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Research Paper

Comparative Study of Proximate and Mineral Composition of selected varieties of rice *Oryza sativa* L.

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ABSTRACT
The study investigated and compared the proximate and mineral composition of three local varieties of Nigeria rice(Igbemo, Benue, and Faro 60 variety) and one foreign rice variety, namely, Aroso. This investigation was carried out, using standard method of the Association of Official Analytical Chemists, [5,6]. Atomic Absorption Spectrophotometer was used to analyze the mineral content. The results showed that the moisture level was lowest in Faro 60 (8.36 %), while the highest value was obtained in Igbemo rice variety. Faro 60 recorded the highest (1.48 %) fat content. The highest crude protein (8.34 %) was found in Igbemo variety followed by Benue (8.15 %). The least protein was recorded in Faro 60 variety. All four rice varieties recorded high carbohydrate content, ranging from 77.15 % to 82.70 %. Faro 60 variety recorded the highest (82.72 %) followed by Aroso (80.30 %) and Benue (78.15 %) while the least (77.15 %) carbohydrate content was recorded inIgbemo rice variety. The highest (1.53 %) fibre was recordedIgbemo variety while the fibre contents in the remaining varieties were not significantly different.Igbemo and Benue rice varieties recorded the highest (1.19 % and 1.20 % respectively) ash content. Potassium and phosphorus were more abundant but lead (Pb) was not discovered. The highest minerals obtained in the rice varieties are follows: Sodium (6.20 mg/100g) in Igbemo, Potassium (118.25 mg/100g) in Igbemo, Calcium (29.20 mg/100g) in Faro 60, Phosphorus (120.40mg/100g) in Faro 60, Zinc (1.98mg/100g) in Faro 60. Magnesium(24.74 mg/100g) in Aroso, Iron (4.60 mg/100g) in Aroso, Manganese (1.80 mg/100g) in Aroso.Copper (0.22mg/100g) in Aroso. The local varieties of rice were nutritious and compared favourably well with the foreign rice, hence their consumption should be encouraged and awareness should be created among the populace.

KEYWORDS*: Rice varieties, proximate composition, mineral composition, Igbemo, Faro 60, Benue, Aroso*

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I. INTRODUCTION

Rice (*Oryza sativa* L.)is considered the most important staple food in most countries and it is an important cereal crop that feed more than half of the world population [3]. The flour of rice is also considered as a good substitute to wheat flour (14). It is consumed in a variety of forms including pastes, noodles, cakes and breads[12]. It is cultivated in over 100 countries on every continent.

Nigeria is the largest rice producer in Africa, where it is produced in virtually all the ecological zones[25]. The commonly cultivated varieties of Rice in Nigeria are *Oryza sativa* and *Oryzaglabberima*[1] and [25]. The world top rice producing countries are China, India and Indonesia.Rice is an economic crop which is important in the household food menu, ceremonies, nutritionaldiversification, income generation and employment [23]. It is utilized mostly at the household level where it is consumed as boiled, fried or ground rice with stew or soup. Polished rice is produced through a series of processing and it is the predominant type of rice consumed worldwide [30] and [16]

Rice contains micro nutrients such as vitamins, minerals and secondary metabolite [21]. The dietary minerals in rice includes: Potassium, Sodium calcium, Iron, Magnesium, Copper and Phosphorus. In human diets, minerals are required to maintain human good health and lack of thesecan lead to undesirable pathological conditions. Rice is essential for healthy gum, strong bones and teeth development in children. Calcium helps to

regulate heartbeat rate and nerves impulses, prevents atherosclerosis, lowers cholesterol level, develops muscles, prevents muscle cramp and blood clothing [1].

Researches reveal that rice is a potential source of functional Macro and Micro components such as gluten, starch, fiber, fatty acid, etc. Such constituents of rice can control hypertension, assist in curing cardiovascular diseases and protect the body from chemical contamination [32].

