

## Physical and Chemical Properties of Some Selected Rice Varieties in Ebonyi State.

Alaka, I.C., Ituma, J.O.S and Ekwu, F.C

Department of Food Science and Technology, Ebonyi State University, Abakaliki

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### Abstract

Physical and chemical properties of nine rice varieties grown and processed in Ebonyi State were studied. Average length and width of the tested varieties ranged between 6.31 and 7.63mm and 2.04 to 2.28mm respectively. All the grains are long grain but, Afikpo mars had the longest grain length of 7.63mm while kpurukpuru had the least grain length of 6.31mm. The length/width ratio for Afikpo mars 3.74 was the highest, and IR8 Izzi 2.87 was the lowest. The nine rice varieties tested had translucent grain except Awilo Ikwo, Faro 15 Izzi and Kpurukpuru Afikpo which had opaque grains. The appearance of Awilo Ikwo, Mars Izzi and Afikpo mars were very good, IR8 Ngbo rice was fair. Size and shape of all the varieties tested were long slender except IR8 Izzi rice and IR8 Ngbo. Ash, Moisture and Fat content of the varieties ranged from 0.80 to 2.40%, 2.02 to 2.23% and 7.6 to 12.2% respectively. Protein content of the varieties ranged from 7.86 to 9.48%. The highest and lowest found in kpurukpuru Afikpo and Mars Afikpo rice respectively. All the varieties tested had protein content of more than the recommended standard (7%) of protein. Vitamin B content; thiamine (B<sub>1</sub>), Riboflavin (B<sub>2</sub>) and Niacin (B<sub>3</sub>) contents ranged from 0.17 to 0.24mg, 0.23 to 0.29mg and 1.60 to 1.81mg respectively. Zinc content of the tested varieties ranged from 6.48 to 9.81mg/100g with the highest (9.81mg/100g) found in Awilo Ikwo rice and Kpurukpuru Afikpo rice respectively. Iron and calcium contents of the varieties range from 0.94 to 1.21mg/100g and 1.00 to 1.75mg/100g with IR8 Ngbo rice having the highest values.

**Key words:** Rice (*Oryza sativa* L); physical; chemical; mineral; vitamin; appearance

Correspondence: [lakas2nice@yahoo.com](mailto:lakas2nice@yahoo.com)

### Introduction

Rice (*Oryza sativa*) is one cereal grain that plays a very important dietary role in the nutrition of human beings. It ranks third after wheat and maize (Akintola, 1998), and constitutes the most important staple food of about half the world's population (Thakur and Gupta, 2006; Osaretin and Abosede, 2007). Rice constitutes 95 % cereal consumed and supplies more than 80% of the calories and about 50% of the protein in the diet of the general people of Bangladesh (Yusuf, 1997). Sanint(2004) reported that rice plays a very important role in the diets of many in developing countries where it provides 27% of the dietary energy supply and 20% of dietary protein intake. Rice is an excellent source of complex carbohydrates, protein, vitamins and minerals (Yadav and Jindal, 2007). Rice per-capital consumption has risen from 21.21kg in 1992 to 24.50kg between 1995-1999, which represents about 9% of the total calorie intake in Nigeria (Akpokodye et al., 2001). There is a structural increase in rice consumption in the country, and this increase would continue in the nearest future.

Rice is grown in all the ecological zones of Nigeria with different varieties, processing, and adaptation traits for each ecology (Sanni et al., 2005). Abakaliki in Ebonyi State is a major rice producer in Nigeria (Ofomata, 1975), and its production in the state has witnessed a spectacular increase in the recent time. The ideal vegetation for rice production in Ebonyi State, has given rise to different varieties that have adapted to specific local environment, and these varieties bear names reflecting the towns in which they are grown (Alaka and Okaka 2011). Rice is an economic crop which is important in household food security, ceremonies, nutritional diversification, income generation and employment (Perez et

al.,1987).It is utilized mostly at the house hold level where it is consumed as boiled ,fried or ground rice with stew or soup(Osaretin and Abosedede ,2007). Consumer demand for good quality rice is high due to their patronage for imported rice. Since rice production is the major occupation of most farmers in Ebonyi State, and to ensure that locally processed rice varieties remain vital and relevant to rural economy and agricultural production, there is the need to evaluate their quality so as to compare them with their imported counterparts.

### Materials and Methods

Nine milled rice varieties, Awilo Ikwo, Mirimiri (306) Ikwo, Mars Izzi, IR8 Izzi ,Faro 15 Izzi, IR8 Ngbo, Faro 15 Ngbo, Mars Afikpo and KpuruKpuru Afikpo where purchased from four different local markets located within the areas in which the rice were grown. The markets are Okwo Ngbo market, Afikpo market, Iboko market, Eke Imoha market and Abakaliki rice mill.

