IJBPAS, August, 2019, 8(8): 1596-1606

ISSN: 2277–4998

International Journal of Biology, Pharmacy and Allied Sciences (IJBPAS)

'A Bridge Between Laboratory and Reader'

www.ijbpas.com

INFLUENCE OF PLANTING METHODS ON THE PROXIMATE COMPOSITIONS OF SOME SELECTED RICE VARIETIES IN SOUTH EASTERN NIGERIA

[*1]Oko, Augustine Okpani, [1]Eluu, Stanley Chijioke, [2]Oluwole, Akinjide Omoniyi and [3]Umego Chukwudi

1: Department of Biotechnology, Ebonyi State University, Abakaliki, Nigeria

2: Department of Materials Science and Engineering African University of Science and Technology Abuja

3: Department of Genetics and Biotechnology, University of Calabar

okpanioko@gmail.com

Received 10th Jan. 2019; Revised 29th Jan. 2019; Accepted 9th Feb. 2019; Available online 1st Aug. 2019

https://doi.org/10.31032/IJBPAS/2019/8.8.4789

ABSTRACT

This study was carried out to evaluate the effect of the two main different planting methods on the proximate compositions of different rice varieties. The proximate composition of fourteen (14) selected rice varieties in Nigeria was analyzed using different planting methods viz: broadcasted and transplanted. The proximate composition was estimated using compositional analysis of Association of Official Analytical Chemists (AOAC), methods. The results showed that majority of the rice varieties cultivated by broadcasting method had significantly higher ($p<0.05$) percentage moisture, crude protein and crude fats than the transplanted rice while percentage crude fibre, and ash were higher in transplanted rice. There were no significant differences ($p>0.05$) between the two planting methods in percentage carbohydrates and energy value. Consumers and farmers should therefore be better informed on the choice of rice varieties based on their nutritional compositions.

Keywords: Transplanting, broadcasting, rice, proximate

INTRODUCTION

Rice is the world's second most important crop and a primary source of food for more than half of the world's population. More than 90% of the world's rice is grown and consumed in Asia where 60% of the earth's people live [1]. It has been reported that globally rice accounts for 22% of total energy intake for population in many developing countries [2]. Rice cultivation is well suited to countries and regions with low labour costs and high rainfall, as it is very labour intensive to cultivate and requires plenty of water for cultivation. Rice can be grown particularly anywhere, even on a steep hill or mountain. Although its parent species are native to South Asia and certain parts of Africa, centuries of trade and exportation have made it commonplace in many cultures worldwide [4].

Rice grain is composed of the endosperm and the a-coat. Most rice is consumed as white polished grain despite the valuable food content of brown rice. These nutrients are lost when bran is removed during milling, health conscious people prefer brown rice. Rice is consumed in milled form. The consumer acceptability and preference of rice depends on the quality of milled rice. [5] reported that rice composition differs according to rice variety and processing method used. Besides to its importance for food security, it is becoming a good source of income and employment opportunity.

Different planting methods may have effect on the nutritional qualities of the rice grain. Although, several studies have focused on nutritional qualities of different rice varieties in Nigeria, not much work, if any, has focused on the effect of different planting methods on the nutritional profile of the rice. Hence, this study was aimed at evaluating the effect of planting methods on the nutritional composition of some selected rice varieties in Nigeria with the purpose of determining the effect of planting methods on proximate and mineral composition of the different rice varieties in Nigeria.

MATERIALS AND METHOD

Location of Study

This research was carried out in Ebonyi State University, Abakaliki and the project sites were in Presco Campus Abakaliki. The research was conducted between the months of January and August, 2015.

Methods

A total of fourteen (14) rice cultivars collected from different rice growing States in Nigeria were used for this study. A pure line of each rice variety was collected from different rice breeders across the States in

Nigeria where the samples were obtained. The rice cultivars include Eleco 20, B12, Short Caro, 306, Aiwa 8, Nerica 7, Canada, Maruwa, Mass, Dangot, Cp, Ton2, Faro 52 and Awafum. The rice samples were planted to grow under the same condition using two different planting methods: broadcasting and transplanting methods.

