PROXIMATE AND MINERAL COMPOSITION OF SOME FOREIGN AND LOCAL RICE VARIETIES SOLD IN MILE 3 MARKET, PORT HARCOURT, RIVERS STATE, NIGERIA

ABSTRACT

Rice is a staple food in many countries of Africa and it is nutritionally beneficial. This research work compared the proximate composition and mineral composition of some local rice and foreign rice varieties. Four varieties of rice were analyzed; two types of local rice designated as (L_1 and L_2) and two types of foreign rice (F_1 and F_2). Rice samples were obtained and proximate composition such as moisture content, ash content, carbohydrate content, crude protein, crude fiber and total fat were evaluated using standard methods. The result of the analysis showed that the moisture content was lowest in L_1 (8.56 ± 0.26g) and highest in sample L_2 (9.47 ± 0.48g). All the four varieties recorded high carbohydrate content. The sample L_1 obtained the highest fat content (2.48 ± 0.09g). The highest crude protein was obtained in sample L_2 (8.09 ± 0.22g). The least protein was recorded in the sample F_2 (6.34 ± 0.22g). The sample L_2 obtained the highest fiber content (1.69 ± 0.09g). The highest ash content was recorded in F_1 (1.20 ± 0.20g). K and Zn showed no significant difference in all samples apart from FR1 where K and Zn were significantly different. Ca values for foreign rice showed significant difference when compared to the values for local rice. Local rice appeared to have had a relatively higher level of iron when compared to all the foreign rice samples. The values obtained from this study indicates that Nigerian local rice varieties are nutritionally better compared to foreign rice.

Keywords: Foreign rice, Local rice, Mineral content, proximate composition.

1.0 INTRODUCTION

Rice is a cereal crop with a high energy or high caloric food and a high biological value of protein (Singh *et al.*, 2014). Rice is an important cereal plant belonging to the grass family Poaceae (Vaughan *et al.*, 2008). It is one of the two cultivable species of its genus *Oryza* and originates from Asian countries including India, Thailand and China. *Oryza glaberrima* (African native rice) is mainly grown in West African countries (Linares, 2002). For a vast portion of the global population, rice, also known as *Oryza sativa* (Asian rice) or *Oryza glaberrima* (African rice) is primarily consumed as a staple food. Depending on the type and soil richness, the plant can reach a height of 1–1.8 m. The edible seed is a grain (caryopsis) that is 5–12 mm long and 2-3 mm thick. Due to its nutritional quality and higher digestibility, rice is considered as the queen among cereals (Anjum et al., 2007).

Consumption of rice is extremely beneficial for the health because it does not contain harmful fats, cholesterol or sodium. It forms an integral part of balanced diet (Verma & Srivastav, 2017).

As rice is rich in carbohydrate it acts as fuel for the body and helps in normal functioning of the human brain (Umadevi et al., 2012; Zaghum et al., 2022). It is classified as the most important food depended upon by over 50 percent of the world population. It is relatively easy to produce and it is grown for sale and home consumption (Vanghan et al., 2008)

Rice is an essential commercial crop for diversifying diets, ensuring household food security, and is majorly used in ceremonies (Perez et al., 1987). It is regarded as the primary staple meal in many nations, and the World Health Organization (WHO) notes that it is a significant cereal crop that feeds more than half of the world's population (WHO, 2005). Nearly all ecological zones in Nigeria grow rice.

As stated by Ibrahim et al. (2021), the varieties produced in Nigeria are *O. glaberrima*, (Ofada) grow in Ofada town in the south west region of the country and new rice (NERICA) a hybrid of the *O. sativa* and *O.glaberrima*. However, Oko & Ugwu, (2011), reported that Nigeria has several varieties of rice which are cultivated in Abakaliki in Nigeria.

