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The proximate and anti-nutrients compositions of eleven rice cultivars sampled in South-Western Nigeria

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Abstract

Rice is one the most common staple food in the world. The rate of consumption increases greatly every year. In Nigeria about 6.4million tonnes of rice was consumed in the 2017. This is less than the total rice produced in Nigeria (3.7million tonnes). Rice has nutritional and anti nutritional components. In this study, eleven cultivars of locally grown rice in South-western Nigeria were collected and studied for proximate and anti-nutrients composition. The various local rice cultivars collected were analyzed for nutritional and anti-nutritional purpose. The moisture content (MC) ranged from 9.49% in Papalantoro rice (FARO 63) to 3.03% in Obafemi Owode rice (FARO 63). The crude protein (CP) contents ranged from 3.10% in Akure sunshine (FARO 44) to 7.33% in Ifo (FARO 62). Koka (FARO 52), Ijero (FARO 44) and Igbimo (FARO 58). Igbemo rice (FARO 58) has the highest Ash content (3.3%), this is significant different from Aisegba (NERICA 7), Ijero (FARO44) and Akure Sunshine rice (FARO 44) (0.45%, 0.8% and 0.35% respectively). The Crude fat ranged from 0.80% in Obafemi Owode (FARO 63) to 18.54% in Koka (FARO 52). The value also was significantly different from Koka (FARO 52). The Carbohydrate content ranged from 65.76% in Koka to 82.46% in Bodija. Anti-nutrients varies in all the cultivars, Alkaloid ranged from 9.98mg/g in Akure sunshine to 33.25mg/g in Ifo. The phenol ranged from 0.86mg/g in Akure sunshine to 3.69mg/g in Bodija. The phytate ranged from 6.33mg/g in Erinoke to 14.42mg/g in Ifo. Bodija rice has the highest flavonoid content 0.16mg/g; this is different statistically from samples collected at other study areas. The rice samples collected from Igbemo, Aisegba, Oko and Akure sunshine has the least flavonoid content (0.01mg/g), this is not significantly different from rice samples collected from Ifo (0.02mg/g). The saponin ranged from 49.27 in Erinoke to 61.73mg/g in Papalantoro. The saponin content from Igbemo (56.55mg/g), Aisegba (58.36mg/g), Ijero (55.64mg/g), Koka (57.64mg/g) and Bodija (56.27mg/g) are not significantly different. Igbemo rice has the highest Tannin content with 1.44mg/g; this is not statistically different from rice samples collected from Oko (1.33mg/g), Akure sunshine (1.28mg/g), Ifo (1.20mg/g) and Papalantoro (1.20mg/g) while least in Tannin content was observed in Koka rice (0.56mg/g). These results could be of immense benefit to rice consumers in making choice among the cultivars for health reasons.

Keywords: Anti-nutrients, cultivars, proximate, rice, South-Western Nigeria.

Introduction

Rice is a monocotyledonous plant of the family Poaceae (from formal family Graminae) and genus *Oryza*. Two species of rice are commonly cultivated in the world *Oryza sativa* and *Oryza glaberrima*[1]. *Oryza sativa* is mostly cultivated throughout the world but *Oryza glaberrima* is known to be cultivated is western Africa including Nigeria[1]. Rice is a staple food which majority of household in developing countries depend on daily as a major meal[2]. Nutritionally, rice is a carbohydrate food but a good source of thiamine, riboflavin and niacin; magnesium, phosphorus, potassium and zinc[3,4]. In the olden days rice is majorly consumed during festive period or special occasion but the case has changed as many homes depend on rice than any other food items. Rice is a staple food that more than 3million out of the world depend on as food[5].

To Nigerians, rice is more than just an ordinary food but a staple food since an average Nigerian consumes nearly 24.8kg of rice in a year which sum up to be 9% of the overall calories consumed[1]. Nutrition is one of the major factors that influences the state of health of the citizen.

One of the major challenges facing this part of the world is the lack of sufficient nutrient in food which eventually graduate to malnutrition[6]. Sufficient nutrition played an importance role in economic state, human growth and development as well aid to achieve the sustainability of millennium goals[7]. Foods that are rich in the needed nutrients are very important because of the vital roles in the health stability of the people. Food substances such as rice, maize, cowpea and wheat are the common source of the nutrients needed for the body nourishment. Rice as a common food, contains nutrients that are important for human health. To attend to this challenge, crops that contains these nutrients should be sort for, recommend, put plans in place for its continuity and large production.

