= Conversion factor (5.5 for plant sample).

**RESULTS AND DISCUSSION**

Amylose content was the highest in IR-64 followed by Kasalat80(C)1 (Table 1). The highest amylopectin was found in PNR166 followed by MK-35 and Y 12(8-1). EM-2 had the highest protein% followed by RM-16-N-10 and EM-3. The lowest kernel length was found in IR-64. Y-12(8-1) produced the highest kernel breadth followed by EM-4. The highest L/B ratio was found in MK-35. Volume expansion ratio, kernel elongation ratio and 1000-grain weight showed statistically non-significant.

Amylose content ranged 21.53-23.83 mg, amylopectin 76.17-78.47 mg and protein 5.02-7.20% in rice genotypes studied. The results are in conformity of many researchers *viz*. Shobha Rani *et al*. (2006), Shipla (2010), Shipla and Sellappan (2010); Umadevi *et al*. (2010), Chukwuemeka *et al*. (2015), Ojha *et al*. (2018), Anjum and Hossain (2019), Khatoon and Islam (2020a, 2020b, 2021a, 2021b).

Table 1. Amylose, amylopectin and protein content in advanced rice genotypes

| Genotype | Amylose (mg) | Amylopectin (mg) | Protein % |
|---|---|---|---|
| IR-64 | 23.83a | 76.17bc | 6.02b |
| EM-02 | 22.21b | 77.79b | 7.20a |
| EM-04 | 22.12b | 77.78b | 6.30b |
| MV-40 | 22.07b | 77.93b | 6.17b |
| MK-35 | 21.57bc | 78.43a | 5.27c |
| PNR166 | 21.53bc | 78.47a | 5.02c |
| EM-03 | 22.77b | 77.23b | 6.07ba |
| Y 12(8-1) | 21.75bc | 78.25a | 5.26c |
| Kasalat80(C)1 | 23.01a | 76.99bc | 6.18b |
| RM-16-N-10 | 22.96b | 77.04b | 6.83a |

Values having common letter(s) in a column do not differ significantly at 5% lever as per DMRT.

Table 2. Grain shape, size and cooking qualities of advanced rice genotype

| Genotype | Kernel length (mm) | Kernel breadth (mm) | Length/ Breath ratio | Volume expansion ratio | Kernel elongation ratio | 1000-grain weight (g) |
|---|---|---|---|---|---|---|
| IR-64 | 5.28b | 1.62bc | 3.25b | 2.64a | 1.23ab | 21.82a |
| EM-02 | 5.41b | 1.61bcc | 3.36b | 1.95ab | 1.35ab | 22.32a |
| EM-04 | 6.12a | 2.10a | 2.91c | 2.07a | 1.43a | 22.07a |
| MV-40 | 6.06a | 1.76b | 3.44b | 2.21a | 1.55a | 22.63a |
| MK-35 | 6.26a | 1.58bc | 3.69a | 2.15a | 1.45a | 21.54a |
| PNR166 | 6.16a | 1.49bc | 4.13b | 1.38ab | 1.33ab | 23.02a |
| EM-03 | 5.35 b | 1.94b | 2.75c | 1.63ab | 1.30ab | 23.03a |
| Y 12(8-1) | 5.42b | 2.16a | 2.50c | 1.93ab | 1.29ab | 24.30a |
| Kasalat80(C)1 | 6.09a | 1.94b | 3.13b | 1.99ab | 1.21ab | 21.99a |
| RM-16-N-10 | 5.95 b | 1.68bc | 3.54b | 1.76ab | 1.21ab | 21.97a |

Values having common letter(s) in a column do not differ significantly at 5% lever as per DMRT.

## CONCLUSION

Amylose content ranged 21.53-23.83 mg, amylopectin 76.17-78.47 mg and protein 5.02-7.20% in rice genotypes studied. The highest amylopectin was found in PNR166 followed by MK-35 and Y 12(8-1). EM-2 had the highest protein% followed by RM-16-N-10 and EM-3. The highest L/B ratio was found in MK-35.

## REFERENCES

Anjum KI, Hossain MA (2019) Nutritional and cooking properties of some rice varieties in Noakhali region of Bangladesh. *Res. Agric. Livest. Fish.* 6(2), 235-243.

Chukwuemeka AI, Kelechi AJ, Bernard A (2015) Cooking and physicochemical properties of five rice varieties produced in Ohaukwu local government area. *European J. Food Sci. Technol.* 3(1), 1-10.

