



A Comparative Study of The Proximate Composition of Selected Rice Varieties in Tangail, Bangladesh

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Abstract

An investigation was conducted to assess the approximate nutrient composition of Miniket rice collected from different regions and market places of Tangail district in Bangladesh to understand actual fact. Moreover, mostly available variety BRRI-28 milled rice was also analysed to compare with the Miniket milled rice. Moisture, protein, fat, crude fibre, and ash content were higher in Miniket brown rice as compared to the parboiled milled rice except available carbohydrate. Among Miniket parboiled milled rice, Miniket TM-1 (Tangail Market-1) rice and Miniket TM-2 (Tangail Market-2) rice, the content of protein (7.04%), fat (0.37%), crude fibre (0.26%) and ash (0.58%) were comparatively higher in parboiled milled rice than that of two market samples. In a comparison among other cheaper coarse varieties like BRRI-28 and Miniket TM-1 rice and Miniket TM-2 rice, protein, fat, crude fibre and ash content were found lower in Miniket rice of TM-1 and TM-2 than BRRI-28. Beside chemical composition, some physical properties were studied including length, width, L/W ratio, shape and weight.

Key words: BRRI-28, Miniket parboiled milled rice, TM-1, TM-2

Introduction

Rice is the most important and extensively grown food crop in the world. It is a staple food for nearly half of the world's seven billion people (IRRI, 2013). It is mainly produced and consumed in the Asian region. Almost 90 % of the population of Bangladesh consume rice as their staple food (Banglapedia, 2012). It is also consumed in different form around the world such as brown rice, milled rice, parboiled milled rice. In Bangladesh most people consume parboiled milled rice. Rice has a number of varieties. Mostly available and consumed rice varieties of Bangladesh in recent age are Bashmoti rice, Kalijira rice, Miniket rice, BINA rice, BRRI rice, IRRI rice, Balam rice. Rice in our country provides major portion of daily caloric requirement. It is very rich source of carbohydrate with substantial amounts of protein, fat, fibre, mineral and vitamins. Composition and nutrient contents of rice varies with varieties and especially processing method. There are two main types of rice mill in Bangladesh – husky and automatic rice mill. Milling procedure of husky and automatic mills differs. Husky rice mills do some polishing in addition to husking mostly by using two or more passes through hullers to grind off some of the bran after husking. While Automatic rice mills use modern techniques for paddy processing, which involve pre-cleaning, steam parboiling, drying, husking, and finally polishing (Zaman *et al.*, 2001). During milling, brown rice is subjected to abrasive or friction pressure to remove bran layers resulting in high, medium or low degrees of milling depending on the amount of bran removed (Chen and Siebenmorgen, 1997; Chen *et al.*, 1998). The bran layers and germ removed during polishing are high in fibre, vitamins, minerals, essential oils as well as protein (Dinesh *et al.*, 2009). Their removal results in loss of nutrients, especially in substantial losses of vitamins and minerals. Milling brings about considerable loss of nutrients and affects the edible properties of milled rice (Chen *et al.*, 1998 and Doesthale *et al.*, 1979). The complete milling and

polishing that converts brown rice into white rice destroys 67% of the vitamin B₃, 80% of the vitamin B₁, 90% of the vitamin B₆, 50% of the manganese and phosphorus, 60% of the iron and all of the dietary fibre and essential fatty acids. Fibre has been involved in the prevention of major diseases such as gastrointestinal and heart diseases. The essential oils in the bran have also been found to prevent heart diseases because these decrease serum cholesterol, which is a major risk factor in heart disease (Jeyanth and Mohamed, 2009). Miniket rice is very popular in Bangladesh, which is cultivated in some northern districts of Bangladesh. A few unscrupulous rice traders have been deceiving consumers in the name of marketing Miniket rice. These devious traders overpolish coarse rice like BRRI-28, BRRI-29 and BR-23. Such polishing destroys the nutritional values of rice. Keeping the above fact in mind the study with selected rice varieties (Miniket and BRRI-28) was undertaken to compare the chemical and physical parameters of rice of different sources; the nutrient loss or changes caused by milling process of rice to determine.

Materials and Methods

Two varieties of rice (*Oriza sativa*) including Miniket and BRRI-28 were used in this study to compare the proximate composition and quality. The study was conducted at the laboratory of the Department of Food Technology and Nutritional Science, Mawlana Bhashani Science and Technology University, Tangail and the laboratory of District Animal Hospital, Tangail, Bangladesh using analytical grade reagents.