There is a rise in the importation of foreign or imported rice types into Nigeria despite the fact that the country grows a variety of local varieties of rice. The polished rice, also known as "Aroso" rice in local dialect, is a well-known imported and parboiled rice variety made in Thailand, imported into Nigeria, and widely consumed. Foreign rice brands are more commonly consumed in Nigeria than domestically produced types like "Ofada" and "Abakaliki." Low production of these native types is likely a result of lack of knowledge about their nutritional values, the belief that they frequently contain stones and dirt (leftover bran on the rice), the presence of anti-nutrients, and other factors. The physical characteristics of Aroso (imported) rice and its cooking qualities, such as its ability to swell and a quicker cooking time, may be the reason for its acceptance. Consumption of rice bran in food and its constituents has been shown to have anti-chronic disease effects, especially in the prevention of cardiovascular disease and several malignancies (Wilson et al., 2007). Both the domestic and foreign rice sold in Nigerian markets are parboiled. The benefits of parboiling include improving the protein and mineral content of the grain as well as other advantages. When rice is parboiled, minerals, proteins, and vitamins from the hull and bran of paddy move to the starchy endosperm, boosting the nutritious content of the grain (Azuka et al., 2020). Local rice has a smaller market share than imported rice since it is thought to be less nutritious than imported parboiled rice, which has caused imports to see an increase in popularity, particularly among wealthy urban residents. Imported rice has flooded the market as a result of urban inhabitants' reliance on it, while native rice is ignored and kept for the rural and urban poor because it is so inexpensive. This study is aimed to evaluate the proximate composition and mineral content of some local and foreign rice species in order to ascertain the nutritional components of both varieties of rice and its contribution to healthy living.

2.0. Materials and Methods

2.1. Study area

Mile 3 market was selected for this study. Mile 3 market is located in Diobu area of Port Harcourt metropolis at latitude 4° 47' 24" N and longitude 6° 59' 36" E.

2.2. Sample collection

Two local rice varieties as well as two foreign rice namely were bought from random sellers at Mile 3 market.

2.3. Determination of proximate composition

Proximate composition of the samples were determined using the AOAC methods (1990).

2.3.1. Determination of Moisture content

The samples were washed with deionized water and allow to dry under shed. After drying, the samples were pulverized into fine powder

Moisture cans were thoroughly washed and dried in an air oven at 105˚C for 30 minute and allowed to cool inside in the desiccator. After cooling they were weighed as W_1. Then 5g of the finely ground rice samples were put into the moisture cans and weighed as W_2, thereafter, the sample plus the moisture cans were placed inside the oven and dried at 130˚C for 1 hour. The samples were removed from the air oven and cooled inside the desiccator for 15 minutes. After cooling, the samples were weighed as W_3 and moisture content of the rice samples were calculated. Samples were duplicated to avoid spilling and to compare.

$$\text{Moisture \%} = \frac{(W2 - W3)}{(W2 - W1)} \times 100$$

Where:

W_1 = initial weight of empty moisture can

W_2 = weight of moisture can sample before drying

W_3 = finial weight of moisture can + sample after drying.

2.3.2. Determination of Ash content

AOAC (1990) method was used in the determination of the ash content of rice. 1gram of sample was weighed into a previously ignited and cooled porcelain crucible with the lid. The crucible and sample were heated on a heating mantle in 9 fume cupboard until smoking ceased. The crucible and the content were then transferred to a muffle furnace and allowed to ash for 3 hours at 500˚C. At the end of ashing, the crucible with its content were removed from the furnace and cooled in a desiccator and weighed again. The percentage ash content of the samples was then calculated as follow.

$$\text{Ash \%} = \frac{\text{weight of ash}}{\text{weight of sample}}$$

2.3.3. Determination of Crude fat

The crude fat was determined using the soxhlet extraction method (micro extraction unit). 0.5g of dried sample was weighed, wrapped in a whatman No.11 filter paper and extracted in the extraction unit for 3 hours using petroleum ether as solvent. At the end of the extraction process, the ether was evaporated and the weight of the extraction flask taken. The difference in weight of the extraction flask before and after extraction was recorded as the amount of fat or ether extract.

$$\text{\% Crude fat} = \frac{\text{weight} \times \text{ether extract}}{\text{weight of sample}} \times 100$$

2.3.4. Determination of Crude protein

Determination of the crude protein content of rice followed the method of the Association of Official Analytical Chemist. Washington D.C (1990).

0.5g of samples was weighed into a 100ml kjeldahj flask. To this were added one and a half table spoon of kjedahl catalyst and 10ml of Nitrogen free concentrated Sulphuric acid. The mixture was heated slowly for digestion in a fume cupboard with the flask placed at an angle of 40˚C for 30 minutes. Heating was then increased and continued until frothing ceased. The sample was allowed to cool and then transferred into 100 ml volumetric flask and made to volume with distilled water. 10ml of the digest was introduced into 100ml kjedahl distillation flask and 10ml of 45 % NaOH was added. The ammonia liberated was steam distilled into a 5ml of boric acid indicator in a conical flask until 50ml of the distillate was obtained. This was back titrated against 0.05 M H_2SO_4 to give the nitrogen content of the sample. A blank determination was also carried out and subtracted from the sample reading and the % N was calculated thus;

$$\text{N \%} = \frac{(\text{True - Blank})\times\text{Normality of acid}}{\text{weight of sample}} \times 1.4$$