Paddy rice has to pass through a process known as dehulling, before being marketed for commercial uses. As a result of the process of dehulling, that is, the removal of the outermost protective surface sheath, brown rice is produced [18].

De-hulling minimally affects the nutritional value of rice, whereas, it has great economic potential, because the removed hulls is more often used in the paper and silica producing industries [23]. Another process known as de-braning (polishing)is employed to remove the outer brown layer from the rice kernel thus, yielding polished or white rice.

Nigeria is reputable to have comparative advantage in rice production. The purpose of this project is for households to know the best rice varieties we should consume. Most Nigerians believed in imported rice locally referred to as Aroso because they didn`t have the knowledge of the nutritional composition of our local rice varieties. The results of this study would reveal the nutritional and mineral composition of the four varieties of rice investigated.

II. MATERIALS AND METHODS

2.1**Sample collection**

The rice varieties used in this study (Igbemo, Benue and Faro 60) were obtained from ministry of Agriculture, Ado-Ekiti while the polished rice (Aroso) was purchased from Oja Oba market Ado-Ekiti ,Ekiti State, Nigeria.

2.2**Preparation of sample**

Three varieties of unpolished local rice *Oryza sativa* (Benue, Faro 60 and Igbemo) and one foreign(Aroso) rice were sun dried for two days.The rice samples were sorted properly by removing extraneous matters such as unhealthy or infested grains stones and chaffs. Each sample was milled by using the laboratory scale de-hulling machine. The milled kernels from each variety were pulverized into flour using an electric grinder (Model BLG 400)) and sieved with a 1.0 mm^2 mesh to obtain clean and fine flour. Eachof the samples stored in separate polythene bags and taken to the laboratory for proximate and mineral analyses.

2.3**Proximate Analysis**

The samples were analysed in triplicates. The moisture,crude protein content of the samples were determined using the methods of analysis of Association of Official Analytical Chemist, (6) procedure. The crude fat content was determined by soxhlet extraction method. The crude fibre content was determined using the method of (5). The carbohydrate content was determined by difference

Carbohydrate = 100 - (moisture + ash + crude fibre + crude protein + crude fat). Each of the samples was analyzed in triplicates

2.4**Mineral Analysis**

Two grams (2 g) of each sample were digested with tetraoxonitrate (v) acid (HNO_3) and perchloric acid ($HNO_3/HClO_3$): 4:1, v/v) in presence of hydrogen peroxide (H_2O_2) in a fume cupboard until a colourless solution was obtained. The solution was then poured into a standard flask and made up to 50 mL with distilled water. The solution was taken for mineral analysis using Atomic Absorption Spectrophotometer.

DATA ANALYSIS

Data obtained was subjected to statistical analysis of variance (Anova).

III. RESULTS

3.1**Proximate composition**

The proximate compositions of four rice varieties are shown in Table 1.

3.1.1**Moisture content**

The moisture levels of all rice varieties varied between 8.36% t0 10.98 % (Table1). The lowest moisture (8.36 %) was recorded in Faro 60 variety while the highest (10.98%) was recorded in Igbemo rice. There was no significant different in the moisture content of Igbemo and Benue varieties.

3.1.2 **Crude fat content**

The fat content ranged from 0.71 % to 1.48 %. The lowest fat was recorded in Aroso (0.71%) while the highest was in Faro 60 (1.48 %). There was no significant different between the fat content in Igbemo and Benue varieties.

Table 1: Comparative percentage proximate composition of some varieties of rice

Variety	Moisture	Crude protein	Crude fat	Ash	Carbohydrate	Crude fibre
Igbemo	10.98±0.76a	8.34±0.45a	0.91±0.02b	1.19±0.11a	77.15±3.11c	1.53±.0.52a
Benue	10.21±1.13c	8.15±0.65a	0.91±0.04b	1.12±0.22a	78.15±2.33c	1.23±0.43b
Faro 60	8.36±0.72d	5.65±0.34c	1.48±0.12a	0.53±0.03c	82.70±2.13a	1.23±0.60b
Aroso	10.30±0.34b	6.10±0.67b	0.71±0.03c	0.98±0.06b	80.30±2.04b	1.23±0.72b

Each value is the mean ± standard error of three replicates. Means in the same column followed by the same letter are not significantly different at $p \geq 0.05$.