Collection and preservation of samples

Miniket raw brown rice and milled rice was collected from an auto rice mill of Kushtia (one of few districts where Miniket rice is cultivated) for using as control sample. Miniket polished milled rice was collected from two different market places of Tangail, one from remote area market coded as TM-1 and another from central

area market coded as TM-2. BRRI-28 milled rice was collected from an auto rice-mill of Tangail district. Collected samples were preserved in separated plastic containers in dry and cool place. The study was carried out during July, 2014 to October, 2014.

Proximate analysis of samples

Chemical composition of collected samples for moisture, ash, protein, fat, and crude fibre contents were determined as per the methods described by AOAC (2004). Total carbohydrate contents were determined by indirect method (subtract the sum of all other contents from 100 g sample) described by FAO (2004).

Determination of moisture content

Rice as like other cereals contain low amount of moisture. Moisture content of selected sample was determined adopting AOAC (2004) method. At first weight of empty crucible with cover (previously dried at 100 °C for 1 hour) was taken and 3 g of sample was placed into it. Then the crucible was placed in an air oven (thermostatically controlled) and dried at temperature of 105 °C for 24 hrs. After drying, the crucible was removed from the oven and cooled in desiccator. It was then weighed with cover glass. The crucible was again placed in the oven, dried for 30 minutes, taken out from the dryer, cooled in desiccator and weighed. Drying, cooling, and weighing were performed repeatedly until the two consecutive constant weights attained. The moisture content of the rice samples was calculated by applying the following equation:

$$\text{Moisture content (g \%)} = \frac{A-B}{W} \times 100$$

Where,

A = Initial weight of crucible and sample, B = Final weight of crucible and sample, W = Weight of sample.

$$\text{Ash content (g \%)} = \frac{A-B}{W} \times 100$$

Where,

A = Final weight of crucible and sample, B = Weight of empty crucible, W = Weight of sample.

Determination of ash content

Ash content of selected sample was determined adopting AOAC (2004) method. Clean, dry and empty crucible was taken and weighed with the help of electrical balance. Three grams of each sample were weighed out upon polythene paper and was poured into the crucible. The crucible with the samples was kept in an electrical oven at a temperature of 105 °C for 24 hours. After drying, the crucible was transferred to the muffle furnace and was ignited at 600 °C for 5 hrs. After burning, the crucible was removed and cooled in desiccator and subsequently weighed the crucible and ash. Ash content of the rice samples was calculated by applying the following equation:

Determination of fat content

Fat in rice was estimated by dissolving the fat of rice sample in organic solvent using Soxhlet apparatus followed by evaporation of solvent to obtain fat. The dried waded (3g) sample was transferred to a thimble

and plugged the top of the thimble with a wad of fat free cotton. Thimble was dropped into the fat extraction tube attached to a Soxhlet flask. Approximately 75 ml or more of petroleum ether was poured into a flask. The top of the fat extraction tube was attached to the condenser. The sample was extracted for 16 hour or longer on a water bath at 70-80 °C. At the end of the extraction period, the thimble was removed from the apparatus and most of the ether was collected. The ether was poured off when the tube was nearly full. When the ether reached a small volume, it was poured into a small, dry beaker (previously weighed) through a small funnel containing a plug of cotton. The flask was rinsed and filtered thoroughly using ether. The ether was evaporated on a steam bath at low heat; it was then dried at 100°C for 1 hour, cooled and weighed. The difference in the weights gave the ether soluble material present in the sample. The percentage of crude fat of the rice samples was calculated by the following equation:

$$\% \text{ Crude fat} = \frac{\text{weight of soluble material}}{\text{weight of sample}} \times 100$$

Determination of crude fibre content

Crude fibre content was determined using AOAC (2004) method and the percentage of crude fibre content obtained from the experiment was calculated by the following formula:

$$\% \text{ Crude fibre} = \frac{\text{loss of weight}}{\text{weight of sample}} \times 100$$

