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Proximate Composition, Minerals and Heavy Metals Concentration of Some Foreign and Locally Produced Rice in Nigeria

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Abstract

Rice is a cereal crop grown in Nigeria and predominantly in the Northern part of the Country. It is consumed almost in every household. This research work focused on proximate composition, minerals and heavy metals concentration in some local and foreign rice consumed in Nigeria. Eight different products of rice were collected for this study, two of them were foreign products while the other six are locally harvested in Nigeria. The products are Kebbi, Thiland, India, Jigawa, Kano, Abuja, Ebonyi and Nasarawa rice. The products were labeled A-H respectively. Standard methods were used for the analysis of the different parameters. The result of proximate composition showed that India rice had the highest moisture content (10.06%) while Jigawa rice had the least (8.22%). Ash content of Jigawa rice (0.89%) was significantly ($p<0.05$) higher when compared with other samples. Also crude protein content of Kebbi rice (7.94%) was significantly ($p<0.05$) higher when compared with other samples. Result for heavy metal analysis showed that arsenic and lead values were higher in Kebbi rice while Nasarrawa rice had the least values for both metals. The concentration for Cd and Hg showed no significant difference in all the samples. Potassium content was highest when compare with the concentration of other minerals analyzed. Mg and Na values showed no significant difference in all the samples. Ca value for sample F was significantly difference when compared with the values for other samples. Except for sample A which had higher As and Pb concentrations, this study showed that these local rice collected for this study are nutritional good and comparable to the foreign rice, their consumption should be encourage in our household.

Keywords: Rice; Proximate Composition; Heavy Metal and Mineral Content

Introduction

Rice is one of the major staples grown in Nigeria especially in the Northern part. It has earned itself an important position as one of the most commonly consumed staple by the national populace [1]. Rice is the second prevalent cereal crop in the world with an annual global production of approximately 60 million tons [2]. Lack of food safety is a major problem in most developing countries. Many food items are heavily loaded with pollutants including heavy

metals [1]. Consumption of contaminated foods has serious implication on health and economic status of the populace [3,4]. Before 2015, Nigeria was the second largest importer of rice in the world, buying about 2 million metric tons per year from major exporter like China and Thailand. Rice is grown in all the ecological and dietary zones of Nigeria with different processing adaptation trait for ecology [5]. However, heavy metals like cadmium, lead, arsenic and copper have been identified as a risk to human health through consumption of contaminated food [1]. They occur as natural constituent of the earth crust and could also be distributed by human activities. These heavy metals contaminate food source and accumulate in both agricultural products via absorption from contaminated soil [6,7]. Therefore, the need to evaluate the nutritional and metal load in some of our local rice from different states.

Materials and Methods

Sample Collection/Analysis

A total of six different types of locally produced and two foreign rice were bought from the local market. Each of the local rice was cultivated from different states in Nigeria. The samples were Kebbi, Thiland, India, Jigawa, Kano, Abuja, Ebonyi and Nasarawa rice and were labeled A-H respectively. Washington DC [8] method was adopted for both Proximate and mineral content analysis, while Inductive plasma emission spectroscopy (IPES) was used for heavy metal analysis as described by Oleg and Nikolay (2019) [9].

Metals Analysis

Test tubes and beakers were washed and dried at 50°C for 20 minutes in an oven. One gram each of ground rice sample was accurately weighed into the beaker. The sample was dissolve with 5mls of 10% of HCl and heated in a hot plate. Further 5mls of 10% nitric acid was added to completely dissolved the sample. The solution was then transferred quantitatively using a stirring rod and through a 5cm flitter paper and funnel into a clean and dry 50ml volumetric flask, and made up with deionized water. The sample solution was subsequently analyzed for metals.

Statistical Analysis

Data were subjected to analysis using Analysis of Variance (ANOVA). Data from each parameter was expressed as mean ± Standard Deviation. Data were considered to be significantly different at 95% confidence level ($P < 0.05$).