*Physical Properties:* The grains collected were analyzed for the following physical characteristics, kernel length, width, and length/width ratio using veneer calipers as described by Adeyemi (2006). Milled grain appearance was ranked through visual observation as described by Dipti *et al*, (2003). Size and shape were determined by first classifying the rice into three, based on length; long (> 6mm in length), medium (5-6mm in length) and short (<5mm in length). The grains were again classified into three considering length to width ratio; slender (ratio >3.0), bold (ratio 2-3) and round (ratio < 2.0) according to Dipti *et al*, (2003).

*Chemical Properties:* The rice samples were ground with a plate mill, and dried in a hot air oven at 40°C for 12 hours to reduce the moisture to 13%. The crude protein (N x 5.95), fat, and ash for all rice samples were determined using Approved Methods 46-11A, 30-10, and 08-01 (AACC, 2000). The levels of iron, calcium and zinc were determined using AAS Model 305 B (Osaretin and Abosedede, 2007). The base line of the instrument was set to zero with the standards and the Boerhinger commercial control as per manufacturer's instruction. The riboflavin, thiamin and niacin values were determined by the modified methods of Onwuka (2005)

*Statistical Analysis:* Data were analyzed using analysis of variance (ANOVA) according to Snedecor and Cochran (1969) to detect any difference in mean values from triplicate runs of each treatment.

### Results and Discussion

Results on Table 1 Show that the average length of the tested varieties ranged from 6.31 to 7.63mm while average width ranged from 2.04 to 2.28mm and they differed very significantly at (P< 0.05).The longest length and width were obtained from Afikpo mars and IR8 Ngbo rice respectively. Dipti *et al.*, (2002) classified grains whose lengths are greater than 6mm as long, 5mm- 6mm medium and less than 5mm as short. By this classification, all the rice samples tested were long grains. Long grain rice are known to attract high price in the market.

The length-width ratio which is a measure of the shape and size ranges between 2.87 and 3.74. Wasserman and Calderwood (1972) reported that rice samples whose ratio was greater than 3.0 are classified as slender, ratios between 2 – 3 are bold grains while ratios < 2 are round. All the tested varieties fall within the slender shape except IR8 Izzi and IR8 Ngbo which fall within the bold shape. The shape of the grain influences its volume and weight. In Slender varieties of rice occupy more volume than round varieties. Therefore, one tonne of a slender variety of rice will need more storage space than the same weight of a round variety of rice. Conversely, one wagon- load of a slender variety will have less weight than wagon – load of round variety. In order words, if rice is traded in volume rather than in weight, the buyer will gain if it is a round variety while the seller will gain if it is a slender variety. Size and shape of rice affect many other properties like sieving, dehusking, polishing, storage as well as cooking. Consumers' preference for grain size and shape vary from one group to another. Anonymous (1997), reported that in Bangladesh, high income people prefer long slender grains whereas the low income group prefer the short bold grains because of its high volume expansion. All the tested varieties were long slender except IR8 Ngbo rice and IR8 Izzi rice that were long bold. The grain size and shape of most modern rice varieties is short to medium bold with translucent appearance (Biswas *et al.*, 1992).

The appearance of processed rice is extremely important for judging the quality of rice. The appearance of all the tested varieties ranged from good to very good except IR8 Ngbo rice, which was fair. All the nine rice varieties tested had translucent kernel except three, Awilo Ikwo rice, Faro 15 Izzi rice and kpuruKpuru Afikpo rice that had opaque kernel which is an undesirable quality (Table 1). The greater

the amount of chalkiness in the grain, the more it is prone to grain breakage during milling, resulting in lower head rice yield (Khush *et al*, 1979). Although, Awilo Izzi, Faro 15 Izzi and kpurukpuru Afikpo rice varieties had opaque grain, they still produced high percentage of head rice yield except Faro 15 Izzi. Results on Table 2, show that the protein content of the tested varieties were high and they ranged from 7.86 to 9.48% with the highest and lowest found in kpurukpuru Afikpo and Mars Afikpo rice respectively. The nutritional value of rice depends on the total quantity and quality of protein. On the basis of protein content, all the varieties contained sufficient amount which is above the reported values of 7% (Dipti *et al*, 2002; Dutta *et al*, 1998).