Determination of protein content

Protein content was determined adopting AOAC (2004) method. Two grams of sample, 3 g digestion mixture and 25 ml H₂SO₄ was taken in a Kjeldahl digestion flask. It was heated for 4 hours in a Kjeldahl digestion and distillation apparatus. If the colour of the substance is pale yellow the digestion is complete. Following distillation, the ammonia collected was titrated with 0.1N HCl solution and titre value was recorded. The percentage of protein content in the sample was computed using protein factor 5.7 as follows:

$$\% \text{ Nitrogen} = \frac{(TS - TB) \times \text{Normality of acid} \times \text{meq. N}_2}{\text{weight of sample}} \times 100$$

Where,

TS = Titre value of the sample (ml), TB = Titre value of the Bank (ml), Meq. of N₂ = 0.014

$$\% \text{ protein} = \% \text{ Nitrogen} \times 5.7$$

Determination of total carbohydrate content

Total carbohydrate contents of samples were calculated by subtracting the value of moisture, ash, protein, fibre, and fat from 100 (FAO, 2004) as follows:

$$\% \text{ Carbohydrate} = 100 - (\% \text{ Moisture} + \% \text{ Ash} + \% \text{ Protein} + \% \text{ Fibre} + \% \text{ Fat})$$

Proximate analysis of physical properties

Physical characteristics of collected sample for Length, Breadth, Length-Breadth Ratio, Bulk Density and Appearance were performed as follows:

Determination of length

Length of ten grain from each sample was determined using a slide calliper. Each grain was placed between the two jaws of slide calliper along its length and fixed.

Then reading of main scale and Vernier scale was recorded. The length of the rice grain was computed by the following equation.

$$\text{Length} = \text{Main scale reading} + \text{Vernier scale reading} \times \text{Vernier constant}$$

Determination of breadth

Length of ten grain from each sample was determined using a slide calliper. Each grain was placed between the two jaws of slide calliper along its breadth and fixed. Then reading of main scale and Vernier scale was recorded. The breadth of the rice grain was computed by the following equation.

$$\text{Breadth} = \text{Main scale reading} + \text{Vernier scale reading} \times \text{Vernier constant}$$

Determination of weight of 1000 grains

Hundreds of grains of the each sample were counted and weighed with the help of an electrical balance followed by multiplication with 10 to obtain 1000 grains weight.

Results and Discussion

Variation in proximate composition among the selected rice varieties

A comparative proximate composition was studied among the samples, which are defined as Miniket brown rice, parboiled milled rice (as control), two collected market samples (TM-1 and TM-2) and BRR-28 milled rice. Approximate chemical nutrient composition of these selected rice varieties obtained from this study is shown in Table 1.

Table 1. Proximate composition of the selected rice varieties.

Rice varieties	Type	Moisture (%)	Available Carbohydrate (%)	Protein (%)	Fat (%)	Crude fibre (%)	Ash (%)
Miniket	Brown	13.03	75.86	7.28	1.82	0.78	1.23
	Parboiled Milled	11.4	80.35	7.04	0.37	0.26	0.58
	TM-1	11.77	80.93	6.51	0.24	0.22	0.33
	TM-2	11.56	81.06	6.54	0.26	0.20	0.38
BRR-28	Parboiled Milled	12.2	79.65	6.62	0.42	0.28	0.83

Distinct variation was observed between Miniket raw brown rice and Miniket parboiled milled rice, especially in the percentage of fat, ash, crude fibre and available protein. Fat content in Miniket brown rice was observed 1.82 %, while in Miniket Parboiled milled rice it was only 0.37%. Crude fibre content in Miniket brown rice was 0.78 %, while it was 0.26 % in Miniket milled rice. Ash content in Miniket brown rice was 1.23%, while it was 0.58 % in milled rice. Since fat, ash and crude fibre content of Miniket Brown rice was higher than Miniket parboiled milled rice, available carbohydrate content of Miniket brown rice (75.86%) was found lower than milled one (80.35%). Slight difference in moisture and protein content was also observed between these two. Moisture and protein content was higher in brown rice (13.03% and 7.28 % respectively) than that of parboiled milled rice (11.4% and 7.04% respectively). Similar findings are reported by Dinesh *et al.*, (2009) and Bhattacharya and Ali, (1985).

The rice bran, which is rich in fat, fiber and ash, are removed during milling and polishing process of milled rice. Thus Miniket raw-brown rice was found to have more fat, fibre and ash while less in carbohydrate than Miniket parboiled milled rice, supporting the previous report (Dinesh *et al.*, 2009).