The percentage crude protein content of the rice sample was then calculated thus:

% crude protein = % N × 5.7

2.3.5. Determination of Crude Fiber

0.5g of the moisture free sample was extracted for three hours with petroleum ether using a soxhlet apparatus. The fat free material was placed in a 200 ml beaker and 50 ml of 1.25% w/v Sulphuric acid was added and covered with a watch glass. The content of the beaker was heated gently on a hot plate for 30 minutes (acid hydrolysis). At the end of the acid hydrolysis, the content of the beaker was filtered under vacuum through a Buchner funnel fitted with filter paper (whatman No. 40) and washed with boiling water until the washing was no longer acidic to litmus paper. The residue was washed back into the beaker flask with 1.25% NaOH, boiled for 30 minutes covered with a wash glass. The resulting insoluble material was transferred to a dried pre-weighed ash less filter paper and washed thoroughly first with hot water until the washing is no longer alkaline to litmus and then 15 ml of ethanol (95%) by volume, dried at 105˚C to a constant weight for one hour. The filter paper and content was incinerated to ash at 500˚C for one hour. The ash was then cooled and weighed. The weight of the ash was then cooled and weighed. The weight of the ash was subtracted from the increase of weight on the paper due to the insoluble material and the difference reported as fiber.

Crude fiber% $= \frac{\text{Weight of fibre}}{\text{Weight of sample}} \times 100$

2.3.6. Determination of Carbohydrate

The manual Clegg Anthrone method of Osbome & Vopgt, (1978) was used in the determination of total available carbohydrate of rice samples.

1g of rice samples was digested using 13ml of 52 % perchloric acid (diluted with water in the ratio of 270ml: 10ml). 1 ml of the digest was pipetted into a test tube and 5ml of freshly prepared. Anthrone reagent was added, mixed and allowed to stand in a boiling water bath for exactly 12 minutes. The test tube and its content were then removed and cooled quickly to room temperature. The absorbance of the sample mixture and standard were then read at 630nm against the reagent blanks, and the total available carbohydrate content of the sample was then calculated thus;

Total available carbohydrate (as % glucose) $= \frac{25 \times b}{a \times w}$

Where;

a = Absorbance of dilute standard

b = Absorbance of dilute samples

w = Weight (grams) of samples

Carbohydrate (by difference); the carbohydrate content was determined by difference i.e

100 – (% moisture content + % Ash + % fat + % crude protein + % crude fiber).

2.4. Mineral content analysis

The minerals were determined using Atomic Absorption Spectrometer.

2.5. Statistical Analysis

Mean ± standard deviation of triplicate determinations was used to analyze data which was also compared with Analysis of Variance using the IBM Statistical package of Biological and Social Sciences.

3.0. RESULTS

3.1. Percentage variation in moisture, ash content and crude protein of Local Rice (LR) and Foreign Rice (FR)

The percentage variation in moisture, ash content and crude protein of foreign and local rice varieties is presented in figures 1, 2 and 3. Percentage variation in moisture content for foreign rice ranged from 8.60% -8.69%, local rice ranged from 8.56% -9.48%. The percentage variation in ash content for foreign rice ranged from 0.62% -1.20%, local rice ranged from 0.60% -0.68%. The percentage variation in crude protein for foreign rice ranged from 6.34%-7.22% local rice ranged from 7.89%- 8.09%.

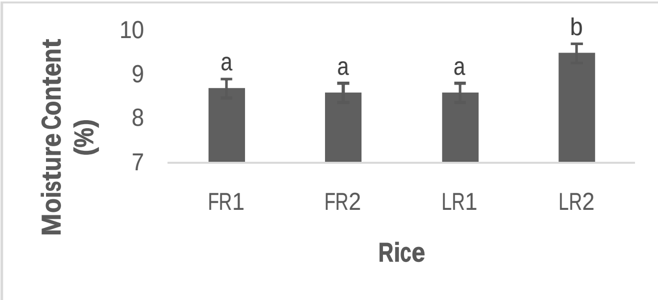

Fig.1 Variation in percentage moisture content of rice varieties.