3.1.3 **Crude Protein content.**

The protein content ranged from 5.65 % to 8.34 %. The Igbemo and Benue rice were high in protein (8.34 % to 8.15 % respectively) and there was no significant difference between them. Protein was lowest in Faro 60 (5.65 %) while Arosovariety had 6.10 %.

3.1.4 **Crude Ash content**

The ash content ranged from 0.53 % to 1.19 %. Faro 60 recorded the least (0.53 %) andIgbemo and Benue varieties recorded the highest (1.19 % and 1.12 % respectively) with no significant different. Ash was lowest in Faro 60 (0.53 %) whileAroso variety had 0.98 %

3.1.5 **Crude Fibre content**

The fibre content ranged from 1.22 % to 1.53 %. The highest (1.53 %) was found in Igbemo rice. There was no significant different between Benue, Faro 60 and Aroso rice varieties.

3.1.6 **Carbohydrate content**

The carbohydrate content ranged from (77.15 % to 82.70 %). All the rice varieties exhibited higher amount of carbohydrate. However, Faro 60 recorded the highest (82.70 %). The least was found in Igbemo rice (77.15 %) while Benue variety had 78.15 %

3.2**Mineral contents**

Table 2 shows the mineral composition the four rice varieties. All the rice varieties are low in sodium, iron, zinc, copper and manganese, ranging from 0.12 mg/100 g to 6.20 mg/100g but moderate in calcium and magnesium, ranging from 24.10 mg/100g to 29.20 mg/100g. Potassium and Phosphorus were the abundant mineral component in all the rice varieties ranging from 110mg/100g to 120mg/100g. The highest potassium (118 .25 mg/100g) was obtained in Igbemo rice, followed by Aroso (116.65 mg/100g) and Faro 60 (113.38 mg/100g) while the least (110.10 mg/100g) was found in Benue variety. Phosphorus was highest (120. 40 mg/100g) in Faro 60 variety, followed by Igbemo variety (119 mg/100g), Benue and Aroso varieties had 116.30 mg/100g 115mg/100g respectively, which are not significantly different.Lead (Pb) was not detected during the study.

Table 2: **Comparative mineral composition (mg/100g) of some rice varieties**

Minerals (mg/100 g	Variety			
	Igbemo	Benue	Faro 60	Aroso
Na	6.20±0.48a	5.52±0.33d	6.15±0.54b	6.04±0.24c
K	118.25±3.71a	110.10±2.73d	113.38±2.33c	116.65±3.17b
Ca	28.20±1.11b	26.20±1.13d	29.20±1.22a	27.40±1.33c
Mg	24.10±1.46c	24.64±1.21b	24.65±2.11b	24.74±2.14a
P	119.40±3.45b	116.30±4.12c	120.40±2.23a	115.19±2.34c
Fe	4.55±0.16b	4.25±0.36c	4.15±0.22c	4.60±0.14a
Zn	1.10±0.11c	1.35±0.31c	1.98±0.23a	1.51±0.18b
Mn	1.53±0.42c	1.40±0.33c	1.60±0.03b	1.80±0.07a
Cu	0.19±0.01b	0.12±0.02c	0.13±0.03c	0.22±0.04a
Pb	ND	ND	ND	ND

Each value is the mean ± standard error of three replicates. Means in the same row followed by the same letter are not significantly different at $p \geq 0.05$.

KEY: Not detected.