Comparison among Miniket parboiled milled, TM-1 and TM-2 rice

A comparison of proximate composition was observed among Miniket parboiled milled rice and that of two market samples, TM-1 and TM-2 (Fig. 1.a and 1.b). Moisture content of those three types was found 11.4%, 11.77% and 11.56% respectively. Miniket parboiled milled rice had higher protein content (7.04 %) than that of rice obtained from TM-1 and TM-2 (6.51 % and 6.54 %, respectively).

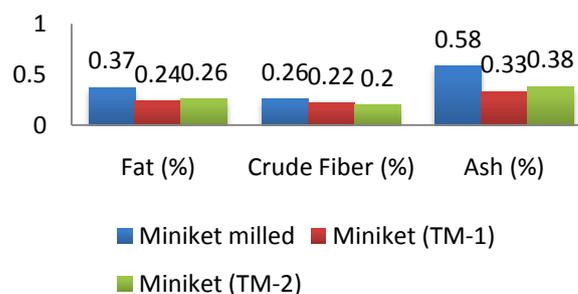


Fig. 1. a. Comparison among Miniket parboiled milled, TM-1, and TM-2 rice

Fat content was found higher in Miniket parboiled milled rice (0.37%) than that of TM-1 and TM-2 (0.24% and 0.26%, respectively). Ash content was found considerably higher in the Miniket parboiled milled rice (0.58 %) than that of TM-1 and TM-2 (0.33 % and 0.38 %, respectively). Crude fibre content was also found slightly higher in the Miniket parboiled milled rice (0.26 %) than that of TM-1 and TM-2 (0.22 % and 20 % respectively) (Fig. 1.a). Unlike fat, ash, protein and crude fibre content, available carbohydrate content was found lower in the

Miniket milled rice (80.35%) than that of TM-1 and TM-2 (80.93% and 81.06 % respectively) (Fig. 1.b). Above tabulated data and analysis suggest that Miniket rice collected from two markets of Tangail were lower in fat, ash, crude fibre and protein except available carbohydrate content than the milled Miniket collected from an automated rice-mill of Kushtia (control sample). That means Miniket rice of TM-1 and TM-2 might be produced by over polishing from other coarse varieties like BRRI-28 other than original Miniket rice as suggested in the previous report.

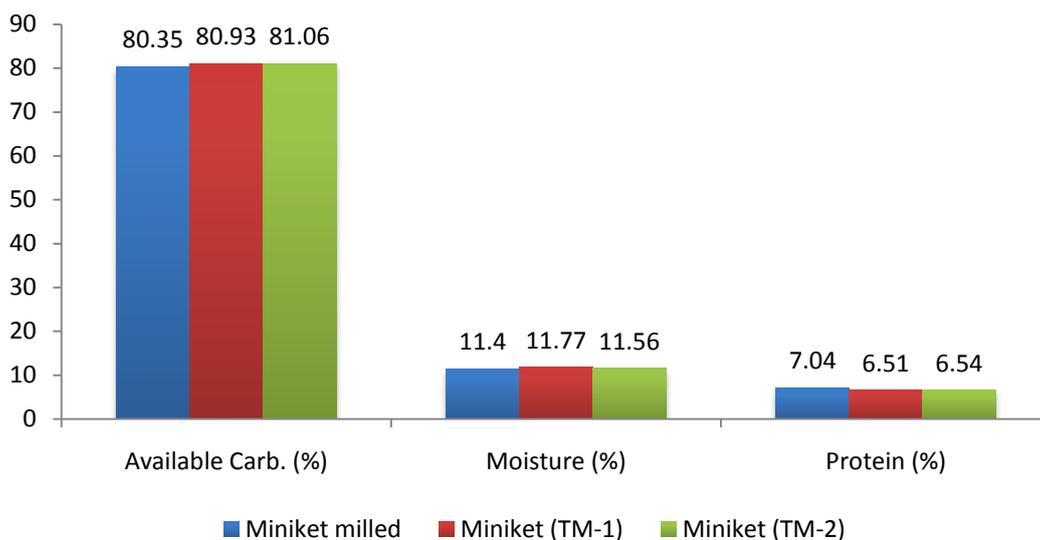


Fig. 1. b. Comparison among Miniket parboiled milled, TM-1, and TM-2 rice

Comparison among parboiled milled rice of BRRI-28, Miniket (TM-1) and Miniket (TM-2)

Variations were observed among the milled rice of BRRI-28 obtained from rice-mill and two different milled miniket rice obtained from markets, TM-1 and TM-2 (Fig. 2.a and 2.b).

