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Detection of Nutritionally Significant Indigenous Rice Varieties from Assam, India

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ABSTRACT
Chakua, a class of indigenous rice used for instant preparation were analyzed for proximate composition, amylose content and some mineral elements. Seventeen indigenous chakua varieties, collected from Regional Agricultural Research Station of Assam Agricultural University were analyzed. Among the chakua varieties (brown rice form), six were found to contain crude protein in higher range (more than 10%). The crude fat on dry weight basis was found to be the highest for 'Sam chakua' (8.20%). The crude fibre was found to be the lowest (0.30%) in 'Kagoli chakua' and the highest in 'Maju chakua 2' (1.65%). The total carbohydrate was found to be 69.30% in 'Nepali chakua' to 85.90% in 'Lahi chakua'. The amylose content of the brown rice ranged from 9.12-16.02 %. The ash content of chakua rice varieties was found to vary from 0.66% for 'Boka chakua -1' to 1.52% for 'Lahi chakua'. The iron content varied from 1.04mg/100g in 'Maju chakua-1' to 643.50mg/100g in 'Kagoli chakua'. The iron content of two chakua rice varieties 'Kagoli chakua' and 'Saru chakua' were found to be remarkably higher. The phosphorus content ranged from 173.95mg/100g (Lahi chakua) to 328.78mg/100g (Pozo chakua).The potassium content varied from 84.71mg/100g (Bor chakua) to 287.6mg/100g (Bora chakua). The sodium content varied from 14.82mg/100g (Bor Chakua) to 22.70mg/100g (Lahi chakua).
***Key words**: Indigenous, Chakua, Soft Rice, Amylose, Minerals, Proximate Composition.*

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INTRODUCTION

Assam, situated at the North East part of India is particularly rich in rice germplasm. Assam is considered as one of the origins for rice and has got wide collection of indigenous rice cultivars. In Assam, the high amylose content rice varieties are consumed as staple food, and the waxy (0-8% amylose) and the intermediate amylose containing varieties are processed to make speciality products. The *chakua* rice is characterized by its semi glutinous character with amylose ranging from 12-17% [1]. This is a indigenous class of rice used for instant preparations. Similar class of rice is not known in other parts of the world. Its preparations are very popular in community feasts and festivals in Assam. 'Komol chaol' (soft rice) are prepared from this class of rice. This rice is very common and popular in rural Assam. Traditionally, *chakua* grains are soaked in water at room temperature for 3–4 days to attain an acceptable moisture level. The excess water is drained, and the grains are put in freshwater and cooked over wood fire till the husks start splitting. The water is again drained and the grains dried under the sun on the same day. Dried grains are milled in a 'dheki,' the traditional foot pounding machine to get the 'Komal chaul'(soft rice) product. Drying of the boiled grains is done on the same day, so that the milled product attains soft texture on simple soaking in water at room temperature.

This preparation can be preserved for quite long time and can be consumed instantly by soaking the rice either in cold or hot water for a brief period of time and then consumed with sugar or molasses, milk or curd and even with salts and oils and pickles. Rice powders and flake rice prepared from *chakua* rice are very tasty and preferred by the local people of the area. These preparations seem to be useful for sailors, travelers, mountaineers, defense personal, etc. However, not much research has been done so far to know

its nutritional composition. Considering paucity of work related to nutritional profile of this group of rice of Assam, India the present study was selected.

MATERIALS AND METHODS

Seventeen varieties of *chakua* rice were collected from the Regional Agricultural Research Station, Assam Agricultural University, Titabor, Assam, India. The brown form of all the collected rice varieties was analyzed for proximate composition, amylose content and mineral content. All the chemicals used for biochemical analysis were of analytical grade.

Determination of moisture content

The moisture content was determined by moisture meter (MA 35, Sartorius AG Germany).

Determination of proximate composition

Standard methods [2] were followed to determine the proximate composition (total ash, crude fat, crude protein and crude fibre).The carbohydrate content (% dry basis) was estimated by subtracting the percent values (on dry weight basis) of crude protein, crude fat, crude fibre and total ash from 100.