Rice tops the list of major carbohydrate foods that is consumed daily in most developing countries. However, compared with other sources, rice is exceptionally high in carbohydrate, and very low in protein content being approximately eight percent (globally). Assimilation of the carbohydrate is equally high due to low fiber contents resulting in high glycemic index. These qualify rice as a complete food for eating.

The antinutrients are plant source, they include alkaloids, saponins, tannins, cyanogenic glysides, protease inhibitors and lectin[8]. The presence of antinutrients in the food affect the absorption of micronutrients and nutrients and this has severe effects on the functions of organs in the body[8]. They could have a severe implication on human health if consumed above the upper limit. It has been recorded that antinutrients are the one of causes reduction in feed intake, feed efficiency, protein digestion in the experimental rat. If the tannin content is too high, it may lead to reduction or depletion of intestinal enzyme activities[9]. Anti-nutrients in foods have been implicated in several human health challenges. Saponin has been reported to cause renal stone[10].

This research provides critical information on the nutrients and antinutrients in rice collected in South-western Nigeria. In recent times there is surge in the number of cases of diabetes and related diseases globally for which rice consumption could be a strong factor. Therefore, the findings in this study could guide consumers in the selection of rice for consumption.

Materials and methods

Study area: A survey of the cultivars of *Oryza sativa* and *Oryza glaberrima* was conducted in five States in the South Western Nigeria, Oyo (28,454km^2) 7,840,864, Ogun (16,762 km^2) 5,217,716, Osun (9,251km^2) 4,705,589, Ondo (15,500 km^2) 4,671,695 and Ekiti (6,353km^2) 3,270,798. Three Local Governments was visited in each State and samples of dehulled paddy rice grown were collected. Storage sites on farms were visited; questionnaire and oral interview were also used to get information from the rice retailers. The coordinate points of location of the stores where samples were collected was taken. The study area maps of the works were prepared and the coordinates of point of location is shown on the map below.

Rice samples collection: Three kilograms each rice cultivars were collected from eleven locations in the South-Western Nigeria. The grains were air dried to prevent moldiness and stored in hessian bags at 27±2^{o}C and 75% rh.

Proximate analysis: Proximate composition of each local rice samples was determined based using the standard method[11]. The proximate components include amount of moisture, carbohydrate, fat, crude protein and raw fibre.

Moisture: The amount of moisture was estimated by the use of oven[12].

Ash: At 350^{0}C, a clean crucible was heated for 15mins, then allowed to returned to room temperature, then it weight was determined. The crucibles were reweighed after transferring 1g each of the needed sample in to them. The crucibles with their contents were transferred into the muffle furnace at 550^{0}C for about 5hrs[13]. When ash formation was completed, the crucibles were allowed to cool in a desiccator, reweighed and the percentage of ash was calculated.

$$\text{Ash } \% = \frac{\text{Ash weight}}{\text{Original sample weight (g)}}\ x\ 100$$

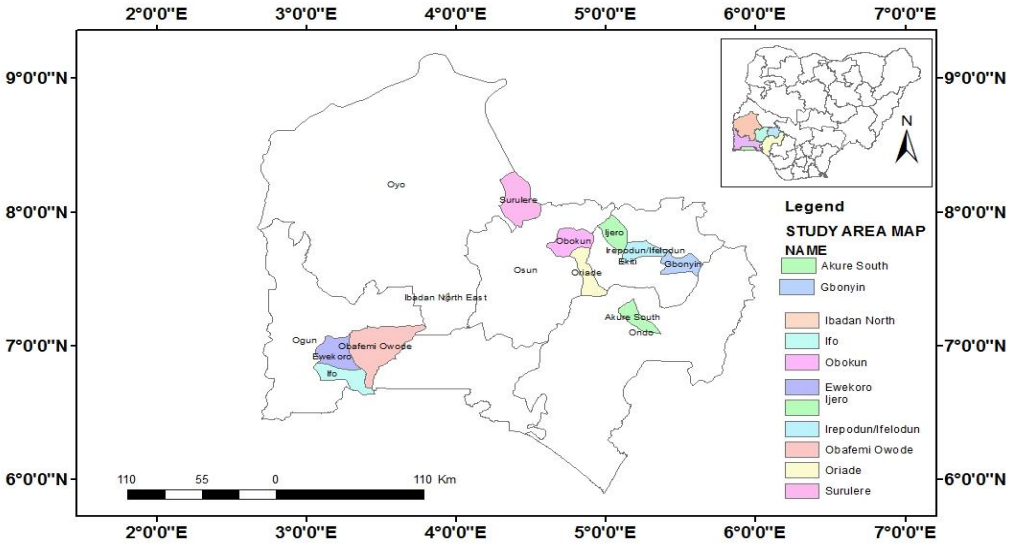

Figure-1: Study area map.