Protein content of Miniket rice of TM-1 and TM-2 (6.51% and 6.54% respectively) was found lower than that of BRRI-28 (6.62%). Similarly, fat content of Miniket rice of TM-1 and TM-2 (0.24% and 0.26% respectively) was found lower than that of BRRI-28 (0.42%). Crude fiber content of Miniket rice of TM-1 and TM-2 (0.22% and 0.20% respectively) was found slightly lower than that of BRRI-28 (0.28%). Ash content of Miniket rice of TM-1 and TM-2 (0.33% and 0.38% respectively) was found considerably lower than that of BRRI-28 (0.83%) (Fig. 2.a). But available carbohydrate content of Miniket rice of TM-1 and TM-2 was found slightly higher than that of BRRI-28 (Fig. 2.b). Thus BRRI-28 was found more nutrients dense (higher fat, ash, protein and fibre content) than the Miniket rice of TM-1 and TM-2. Production of fabricated Miniket by over polishing coarse rice variety BRRI-28 should cause loss valuables nutrients,

especially minerals and fiber as observed from the above data.

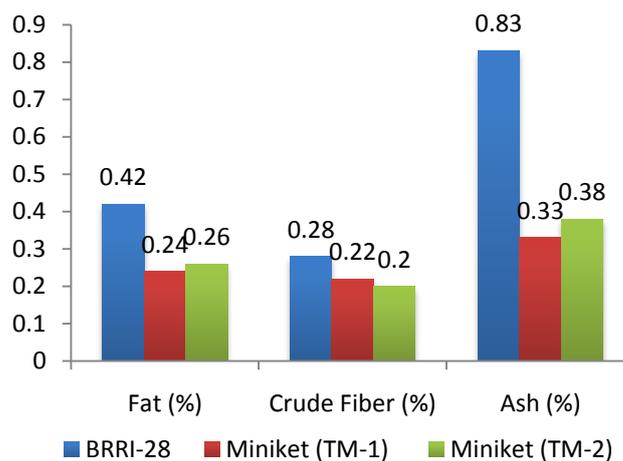


Fig. 2. a. Comparison among parboiled milled BRRI-28, Miniket (TM-1), and Miniket (TM-2) rice

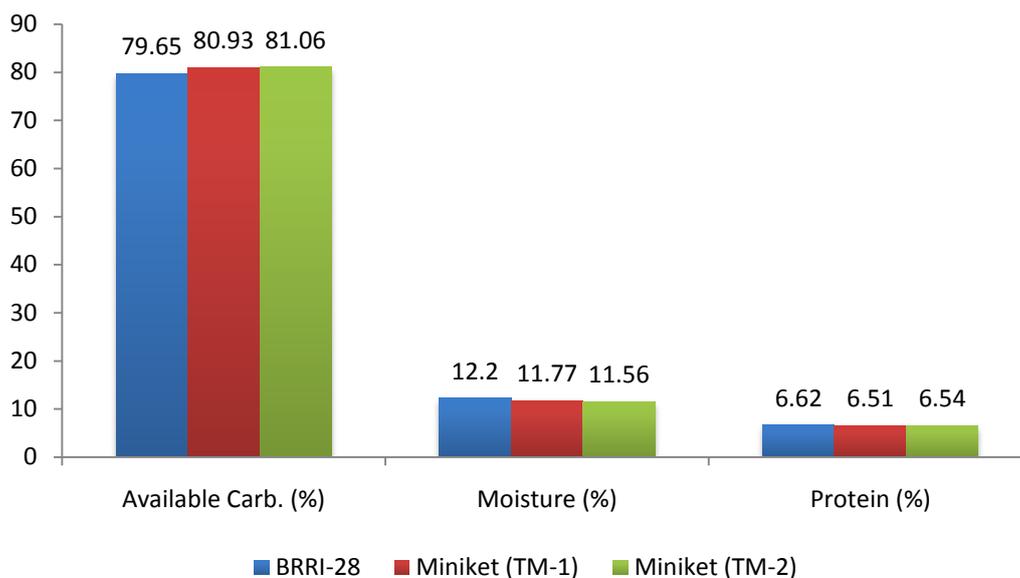


Fig. 2. b. Comparison among parboiled milled BRRI-28, Miniket (TM-1), and Miniket (TM-2) rice

Variation in physical quality among the selected rice varieties

Physical qualities (length, width, shape, colour etc.) of rice work as important factors to make customer choice in market. To understand variation of physical qualities

among the selected rice varieties/types, some important physical parameter of rice including length, width, L/W ratio, shape and weight of 1000 grain were determined in the studies which are shown in Table 2.