Results

Sample	Country	State	Moisture	Ash	Fat	Protein	Fiber	CHO
A	Nigeria	Kebbi	9.16±0.29 acegikm	0.76±0.08 bdfhikn	0.85±0.10 bcehikm	7.94±0.27 bdfhjln	1.63±0.00 bdfhjln	79.69±0.03 bcegikm
B	Thiland	-	9.68±0.45 acfgikm	0.55±0.03 *acfgjlm	2.98±0.01 *adfhjln	7.44±0.00 *acfhjln	3.92±0.00 *adehjlm	75.30±0.48 *dfhiln
C	India	-	10.06±0.68 acfgikm	0.60±0.00 *acfgjkm	0.66±0.19 bcfhikm	7.44±0.00 *acfhjln	2.64±0.00 *bcfgiln	78.34±0.90 bcegikm
D	Nigeria	Jigawa	8.22±0.44b degjln	0.89±0.00 *bdehjln	0.80±0.10 bcehikm	6.63±0.00 *bdegiln	3.79±0.00 *adehjln	79.50±0.56 bcegikm
E	Nigeria	Kano	9.12±0.36 acegikm	0.59±0.00 *acfgjkm	2.32±0.01 *bdfgjln	6.63±0.00 *bdegiln	2.64±0.00 *bcfgiln	78.71±0.36 bcegikm
F	Nigeria	Abuja	9.97±0.03 acfgikm	0.75±0.03 bdfhikn	0.50±0.10 bcfhilm	6.63±0.00 *bdegiln	2.62±0.38 *bcfgiln	79.37±0.49 bcegikm
G	Nigeria	Ebonyi	9.53±0.09 acfgikm	0.69±0.00 bcfgikm	1.07±0.29 bcfhjkm	5.75±0.00 *bdfhjkn	4.38±0.07 *bdfhjkm	78.46±0.32 bcegikm
H	Nigeria	Nasarawa	9.71±0.60 acfgikm	0.60±0.00 *acfgjkm	0.66±0.00 bcfhikm	4.93±0.06 *bdehjlm	4.36±0.07 *bdfhjkm	79.49±0.98 bcegikm

Table 1: Percentage (%) Proximate Composition of some foreign and locally produced rice.

Values are expressed as mean ± standard error of mean (SEM) for n=3. Values with different superscript letter a,b,c,d,e,f,g,h, i,j, k,l,m,n) in the same column are significantly different at the 0.05 level (p≤0.05). * differ significantly when comparing group A with other groups, a, b differ significantly when comparing group B with other groups, c,d differ significantly when comparing group C with other groups, e,f differ significantly when comparing group D with other groups, g,h differ significantly when comparing group E with other groups, i,j differ significantly when comparing group F with other groups, k,l differ significantly when comparing group G with other groups, m,n differ significantly when comparing group H with other groups. Value with the same superscript letter show no significant difference.

Sample	Country	States	As	Cd	Hg	Pb
	Cultivated	Cultivated				
A	Nigeria	Kebbi	0.8311	0.0024	<0.001	0.1455
B	Thiland	-	0.6993	0.0016	<0.001	0.0992
C	India	-	0.7894	0.0014	<0.001	0.1027
D	Nigeria	Jigawa	0.795	0.0014	<0.001	0.0909
E	Nigeria	Kano	0.6566	<0.0011	<0.001	0.0915
F	Nigeria	Abuja	0.6878	0.0065	0.0117	0.1306
G	Nigeria	Ebonyi	4.864583	0.0017	<0.001	0.1021
H	Nigeria	Nasarawa	0.6284	0.002	<0.001	0.002
WHO limits			0.06	0.03	0.003	0.026

Table 2: Heavy Metal Content (mg/kg) of some foreign and locally produced rice.