Determination of food energy

The gross food energy was estimated [3] using the equation:

Food energy (kCal/100g) = ($CP \times 4$) + ($F \times 9$) + ($CHO \times 4$), *CP* means crude protein (%); *F* means crude fat (%); and *CHO* means carbohydrate content (%).

Determination of amylase

The amylose was determined by the method of Sowbhagya and Bhattacharya [4].

Determination of mineral content

Standard methods were followed to determine the minerals. The phosphorus and iron were estimated by spectrophotometric method [5,6, respectively] and potassium and sodium were estimated with flame photometer.

RESULT AND DISCUSSION

Proximate composition

Proximate composition of brown rice of *chakua* varieties of Assam are presented in Table 1.

Table 1. Proximate composition and energy values of brown rice of *chakua* varieties of Assam

Names of 'Chakua' varieties	% Moisture (wet basis)	% Crude protein	% The crude fat(dry basis)	% The Crude fibre(dry basis)	% Total carbohydrate (dry basis)	% Ash (dry basis)	Energy value (kCal/ 100g)
Boga Chakua	11.1	11.24	2.27	0.75	73.62	1.02	359.87
Boka Chakua-1	10.4	9.99	2.82	1.55	74.58	0.66	363.66
Boka Chakua-2	10.3	11.24	2.81	0.95	74.70	1.32	369.05
Bor Chakua	10.5	4.99	1.19	0.70	81.64	0.98	357.23
Bora Chakua	11.0	2.91	0.08	0.85	84.37	0.786	349.84
Chakua-6	10.9	6.18	1.92	0.45	79.69	0.86	360.76
Haru Chakua	10.6	11.66	2.09	0.40	74.13	1.12	361.97
Kagoli Chakua	11.8	13.32	1.72	0.30	71.58	1.28	355.08
Kalomdani Chakua	11.2	7.08	1.68	0.40	78.65	0.99	358.04
Lahi Chakua	10.6	0.83	0.90	0.25	85.9	1.52	355.02
Maju Chakua-1	10.8	12.07	4.97	1.05	69.96	1.15	372.85
Maju Chakua-2	10.1	8.33	2.40	1.65	76.71	0.81	361.76
Malbhog Chakua	10.9	6.66	Nil	0.45	81.02	0.97	350.72
Nepali Chakua	10.8	9.99	8.00	0.80	69.30	1.11	389.16
Sam Chakua	11.3	6.66	8.20	1.30	71.47	1.07	386.32
Saru Chakua	10.6	8.74	4.35	1.05	73.98	1.28	370.03
Pozo Chakua	10.2	15.41	2.45	0.85	69.92	1.17	363.37
Mean	10.77	8.66	2.81	0.80	75.95	1.06	363.80
$CD_{0.05}$	0.34	2.37	0.33	0.08	0.10	0.02	0.01

Moisture content

The percentage of moisture is an important factor for storing, processing and marketing quality of the rice. It is dependent upon many factors such as variety of rice, yield, proportionate amount of chemical constituents of the grains, processing, environmental factors, etc. In the present observation, the moisture content of the brown rice varieties varied from 10.1 % for 'Maju chakua -2' to 11.8 % for 'Kagoli chakua' on fresh weight basis. However, the moisture content of all the varieties was found within safe level of

moisture for storage. Around 12% moisture is recommended for long term storage to avoid insect infestation and microbial growth [7,8]. The moisture content of high amylose content rice varieties of Assam like *Ranjit, Kala chakua, Aguni bora* and *Bhogali bora* were reported to be 13.1%, 12.9%, 13.1% and 13.2%, respectively [9].