Table 2. Variation in physical quality among the selected rice varieties.

Rice varieties	Type	Length (mm)	Width	L/W ratio	Shape	Weight of 100 grain (g)	Grain colour
Miniket	Brown	7.2	2.1	3.4	Slender	15.54	Brown
	Parboiled Milled	6.6	2	3.3	Slender	14.5	Grainy White
	TM-1	6.6	2	3.3	Slender	14.52	Grainy White
	TM-2	6.5	2	3.25	Slender	14.74	Grainy White, (slightly brighter)
BRRI-28	Parboiled Milled	6.6	2.4	2.7	Medium	17	Slightly brownish white

*The ISO Classification is as follows according to Scale Shape L/W ratio: Slender over 3.0, Medium 2.1 – 3.0, Bold 1.1 – 2.0, Round 1.0 or less

As shown in the Fig. 3, Miniket brown rice was found in distinctive brown colour unlike other milled rice (white rice). Certain variation was observed in the degree of whiteness among the milled rice by eye observation (data not shown). BRRI-28 was found less bright than Miniket. Among three miniket milled rice, miniket of TM-2 was found slightly brighter than other two varieties. Miniket brown rice was found slightly

longer and wider than the same milled Miniket rice. There were almost no variation in length and width found among the milled Miniket rice of Kushtia (standard sample), TM-1 and TM-2. Unlike length, BRRI-28 was found coarser in width than others. Based on L/W ratio Miniket brown rice and other milled rice were classified as ‘slender’ in shape while BRRI-28 was classified as ‘medium’ in shape.

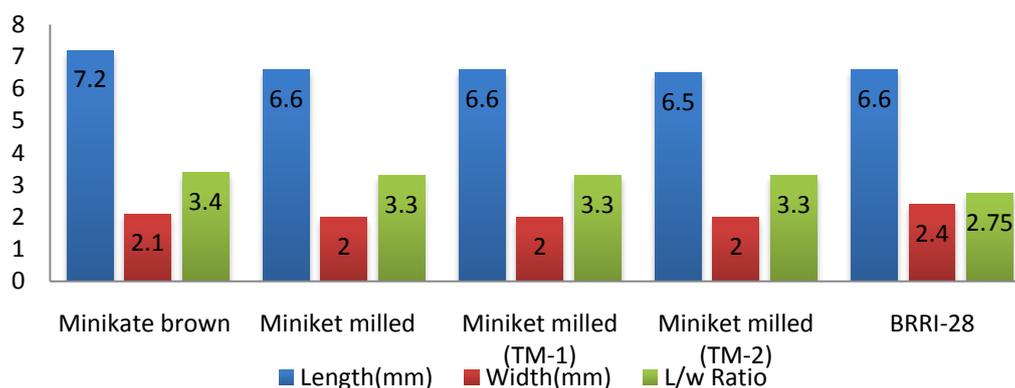


Fig. 3. Variation in physical quality among the selected rice varieties

Conclusions

In the present investigation, approximate composition of Miniket milled rice collected from two different market places of Tangail district was compared with original sample of Miniket parboiled milled rice (collected from Kushtia) and BRRI-28 milled rice (collected from rice-mill of Tangail). The protein, fat, fibre and ash content of two market samples were found as lower than that of parboiled milled rice and BRRI-28 milled rice, while higher in available carbohydrate content. This fact suggests that Miniket milled rice collected from the two market places of Tangail were

over polished than the original parboiled milled sample and BRRI-28. Since physical quality test suggests that Miniket rice of the two market places and original parboiled milled rice were identical in length and width unlike BRRI-28, the Miniket market samples might be fabricated from BRRI-28 or other coarse varieties. When rice is over polished and refined, valuable nutrient content like fibre, minerals, and protein also reduced leading to higher density of carbohydrate content. Regular consumption of such rice is related to some health problems as suggested by current researches.

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