Sample	Country	States	K	Mg	Ca	Na
	Cultivated					
A	Nigeria	Kebbi	9.83±0.2	2.67±0.1	4.12±0.0	4.25±0.0
B	Thailand	-	10.43±0.1	2.37±0.0	3.36±0.0	3.65±0.1
C	India	-	10.08±0.0	2.59±0.0	4.34±0.1	3.65±0.1
D	Nigeria	Jigawa	10.56±0.0	2.60±0.1	3.97±0.1	3.59±0.0
E	Nigeria	Kano	9.70±0.1	2.41±0.2	3.75±0.0	3.39±0.0
F	Nigeria	Abuja	10.75±0.0	3.42±0.0	8.26±0.0[b]	3.70±0.0
G	Nigeria	Ebonyi	11.14±0.0	3.32±0.0	5.49±0.1	3.93±0.2
H	Nigeria	Nasarawa	10.74±0.0	2.89±0.1	4.04±0.0	4.06±0.0

Table 3: Minerals Content (mg/kg) of some foreign and locally produced rice.

Discussion

Proximate composition describes the percentage content of moisture, crude protein, crude fibre ash and nitrogen free extracts [2]. Table 1 showed the composition of these parameters. The decreasing order of the moisture content were C > F >H >B > G > A > E, sample D has the least moisture content while C had the highest composition. Also the value for sample D showed significant decrease when compared with the moisture values for samples B, F, G and H. Ash and fat content for samples D and B respectively, showed significant different when compared with their values for other samples. The result for crude protein showed that sample A had the highest value, followed by sample B and C which had the same values. Sample D, E, and F also have the same values while sample H had the least value. From the result gotten from the analysis for crude fibre, sample G has the highest value, followed by sample F, B, D, and C. Sample E and F have the same value while sample A has the least value.

For carbohydrate analysis, the result shows that sample A has the highest carbohydrate content followed by sample D and F. The remaining samples result shows, F > E> G > C while sample B has the least value. This study suggests that, locally produced rice in Nigeria is nutritious as compared to the foreign rice and it is in agreement with report of Otitoju,

et al. (2014) [1].

Toxicity induced by heavy metals is associated with bioaccumulation and biomagnification. Plants are good source for bioaccumulation of metals if they are bioavailable [10,11]. This property is responsible for the usage of plant for phytoremediation, but on the other hand, there is great concern about heavy metal toxicity when the heavy metals load are not been verified due to environmental pollution in our plants and food. A total of 4 heavy metals (As, Cd, Hg and Pb) were determined. The result showed that Arsenic has the highest heavy metal concentration with value of 0.8311mg/kg as observed in sample A. the other samples result for Arsenic were in this order: D > C > G > B > F > E while sample F has the least value with 0.6284mg/kg. The test for cadmium showed that the concentration of cadmium in the various rice samples ranges from less than 0.0001 to 10.0065mg/kg. The highest value was obtained for sample F while the least value was found in sample E. Mercury was discovered to be the lowest in concentration among all the rice samples where sample A, B, C, D, F, G, F Was found to be less than 0.00001mg/kg and sample E has the highest value for mercury which is 0.0119mg/kg.

The result for lead shows that the sample with the highest accumulation of lead was sample A, with value of 0.1455mg/kg. This was followed by sample F which was greater than sample C. The above result however shows that the heavy metals were within the acceptable limit and their concentrations were lower in locally produced rice when compared with the foreign rice.

The result for mineral content showed that potassium has the highest concentration across all the samples analyzed. The highest value was 11.14 mg/kg which was obtained in sample G. The rest was in decreasing order as F > H > D > B > C >A while sample E has the least concentration (9.70mg/kg). Magnesium values ranges from 2.37 mg/kg to 3.42 mg/kg and sample F had the highest concentration. Magnesium was the least concentrated among all minerals content measured across all the samples. Also the locally produced rice had higher magnesium content than foreign ones. Calcium content showed that sample F value significantly increased when compared with other samples.

Conclusion

This study suggests that it is preferable to consume locally produced rice in Nigeria because of their nutritious advantage as compared to the foreign rice. Also, due to the low metal load found in the locally produced rice except for Kebbi rice, food safety is guaranteed while consuming locally produced rice [12,13].

Authors Contribution

This work was design and carried out in collaboration among all authors.

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