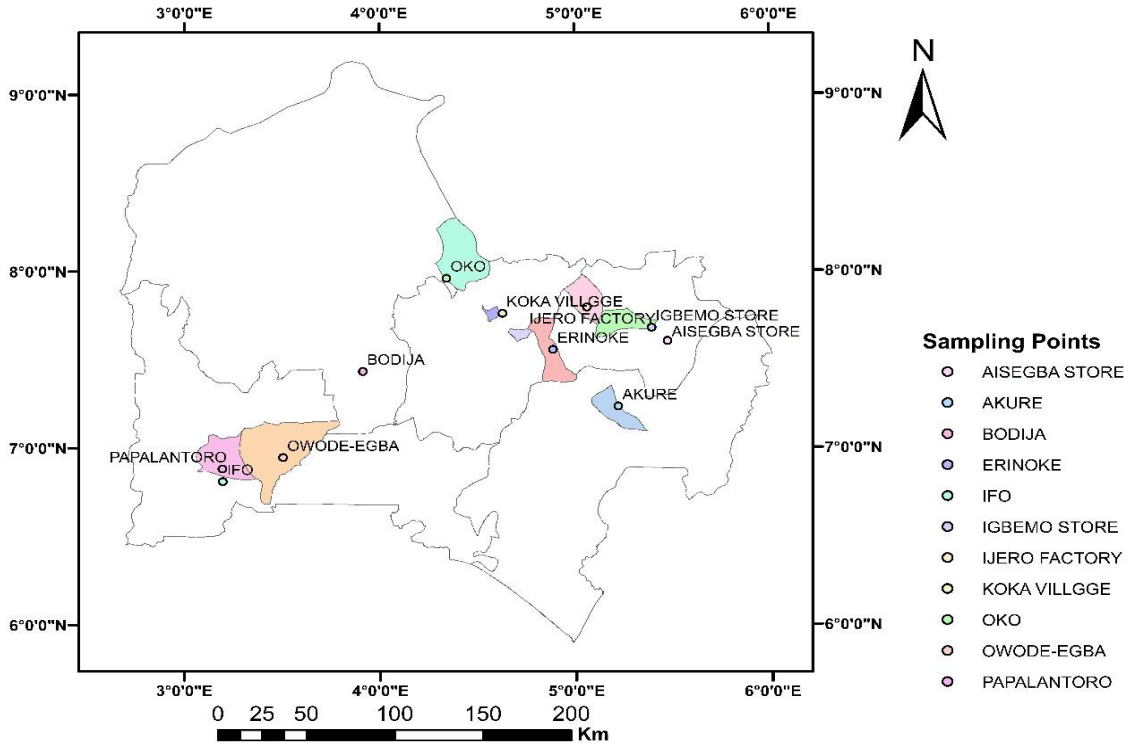

Figure-2: Rice samples collection site.

Crude Protein: Crude protein content was calculated with Kjeldahl[14]. The blank was calculated with 0.5g of the sample in the digestion tube. For digestion at high temperature, 1.1g digestion mixture in the tube was added to 10ml of concentrated sulfuric acid. The temperature of the digester was set at 420^{o}C for 45 minutes with water supply and gas discharge easily. 5ml of sodium thio-sulphate (33% of $Na_2S_2O_3$) with 30 ml of sodium hydroxide (NaOH) solutions was added in each cooled digestion channel. Hydrochloric acid (0.2N) was titrated with the distilled extract in addition with 25ml of 4% boric acid. The present amount of nitrogen was turned to crude protein percentage by multiplying with a factor of 6.25 assuming that protein contains 16% nitrogen.

$$\text{Nitrogen \%} = \frac{\text{Milliequivalent of nitrogen (0.014)} \times \text{Volume of acid needed for titration (ml)} \times \text{strength of HCl}}{\text{weight of the Sample (g)}} \; x\,100$$

Crude protein % = Nitrogen % × 6.25.

