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NUTRIENT CONTENT EVALUATION OF RAINFED RICE VARIETIES IN SEKE-BANZA AREA, DEMOCRATIC REPUBLIC OF CONGO

Franck Ngoyi Tshite[1]*, Van Tshiombe Mulamba[2], Daniel Dibue Munkamba[3] and Jules Bongobele[4]

*Corresponding Author: Franck Ngoyi Tshite, ✉ tshitengoyi@gmail.com

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Study was carried out to evaluate nutrient content of five rainfed lines of rice (IR47686-13, NERICA11, WAB569-35-1-1-1-HB, WAB781-140-1-1-HB, WAB897-B-B-B-B2) introduced in INERA GIMBI station. NERICA4 was used as local improved control. After moving away the husk, samples were separated in Husk and brown grains. These were separately analyzed at the Laboratory of biochemistry and food technology of CGEA/ CREN-K, in Kinshasa. Following parameters were evaluated on 100 g of each sample: moisture content (%), ash (%), fat (%), protein (%), dietary fibre (%) and lignin (%). Statistical analysis did not reveal significant difference in evaluated parameters of each part (grain and husk) of all varieties (Table 1), except protein content and lignin in husk (Table 3). Moisture, ash, protein, fibre, lignin and fat content were determined according to AOAC methods. It appears that the contents expressed as g/100 g (%) range as follows: moisture, 12.09-10.85; ash 1.51-1.01; protein, 7.57-5.70; fat, 2.73-0.93; fibre, 0.95-0. 74 and lignin, 2.34-1.82 for brown grain. For husk, following values (%) were obtained: moisture, 8.72-7.22; ash, 22.85-15.83; protein, 1.77-1.45; fibre, 44.34-35.63; lignin, 59.00-45.58. These results can orient industry makers in the choice of rice varieties for milling to fight against malnutrition.

Keywords: Rainfed rice varieties, Nutrient content, Seke-banza area, Milling process

INTRODUCTION

Rice (*Oryza sativa L*) has been considered the best staple food among all cereals and is the staple food for over 3 billion people, constituting over half of the world's population (Cantral and Reeves, 2002). It is usually consumed as a whole grain after cooking, and in a regular Asian diet, it can contribute for 40 to 80% of the total calorie intake (Paramita *et al.*, 2002; Singh *et al.*, 2005; Hossain *et al.*, 2009; and Cai *et al.*, 2011).

Rice is rich in genetic diversity based on thousands of varieties grown around the world. In the natural condition, the grain of rice can have different colors ranging from brown to red through violet and even black. These different colored varieties are often appreciated for their medicinal properties (Table 1).

Consumption of rice in the word has increased tremendously over the last few years and this is mainly as a result of increased urbanization and the relative ease with which it can be cooked (Tomlins *et al.*, 2007; and Gayin *et al.*, 2009). However, the increasing demand for rice (both in quantity and quality) far outweighs local production.

[1] INERA, Research Station of Gimbi, Democratic Republic of Congo.
[2] UNIKIN (University of Kinshasa), Democratic Republic of Congo.
[3] INERA, Head office, Kinshasa, Democratic Republic of Congo.
[4] INERA, Research Center of M'Vuazi, Democratic Republic of Congo.

Table 1: Nutrient Content of Brown Grain (%)

Varieties	Moisture	Ash	Protein	Fat	Lignin	Total Dietary Fibre
NERICA4	11.751	1.019	5.79	1.332	2.34	0.833
WAB781-140-1-1-HB	12.094	1.028	7.57	0.934	1.873	0.748
IR47686-13-12-2	11.783	1.262	6.566	1.433	1.82	0.953
NERICA11	10.85	1.256	5.706	1.221	1.84	0.79
WAB897-B-B-B-B-24	11.474	1.175	6.316	1.289	2	0.896
WAB569-35-1-1-HB	11.038	1.518	6.433	2.735	1.85	0.913
LSD (0.05)	0	0	0	0	0	0

Congolese preference is for imported rice over locally produced. This has been attributed to several factors including physical characteristics and nutritional quality (Adu *et al.*, 2003).

It has been opined that variations in composition and cooking quality of rice to mainly depend on the genetic as well as surrounding environmental factors where they are grown (Giri and Vijaya Laxmi, 2000; and Singh *et al.*, 2005). Rice grain quality is reported to be influenced by various physicochemical characteristics that determine the cooking behaviour as well as the cooked rice texture (Bocevska *et al.*, 2009; and Moongngarm *et al.*, 2010).

The research on rice in DRC has focused on the production of improved varieties with better production yield and stress resistance. However, there is paucity of data on physical proprieties, nutrient composition, sensory attributes and processing characteristics of the different rice varieties being cultivated by farmers in the country.