Total Carbohydrate content

Rice carbohydrates are mainly starch which is composed of amylose and amylopectin. The total carbohydrate was found to be in the range of 69.30% in 'Nepali chakua' to 85.90% in 'Lahi chakua'. The total carbohydrate content of nine milled rice varieties of China were reported to be in the range between 87.2%-92.5% [10]. Our findings on total carbohydrate content was found to be similar with those reported earlier for aromatic rice verities of India (75.87-82.70%) [11] and some rice varieties of Malayasia (67.48-77.51%) [12].

Crude fibre content

The crude fibre is not a significant component for rice. The crude fibre content on dry weight basis was found to be the lowest (0.30%) in 'Kagoli chakua' and the highest in 'Maju chakua-2' (1.65%). The crude fibre detected in the present study (0.30% to 1.65%) was found to be similar to those reported earlier [13,14]. However, the crude fibre content of aromatic rice ranged between 0.48- 0.85% and non aromatic rice ranged between 0.64-0.65% [11].

Crude protein content

Protein content influences the nutritional quality of rice [15]. Rice protein content comprises up to 8% of the grain [16], which is low but of high nutritional value [17,18]. Earlier, the protein content up to 15% in different rice varieties are being reported [19,20]. The protein content of more than 10% for rice is classified as high protein content [21]. In the present study too, in six *chakua* varieties, the protein content of brown rice was more than 10%. However, the crude protein content of aromatic rice varieties ranged between 7.23-9.51% and the non-aromatic varieties ranged from 6.87% to 7.09% [11].The crude protein content of brown rice of some varieties of Malayasia and Pakistan were reported to be 9.50-9.83% [12] and 7.50-9.16% [22], respectively.

Crude fat content

Crude fat content influences the taste of cooked rice, because rice with high fat content tends to be tastier and have less starch [23]. Among the *chakua* varieties, the crude fat was found to be the highest (8.20%) for 'Sam chakua' and the lowest for 'Malbhog chakua' (nil). Earlier, the crude fat content for brown rice of some varieties from Malayasia were reported to be in the range of 5.85-8.9% [12]. However, the crude fat content of milled form of rice varieties from India and Pakistan were reported to be less than 1% [11] and 1.92-2.70% [22].

Ash content

Ash content plays an important role to reflect the mineral elements of a food sample [24,25]. It gives an idea to determine the levels of essential minerals present in the food [26].The ash content of *chakua* rice varieties was found to vary from 0.66% for 'Boka Chakua -1' to 1.52% for 'Lahi Chakua'. The ash content of brown rice of *chakua* varieties were found to be lower than those reported earlier for some brown form of rice varieties from Malayasia (1.67-1.83%) [12]. However, the ash content for some aromatic rice varieties of India and Pakistan were reported to be in the range of 0.38%-0.73% and 1.48%-1.98%, respectively [11, 22].

Energy content

Among the *chakua* varieties, the energy value was found to be the highest (389.16 kCal/100g) for 'Nepali chakua' and the lowest for 'Bora chakua' (349.84 kCal/100g) (Table 1). Higher energy content of some of the *chakua* varieties might be attributed to their brown form, as most of the crude fat is retained on the outer layer of rice grain. Earlier, the energy content for aromatic rice varieties of India and brown rice of Malayasia were reported to be 348.79-365.23kCal/100g and 372.53-388.02kCal/100g, respectively [11,12].

Amylose content

Amylose content of rice grain is considered to be one of the most important compositional indices of rice cooking and processing behavior. The varieties having very low amylose (<2 to 9%) content are sticky, moist and tender when cooked. On the other hand, the varieties having a high content of amylose (>27%) become very hard when cooked. Amylose is almost absent from the waxy (glutinous) rice. Such rice does not expand in volume, are glossy and sticky and remain firm when cooked. Intermediate amylose content is preferred by the major world rice market.

In the present study, the amylose was detected in the range of 9.12% in 'Bor chakua' to 16.02% in 'Lahi chakua'(Table 2). From the earlier study [27] on parboiled rice of Assam like *Ranjit, Kala chakua, Agoni bora* and *Bhogali bora*, the amylose content was reported to be 27.2% and 12.6% for *Ranjit, Kala chakua,*

respectively and the same for *Aguni bora* and *Bhogali bora* was 1.1%. Earlier, the amylose content of some rice varieties of Malayasia was reported to be 12.50-25.70% [12].

