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Organoletic Properties and Proximate Compositions of Rice Varieties Available in Ebonyi State, Nigeria

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Abstract: Rice is a staple food that covers partly the world's major food reqiurements. Abakaliki rice is extraordinarily and widely demanded due to its imaginary outstanding taste, aroma and nutritional qualities, nevertheless, there is limited information on its sensory evaluation and nutritinal qualities. Hence, this study evaluated the nutritional qualities and organoleptic properties of 35 rice accessions in Ebonyi state. *Materials and Methods*: Proximate compostions were determined using the procedure of Association of Analytical Chemists (AOAC) while the organoleptic properties were evaluated using 50 non-trained pannelist. *Results and Conclusion*: The moisture and ash contents markedly varied from 4.80% - 7.45% and 0.55%-1.78% respectively. Crude fibre content widely varied from 0.85% to 2.37% .The percentage fat, protein and carbonhydrate contents varied from 0.58%-1.34%, 1.97-4.78 and 50.05- 88.77, respectively. The sensory evaluation test on Taste, Aroma, Colour, Appearance and overall Acceptability showed that the cultivars (Chinyere and Okporogwu) were the best in taste. The accession (kpurupuru) scored highest in Aroma followed by FARO 46. In a descending order, Iron-Long, 306 and 305 rice accessions scored higher in appearance while Atom 1 had very low rating. Iron-Long scored highest value in colour followed by FARO 44 while Atom 1 had the lowest colour rating. However, in the overall acceptability, 306 had the highest rating followed by Chinyere, FARO 60 and FARO 44 in that order while Atom 1 was the least accepted by the panelist.The results of this present study revealed that Abakaliki Rice has exceptional nutritional qualities and organoleptic properties.

Key words: Abakaliki Rice · Organoleptic Properties · Proximate Composition

INTRODUCTION

Rice, particularly *Oryza sativa L*is one food that is so common in the world and according to scientific studies of [1] it forms over 20% of the world's dietary energy supply. The studies of [2] also reported that rice is the second most important cereal in the world after wheat in terms of production. In Nigeria, Rice is a common food grown mostly in all the six geopolitical zones ranking 6th in production when compared to other valuable crops such as sorghum, millet, cowpea, cassava and [3]. In the past, rice was only associated with the rich people and mostly eaten once in a year that is on chrismas day but nowadays the increase in rice production have made it food for all calibres irrespective of your finacial status. Studies stated that it is a daily food for over 1.5 million people and mostly consumed at the household level where it is eating as boiled or fried with condiments as in Nigeria. Different studies including [4] have shown that rice contains mineral such as calcium, magnesium and phosphorus alongside with some infinitesimal amounts of iron, copper, zinc and manganese. Rice is a good source of important cofactors and vitamins needed for metabolism suchas thiamine, riboflavin and niacin. It has high content of nutritional values, though the concentrationis dependent on soil fertility, fertilizer application and other environmental factors. Freshly harvested rice grains contain about 80 % carbohydrates, which include starch, glucose, sucrose, dextrin, etc. However, rice which is generally low in protein and vitamins A content has been improved through genetic engineering [6]; [7]. Although, rice is eaten by all,

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consumers have different preferences especially on thenutritive values (proximate composition), aroma, taste, texture, colour and appearance.Thus;the market values of rice as afarming product not only depend on its physical qualities after parboiling but also on its organoleptic properties and nutritional qualities. To help both farmers and consumers make choice on Abakalik rice which is gradually gaining its ground in both local and international market with its exceptional qualities, there is need to have handy theknowledgeof its organoleptic properties and proximate compositionfor both old and newly introduced varieties after parboiling.This in no small measure will serve as hand-on information for both farmers and consumers who would wish to eat Abakaliki rice.Conventionally, majority of Abakalikipeople are rice producers, growing many local varieties that have not been documented in terms of proximate composition, taste, texture, colour and appearance. For instance the Biotechnology Research Centre, Ebonyi State University through AGRA and Agribusiness recently, introduced new varieties to the farmer in addition to older varieties they got from neigboring communitiesin an effort to domesticated better varities with high yield. The physical properties of all these varieties introduced into the State have not been studied nutritionally and information on its organoleptic properties are not known.Most studies on the nutrient composition of Abakaliki rice focused on proximate composition of few varieties without any information on its organoleptic properties which also contribute in eatbility and consumer's preference. It is this need that the present studies intend to address. The study area, Abakaliki, Ebonyi State, is geographical located between latitude 6° 15' 00" and longitude 8° 05' 00". A wide range of rice varieties are grown practically all over the State especially in Abakaliki zone. Like other states of Nigeria, rice is abundant only in about last quarter of the year (August to December).

