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Proximate composition and nutritional values of grain of four aromatic and two non aromatic rice cultivars in Bangladesh

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ABSTRACT

Aromatic rice is of vital importance considering nutritive values, pleasant aroma and health benefits for the human diet. In this study, grains of selected four aromatic cultivars, namely (Kalijira (Unboiled), Shampakatari (Boiled), Chinigura (Unboiled), Zirashail (Boiled)) and two non-aromatic rice cultivars, namely BRRI dhan28 (Boiled) and Minicate (Boiled), respectively were analyzed for their nutritional quality attributes including proximate composition with mineral contents. The proximate composition showed that Minicate had the highest moisture content (12.03%). Protein content ranged from 8.7 to 8.84% among the grains of studied cultivars. The grains of Chinigura contained the highest amount of fat while Minicate had the least values. The total dietary fiber and carbohydrate content ranged from 0.9150% - 3.655% and 67.62% - 88.65%, respectively. The Kalijira contained the maximum amount of food energy, carbohydrate (88.65%), Ca (314 mg/100 g), and Zn (258.7 mg/100 g) while Fe (3.152 mg/100 g) was higher in Minicate and Chinigura. The nutritional quality-oriented attributes in this study were competent with recognized prominent aromatic rice varieties as an index of their nutritional worth. It is inferred that the studied aromatic rice varieties might be considered as the effective sources of mineral contents and food nutrients especially in aromatic rice cv. Kalijira and cv. Chinigura for health benefits.

Keywords: Aromatic rice, food energy; mineral, proximate composition

INTRODUCTION

Rice is a major dietary component of most of the countries of Asia including some other countries in the world. It is important that knowledge of rice nutritional quality on health benefits is essential to maintain rice consumption in people's daily diet (Verma and Srivastav 2020). It is one of the chief sources of carbohydrates which are consumed by half of the populace in the globe (Munarko et al. 2020). In the human diet, carbohydrates are the major macro-nutrients that play an important function as an energy source (Thiranusornkij et al. 2018). Rice adds to about 22% of total energy consumption and offers approximately 700 Cal/day per person for 3 billion people within the world (Verma and Srivastav 2017,Vetha et al. 2013). The highest carbohydrate of rice is starch, which consists mainly of amylose and amylopectin. Freshly collected rice grains contain about 80% carbohydrate which contains starch, glucose, sucrose, and dextrin. The rice grain constitutes 12% water, 75%–80% starch, and only 7% protein in the form of amino acids (Verma and Srivastav 2017). Minerals like calcium (Ca), magnesium (Mg), and phosphorus (P) are present accompanied by some traces of iron (Fe), copper (Cu), zinc (Zn), and manganese (Mn) (Oko et al. 2012).

It is highly consumed in Asia and Africa and less in the European Union (Vlachos and Arvanitoyannis 2008). About 80 percent of the world's rice produces by China, India, Indonesia, Bangladesh, Thailand, and Vietnam. Among the leading rice-growing countries of the world, Bangladesh ranked fourth in both area and production. But the position of Bangladesh is more critical due to the highest population density in a situation where the majority of rice-growing areas are rain-fed and flood-prone. In Bangladesh, rice accounts for 95 percent

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of the food grain production. Rice production in Bangladesh was less than 10 million tons in 1970 and then exceeded 53.6 million tons in 2018. Although rice is one of the most predominant cultivated cereals and has a substantial effect on the nutritional status of the people, research on rice in Bangladesh has until now been focused mainly on yield, macro-nutrients like protein and starch, and sensory quality. Micro-nutrient malnutrition, apart from protein-energy malnutrition and is one of the prime concerns along with an increasing trend of diabetes and urban obesity. It is well established that malnutrition is a health concern but its solution lies more in food-based actions rather than in other preventive or curative approaches. The food-based approach though not suitable for treatment purposes, constitutes the most desirable and sustainable methods of preventing malnutrition. To achieve food-based actions to prevent malnutrition, the nutrient contents of foods must be known. Beneath the overhead circumstances, we aim to investigate the proximate composition, protein content and mineral profile of aromatic and non aromatic rice grains and compared these food values as an index of their nutritional worth.