The land was first cleared and the grasses burnt. The burning was done in order to eradicate any contaminating rice samples that may be present in the field under cultivation. Then, the land was tilled and pulverized. Mapping out of the planting spaces within the land area was carried out by making beds of 80cm x 80cm measurement. Within these beds, planting spacing of 20cm was observed. Also, 40cm space was mapped out to aid easy movement within the rice farm. The broadcasting method and the transplanting method were adopted for each rice variety in triplicates. The farm was irrigated with the help of water supplied through the tap located in the rice field. The irrigation commenced immediately after sowing of the seeds as the rice seeds needed sufficient water to germinate and was continued all through the period of cultivation until maturity. Weeding was carried out on two occasions, first on 21days after sowing and secondly during panicle initiation (42days after sowing). Urea fertilizer was applied using broadcasting method to improve the nutrient supply to the rice plant and enhance growth and yield of rice plants.

The rice varieties were harvested from the field as soon as they were ripe (45 % maturity), although their harvesting dates differed as a result of difference in maturity dates among the varieties. The rice varieties were harvested by hand-cutting method and then dried to less 14% moisture content under the sun and then threshed to release the grains from the panicle. The rice samples were then dehusked and 50g of each variety from the different planting methods ground to powder for the analysis. The samples were then used for the comparative evaluation of the proximate composition of the various samples using the standard method of the Association of Official Analytical Chemists [6] as reported by [7].

Determination of Moisture Content: Moisture was determined by Standard Official Methods of Analysis of the AOAC (method 14:004). This involved drying to a constant weight at 100 0C and calculating moisture as the loss in weight of the dried rice samples. The crucible was thoroughly washed and dried in an oven at 100 0C for 30 min and allowed to cool inside desiccators.

After cooling, they were weighed using weighing balance and their various weights recorded as (W1). Then, 2.0 g of the finely ground rice samples were put into the crucibles and weighed to get W2. Thereafter, the sample plus crucible were placed inside the oven and dried at 100 0C for 4 hours, cooled and weighed at the same temperature for 30 min until constant weights were obtained to get W3. Then, the moisture content of the rice sample was calculated from the equation:

% moisture = (W2 – W3) / (W2 – W1) x 100 where, W1 = Initial weight of empty crucible, W2 = Weight of crucible + sample before drying and W3 = Final weight of crucible + sample after drying.

Determination of Ash Content: Total ash of the rice sample was determined by Furnace Incineration described by AOAC (method 14:006) based on the vaporization of water and volatiles with burning organic substances in the presence of oxygen in the air to CO2 at a temperature of 600 0C (dry ashing). About 1.0 g of finely ground dried sample was weighed into a 277 tared porcelain crucible and incinerated at 600 0C for 6 hours in an ashing muffle furnace (Model 1184A Fisher Scientific, Houston, TX) until ash was obtained. The ash was cooled in a dessicator and reweighed. The % ash content in the rice sample was calculated as:

% Ash = Weight of Ash x 100 Weight of original sample

Determination of Crude Fibre: Crude fiber was determined using the method of AOAC (method14:020). About 2.0 g of the rice sample was hydrolyzed in a beaker with petroleum ether after which it was boiled under reflex for 30 min with 200 ml of a solution containing 1.25% H2SO4 per 100 ml of solution. The solution was filtered through a filter paper onto a fluted funnel. After filtration, the samples were washed with boiled water until they were no longer acidic. Then, the residue was transferred onto a beaker and boiled for another 30 min with 200 ml of solution containing 1.25 % NaOH per 100 ml. The boiled samples were washed with boiled distilled water. The residues were filtered through Gooch filter crucible, dried at 1000C for 2 hours in an oven, cooled and washed. The percentage crude fibre in the rice sample was calculated as per the formula: % Crude fiber = (Wt. after drying) / (Wt. of sample) x 100 2.2.4.

Determination of Fat: Total fat in the rice sample was determined using Soxhlet extraction for 4 hours starting with methanol and ethanol, respectively (Eromosele, I. C and Eromosele, C. O 1994). About 250 ml clean boiling flasks were dried in an oven at 105 – 110 0C for about 30 min and cooled in

a dessicator. Approximately, 2.0 g of samples were weighed accurately into labeled thimbles. The dried boiling flasks were weighed correspondingly and filled with about 300 ml of petroleum ether (boiling point 40 -60 0C). The extraction thimbles were plugged tightly with cotton wool. After that, the Soxhlet apparatus was assembled and allowed to reflux for 6 hrs. The thimble was removed with care and petroleum ether collected from the top container and drained into another container for re-use. After that, the flask was dried at 105 – 110 0C for 1 hour when it was almost free of petroleum ether. After drying, it was cooled in a dessicator and weighed. Then, % fat in the rice sample was computed using the formula below:

% fat = Weight of fat x 100 Weight of sample 2.2.5.