MATERIALS AND METHODS

Sample Collection and Preparation: Thirty five (35) different rice varieties were obtained from farmers inIzzi, Ezza, Ikwo and Ohaukwu Local Government Areas of Ebonyi State. The samples were identified scientifically and locally (Table 1-5). One killogram of each cultivar was taken and parboiled at 40°C for 30mins. The rice was left

Table 1: List and Pictures of Local RiceSamples Studied

SAMPLE ID	SPECIES NAME	LOCAL NAME	LGA	PICTURES
Rice 1	*Oryza sativa*	Atom I	Ikwo L.G.A	
Rice 2	*Oryza sativa*	Atom II	Ikwo L.G.A	
Rice 3	*Oryza sativa*	Surugede	Ikwo L.G.A	
Rice 4	*Oryza sativa*	Chinyere	Ikwo L.G.A	
Rice 5	*Oryza sativa*	Mirimiri	Ikwo L.G.A	
Rice 6	*Oryza sativa*	Iron Long	Ikwo L.G.A	
Rice 7	*Oryza sativa*	Iron Oporoko	Ikwo L.G.A	
Rice 8	*Oryza sativa*	Fero 52	Ikwo L.G.A	

Table 2: List and Pictures ofLocal RiceSamples Studied contd

Sample ID	Species Name	Local Name	LGA	Pictures
Rice 9	*Oryza sativa*	FFAR 44	Ikwo L.G.A	
Rice 10	*Oryza sativa*	FARO 57	Ikwo L.G.A	
Rice 11	*Oryza sativa*	20 MJE	Ikwo L.G.A	
Rice 12	*Oryza sativa*	Fero 60	Ikwo L.G.A	
Rice 13	*Oryza sativa*	Cp-Bend	Izzi L. G.A	
Rice 14	*Oryza sativa*	Awilo	Izzi L. G.A	
Rice 15	*Oryza sativa*	Nwogu	Izzi L. G.A	
Rice 16	*Oryza sativa*	Nwangbenya	Izzi L. G.A	

Table 3: List and Pictures of Local RiceSamples Studied contd

Sample ID	Species Name	Local Name	LGA	Pictures
Rice 17	*Oryza sativa*	Abuja Rice	Izzi L. G.A	
Rice 18	*Oryza sativa*	Foregn I	Izzi L. G.A	
Rice 19	*Oryza sativa*	Downgoat	Izzi L. G.A	
Rice 20	*Oryza sativa*	NwaNgozi	Izzi L. G.A	
Rice 21	*Oryza sativa*	Okaufie	Izzi L. G.A	
Rice 22	*Oryza sativa*	Forcign II	Izzi L. G.A	
Rice 23	*Oryza sativa*	Ogbakpoite	Izzi L. G.A	
Rice 24	*Oryza sativa*	306	Ezza L.G.A	
Rice 25	*Oryza sativa*	305	Ezza L.G.A	