MATERIALS AND METHODS

The experiment was conducted at the laboratory of the Department of Agricultural Chemistry, Hajee Mohammad Danesh Science and Technology University, Dinajpur from January to July 2019. Grains of four aromatic rice cv. Kalijira (Unboiled), Shampakatari (Boiled), Chinigura (Unboiled) and Zirashail (Boiled) and two non aromatic rice cv. BRRI dhan28 (Boiled) and Minicate (Boiled), respectively were collected from local market at Dinajpur town, Dinajpur, Bangladesh. Rice grains of six cultivars were used as raw samples in different biochemical and mineral analyses. All collected rice grains were ground to fine flour usinga blender machinecontaining rust free and stainless still surface and sieved using 40 Tylermesh. The obtained aromatic and non aromatic rice flour of six cultivars waspacked in polythene bag and stored at refrigerator to avoid microbial attack and for further chemical analyses.

Moisture content: Moisture was determined by Standard Official Methods of Analysis of the AOAC Method 1990. These rice samples were dried in an oven at 60ºC until a constant weight obtained for moisture analysis.By this method the moisture content of the rice grain sample was calculated from the equation:

% Moisture=$(W_2-W_3)\times100/(W_2-W_1)$

Where, W_1=Initial weight of empty crucible, W_2=Weight of crucible + sample before drying and W_3=Final weight of crucible + sample after drying.

Ash content: AOAC method (1990) was used to determine the total ash content. Here, 5.0 g of sample was weighed accurately in the pre-weighed crucible (W_1). The crucible was heated in a furnace at 650ºC for a maximum of 4 hour Then cooled the crucible in desiccators and weighed (W_2). Ash content was calculated using the following equation. Ash content (%) =Weight of ash (g)×100/Weight of sample (g)

Crude proteins: Exactly 1.0 g previously oven-dried rice flour was taken in a digestion flask. Crude protein content of tested aromatic rice flour was analyzed by using FOSS 2020 digestor and FOSS 2400 Kjeltec analyzer unit (Foss Food Technology Corp., Hillerod, Denmark). Nitrogen coefficient of rice was set at 5.95 (MIFAFF 2002).

Crude fat: Crude fat content of tested aromatic rice flour was determined by Soxhlet extraction method (MIFAFF 2002) using TecatorSoxtec System 1046 (Foss Food Technology Corp.).

Crude fiber: Exactly 5.0 g previously oven-dried rice flour was taken in a porcelain crucible. Crude fiber was determined according to Association of Analytical Communities (AOAC) method 991.43 (AOAC 2000), as well as the standard analytical method in feed (MIFAFF2002) using FOSS Fibertec system 1020 Hot Extractor (Foss Food Technology Corp) and crucible-fritted glass (30 mL, porosity 2).

Carbohydrate content: The total percentage carbohydrate content in the rice sample was determined by the method as described by Onyeike et al. (1995). This method involved adding the total values of crude protein, lipid, crude fiber, moisture and ash constituents of the sample and subtracting it from 100. The value obtained is the percentage carbohydrate constituent of the sample

% Carbohydrate = 100 **-** (% moisture + % crude fibre + % protein + % lipid + % ash).

Starch content: The starch content was determined by Lane and Eynon (1923) method with some modification. One gram of oven dried rice powder sample was taken in conical flask and 50 ml of cold water was added. The content of flask allowed standing for one hour with occasional stirring. It was then filtered and residue was washed with 50 mL of distilled water. The sample was hydrolyzed with 10% HCl for 2.5 hours under reflux. Then it was neutralized with dilute sodium hydroxide

solution and filtered. The filtrate was transferred in a 100

mL volumetric flask and volume was made up to the mark. The end point was indicated by brick- red color. The starch content was calculated by the following formula:

$$\text{Reducing sugar} = \frac{\text{Factor for Fehling's solution} \times \text{dilution} \times 100}{\text{Trite value} \times \text{weight power}},$$

and % starch = % reducing sugar × 0.9

Minerals (Ca, Zn and Fe) content: Rice flour was digested by di-acid mixer (HNO_3:$HClO_4$) and extract was prepared for mineral content determination. Calcium content of rice grain was estimated by complexometric titration using NA_2-EDTA as titrant. Zinc and iron content were determined by atomic absorption spectrophotometry (AA-6401, Shimadzu, Tokyo, Japan) from the previously prepared extract.

Statistical analysis: Collected data on different parameters were statistically analyzed by One-way Analyses of variance (ANOVA). The means were adjudged by Duncan's Multiple Range Test (Gomez and Gomez 1984).