Determination of Protein: The crude protein content of the rice samples was determined using the Microkjeldahl method of [8], which involved protein digestion and distillation.

a. Protein Digestion: About 2.0 g of the rice sample was weighed into a Kjeldahl flask and 4 tablets of Kjeldahl Catalyst were added. This was followed up with the addition of 1.0 g copper sulphate and a speck of selenium catalyst into the mixture, and 25 ml concentrated sulphuric acid was introduced. The whole mixture was subjected to heating in the fume cupboard. The heating was done gently at first and increased with occasional shaking till the solution assumed a green color. The temperature of digester was above 420℃ for about 30min. The solution was cooled and black particles showing at the neck of the flask were washed down with distilled water. The solution was re-heated gently at first until the green color disappeared. Then, it was allowed to cool. After cooling, the digest was transferred into a 250 ml volumetric flask with several washings and made up to the mark with distilled water and then distilled using Markham distillation apparatus.

b. Protein Distillation: Before use, the Markham distillation apparatus was steamed through for 15 min after which a 100 ml conical flask containing 5 ml boric acid /indicator was placed under the condenser such that the condenser tip was under the liquid. About 5.0 ml of the digest was pipetted into the body of the apparatus via a small funnel aperture. The digest was washed down with distilled water followed by addition of 50 ml of 60 % NaOH solution. The digest in the condenser was steamed through for about 5-1 minutes after which enough ammonium sulphate was collected.

The receiving flask was removed and the tip of the condenser washed down into the flask after which the condensed water was removed. The solution in the receiving flask was treated with 0.01M hydrochloric acid. Also, a blank was run through along with the sample. After titration, the % nitrogen was calculated using the formulae below: % Nitrogen = Vs–VB x Macidx0.01401 x100 W where, Vs = Volume (ml) of acid required to titrate sample; VB = Volume (ml) of acid required to titrate the blank; M acid = Molarity of acid; W=Weight of sample (g). Then, percentage crude protein in the rice sample was calculated from the % Nitrogen as: % crude protein = % N x F, where, F (conversion factor), is equivalent to 6.25.

Determination of Carbohydrate: The total percentage carbohydrate content in the rice sample was determined by the difference method as reported by [9]. This method involved adding the total values of crude protein, lipid, crude fibre, moisture and ash constituents of the sample and subtracting it from 100. The value obtained is the percentage carbohydrate constituent of the sample. Thus: % carbohydrate=100–(% moisture + % crude fibre +% protein+%lipid+% ash).

RESULTS

The result of the proximate composition of the 14 rice varieties showed that moisture contents ranged from 10.01 % (Eleco 20) to 4.29% (Aiwa 8) in broadcasted rice and from 6.57 % (Nerica 7) to 3.75 % (Dangot) in the transplanted. The moisture content was significantly higher ($p<0.05$) in most of the broadcasted rice varieties except Aiwa 8 where moisture content was significantly higher in transplanted rice (6.46 %) compared to broadcasting method (4.29 %) (Figure 1).

Also the protein content was significantly higher ($p<0.05$) in rice accessions cultivated by broadcasting method compared to accession cultivated by transplanting method. The rice accession with the highest protein content include Awafum (13.2±1.3 %), Eleco 20 (13.2±0.5 %), 306 (12.7±0.5 %) and Canada (11.6±0.1 %) which were broadcasted while accessions with lowest protein contents includes transplanted Canada (6.0±0.1 %), Faro (5.5±0.1 %) and Maruwa (5.8±0.0 %) as shown in Figure 1.

Figure 2 shows the effects of transplanting and broadcasting methods of rice cultivation on the fat, fibre and ash contents of 14 rice varieties cultivated in Nigeria. Percentage crude fat was significantly higher ($p<0.05$) in majority (9/14) of the rice cultivars planted by broadcasting method than the transplanted

counterparts. On the other hand, the percentage crude fibre was significantly higher ($p<0.05$) in the transplanted rice than in their broadcasted counterparts. In the same vein, ash content was generally higher in transplanted rice accessions than broadcasted rice varieties with Short caro and Canada having the highest ash contents among the cultivars as shown in figure 2.

Also, the transplanted rice varieties had significantly higher ($p<0.05$) percentage carbohydrate and energy value than broadcasted ones as shown in Figure 3.