In general, the rice grain consists of 75-80% starch, 12% water and only 7% protein with a full complement of amino acids. Its protein is highly digestible with excellent biological value and protein efficiency ratio owing to the presence of higher concentration (4%) of lysine (FAO, 1998). These compositions vary with many elements like variety, soil composition, fertilizer application, milling processing method (Pomeranz, 1992; and Muhamed *et al.*, 2016).

The objective of this study was to assess the nutrient content of evaluated materials.

MATERIALS

Experimental Area

Analyzed materials were grounded in INERA GIMBI station located on 5°22’531’’south latitude, 13°22’ longitude East, 339 m of altitude, in DRC. Experimental site has the following characteristics: 13°20’883’’ longitude East, 53°11’21’’ south latitude, 409 m altitude, clay-sandy soil classified in the group of ferrasol on alkaline rock, climate type AW5 according to Koppen classification, mean annual pluviometer 1185.24 mm (Muderhwa, 2009; and SENAFIC, 2011). The laboratory of biochemistry and food technology of CGEA/CREN-K, Kinshasa, implemented the nutrient content analysis.

Biological Material

Five rainfed rice lines (IR47686-13, NERICA11, WAB569-35-1-1-1-HB, WAB781-140-1-1-HB, WAB897-B-B-B-B2), NERICA4 (improved variety cultivated as control) in INERA GIMBI station without fertilizer, were sent to the Laboratory of biochemistry and food technology of CREN-K for analysis.

These materials make parties of the new varieties selected through the project “Improvement of the access of the small farmers to the NERICA, for the reduction of rural poverty in Centre and West Africa “FIDA4” (Anonymous, 2011) and the project “Dissemination of NERICA in DRC” for the NERICA 4 (Dibwe *et al.*, 2006).

METHODS

Samples Preparation

Sufficient quantity of paddy of each variety, moisture 13%, was dehusked in a Satake testing Rice Husker (THU-34A, Satake Co. Ltd. Tokyo, Japan).

Nutritional Value

Samples of husk and brown grain were grounded separately into fine flour prior to analysis.

Moisture, Ash, Protein, Fat, Lignin and Fiber Evaluation

Moisture, ash, fat, protein, fiber and lignin were evaluated following the official AOAC (1980 and 2012) methods of analysis.

Moisture was determined by oven drying samples at 105 °C during 24 h until constant weight. Ash evaluation was obtained by stove incineration of samples (2 g) in a furnace at 550 °C during 48 hours, then weighting the residue after cooling to room temperature in a desiccator (AOAC, 2012). Continue Soxhlet extraction method during 8 hours was used to evaluate fat using ether (40-60 °C). Protein was obtained by nitrogen contents (N x 6.25) gotten after using Kjeldahl method (AOAC, 1980). Lignin was obtained by gravimetric methods based on treatment of samples with concentrated sulfuric acid (Armitage *et al.*, 1948). Enzymatic gravimetric method was used to evaluate total dietary fibre.

All Analyzes were accomplished three times.

Statistical Analysis

Collected data of evaluated parameters were submitted to analysis of variance (ANOVA) using Statistix software. Main effects were separated by Least Significant Difference (LSD) test ranged at 5% level.

RESULTS AND DISCUSSION

Brown Grain

Results of evaluated materials and their correlation are presented in Tables 1 and 2 respectively. No significant difference was reported (($P \leq 0.05$). The expressed contents in % ranged as follows: moisture, 12.099 -10.850; ash 1.518-1.019; protein, 7.570-5.790; fat, 2.735-0.934; fibre, 0.953-0.748 and lignin, 2.34-1.820. Varieties and local conditions play important role in chemical composition. Correlation was reported between fat and ash (0.676), protein and moisture (0.557). Many parameters were negatively correlated.

Moisture content plays a significant role in determining the shelf-life (Webb, 1985). It should be maintained between 11.5% to 16% level in the case of the food grains like cereals, millets and pulses (Chandy *et al.*, 2007; and Gautam *et al.*, 2015). High value can be responsible of quality deterioration. Mean presented (11.498%) is low compared to 12.88% reported by Thomas et al. (2013). According to Ponka *et al.* (2016), moisture content varying between 8.86 to 16.65% indicates the high concentration of dry matter and nutrients like protein, fat, carbohydrates and minerals salts. Value presented in this study indicates safe storage stability.

Ash represents the total of mineral content (Bhat and Sridhar, 2008). Mean of 1.20% was reported. This value is high compared to 0.56% and 0.52% reported by Adu *et al.* (2002) in local and improved varieties respectively, while comparing local to new varieties in Ghana. Our value is also higher than 0.55% reported by Thomas *et al.* (2013) while evaluating physiochemical properties, proximate composition, and cooking qualities of locally grown and imported rice varieties marketed in Penang, Malaysia. Sarh *et al.* (2015) reported 1.75% in yam tubers.