RESULT AND DISCUSSS

Moisture content in different aromatic rice: The highest moisture content was 12.03%obtained from rice grain cv. Minicate and the lowest was 10.65% from Chinigura (Table 1) which was lower than the permissible moisture content (14.0%) for the safe storage of processed rice. The acceptable value of around 12.0% is recommended for long-term storage and to avoid insect infestation and microbial growth (Adair et al. 1973,Cogburn 1985). The moisture levels of studied rice cultivars varied between 8.90–13.57% (Verma and Srivastav 2017) which is in well agreement with present findings. The variability of moisture content in the present study might be due to varietal differences as well as drying condition.

Ash content in different aromatic rice: Table 1 shows the % ash content of tested rice grain of six cultivars. The maximum ash content (0.291%) was observed from the aromatic rice cv. Zirashail while the minimum (0.216%) was from the Kalijira (Table 1). The present finding was variable but was quite similar to the result of Verma and Srivastav (2017) and the variation might be due to the genetic makeup.

Fiber content: A marked variation was observed among the rice grains of different varieties considering fiber content. BRRI dhan28 had the highest content of fiber (1.66%) and the least content of fiber was found in Chinigura (Table 1). The fiber percentages of three rice varieties (BRRI dhan28, Shampakatari and Kalijira) were above 1.0%. The more fiber is good health especially for constipation. In the present study, BRRI dhan28 contained more fiber and considered better for controlling cholesterol and normalizes bowl movements.

Protein content in different rice variety: The utmost protein content of 8.84% was recorded from the rice variety BRRI dhan28 and the miniminal protein content of 8.75% from the aromatic rice cv. Shampakatari and Zirashail (Table 2). There was no marked difference in protein content of among the studied rice grains (Kalijira, Chinigura, BRRI dhan28, Minicate, andZirashail.

Table 1. Moisture, Ash and Fiber content of grains from four aromatic and two non aromatic rice

Rice cultivars	%Moisture	%Ash	%Fiber
Kalijira	11.30c±0.81	0.216d±0.02	1.02c±0.01
Shampakatari	10.94d±0.72	0.219d±0.07	1.11b±0.17
Chinigura	10.65e±0.95	0.256c±b0.07	0.92d±0.09
Zirashail	11.78b±0.80	0.291a±0.04	0.97d±0.10
BRRI dhan28	11.78b±0.69	0.272b±a0.02	1.66a±0.09
Minicate	12.03a±0.88	0.270b±0.04	1.13b±0.08
CV %	1.15	1.81	1.26

The figures in a column having common letter(s) do not differ significantly at $p<0.05$.± Values indicates the standard deviation of analyzed parameters

Fat content in different aromatic rice grains: The fat content ranged between 0.248 to 0.290%. The Chinigura sample contained the highest amount of fat followed by Zirashail and BRRI dhan28 but Minicate had the least values (Table 2). Oko et al. (2011) observed that the fat content of different rice varieties varied 0.5% to 3.5%

which was the higher than that of present value and must be due to genetic variation.

Carbohydrate content: The carbohydrate content of studied six cultivars ranged from 77.62 to 79.53%. All the grains of studied cultivars exhibited a fairly higher amount of carbohydrate, except Minicate (77.62%) (Table 2). However, the carbohydrate content of all the rice varieties was more than 70.0% (Table 1) and it is the main energy source from food. Oko et al. (2011) revealed a large variation and found that the carbohydrate content of different rice varieties was 51.50 to 86.92%.

Starch content: The highest starch content 64.2% was observed in the non aromatic rice cv. Minicate and the lowest starch content 63.4% from aromatic rice cv. Zirashail (Figure 1).Asaduzzaman et al. (2013) observed the starch content of the Kalijira variety was 68.07 g/100g which was higher than that of present study that Kalijia contained 64.1% starch. In the present study, there is no marked variation in starch content rice grain.

Iron content: The maximum iron content of 3.152 mg/100 g gain was obtained from the aromatic rice cv. Chinigura and the minimum was 2.687 mg/100 g recorded from Shampakatari and Zirashail (Table 3). The iron content in rice is mainly affected by the iron absorption from the soil, and the transportation and accumulation of iron in rice. Iron content also varies greatly based on rice cultivars or genotypes, mainly controlled by the correlated genes (Meng et al. 2005).

Zinc content: A considerable variation of zinc content was found among the aromatic and non aromatic rice grains. The higher zinc content of 148.7 mg/100 g grain was recorded from the rice variety Kalijira where the minimum zinc content of 138.1 mg/100 g (Table 3) was recorded from the non aromatic rice cv. Minicate. Rahman et al. (2017) found 131 mg/100 g in Kalijira which was much lower than that of present study.