Table 2. The amylose content (%, dry weight basis) of brown rice of *chakua* varieties of Assam

Names of Chakua varieties	Amylose content%
Boga Chakua	13.76
Boka Chakua-1	9.84
Boka Chakua-2	10.26
Bor Chakua	9.12
Bora Chakua	12.78
Chakua-6	10.50
Haru Chakua	12.44
Kagoli Chakua	11.78
Kalomdani Chakua	14.04
Lahi Chakua	16.02
Maju Chakua-1	14.84
Maju Chakua-2	12.70
Malbhog Chakua	9.22
Nepali Chakua	11.72
Sam Chakua	10.14
Saru Chakua	12.28
Pozo Chakua	12.76
Mean	12.01
$CD_{0.05}$	0.046

Table 3. The mineral content (mg/100g) of brown rice of *chakua* rice varieties of Assam (on dry weight basis)

Varieties	Sodium (mg/100g)	Potassium (mg/100g)	Phosphorus (mg/100g)	Iron (mg/100g)
Boga Chakua	20.48	216.97	280.18	3.70
Boka Chakua-1	19.08	152.67	269.31	3.81
Boka Chakua-2	19.08	153.22	230.55	4.08
Bor Chakua	14.82	84.71	205.10	10.97
Bora Chakua	20.48	287.60	250.20	7.68
Chakua-6	20.48	152.78	262.46	7.73
Haru Chakua	17.84	87.32	192.54	4.09
Kagoli Chakua	20.48	169.38	198.07	643.50
Kalomdani Chakua	19.08	214.87	291.66	3.20
Lahi Chakua	22.7	86.28	173.95	3.92
Maju Chakua-1	20.48	276.73	239.52	1.04
Maju Chakua-2	19.08	216.25	195.75	3.39
Malbhog Chakua	19.08	154.92	213.77	4.04
Nepali Chakua	21.6	220.22	311.40	3.87
Sam Chakua	19.08	219.92	267.58	6.86
Saru Chakua	19.08	154.21	219.47	44.97
Pozo Chakua	21.60	222.02	328.78	2.72
Mean	19.67	180.59	242.95	44.68
$CD_{0.05}$	0.064	0.01	0.044	0.04

Mineral content

Some of the important mineral content of *chakua* rice varieties are presented at the Table 3. The phosphorus content of c*hakua* rice varieties of Assam ranged from 173.95mg/100g (Lahi Chakua) to 328.78mg (Pozo Chakua), with an average value of 242.95 mg/100g**.** However, the phosphorus content of rice were reported to be higher (0.50-0.55% or 500-550mg/100g) [28].

In the present study, the potassium content varied from 84.71mg/100g (Bor chakua) to 287.6mg/100g (Bora chakua), with an average value of 180.59 mg/100g. Earlier, the potassium content of rice were reported to be 0.15-0.23% or 150-230mg/100g [28], 237.8-279.1mg/100g [22] and 50-265mg/100g [11].

The sodium content varied from 14.82mg/100g (Bor Chakua) to 22.70mg/100g (Lahi chakua), with an average of 19.67mg/100g. The sodium composition of 20 rice varieties of Nigeria ranged from 0.09 – 0.17

% or 90-170mg/100g [28]. However, the sodium content for some rice varieties of Pakistan varied from 8.9-10.9mg/100g [22] and for some aromatic rice varieties of India, it varied from 4.14-6.88mg/100g [11].