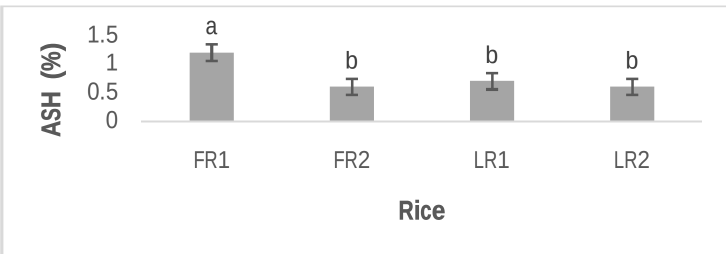

Fig.2. Variation in percentage ash content of rice varieties

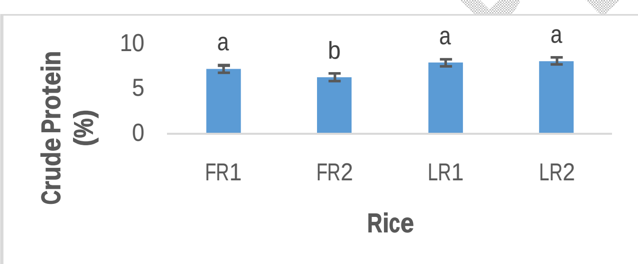

Fig.3. Variation in percentage crude protein of rice varieties.

3.2. Percentage variation in total fat content, crude fiber and carbohydrate content of Local Rice (LR) and Foreign Rice (FR)

The percentage variation for total fat content, crude fiber and carbohydrate content of foreign and local rice varieties is presented in figures 4, 5 and 6. The Percentage variation in total fat content for foreign rice ranged from 1.69%-1.99%. Local rice ranged from 1.19% -2.48%. The percentage variation in crude fiber for foreign rice ranged from 0.29% -0.39%. Local rice ranged from 1.49% -1.69%. The percentage variation in carbohydrate content for foreign rice ranged from 80.6%- 82.6%. Local rice had the value 78.9%.

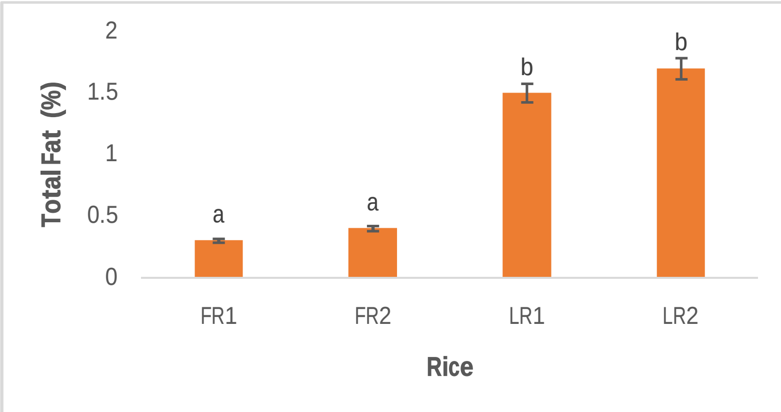

Fig.4. Variation in percentage total fat of rice varieties.

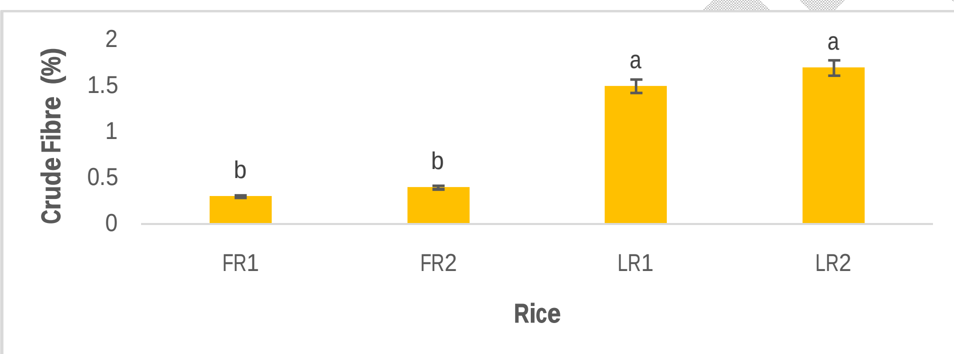

Fig.5. Variation in percentage crude fiber of rice varieties.