Table 4: List and Pictures of Local Rice Samples Studied

Sample ID	Species Name	Local Name	LGA	Pictures
Rice 27	*Oryza sativa*	kpurukpuru	Ezza L.G.A	
Rice 28	*Oryza sativa*	Fero 12	Ezza L.G.A	
Rice 29	*Oryza sativa*	Nwanchor	Ezza L.G.A	
Rice 31	*Oryza sativa*	Fero 46	Ezza L.G.A	
Rice 32	*Oryza sativa*	Odarugwo	Ezza L.G.A	
Rice 34	*Oryza sativa*	Ri8	Ngbo L.G.A	
Rice 35	*Oryza sativa*	Ri5	Ngbo L.G.A	

Table 5: Percentage Proximate Composition of Local Rice Varieties Available in Ebonyi State, Nigeria

S/N	Rice varieties	Moisture (%)	ASH (%)	Crude fibre (%)	Fat (%)	Protein (%)	Carbohydrate (%)
1	305	5.63 ± 0.3^{cdefg}	1.44 ± 0.03^{ijkl}	2.35 ± 0.01^{qr}	0.99 ± 0.01^{hijkl}	4.19 ± 0.01^{x}	85.24 ± 0.01^{d}
2	306	6.59 ± 0.27^{l}	1.31 ± 0.31^{fghij}	1.05 ± 0.03^{bc}	0.65 ± 0.02^{abcd}	3.65 ± 0.01^{q}	87.55 ± 0.02^{q}
3	20 MJE	7.45 ± 0.27^{m}	$1.42 \pm 0.^{31h}jkl$	0.85 ± 0.03^{a}	0.84 ± 0.02^{defgh}	3.95 ± 0.01^{v}	86.69 ± 0.01^{k}
4	Abuja Rice	5.22 ± 0.14^{abcde}	1.37 ± 0.07^{ghijk}	2.17 ± 0.02^{opq}	0.78 ± 0.01^{cdefg}	3.12 ± 0.02^{g}	87.65 ± 0.01^{r}
5	Atom one (i)	6.65 ± 0.11^{l}	1.15 ± 0.02^{defg}	2.15 ± 0.05^{mnop}	0.79 ± 0.01^{cdefgh}	3.77 ± 0.01^{t}	85.75 ± 0.12^{f}
6	Atom one (ii)	5.60 ± 0.48^{cdefg}	1.36 ± 0.02^{ghijk}	2.14 ± 0.03^{mnop}	0.58 ± 0.01^{ab}	3.53 ± 0.01^{n}	86.92 ± 0.01^{l}
7	Awilo	4.80 ± 0.07^{a}	1.26 ± 0.06^{fgh}	2.18 ± 0.02opq	0.87 ± 0.02^{efghi}	3.73 ± 0.01^{s}	87.23 ± 0.02^{p}
8	Chinyere	6.33 ± 0.52^{hijkl}	1.50 ± 0.03^{kl}	2.08 ± 0.02^{lmnop}	0.92 ± 0.06^{fghijk}	3.69 ± 0.05^{r}	85.92 ± 0.06^{g}
9	Cp-Bend	5.78 ± 0.16^{efgh}	1.34 ± 0.02^{ghijk}	2.37 ± 0.08^{r}	0.84 ± 0.01^{defgh}	3.88 ± 0.01^{u}	86.53 ± 0.02^{i}
10	Down Goat	5.03 ± 0.04^{abc}	1.15 ± 0.03^{defg}	1.96 ± 0.03^{klm}	0.95 ± 0.01^{ghijk}	3.06 ± 0.01^{e}	87.97 ± 0.02^{u}
11	Fero 12	5.78 ± 0.17^{efgh}	1.38 ± 0.01^{ghijk}	1.58 ± 0.04^{gh}	0.82 ± 0.02^{cdefgh}	3.45 ± 0.01^{l}	87.16 ± 0.01^{o}
12	Fero44	4.92 ± 0.06^{ab}	0.91 ± 0.08^{bcd}	1.11 ± 0.01^{bc}	1.25 ± 0.01^{mn}	3.57 ± 0.01^{o}	85.97 ± 0.02^{g}
13	Fero46	5.93 ± 0.07^{fghij}	1.23 ± 0.03^{efg}	2.04 ± 0.01^{lmnop}	1.24 ± 0.02^{mn}	2.86 ± 0.01^{b}	86.95 ± 0.01^{m}
14	Fero52	6.35 ± 0.50^{hijkl}	1.58 ± 0.02^{lm}	1.31 ± 0.01^{def}	1.08 ± 0.01^{jklm}	3.14 ± 0.01^{g}	87.97 ± 0.01^{u}
15	Fero57	5.49 ± 0.25^{bcdef}	1.06 ± 0.03^{cdef}	1.22 ± 0.01^{cde}	0.97 ± 0.01^{ghijk}	3.42 ± 0.01^{k}	84.89 ± 0.01^{c}
16	Fero60	5.65 ± 0.03^{cdefg}	1.55 ± 0.04^{lm}	0.93 ± 0.01^{ab}	1.34 ± 0.01^{n}	3.09 ± 0.01^{f}	87.16 ± 0.02^{o}
17	Foreign I	5.74 ± 0.11^{defgh}	1.08 ± 0.02^{cdef}	2.15 ± 0.01^{mnop}	1.08 ± 0.01^{jklm}	3.18 ± 0.01^{h}	86.68 ± 0.01^{k}