Table 2. Protein, Fat and Carbohydrate content of grains from four aromatic and two non aromatic rice

Rice cultivars	%Protein	%Fat	%Carbohydrate
Kalijira	8.83ns±0.85	0.262b±0.03	78.25c±1.09
Shampakatari	8.75ns±0.90	0.248a±0.03	78.99b±1.35
Chinigura	8.81ns±0.98	0.290a±0.06	79.53a±1.53
Zirashail	8.75ns±0.95	0.280b±0.33	78.17±1.53
BRRI dhan28	8.84ns±0.90	0.281a±0.02	78.51c±1.31
Minicate	8.74ns±0.85	0.240±0.04	77.62d±1.35
CV %	1.00	1.92	0.30

The figures in a column having common letter(s) do not differ significantly at p<0.05. ± Values indicates the standard deviation of analyzed parameters

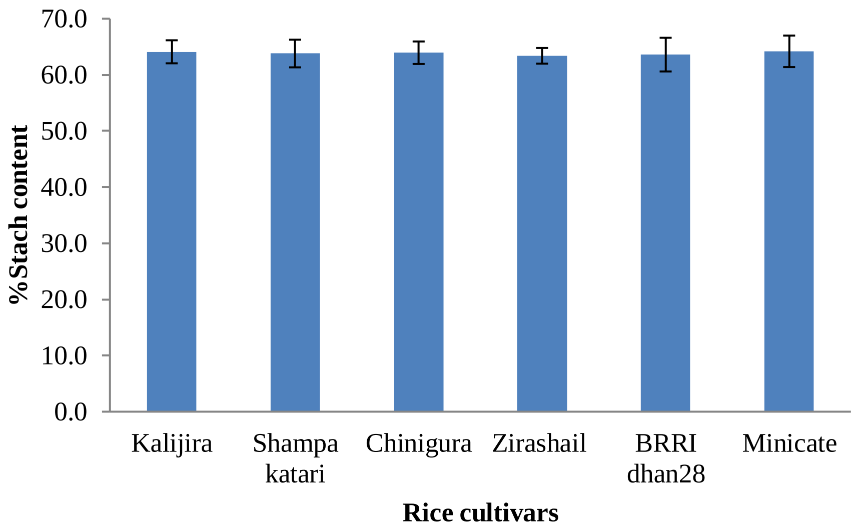

Figure 1. Starch content in different rice cultivar grain

Calcium: There was a significant difference in calcium content among the studied grains of aromatic and non aromatic rice cultivars.The highest calcium content was 314.0 mg/100 g in aromatic rice cv. Kalijira but the lowest calcium content (229.3 mg/100 g) was found in non aromatic rice cv. Minicate (Table 3). But there was marked differences in calcium content among the studied rice grain. Rice grain having more calcium is more beneficial for bone formation and anti-oestoporesis.

Table 3. Mineral content of the studied rice grain cultivars

Rice cultivars	Iron mg/100 g	Zn mg/100 g	Ca mg/100 g
Kalijira	2.70b±0.03	1488.7a±2.6	314.0a±5.4
Shampakatari	2.69b±0.04	145.9 ab±2.6	313.2a±4.5
Chinigura	3.15a±0.03	143.9b±1.3	310.6a±3.7
Zirashail	2.76b±0.04	144.4b±1.3	311.6a±6.2
BRRI dhan28	2.70b±0.03	145.4ab±2.6	302.3a±4.4
Minicate	3.05a±0.03	138.1c±1.3	229.3b±5,6
CV %	1.11	0.79	8.05

The figures in a column having common letter(s) do not differ significantly at $p<0.05$.±Values indicates the standard deviation of mean values of analyzed parameters

CONCLUSION

There were differences in proximate composition and mineral content among the tested aromatic rice cultivars. Minicate had the maximum moisture (12.03%) while Chinigura contained higher fat content (0.290%). The higher protein value (8.84%), ash value (0.291%) and fiber content (1.66%) was in BRRI dhan28. Higher energy and carbohydrate content (79.53%) and starch (64.20%) was present in non aromatic rice cv. Minicate. The aromatic rice variety was observed to be superior as a good energy source and effective digestibility of food. Most of the cultivars may be the preferable in respect to minerals viz. Fe, Ca and Zn. All the studied cultivars were preferred to nutritionally point of view but grains of aromatic rice cv. Kalijira and Chinigura contained the higher amount of desirable food values and mineral contents which considered the best among the tested rice grains for health benefits.

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