Crude Lipid: Crude lipid was estimated by extracting 3g weight of the sample's quantity with the use of ground joint Soxhlet apparatus for 3 hr with analytical grade acetone at 70^{o}C temperature till transparent acetone (without oil) was observed in the siphon. The extract was then was then transferred into a pre-weight beaker and acetone was allowed to evaporate from the extract. The remaining percentage of lipid in the beaker was estimated[15].

$$\text{\% Crude lipid} = \frac{\text{Lipid with Beaker Weight} - \text{Empty Beaker Weight}}{\text{Sample weight (g)}} \; x\,100$$

Crude Fibre: A small portion of the grounded sample (2g) was placed in a filter crucible and was placed into the hot extraction unit (Hot Extractor, Model-1017). Pre-heated 0.128M H_2SO_4 was introduced into the reagent heating chamber then drops of octanol introduced via the valves. This digestion process took 30minutes. Boiling water and filtering was used to remove the acid mixture in the process. The remain residue was the boiled with 0.223M KOH for 30 minutes and then filtered with washing in boiling water and acetone. The residue was oven - dried at temperature of 105°C for some hours, then ignited in muffle furnace at 550°C for 3 hours. The loss of weight represented the crude fibre[16]. The percentage crude fibre was estimated using the below formular:

$$\text{\% Crude fibre} = \frac{\text{Weight of Oven dried sample (g)} - \text{Weight of Ash sample (g)}}{\text{Sample weight (g)}} \; x\,100$$

Carbohydrate: For carbohydrate composition in the samples, the sum total of the content of moisture, crude protein, ash, lipid and crude fibre was deducted from 100. According to Lee and Won[17], Carbohydrate % = (100 minus (Moisture + Crude protein + Crude lipid + ash + crude fibre).

Antinutrients: Tannin Determination: About 0.2g of finely ground sample was weighed into a 50ml sample bottle. 10ml of 70% aqueous acetone was added and properly covered. The bottle was put in an ice bath shaker and shaken for 2hr at 30^{o}C. Each solution was then centrifuge and the supernatant store in

ice. 0.2ml of each solution was pipette into the test tube and 0.8ml of distilled water was added. Standard tannin acid solutions were prepared from a 0.5mg/ml of the stock and the solution made up to 1ml with distilled water. 0.5ml of Folin ciocateau reagent was added to both sample and standard followed by 2.5ml of 20% Na_2CO_3 the solution was then vortexed and allow to incubate for 40minutes at room temperature, its absorbance was read at 725nm against a reagent blank concentration of the same solution from a standard tannic acid curve was prepared[18].

Determination of Phytate: Phytate will be determining according to the method of Oboh[19]. 4g Sample was soaked in 100ml of 2% HCl for 3hrs and then filter through a No 1 Whatman filter paper. 25ml was taking out of the filtrate and placed in a conical flask and 5ml of 0.3% of ammonium thiocyanate solution was added as indicator after which 53.5 of distilled water was added to give it the proper acidity and this was titrated against 0.00566g per milliliter of standard iron (iii) chloride solution that contain about 0.00195g of iron per milliliter[20].

Determination of saponin: The spectrophotometric method was used for Saponin determination[21]. 2g of the finely ground sample was weighed into a 250ml beaker and 100ml of Isobutyl alcohol was added. Shaker was used to shake the mixture for 5hr to ensure uniform mixing. The mixture was filtered with No 1 Whatman filter paper into 100ml beaker containing 20ml of 40% saturated solution of magnesium carbonate ($MgCO_3$). The mixture obtained was filtered though No 1 Whatman filter paper to obtain a clean colourless solution. 1ml of the colourless solution was taken into 50ml volumetric flask using pipette, 2ml of 5% iron (III) chloride ($FeCl_3$) solution was added and made up to the mark with distilled water. It was allowed to stand for 30min for the colour to develop. The absorbance was read against the blank at 380nm.

Determination of alkaloid: 5g of the sample was weighed into a 250ml beaker and 200ml of 10% acetic acid in ethanol was added and allowed to stand for 4min. This was filtered and extract was concentrated on a water bath to one quarter of the original volume. Concentrated ammonium hydroxide was added drop-wise to the extract until the precipitation was completed. The whole solution was allowed to settle and the precipitate was collected[22].