The fat content ranged from 2.02 to 2.23%. The results were much higher than the values of 1.10-1.50% for some milled rice varieties earlier reported by Juliano and Villareal (1993). Since fat is more on the bran layer and the more this layer is removed during milling the less the fat content of the milled rice (Okaka, 2005). Higher fat content, exposes the grains to spoilage during storage due to oxidation.

The moisture content of the rice varieties ranged between 7.6 to 12.2% and they differed significantly  $P < 0.05$ . Their values were below 14% optimal values for bag storage of grains (Juliano and Villarreal, 1993). Low moisture content are known to enhance keeping quality of rice under storage.

Ash residual is generally taken to be a measure of the mineral content of materials. High ash content in milled rice is an indication of a good quality of minerals in the rice sample (Dipti *et al*, 2003). All the tested varieties showed high ash content which ranged from 0.80 to 2.40%. The ash content of all the tested varieties did not differ significantly ( $p < 0.050$ ) even though IR8 Izzi was much higher.

The Zinc (Zn) content of the nine samples of rice from Ebonyi State ranged between 6.48mg and 9.81mg with Awilo Ikwo rice and Kpurukpuru Afikpo rice having the highest and Mars Izzi rice having the least. The Zinc content of all the tested varieties was found satisfactory, as it was higher than the range of 1.2 to 4.6mg reported by (Kennedy *et al*, 1975). The Iron (Fe) content of the tested varieties ranged from 0.94 to 1.21mg with the lowest and highest obtained from Mars Afikpo and IR8 Ngbo rice respectively. This is within the range of 0.2 to 2.8mg reported (Kennedy *et al*, 1975). Iron is essential for the formation of haemoglobin of red blood cells. Calcium (Ca) content of the samples ranged from 1.00 to 1.75mg with the lowest and highest calcium content found in Mars Afikpo rice and IR8 Ngbo rice respectively. The calcium content of the samples was high when compared to the range of 0.01 to 0.03mg reported (Kennedy *et al*, 1975). Presence of Calcium in rice is a clear indication that when taken will aid normal development and maintenance of bones and teeth, clotting of the blood, nerve irritability in the blood.

Thiamine ( $B_1$ ) content of the samples ranged from 0.17 to 0.24mg. This shows that the thiamine level of the varieties were satisfactory, as it was higher than the range of 0.02 to 0.11mg reported by ingredients101.com. Riboflavin ( $B_2$ ) content ranged from 0.23 to 0.29mg which also high when compared to the range of 0.02-0.06mg reported by ingredients101.com while all the tested varieties showed high Niacin ( $B_3$ ) content of 1.60 to 1.81mg. The Niacin content was satisfactory, as it is within the range of 1.3 to 2.4mg reported in literature (Kennedy *et al*, 1975). Statistically, all the varieties did not show any significant difference ( $p < 0.05$ ) in the values of vitamins.

Table1: Physical properties of some rice varieties grown in Ebonyi State.

Name of the Varieties	Chalkiness	Appearance	Average Length (mm)	Average Width (mm)	L/W Ratio	Size & Shape
Awilo Ikwo rice	Opaque	Very good	7.03 <sup>b</sup>	2.16 <sup>ab</sup>	3.25 <sup>bc</sup>	Long slender
Mirimiri (306)Ikwo	Translucent	Good	6.50 <sup>c</sup>	2.10 <sup>ab</sup>	3.10 <sup>cd</sup>	Long slender
Mars Izzi rice	Translucent	Very good	7.09 <sup>b</sup>	2.08 <sup>b</sup>	3.41 <sup>b</sup>	Long slender
IR8 Izzi rice	Translucent	Good	6.37 <sup>c</sup>	2.22 <sup>ab</sup>	2.87 <sup>d</sup>	Long bold
Faro 15 Izzi rice	Opaque	Good	6.38 <sup>c</sup>	2.10 <sup>ab</sup>	3.04 <sup>d</sup>	Long slender
IR8 Ngbo rice	Translucent	Fair	6.56 <sup>c</sup>	2.28 <sup>a</sup>	2.88 <sup>d</sup>	Long bold
Faro 15 Ngbo rice	Translucent	Good	6.51 <sup>c</sup>	2.16 <sup>ab</sup>	3.01 <sup>d</sup>	Long slender
Mars Afikpo rice	Translucent	Very good	7.63 <sup>a</sup>	2.04 <sup>b</sup>	3.74 <sup>a</sup>	Long slender
Kpirikpiri Afikpo rice	Opaque	Good	6.31 <sup>c</sup>	2.10 <sup>ab</sup>	3.00 <sup>d</sup>	Long slender

Values are means of triplicate determination. Means in the same column with same letter(s) did not differ significantly ( $p>0.05$ ).