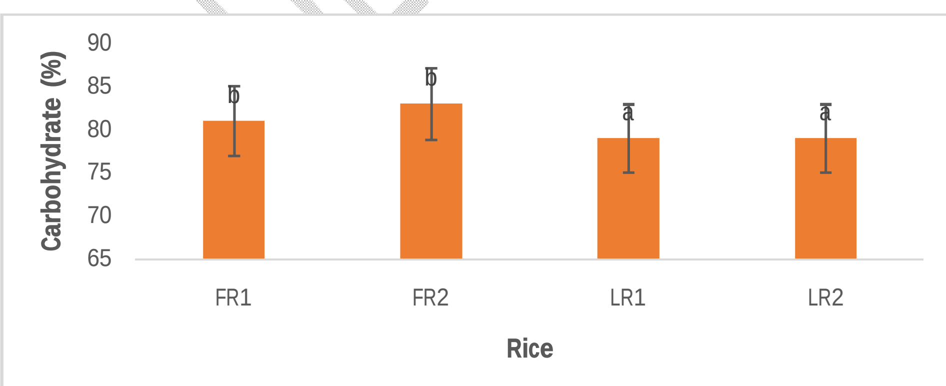

Fig.6. Variation in percentage carbohydrate of rice varieties.

3.3. Mineral composition of rice varieties

Table 1 shows the result for the concentration of iron, potassium, magnesium, phosphorous, calcium and zinc, for both varieties of rice.

Table 1: Minerals content (mg/100g) of some foreign and local rice in Mile 3 Market, Port Harcourt

Groups/ Parameters	Calcium	Magnesium	Potassium	Iron	Phosphorous	Zinc
LR1	$99.40^{c}\pm1.92$	$210.77^{c}\pm1.17$	$187.93^{b}\pm0.91$	$6.18^{b}\pm0.01$	$187.75^{a}\pm1.89$	$4.29^{b}\pm0.03$
LR2	$87.27^{b}\pm5.29$	$177.63^{b}\pm3.94$	$168.20^{b}\pm7.62$	$8.46^{c}\pm1.50$	$165.20^{b}\pm4.02$	$4.68^{b}\pm0.13$
FR1	$73.52^{a}\pm1.14$	$152.81^{a}\pm2.18$	$296.25^{a}\pm0.53$	$4.70.^{a}\pm0.30$	$179.09^{a}\pm2.17$	$3.45^{a}\pm0.16$
FR2	$78.57^{a}\pm7.07$	$185.33^{b}\pm5.49$	$195.06^{b}\pm3.12$	$6.50^{b}\pm0.00$	$157.76^{b}\pm4.42$	$3.37^{b}\pm0.04$

Variables are expressed as mean $\pm$ standard deviation (SD). Values with different subscript shows significant difference at the 0.05 level.

4.0. DISCUSSION

Moisture content plays a significant role in the determination of the quality of rice and its palatability. Furthermore, it plays a role in the determination of the shelf life (Oko et al., 2010; Obembe et al., 2022). Percentage variation in moisture content for the four varieties of rice ranged from 8.60% -9.48%. The values obtained in this work corresponds closely the values obtained by Obembe et al., (2022) on proximate composition, mineral and heavy metals concentration of some foreign and locally produced rice in Nigeria.

It was observed that the ash content for the four rice varieties ranged between 0.6%-1.2%. Values obtained in this study is higher than the values obtained by Faustina & Cleopatra, (2017) on comparative studies of proximate and some mineral composition of selected local rice varieties and imported rice brands in Ghana.

The percentage variation in crude protein for the four rice varieties ranged from 6.34%- 8.09%. The protein content in this study is in agreement with the values obtained is in close ranged to the values obtained by Obembe et al., (2022). Factors such as handling, water supply, may be the reason for variations in protein content of the varieties of rice studied (Obemebe et al., 2022).

The Percentage variation in total fat content for different rice varieties ranged from 1.69%-2.48%. The values obtained in this work is in close range to the values obtained by Faustina & Cleopatra, (2017).

The percentage variation in crude fiber for the different rice species ranged from 0.29% -1.69%. Crude fiber are easy digestible polysaccharide which can be in soluble or non-soluble form and increase faecal bulk. They form complexes with protein, sugars and cholesterol. When taken in excess, they help to reduce the risk of colon cancer and scrub out the intestine leaving a much healthier digestive system (Okezie et al., 2017).

The percentage variation in carbohydrate content for foreign rice ranged from 78.9%- 82.6%. The values obtained in this week is similar to the values reported by Ebubechi &Oyewole, (2007).

The result for mineral content showed that Mg had the highest values across all rice varieties. The highest value was 210.77mg/kg. K had the next highest value while zinc had the lowest values for all rice varieties.

CONCLUSION

The result of this study shows that local rice is a nutritive crop containing most of the essential nutrients and minerals. It is highly nutritive when compared to foreign rice and thus preferable to consume locally made rice.

DISCLAIMER

COMPETING INTERESTS

Authors have declared that no competing interest exist. The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, this research was not funded by the producing company rather it was funded by personal efforts of the authors.

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