IV. DISCUSSION

Cereals and grains constitute major sources of nutrients worldwide. Rice is a major staple food in many households in Nigeria. Majority of people prefer imported rice to local ones regardless of the facts that the imported rice varieties are costlier. Knowledge about the proximate and mineral composition of the local rice can promote its acceptability and consumption among Nigerians [2]

The moisture contents in the four varieties of rice in this research work ranged between 8.36% and 10.98 %. This is in agreement with most literature for white rice[19]. Moisture content invariably affects the quality and palatability of rice grains [17] and plays a significant role in determining the shelf life and controls the rate of deterioration and infestation of the grains during storage[30] and [20]. It also affects the milling characteristics and the taste of the rice after cooking. Faro 60 possessed low moisture content which is good for

long term storage of rice [20]when compared with the other varieties. The difference in moisture content among the rice varieties might be due to the variation in moisture content in the paddy after harvesting. The range of the moisture content (8.36 % and 10.98%) in this study was under the values reported by[15].

Fat in rice is a good source of linoleic and other essential fatty acids but does not contain cholesterol [9]. Fat content influences the taste of cooked rice because rice with high fat tends to be more palatableand have less starch [11]. Fat content in this study were comparatively somewhat similar to the ones obtained by[10], [18] and[23]. The variations in fat value in rice varieties may be due to oxidation of fat because most fat in rice grains is unsaturated and undergoes oxidation easily by atmospheric oxygen interaction[11]

The protein content range (5.65 % to 8.34 %) in this study is in agreement with the ones obtained by other researchers [4]and[28].Proteins in rice are very essential as proteins form the basic building blocks for cells and tissue repairs in the body [15]. The presence of protein influences the nutritional quality of rice [15]. The variations of protein content in different rice varieties might be due to several factors such as water supply, handling, application of fertilizer, environmental stress (such as salinity and alkalinity, temperatures and diseases), location of growing areas, growing conditions and time which tend to increase the grain protein content.

Ash is the inorganic residue remaining after the water and the organic matter have been removed by heating. Ash plays an important role to reflect the mineral elements of a food sample [15]and gives an idea to determine the levels of essential minerals present in the food [8]. The values of ash in rice recorded in this study is similar to those reported [15]. The differences in ash content in the rice varieties may due to the differences in mineral content of the soils and the water used for irrigation [26].

The presence of fibre in diet increases the bulk of feaces, which has a laxative effect in the gut [15]. The standard fibre content for well milled rice is 0.5– 1.0 (17). Fibrecontent inthis study agreed with the one obtained by[28] and [23].The crude fibre content affects the rice digestibility whereby high content of crude fibre in rice lowers its digestibility [32].

The four rice varietiesstudied in this finding contained a high quantity of carbohydrate ranging from 77.15 % to 82.70 % .Rice carbohydrates are mainly starch which is composed of amylose and amylopectin. Similar ranges of the carbohydrate contents ofhasbeen reported [28] and [23]. A high level of starch makes the individual grains stick together while low starch content preventssticking of the grains after cooking[15]Carbohydrate content was high in all the four rice varieties (greater than 77 %) and hence can be considered to be good source of carbohydrate [28] and hence, a good source of energy.

Minerals are well-known essential nutrients and play vital roles in the effective functioning of the body activity.In rice, genetic characteristics of varieties and environmental factors affect mineral content[33]. The genotypic variations might provide opportunities to select for rice germplasm with higher mineral element[13]. Potassium content in all the four varieties of rice is absolutely within the range of values [7], but lower than that [25]

V. CONCLUSIONS

The four varieties of rice were high in carbohydrates with the highest percentage recorded in Faro 60. Fat content was also highest in Faro 60 while protein was highest in Igbemo and Benue varieties. The local rice varieties had higher carbohydrate content with higher protein, moisture, ash, fat and mineral contents compared to foreign rice sample. The values obtained in Nigeria local rice indicate that the local varieties of the rice under study are packed full with nutrients and minerals and so are highly nutritious than the foreign rice. Since the local rice varieties contain more nutrients and minerals than the imported (Aroso) variety in many cases, their consumption should be encouraged and awareness should be created among the populace.

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