Proteins are a key factor influencing the eating quality of rice (Adu *et al.*, 2002). They are very crucial part of the human diet as they play a vital role in maintaining many physiological functions and human immune system (Doke and Guha, 2015). Mean, 6.396%, reported in this study varies between 7.570-5.706%. This value is low to mean varying between 6.78-10.5% reported by Adu *et al.* (2002). Eggum and Juliano (1975) and Juliano (1985) reported that use of fertilizer increase total protein content. Other factors such as short growth periods, soil salinity or alkalinity may also increase protein content (Adu *et al.*, 2002).

Table 2: Correlations of Pearson Between Evaluated Parameters in Brown Grains

Varieties	Moisture	Ash	Protein	Fat	Lignin	Total Dietary Fibre
Moisture	1					
Ash	-0.6468	1				
Protein	0.5578	-0.1168	1			
Fat	-0.4608	0.6763	-0.1664	1		
Lignin	0.2531	-0.4322	-0.3912	-0.02444	1	
Total Dietary Fibre	-0.151	0.4821	-0.1746	0.4737	-.0.0733	1

Mean value of fat varying between 0,934 and 2.735% was reported. This value is higher than 0.07-1.74% reported by Thomas *et al.* (2013). According to Doke and Guha (2016), fat content of food vary with process. The activity of lipase enzyme which split off the fat into free fatty acids and glycerol in the presence of catalyst like moisture, light and heat can deteriorate fat during storage (Balfour and Sharma, 2014). This situation can explain the correlation between protein-moisture and fat-ash reported in this investigation.

Mean value of Fibre varying from 0.953 to 0.748% was reported. Thomas *et al.* (2013) reported high values (7.07-8.47%), while evaluating physiochemical properties, proximate composition, and cooking qualities of locally grown and imported rice varieties marketed in Penang, Malaysia.

Lignin is one of the parietal compounds with high molecular weight (Giger, 1985). Value varying between (2-8%) produces negative effects on food digestibility (Gidenne *et al.*, 1994). Value varying from 2.340 to 1.820 was presented in this study.

Husk

Husk results and correlation are recorded in Tables 3 and 4 respectively. No significant difference revealed in evaluated parameters ($P \leq 0.05$), except protein content and lignin ($P \leq 0.05$).

Following values were reported (%): moisture, 8.70-7.22; ash, 22.85-15.83; protein, 1.77-1.44; fiber, 44.34-36.54; lignin, 53.54-45.58. High value of protein was reported by IR47686-12-3 (1.77%) followed by NERICA11 (1.62%). Low value comes from WAB 569-35-1-1-HB (1.44%). High value of lignin was reported in NERICA4 variety (59.00), the lower coming from WAB 569-35-1-1-HB. Correlation was reported between lignin and moisture. No correlation between others evaluated parameters. Negative correlation was also reported between lignin-ash (-0.5300) and moisture-ash (-0.4842).

Table 3: Nutrient Content in Husk (%)

Varieties	Moisture	Ash	Protein	Lignin	Total Dietary Fiber
NERICA4	8.5533	15.834	1.47	59	37.127
WAB781-140-1-1-HB	8.5753	16.82	1.57	48.36	43.823
IR47686-13-12-2	8.7059	17.519	1.77	53.54	42.997
NERICA11	8.1107	21.939	1.625	47.39	36.546
WAB897-B-B-B-B-24	7.9253	22.853	1.588	46.15	44.341
WAB569-35-1-1-HB	7.2241	19.336	1.445	45.587	37.121
LSD (0.05)	0.0005	0	0.204	0.458	0

Table 4: Correlation of Pearson Between Evaluated Parameters, in Husk Rice

Varieties	Moisture	Ash	Protein	Lignin	Total Dietary Fibre
Moisture	1				
Ash	0.4842	1			
Protein	0.153	0.0877	1		
Lignin	0.7194	-0.53	0.4402	1	
Total Dietary Fibre	0.2847	0.0307	0.3206	.0.2880	1

The average moisture content of husk revealed in this investigation (8.21%) is low compared to the value reported by Ponka *et al.* (2016) (12.05%/100 g of flower), but higher than 5.45% reported by Ngom (2004) in rice husk of Senegal.

Mean of 1.58% of protein in husk was reported. This value is low to (5.51 g/100 g) reported by Ponka *et al.* (2016) and 3.03 g/100 g reported by Ngom (2004). This difference in husk protein content of varieties can be explained by presence of milled rice powder in husk of some varieties.

Value of ash was varying between 19 and 15%. Mean of 19.05% was reported. This value was higher than 9.57% reported by Ponka *et al.* (2016), compared to 19.9% reported by Ngom (2004).

CONCLUSION

Investigation conducted on chemical composition of six rainfed rice lines grown in INERA Gimbi station did not reveal significant difference (P-value$\leq$0.05), except husk which showed protein content and lignin (P-value$\leq$0.05) compared to the grain.

During milling process of some varieties, powder should pass in husk to increase protein quantity. Obtained results constitute a basic data which will be helpful to industry makers in choosing milling rice variety for consumption, in order to fight against malnutrition.

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