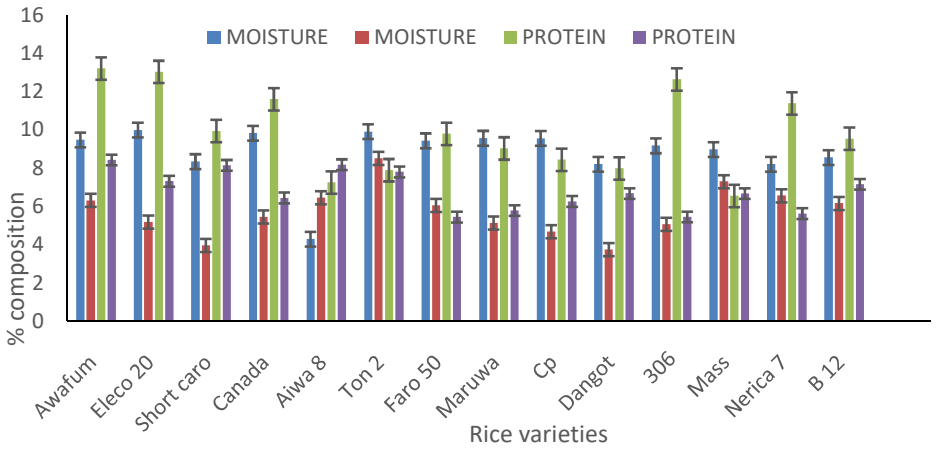

Figure 1: Effect of planting methods on the moisture and protein contents of different rice varieties cultivated in Nigeria

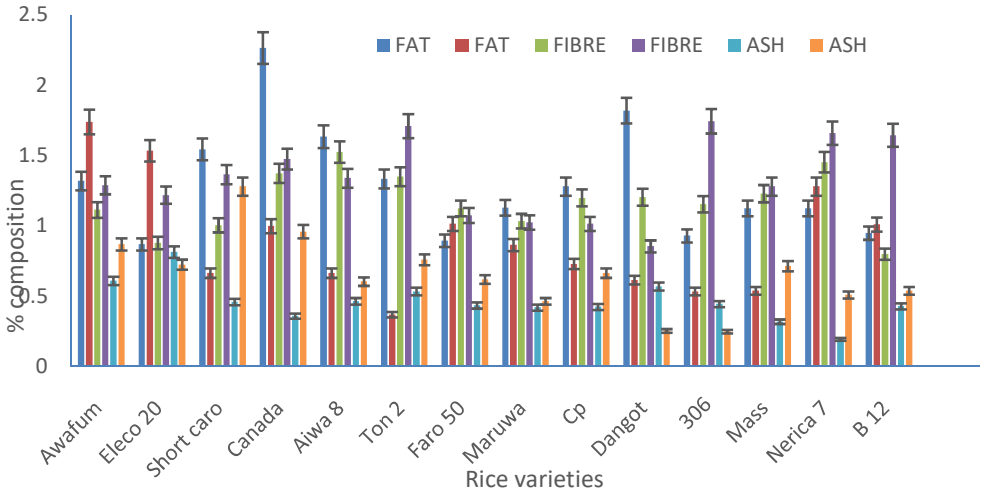

Figure 2: Effect of planting methods on fat, fibre and ash contents of different rice accessions