Results and Discussion

The Table-1 shows that rice grown in Southwestern Nigeria are of various colours, shapes, structures and moisture content. The colour of the rice cultivar ranges from white, cream, brown to dark brown. Some of the cultivars has patches on their grains. the grains are of different shapes and structures. Some of the grains are short others are long, long thin and long-robust. The moisture content of the rice sampled range from 12.3% to 16.2%. Papalantoro rice has the highest moisture content on arrival from the field (16.2%), followed by Oko rice (16%) while the least was recorded in Ifo rice (12.3%).

Table-2 shows the proximate composition of the rice sampled in the five states in South western Nigeria. The rice collected from Oyo state has the highest Moisture content (8.1±0.34) while the rice samples collected from Osun has the least (5.52±0.81). Equally, there is no significant different between the mc in the rice collected from Ekiti, Ondo and Ogun (6.19±0.61, 7.38±0.29 and 6.12±0.95 respectively). Rice collected from Oyo (8.1±0.34) and Osun (5.52±0.81) are significantly different. Crude fibre from the rice collected in Osun State is the highest (2.00%) followed by Ogun (6.12%) and the Ondo sunshine rice had the least (0.45%). There was no significant difference between values from Ekiti (1.19±0.08), Ondo (0.45±0.08) and Oyo (0.87±0.93) rice. No significant difference was recorded in crude fibre composition between the Ogun (1.98±0.40) and Oyo (0.87±0.93) rice. This result also shows that the rice contains crude protein. Ogun state has the highest (6.74%) followed by Oyo state rice (5.78%) and the least in Ondo rice (3.10%). No significant difference in Crude protein between Ekiti State (5.52±0.23) and Oyo State (5.78±0.37) rice but Ekiti, Ondo, Ogun and Osun State are significantly different. Osun State rice has the highest ash content (2.36%) followed by Oyo State (1.63%) and the Ondo State has the least percentage (0.35%). In fat content, Osun state rice has the highest (14.41%) followed by Ondo State rice (11.64%) and the least was recorded in Oyo State rice (4.51%). All rice obtain shows a high percentage of carbohydrates Range from 71.54 to 74.05. Although Oyo State has the highest content (79.10%), followed by Ekiti State (77.74%) and the least was Osun State (71.54%). The is no significant difference among Ekiti, Ondo and Ogun. Oyo state rice was significantly different from that collected from Ekiti, Ondo, Ogun and Osun State.

The Table-2 shows the mean values of the anti-nutrients composition of the rice samples collected at Ekiti, Ondo, Ogun, Oyo and Osun State in the South west Nigeria. Local rice collected at Ogun State has the highest Alkaloid content (22.58±3.04) while the rice from Ondo State has least (9.98±0.00). There is no significant difference in the alkaloid contents of the rice collected at Ekiti and that of Ogun State, also there is no significant difference between the rice collected from Oyo and Osun State, no significant difference in Alkaloid content in the rice collected in Ondo and Oyo. There is a significant difference in the alkaloid contents in the rice collected in ekiti, Ondo and Osun State. It is also shown from the Table-2 that the rice collected from States in Southwest contains Phenol. Rice samples from Oyo state has the highest mean value (2.88±0.48) while that of Ondo has the least value (0.86±0.03). There is no significant difference between the rice collected from Ekiti and Ogun State. Equally no significant differences in the mean between the rice samples from Ondo and Osun. There is a statistical significant difference between Oyo, Osun and Osun State.

Table-1: Physical observation of some locally grown rice in South-western Nigeria.

Location/Name	Colour	Shape and Struc	MC (%)
Erioke/FARO 58	Dark brown	Robust grains With white patches	13.2
Igbemo/FARO 58	Dirty brown	Long-robust grains	13.3
Aisegba/NERICA 7	Light Brown	Long-robust grains	13.5
Ijero /FARO 44	Light Brown	Long-thinning grains	13.3
Oko/FARO 52	Light-brown	Short- grains	16.0
Koka/FARO 52	Dirty white	Thin grains	15.8
Bodija/FARO44	Light brown	Thinning grains	13.3
Akure/ FARO 44	Cream	Moderately big and long grains	13.3
Obafemi Owode/ /FARO 63 (OFADA 1)	Verydark brown	Thinning grains	13.6
Ifo/FARO 62(OFADA 1)	Dark brown	Robust grains	12.3
Papalantoro/FARO 63	White	Robust grains	16.2

Table-2: Nutritional composition of local rice grown and consumed in South west Nigeria (Comparism per state).