The iron content of the brown form of *chakua* rice varieties varied from 1.04mg/100g in 'Maju chakua-1' to 643.50mg/100g in 'Kagoli chakua', with an average of 44.68 mg/100g. In the present study, the iron content of two *chakua* varieties in brown form were found to be higher than the already reported values, 0.24-3.15mg/100g [11], and 18.6-31.7mg/100g [22], for some rice varieties of India and Pakistan. The iron content of two *chakua* rice varieties 'Kagoli chakua' and 'Saru chakua' were found to be remarkably higher, 643mg per 100g (almost 50% of total minerals) and 44.97mg per 100g, respectively. The highly intense colour of the brown form of this variety justifies the vernacular name of the variety 'Kagoli chakua', which means red colour. Detection of high iron containing rice varieties may lead to utilization of this prominent variety in future rice breeding program. However, in earlier studies involving high iron containing rice varieties, the iron content of seed was found to be 15.7 µg/g (1.57mg/100g) in rice (*Oryza sativa* L. subspecies *indica*) cv. IR68144 [29]. In a recently conducted experiment to develop high iron containing rice at International Rice Research Institute, Phillipines the average iron content of the milled rice of developed lines was found to be 1.2-1.5 mg/100g [30].

CONCLUSION

The present study reveals a significant finding regarding crude protein and iron content of some indigenous *chakua* rice varieties of Assam, India. The iron content varied from 1.04mg/100g in 'Maju chakua-1' to 643.50mg/100g in 'Kagoli chakua', with an average of 40.49mg/100g. The amylose content of chakua rice was found to be of intermediate type.

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REFERENCES

1. Dutta, H. and Mahanta, C L. 2014. Traditional parboiled rice-based products revisited: Current status and future research challenges. *Rice Sci.* **21**: 187-200.
2. AOAC. 2000. Official Methods of Analysis of Association of Official Analytical Chemists. 17th edn. Maryland, USA: 452–456.
3. Osborn, D. R. and Voogt, P. 1978. Calculation of calorific value. *In*: The Analysis of Nutrients in Foods. New York, USA: Academic Press: 239–240.
4. Sowbhagya, C. M. and Bhattacharya, K. R . 1979. Simplified Determination of Amylose in Milled Rice. *Starch* **31**(5):159–163.
5. Fiske, C.H. and Subba Row, Y. 1925. In : *Experimental Biochemical Research Techniques*. Cowgill, R.W. and Pardec, B. (Eds.). p. 177.
6. Wong. 1923. Colorimetric determination of iron and hemoglobin in blood. *J. Biol. Chem*. **55**: 421.
7. Adair, C. R., Bollich, C. N., Bowman, D. H., Joson, N. E., Johnston, T. H., Webb, B. D. and Atkins, J G. 1973. Rice breeding and testing method in the United States. *In*: Rice in the United States: Varieties and Production. Department of Agriculture of the United States: 22–27.
8. Cogburn, R.R. 1985. Rough rice storage. *In*: Juliano B O. Rice Chemists and Technology. 2nd. St Paul, MI, USA: The American Association of Cereal Chemists: 265–287.
9. Dutta, H. and Mahanta, C.L. and Singh,V. 2015. Changes in the properties of rice varieties with different amylose content on dry heat parboiling. *J. Cer. Sci*. **65**: 227-235.
10. Leewatchararongjaroen, J. and Anuntagool, J. 2016. Effects of dry-milling and wet-milling on chemical, physical and gelatinization properties of rice flour. *Rice Sci.* **23**: 274-281.
11. Verma, D. K. and Srivastav, P. P. 2017. Proximate Composition, Mineral Content and Fatty Acids Analyses of Aromatic and Non-Aromatic Indian Rice. *Rice Sci*. **24**: 21-31.
12. Abubakar, B., Yakasai, H. M., Zawawi, N., Ismail, M. 2017. Compositional analyses of white, brown and germinated forms of popular Malaysian rice to offer insight into the growing diet-related diseases. *J. Food Drug Anal.* **30**: 1-10.
13. Kumar, S., Haq, R.U. and Prasad, K. 2016.Studies on physico-chemical, functional, pasting and morphological characteristics of developed extra thin flaked rice. *J. Saudi. Soc. Agric. Sci*. (In press).
14. Kariyawasam, T.I., Godakumbura, P.I., Prashantha, M. A. B. and Premakumara, G.A.S. 2016. Proximate Composition, Calorie Content and Heavy Metals (As, Cd, Pb) of Selected Sri Lankan Traditional Rice (Oryza Sativa L.) Varieties. . **6 :** 253-256**.**
15. Sompong, R., Siebenhandl-Ehn, S., Linsberger-Martin, G. and Berghofer, E. 2011. Physicochemical and antioxidative properties of red and black rice varieties from Thailand, China and Sri Lanka. *Food Chem*. **124**: 132–140.