Table 6: Percentage Proximate Composition of Local Rice Varieties Available in Ebonyi State, Nigeria contd.

18	Foreign II	5.76 ± 0.21^{efgh}	1.07 ± 0.02^{cdef}	1.82 ± 0.02^{ijk}	0.74 ± 0.01^{abcdef}	4.19 ± 0.01^{x}	86.19 ± 0.01^{h}
19	Iron long	5.69 ± 0.17^{cdefgh}	1.57 ± 0.01^{lm}	1.71 ± 0.01^{hi}	0.62 ± 0.01^{abc}	3.03 ± 0.01^{d}	87.54 ± 0.01^{q}
20	Iron okporoko	5.08 ± 0.03^{abcd}	1.78 ± 0.02^{o}	1.37 ± 0.01^{ef}	1.12 ± 0.01^{klm}	4.78 ± 0.01^{z}	86.87 ± 0.01^{lm}
21	Kpurukpuru	4.92 ± 0.05^{ab}	1.04 ± 0.04^{cde}	1.75 ± 0.03^{hj}	1.06 ± 0.01^{ijklm}	3.26 ± 0.01^{k}	88.07 ± 0.01^{v}
22	Mirimiri	6.44 ± 0.3^{ijkl}	1.27 ± 0.01^{fghi}	2.24 ± 0.02^{pqr}	0.78 ± 0.02^{bcdefg}	4.02 ± 0.01^{w}	85.46 ± 0.05^{e}
23	NwaNgozi	5.97 ± 0.03^{fghijk}	1.29 ± 0.01^{fghij}	1.92 ± 0.06^{jkl}	1.76 ± 0.01^{o}	3.22 ± 0.02^{i}	85.96 ± 0.01^{g}
24	Nwanchor	6.46 ± 0.36^{ikl}	1.08 ± 0.01^{def}	2.17 ± 0.01^{nopq}	0.96 ± 0.01^{ghijk}	4.75 ± 0.03^{y}	84.37 ± 0.03^{b}
25	Nwangbenya	4.92 ± 0.06^{ab}	1.45 ± 0.04^{jkl}	$1.48 \pm 0.01f^{g}$	0.56 ± 0.02^{a}	2.94 ± 0.01^{c}	88.77 ± 0.02^{x}
26	Nwogwu	4.85 ± 0.04^{ab}	1.06 ± 0.01^{cdef}	1.97 ± 0.02^{klmn}	0.68 ± 0.01^{abcde}	1.97 ± 0.02^{a}	50.05 ± 0.01^{a}
27	Odaraugwo	6.23 ± 0.12^{ghijkl}	1.16 ± 0.02^{efg}	1.18 ± 0.02cd	0.96 ± 0.01^{ghijk}	3.14 ± 0.01^{g}	87.54 ± 0.02^{q}
28	Ogbokpoite	5.17 ± 0.09^{abcde}	0.97 ± 0.02^{cd}	2.05 ± 0.01^{lmnop}	0.79 ± 0.01^{cdefgh}	3.23 ± 0.02^{i}	87.92 ± 0.05^{x}
29	Okaufie	6.65 ± 0.47^{l}	1.16 ± 0.03^{efg}	2.07 ± 0.01^{lmnop}	0.71 ± 0.57^{abcdef}	4.78 ± 0.01^{z}	84.89 ± 0.02^{c}
30	Okporogwu	4.91 ± 0.06^{ab}	1.27 ± 0.20^{fghi}	1.68 ± 0.01^{hi}	1.17 ± 0.02^{lmn}	3.54 ± 0.01^{n}	86.89 ± 0.01^{l}
31	R5	5.22 ± 0.12^{abcde}	0.81 ± 0.06^{b}	2.05 ± 0.04^{lmnop}	0.65 ± 0.01^{abcd}	3.61 ± 0.01^{p}	87.91 ± 0.01^{t}
32	Ri8	7.43 ± 1.37^{m}	0.55 ± 0.01^{a}	1.96 ± 0.02^{klm}	0.72 ± 0.02^{abcdef}	3.49 ± 0.01^{m}	87.02 ± 0.02^{n}
33	Surugede	5.48 ± 0.45^{bcdef}	1.26 ± 0.09^{fghi}	1.74 ± 0.03^{hi}	0.91 ± 0.23^{fghij}	3.23 ± 0.02^{i}	87.66 ± 0.02^{r}
34	TOX 6	5.81 ± 0.28^{efghi}	1.04 ± 0.03^{cde}	1.62 ± 0.59^{gh}	0.97 ± 0.01^{ghijk}	2.96 ± 0.01^{c}	87.85 ± 0.01^{s}
35	TOX 8	6.64 ± 0.43^{l}	1.71 ± 0.14^{nm}	1.15 ± 0.02^{cd}	0.89 ± 0.01^{fghij}	4.14 ± 0.02^{u}	86.62 ± 0.01^{j}