State	Nutritional Content (%)					
	Moisture Content	Crude Fibre	Crude Protein	Ash	Crude Fat	Carbohydrate
Ekiti	6.19±0.61ab	1.19±0.08a	5.52±0.23c	1.51±0.48b	7.81±1.29b	77.74±0.49bc
Ondo	7.38±0.29ab	0.45±0.08a	3.10±0.28a	0.35±0.00a	11.64±0.03cd	77.06±0.29bc
Ogun	6.12±0.95ab	1.98±0.40b	6.74±0.29d	1.57±0.27b	9.48±1.57bc	74.05±2.07ab
Oyo	8.1±0.34b	0.87±0.93a	5.78±0.37c	1.63±0.11bc	4.51±1.45a	79.10±1.70c
Osun	5.52±0.81a	2.00±.035b	4.27±0.18b	2.36±0.12c	14.41±1.04d	71.54±2.22a

Note: Means followed by the same letter in column are not significant different (p>0.05).

Table-3: Anti-nutritional composition of local rice cultivar in South-western Nigeria (Comparism per state).

State	Anti-nutritional Content					
	Alkaloid (%)	Phenol (mg/g)	Phytate (mg/g)	Flavonoid (mg/g)	Saponin (mg/g)	Tannin (mg/g)
Ekiti	22.52±0.93c	1.94±0.19b	9.61±0.42b	0.03±0.02ab	56.85±0.52b	1.78±0.09ab
Ondo	9.98±0.00a	0.86±0.03a	8.24±0.00ab	0.01±0.00a	52.91±0.29b	1.28±0.00ab
Ogun	22.58±3.04c	1.95±0.26b	9.93±1.50b	0.05±0.01ab	51.76±0.76a	1.04±0.08ab
Oyo	13.59±0.38ab	2.88±0.48c	10.44±0.35b	0.11±0.02c	55.30±0.67b	0.87±0.11a
Osun	15.52±1.76b	1.51±0.05a	7.00±0.38a	0.07±0.00b	60.31±0.68c	0.92±0.09a

Note: Means followed by the same letter in column are not significant different (p>0.05).

Table-4: Nutritional composition of local rice cultivar in South-western (Towns) Nigeria.

Towns/ Name	Nutritional Content %					
	Moisture content	crude fibre	Crude Protein	Ash	Crude Fat	Carbohydrate
Erioke/FARO 58	3.89±0.00a	2.60±0.12e	4.26±0.00ab	2.55±0.20cde	12.35±0.35ef	74.44±0.58bc
Igbemo/FARO 58	6.39±0.06bc	0.88±0.06abc	6.21±0.06def	3.30±0.58f	5.22±0.58c	78.96±0.58bcd
Aisegba/NERICA 7	8.22±0.06def	1.35±0.06cd	5.76±0.06cde	0.45±0.58a	5.26±0.64c	78.96±0.58cd
Ijero/ FARO 44	3.96±0.00a	1.37±0.02cd	4.63±0.58bc	0.80±0.58a	11.95±0.00fg	76.26±0.58bcd
Oko/FARO52	8.99±0.00ef	0.50±0.06a	6.95±0.00ef	2.05±0.00cd	9.10±0.00d	72.40±0.64abc
Koka/ FARO 52	8.79±0.58def	0.60±0.12ab	4.30±0.63ab	2.00±0.29c	18.54±0.58h	65.76±5.77a
Bodija/FARO 52	7.66±0.64cde	1.05±0.00bcd	5.20±0.58bcd	1.40±0.12b	2.22±0.07a	82.46±0.53d
Akure/FARO 44	7.38±0.58cd	0.45±0.58a	3.10±0.58a	0.35±0.00a	11.64±0.06e	77.06±0.58bcd
Obafemi Owode / FARO 63(OFADA 1)	3.03±0.58a	1.50±0.00d	6.68±0.06ef	0.80±0.06b	0.80±0.06g	73.88±0.00bc
Ifo/FARO62 (OFADA 1)	5.58±0.64b	3.42±0.62f	7.33±0.58f	2.60±0.06e	3.35±0.06b	77.39±6.35bcd
Papalantoro / FARO 63	9.49±0.64f	1.05±0.00bcd	6.23±0.58def	0.80±0.06a	11.55±0.58e	70.58±0.64ab

Note: Means followed by the same letter in column are not significant different ($p>0.05$).