Coffman WR, Juliano BO (1987) Rice. In: Olson RA, Frey KJ (eds) Nutritional quality of cereal grains: geneticand agronomic improvement. Agronomy monograph no. 28, American Society of Agronomy, Madison, pp. 101–131.

Gearing ME (2015) Good as gold: Can golden rice and other bio fortified crops prevent malnutrition? Science inthe News, Harvard University.http://sitn.hms.harvard.edu/

Iqbal A, Khalil IA, Ateeq N, Khan MS (2006) Nutritional quality of important food legumes. Food Chem97:331–335.

Jane J, Chen YY, Lee LF, McPherson AE, Wong KS, Radosavljevic M, Kasemsuwan T (1999) Effects ofamylopectin branch chain length and amylase content on the gelatinization and pasting properties of starch. *Cereal Chem*. 76(5), 629-637.

Juliano BO, Perez CM, Kaos M (1990) Grain quality characteristics of export rice in selected markers. *Cereal Chem*. 67: 192-197.

Khatoon M, Islam MT (2020a) Grain shape, protein, zinc and iron content of rice land races in Bangladesh. *Int. J. Expt. Agric*. 10(2), 7-11.

Khatoon M, Islam MT (2020b) Amylose, amylopectin, volume expansion ratio and kernel elongation ratio of rice land races in Bangladesh. *Int. J. Sustain. Crop Prod*. 15(2), 1-3.

Khatoon M, Islam MT (2021a) Grain quality, nutritional characters and cooking quality of rice genotypes including salt and drought tolerant varieties. *Int. J. Sustain Crop Prod*. 16(1), 1-6.

Khatoon M, Islam MT (2021b) Grain quality, nutritional characters and cooking qualities of ten advanced rice genotypes. *Int. J. Sustain Crop Prod*. 16(4), 9-14.

Lisle AJ, Martin M, Fitzgerald M (2000) A chalky and translucent rice grain differs in starch composition and structure of cooking properties. *Cereal Chem*. 77:627-632.

Little RR, Hilder GB, Dawson EH, Elsie H (1958) Differential effect of dilute alkali on 25 varieties of milled white rice. *Cereal Chem*. 35:111-126.

Ojha P, Chaudhary O, Subedi U, Karki R, Dongol DMS (2018) Milling, nutritional, physical and cooking properties of four Basmati rice varieties. *J. Nepal Agril. Res. Council*. 4:18-24.

Pfeiffer WH, McClafferty B (2007) Biofortification: breeding micronutrient-dense crops. In: Kang MS (ed) Breeding major food staples. Blackwell, Oxford Pingali PL, Hossain M, Gerpacio.

Robyt JF, Whelan WJ (1968) Alyloses and their action on starch. Chapter 14 in: Starch and its derivatives. 4thed. Radley JA, ed. Chapman and Hall Ltd., London.

Seshadri S (1997) Nutritional anemia in South Asia. In: Gillespie S (ed) Malnutrition in south asia-a regional profile. In: UNICEF Regional Office for South Asia, pp.75–124.

Shahzad Z, Rouached H, Rakha A (2014) Combating mineral malnutrition through iron and zinc biofortification of cereals. Compr Rev Food Sci Food Saf 13:329–346.

Shipla JB (2010) Grain quality evaluation and organoleptic analysis of aromatic varieties of Goa, *India.J. Agril.Sci.* 2(3), 99-107.

Shipla JB, Sellappan K (2010) Grain quality evaluation of traditionally cultivated rice varieties of Goa, *India. Recent Res. Sci. Technol*. 2(6), 88-97.

Shobha Rani N, Pandey MK, Prasad GSV, Sudharshan I (2006) Historical significance, grain quality features and precision breeding for improvement of export quality basmati varieties in India. *Indian J Crop Sci* 1(1–2), 29–41.

Shozib HB, Hossain MM, Jahan S, Alam MS, Das SC, Alam S, Amin RB, Hasan MM, Malo R, Islam MR,Shekhar HU, Siddiquee MA (2017) Study of biochemical and cooking quality traits of major rice varieties of Bangladesh. *Malaysian Applied Biol. J*. 46(4), 55-62.

Umadevi, Veerabadhiran MP, Manonmani S, Shanmugasundaram P (2010) Physico-chemical and cooking characteristics of rice genotypes. *Electronic J. Plant Breed*. 1(2), 114-123.

World Food Programme (2015) Types of malnutrition. http://www.wfp.org/hunger/malnutrition/types