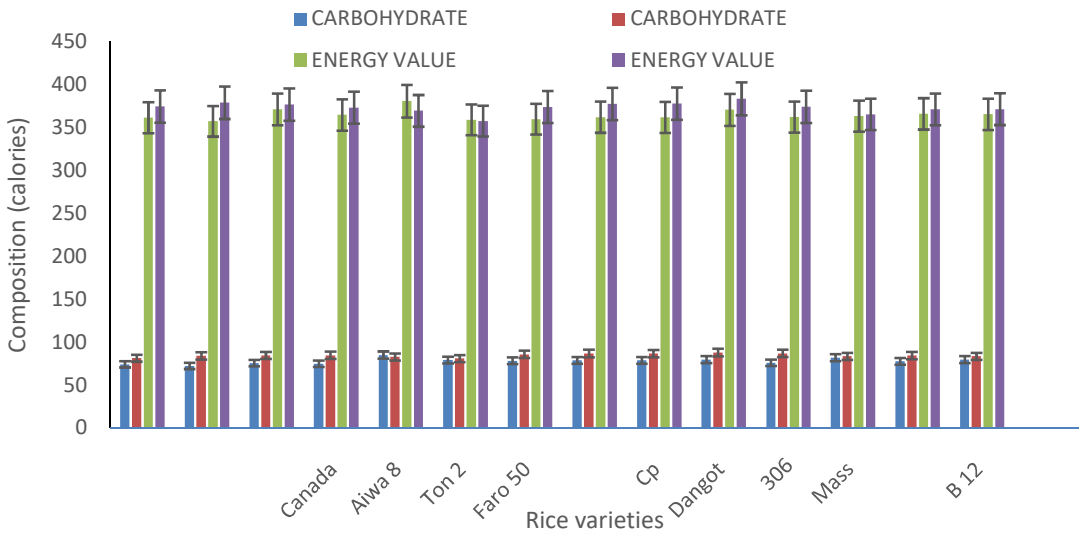

Figure 3: Effect of planting methods on carbohydrate content and energy level of different rice varieties

DISCUSSION

The results of this study shows that majority of the rice varieties cultivated by broadcasting method had higher moisture, protein and fats contents compared to the transplanted rice while carbohydrate content, energy value, fiber and ash contents were observed to be higher in transplanted rice. The result showed that the rice sample contained high quantities of carbohydrate ranging from 74.24 % to 34.97% in broadcasted and 77.99 % to 87.85% in transplanted rice. Although these values are higher than the value obtained by [10] in transplanted rice, they are a bit lower than the values (75.37 – 76.37%) reported by [11] although planting method was not specified. The high quantities of carbohydrate in transplanted rice could be as a result of the much needed energy to adapt and perform favorably in the field compared to broadcasted rice accessions which have stable adapted over months hence were able to express more proteins. Transplantation implies removing a rice plant from nursery field to a different environment where it will need to adapt mature and bear seeds. This low carbohydrate content may be attributed to its high moisture and protein contents as suggested by USA Rice Federation (2002) and other environmental factors. The high percentage carbohydrate content of the rice varieties show that rice is a good source of energy. Among the fourteen varieties Awafum has the highest protein content of 8.435% in transplanted and 13.22% in broadcasted. This is in agreement with the findings of [12] who analyzed the effect of

different treatments on physical characteristics, nutrient composition and sensory evaluation of hydrogenous and foreign rice varieties in Nigeria.

The percentage fibre content among the fourteen rice sample was in the range of 0.855% to 1.745% in transplanted and 0.800 to 1.525% in broadcasted. Although this was lower than the range (1.93 to 4.3%) obtained by [13] it is similar to the mean value obtained [14] who further stated that milling of rice generally decreased the fiber content of rice. Most of the broadcasted rice varieties showed moisture content between above 10 % moisture. [15] also reported that the moisture content of rice also affects its storage. Also, the percentage moisture content obtained may be attributed to duration of drying temperature [6]. Such high percentage moisture affects milling characteristics and the fasted of cooked rice [2].

Percentage proteins were higher in broadcasted rice than in their transplanted counterpart. The values for percentage protein content are in the range of 7.260 to 13.22% in Broadcasted and 5.45 – 8.44% in transplanted. Meanwhile, the percentage fat content of the rice is in the range of 0.3700 to 1.740% in transplanted and 0.870 to 1.82% in broadcasted. The results of this study are in agreement with the earlier result reported by [9]; [10] who also gave the range of 0.9 to 1.97% in different milling fractions. However, this range is lower than that of [15] although they did not compare planting methods but processing methods. The difference in proximate composition may be attributed to the interaction between plant roots and available soil nutrient [5]. In line with this assertion, the high protein, fat and moisture content of the broadcasted rice over transplanted rice accessions due to developed root system.

The result also showed significant difference ($p<0.05$) in the mineral compositions of rice varieties planted using different methods. The difference in mineral can be as a result of different cultivation methods as most of the broadcasted rice may have better developed root system compared to the transplanted rice which may have to adopt after transplantation. The amounts of soil nutrient available to plant roots and rate of absorption of nutrient by root hairs was therefore, affected. This study generally revealed that revealed that planting methods affects the nutritional composition of different rice varieties with protein, moisture, and fat being higher in broadcasted rice while carbohydrate, fibre, ash contents and energy value was predominant in transplanted rice.

This study has shown that planting methods affects the proximate of different rice varieties. Hence, this study can be exploited by both rice farmers and consumers in making their choices regarding nutritional needs and to meet consumer demands through the adoption of the different planting methods.

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