*Values are means ± standard deviations of two determinations. Means with the same letters in the same column are not significantly different at 95% confidence level.

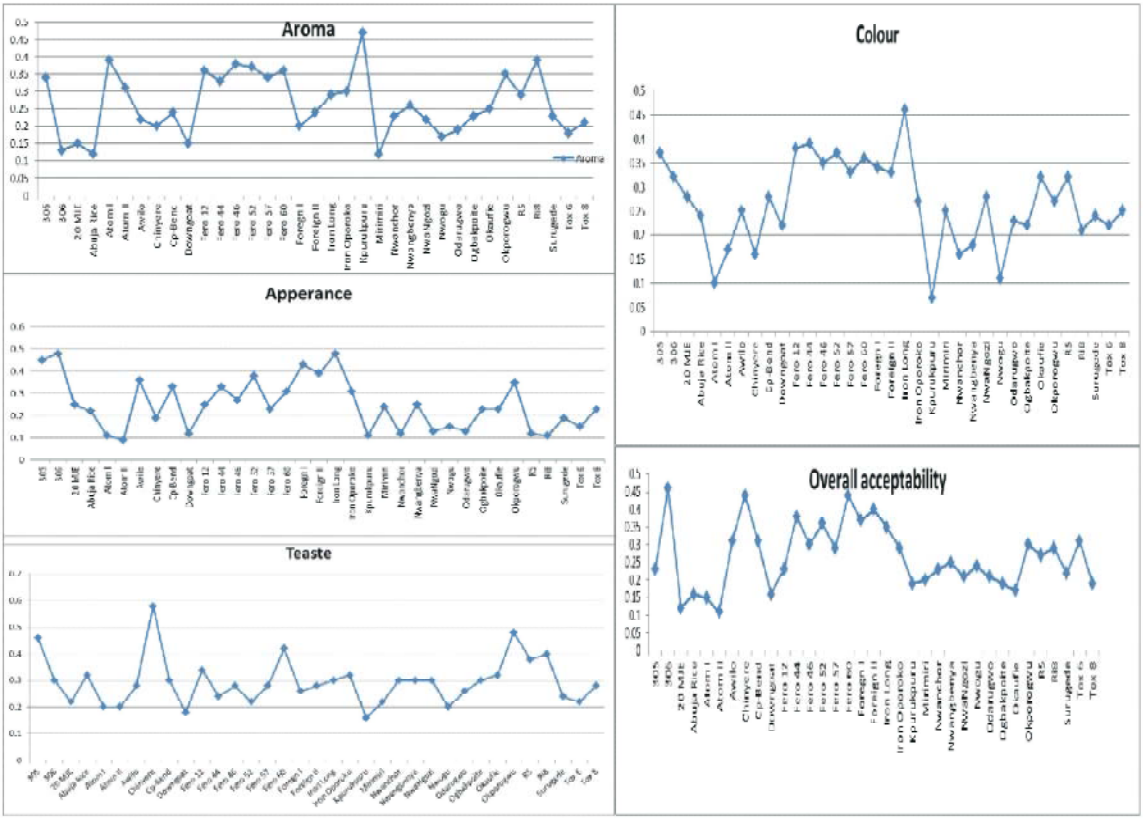

Fig. 1: Line plot of organoleptic Properties Local Rice Varieties Available in Ebonyi State, Nigeria contd

over night and preparboiled in the morning at the same tempreature before drying at a room temperature for 8 hours. Prior to the laboratory analysis, the rice husk was removed grinded into powdered form using morter and pestile. The dry powder was used for the proximate analyses.

Sample Preparation for Sensory Evaluation: Five hundred gram (500g) each of the milled rice was cooked differently with salt as the only ingreedient. Student were invited to teaste, percieved the aroma, observe the colour, select based on apperance and then make choice (overall acceptability). In evaluating the sensory status of the cooked foods, the rating test of a 7-point hedonic scale according to [8] was adopted in evaluating the consumer preference of the colour, flavor, taste, appearance and overall acceptability with a scaling range of 1 to 7 (1 = dislike extremely, 2 = like very much, 3 = like very much, 4 = liked extremely, 5 = neither liked nor disliked, 6 = liked moderately, 7 = liked slightly,