Table 2: Chemical properties of some rice varieties grown in Ebonyi State.

Varieties	Protein (%)	Proximate			Mineral			Vitamins		
		Fat (%)	Ash (%)	Moisture(%) LSD=3.087	Zinc (mg/100g)	Iron (mg/100g)	Calcium (mg/ 100g)	Thiamine (mg/100g)	Riboflavin mg/100g)	Niacin (mg/100g)
Awilo Ikwo rice	7.88 <sup>NS</sup>	2.23 <sup>NS</sup>	0.80 <sup>NS</sup>	10.0 <sup>ab</sup>	9.81 <sup>NS</sup>	1.15 <sup>NS</sup>	1.72 <sup>NS</sup>	0.18 <sup>NS</sup>	0.24 <sup>NS</sup>	1.81 <sup>NS</sup>
Mirimiiri (306) Ikwo	8.82 <sup>NS</sup>	2.10 <sup>NS</sup>	1.00 <sup>NS</sup>	12.2 <sup>a</sup>	6.55 <sup>NS</sup>	1.17 <sup>NS</sup>	1.74 <sup>NS</sup>	0.21 <sup>NS</sup>	0.28 <sup>NS</sup>	1.75 <sup>NS</sup>
Mars Izzi rice	8.60 <sup>NS</sup>	2.03 <sup>NS</sup>	1.20 <sup>NS</sup>	9.6 <sup>ab</sup>	6.48 <sup>NS</sup>	0.99 <sup>NS</sup>	1.28 <sup>NS</sup>	0.19 <sup>NS</sup>	0.23 <sup>NS</sup>	1.68 <sup>NS</sup>
IR8 Izzi Rice	8.86 <sup>NS</sup>	2.06 <sup>NS</sup>	2.40 <sup>NS</sup>	10.6 <sup>ab</sup>	7.21 <sup>NS</sup>	0.96 <sup>NS</sup>	1.26 <sup>NS</sup>	0.22 <sup>NS</sup>	0.26 <sup>NS</sup>	1.63 <sup>NS</sup>
Faro 15 Izzi rice	8.82 <sup>NS</sup>	2.04 <sup>NS</sup>	1.00 <sup>NS</sup>	10.2 <sup>ab</sup>	6.54 <sup>NS</sup>	0.98 <sup>NS</sup>	1.27 <sup>NS</sup>	0.24 <sup>NS</sup>	0.26 <sup>NS</sup>	1.62 <sup>NS</sup>
IR8 Ngbo rice	9.40 <sup>NS</sup>	2.12 <sup>NS</sup>	1.20 <sup>NS</sup>	8.8 <sup>b</sup>	6.83 <sup>NS</sup>	1.21 <sup>NS</sup>	1.75 <sup>NS</sup>	0.24 <sup>NS</sup>	0.29 <sup>NS</sup>	1.66 <sup>NS</sup>
Faro 15 Ngbo rice	9.23 <sup>NS</sup>	2.10 <sup>NS</sup>	1.40 <sup>NS</sup>	7.8 <sup>b</sup>	6.72 <sup>NS</sup>	1.15 <sup>NS</sup>	1.73 <sup>NS</sup>	0.21 <sup>NS</sup>	0.28 <sup>NS</sup>	1.70 <sup>NS</sup>
Mars Afikpo rice	7.86 <sup>NS</sup>	2.02 <sup>NS</sup>	1.40 <sup>NS</sup>	7.6 <sup>b</sup>	6.56 <sup>NS</sup>	0.94 <sup>NS</sup>	1.00 <sup>NS</sup>	0.17 <sup>NS</sup>	0.24 <sup>NS</sup>	1.60 <sup>NS</sup>
KpuruKpuru Afikpo rice	9.48 <sup>NS</sup>	2.23 <sup>NS</sup>	0.80 <sup>NS</sup>	8.6 <sup>b</sup>	9.81 <sup>NS</sup>	0.99 <sup>NS</sup>	1.26 <sup>NS</sup>	0.20 <sup>NS</sup>	0.25 <sup>NS</sup>	1.80 <sup>NS</sup>

All analyses were carried out in triplicate. Means in the same column with same letter(s) did not differ significantly at P< 0.05.

NS = Not Significant

## Conclusion

The physical characteristics of the nine rice varieties tested are quite good. Their grain size are long, and their appearance which is an important index of quality is good. Their proximate composition, minerals, and vitamins were all within acceptable levels. Therefore, the varieties are of good quality.

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