16. Juliano, B.O. 1985. Factors affecting nutritional properties of rice protein. *Trans. Nat. Acad. Sci. Technol.* **7**: 205–216.
17. FAO. 1970. Amino Acid Content of Foods and Biological Data on Proteins. Rome Nutrition Division: FAO, 122.
18. Chaudhary, R. C. and Tran, D.V. 2001. Specialty rices of the world: A prologue. *In*: Chaudhary R C, Tran D V. Specialty Rice of the World: Breeding, Production, and Marketing. Rome, Italy: FAO, and New Delhi, India: Oxford & IBH Publishing Co. Pvt. Ltd: 3–14.
19. Sotelo, A., Sousa, V., Montalvo, I., Hernandez, M. and Hernandez-Arago, I. 1990. Chemical composition fractions of 12 Mexican varieties of rice obtained during milling. *J. Cereal Chem*. **67**(2): 209–212.
20. Kennedy, G. and Burlingame, B. 2003. Analysis of food composition data on rice from a genetic resource perspective. *Food Chem*. **80**(4): 589–596.
21. Resurrection, A. P., Juliano, B. O. and Tanaka, Y. 1979. Nutritional content and distribution in milling fractions of rice grains. *J. Sci. Food Agric*. **30**(5): 475–481.
22. Zubair, M., Anwar, F., Ali, S. and Iqbal. T. 2012. Proximate Composition and Minerals Profile of Selected Rice (*Oryza sativa L.*) Varieties of Pakistan. *Asian J. Chem.* **24**(1): 417-421.
23. Hirokadzu,T., Harue, T. and Keishi F. 1979. Influence of cropping season on lipid content and fatty acid composition of lowland non-glutinous brown rice. *Jpn. J. Crop. Sci*. **48**(3): 371–377.
24. Bhat, R. and Sridhar, K.R. 2008. Nutritional quality evaluation of electron beam-irradirated lotus (*Nelumbo Nucifera*) seeds. *Food Chem*, **107**(1): 174–184.
25. Mbatchou, V. C. and Dawda, S. 2013. The nutritional composition of four rice varieties grown and used in different food preparations in Kassena-Nankana district, Ghana. *Int. J. Res. Chem. Environ*. **3**(1): 308–315.
26. Edeogu, C.O., Ezeonu, F.C., Okaka, A.N.C., Ekuma, C. E. and Elom, S. O. 2007. Proximate composition of staple food crops in Ebonyi State (South Eastern Nigeria). *Int. J. Biotechnol. Biochem*. **3** (1): 1–8.
27. Dutta, H. and Mahanta, C. L. 2012. Effect of hydrothermal treatment varying in time and pressure on the properties of parboiled riceswith different amylose content. *Food Res. Inter.* **49**: 655-663.
28. Oko, A. O., Ubi, B. E., Efisue, A. A. and Dambaba, N. 2012. Comparative analysis of the chemical nutrient composition of selected local and newly introduced rice varieties grown in Ebonyi State of Nigeria. *Int. J. Agric. Forest* **2**(2): 16–23.
29. Paul, S., Gayen, D., Datta, S. K. and Datta, K. 2016. Analysis of high iron rice lines reveals new miRNAs that target iron transporters in roots. *J. Expt. Bot.* **67**(19): 5811–5824.
30. IRRI. 2017. Healthier Rice Varieties High iron and high zinc rice, www.irri.org, Accessed 8th January, 2018.

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