Determination of Proximate Composition: The powdered rice sample was used for proximate composition analysis based on the Official Method of Analysis of the Association of Official Analytical Chemists [9]. The components determined are crude protein, crude fat, ash, crude fibre, moisture and carbohydrates.

Statistical Analysis: One-way Analysis of Variance (ANOVA) procedure of SAS software version 2.0 was used to perform descriptive statistics on the data and detect the level of mean difference among the accessions. Differences were considered statistically significant at $P< 0.05$ and the means were ranked by the least significant difference (LSD) procedure at 0.05 probability level.

RESULTS AND DISCUSSION

Proximate Components: Table two contains the proximate composition of rice varieties on dry weight basis in percent. The results generally showed significantl variability ($P<0.05$) among the chemical nutrients composition of the rice cultivars analysedin Ebonyi state.

The moisture contents distinctly varied from 4.80% - 7.45% with 5.03% as the avarage value. Percentage moisture content of 7.45% was observed in 20MJE, followed by Ri8 with value of 7.43%. Awilo and Nwogwu cultivars had lowest moisture percentage

content with values of 4.80% and 4.85% respectively. Although there is limited study on the cultivars used, Awilo had relatively low moisture content compare to the study [10] who reported percentage moisture content of 6.67%. The low percentage moisture content of these cultivars including Awilo and 20MJE may be the reason why they had high content of the carbohydrate [11]: [10].

The percentage ash content ranged from 1.78% in iron okporoko to 0.55% in Ri8. High percentage content of ash was observed in iron okporoko followed by Tox 8 and Fero 52 with value of 1.78%, 1.75% and 1.58% respectively. Rice cultivars such as Ri8, R5 and Ogbokpoite contain lower percentage ash content with values of 0.55%, 0.81% and 0.97% respectively. Generally, Ash content did not vary widely as compare to moisture content among the cultivars used. The differences in the percentages of the ash content among the cultivars may be due to their genetic architetural differences [4].

Crude fibre content is more abundance than ash and fat contents. The value ranged from 2.37% to 2.35% for 305 and Cp-Band respectively. In an increasing order, cultivars such as Cp-Bend, 305, Mirimiri, Awilo and Abuja rice topped the list while cultivars like 20MJE and 306 in a decreasing order had lower content of crude fibre. The percentage crude fibre in the studies of [2] ranged from 1.50 to 2.00 and relatively lower than the range of 1.93-4.3 reported by the study of [6]. The presnce of crude fibre in a diet increases the bulkness of a Feaces which has laxature effect in the gut. Hence the relative high percentages of crude fibre in our study compare to the standard content of 0.5-1.0% suggest that it will have a potential effect in decreasing risk of chronic diseases. Those cultivars may also aid bowel function and possiblily reduced intestinal disorder [8].

The percentage fat content was the least in abundance among all the nutrient composition analysed. The value slightly varied from1.34%-0.58%. Faro60 had the highest fat content followed by Foerign1 and Faro52 with values of 1.34, 1.08 and 1.08 respectively. Atom1 and 306 had the lowest fat content with values of 0.58 and 0.65 respectively. The presence of fat in rice studied is an indication that rice is a good sources of essential fatty acid especially linoliec acid [9].

The protein content distinctly varied from 1.97-4.78 with average values of 3.26. The highest value of 4.78 was observed in Okaufie and Iron Okporogwu while Faro 46 and Nwogwu had the least value of 2.86 and 1.97 respectively. The protein content in this study is lower than the range (5.9-11.0) in the studies of [9] and 1.58-6.22 reported by [5]: [6]. Notwithstanding the range is in agreement with the studies of Ibukun (2008). Rice nutritional quality is dependent on the protein content. According to [7], rice protein is made up of essential a unique amino acid. The wide variability of protein content amongst thesecultivars may be as a result of environmental and edaphic factors [2].

Carbohydrate in this study was the most abundant chemical nutrient across all the rice samples used. The values slightly varied from 50.05- 88.77. Thehighest value was observed in okpurukpuru with valueof 88.67 while the lowest carbohydrate content was obseved in Nwangbenya with value of 50.05%. Some cultivars such as Ri8 and 20MJE had average values of 69.02 and 66.69 respectively. This result is similar to the result of [11] and slightly lower than 99.80% reported in [8]. The highcarbohydratecontent in some of the samples especially Nwangbenya may likely be the reason for high moisture content. However, the high carbohydrate content suggests that rice is word source energy.

Sensory Evaluation: The sensory evaluation test on Teaste, Aroma, Colour, Apperance and overal Aceptability by 50 non-trained judges using a 7-point hedonic scale ranging from dislike extremely to dislike very muchshowed that cultivars such as chinyere was scored highest followed by 305 while kpurupuru and Downgoat were scored very low in taste.Aroma of kpurupuru was scored highest followed by Faro 46, 52 and Ri8. Abuja Rice scored lowest in aroma content. In terms apperance ironLong, 306 and 305 were rated high while Atom1, kpurupuru and Ri8 had very low rating. The colour of IronLong scored highest followed by Faro44 while Atom1 had the lowest ratinng. However, in the overall aceeptability, 306, Chinyere, Faro60, Faro44 Fioreign1 and Ironglong were generally accepted while Atom1 and 20MJE were least accepted by the panelist.

CONCLUSION

This study has shown that Abakaliki rice is exceptional in both nutritionally and sensory attributes as shown by the proximate composition and its exceptional organoleptic properties.

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