Table-3 shows the mean values of the anti-nutrients composition of the rice samples collected in the study areas. Rice samples collected at Ogun State has the highest Alkaloid content percentage (22.58±3.04%), followed by Ekiti State (22.52±0.93) while the rice from Ondo State has least (9.98±0.00%). There is no significant difference in the alkaloid contents of the rice collected at Ekiti and that of Ogun State, also there is no significant difference between the rice collected from Oyo and Osun State, no significant difference in Alkaloid content in the rice collected in Ondo and Oyo. There is a significant difference in the alkaloid contents in the rice collected in Ekiti, Ondo and Osun State. This Table also shown that the rice collected from States in Southwest contains Phenol at various amount from 0.86±0.03 to 2.88±0.48. Rice samples from Oyo state has the highest mean value of Phenol (2.88±0.48) while that of Ondo has the least value (0.86±0.03). There is no significant difference in phenol content between the rice collected from Ekiti and Ogun State. Phytate was present in the rice samples collected. The rice collected from Oyo has the highest phytate value (10.44±0.35) followed by Ogun State rice (9.93±1.50) and Rice collected from Osun State has least value (7.00±0.38). The values from Ekiti, Ondo, Ogun and Oyo state have no significant difference but no significant differences in the mean between the rice samples from Ondo and Osun. There is a significant difference between Oyo, Osun and Osun State. The mean values of flavonoid content in the rice sampled rice range from 0.01±0.00 to 0.11±0.02. Rice sampled in Oyo State has the highest mean value (0.11±0.02) followed by that of Osun (0.07±0.00) and Ondo state has the least flavonoid contents. Saponin content was recorded in all the rice sampled. The mean value of the saponin range from 51.76±0.76 to 60.31±0.68. The rice sampled from Osun state has the highest saponin mean values (60.31±0.68) followed by Ekiti state rice (56.85±0.52) while Ogun State has the least mean values (51.76±0.76). In addition, the sampled rice contains tannin ranges from 0.87±0.11 to 1.78±0.09. The rice sampled at Ekiti was recorded to have highest tannin content (1.78±0.09) followed by Ondo State (1.28±0.00) and the least was recorded in Oyo State rice (0.87±0.11). The $p> 0.05$.

From Table-4, all rice sampled from the South western Nigeria has various nutritional contents such as Moisture contents, Crude fat, Crude protein, Ash, Crude fat, and Carbohydrate. Papalantoro has the highest moisture content (9.49±0.64), followed by Oko (8.99±0.00) and the least was recorded in Obafemi Owode (3.03±0.58). The means from Erinoke, Ijero and Obafemi are not significantly different from one another but they are significantly differently different from other towns where rice were sampled. The rice from Erioke has the highest crude fibre (72.60±0.12), followed by Ifo (3.42±0.62) and Akure sun shine rice has the least value (0.45±0.58). Statistically, Erinoke rice was significantly different from other rice sampled. The mean value from Aisegba, Ijero, Bodija, Obafemi Owode and Papalantoro was not significantly different from one another in the crude fat content. The rice sampled also contain crude protein range from 3.10±0.58 to 7.33±0.58.

Ifo rice has the highest crude protein (7.33±0.58), followed by Oko (6.95±0.00) and Akure sunshine has least crude protein (3.10±0.58). The mean values from Igbemo, Oko, Obafemi, Ifo and Papalantoro was not significantly different from one another. The Ash content from the sampled rice range from 0.35±0.00 to 3.30±0.58. The result shows that Igbemo rice has the highest Ash content (3.30±0.58) followed by Ifo rice (2.60±0.06) and Akure sun shine has the least value (0.35± 0.00). The mean value from Igbemo was significantly different from all other sampled town. The crude fat content of the sampled rice ranges from 0.80±0.06 to 18.54±0.58. Koka rice has the highest crude fat content 18.54±0.58 seconded by Erinoke (12.35±0.35) and the least was recorded in Obafemi owode rice (0.80±0.06). No significant difference was recorded in the mean value from Koka and other towns where rice were sampled. The rice sampled rice containing carbohydrate of different amount ranges from 65.76±5.77 to 82.46±0.53. From the result, Bodija rice has the highest carbohydrate (82.46±0.53) content, then Aisegba and Igemo has the next values (78.96±0.58) and the least mean value was recorded in Koka 65.76±5.77. There is no significant differences in the mean values of Igbemo, Aisegba, Ijero, Bodija, Akure, Ifo and Papalantoro. The mean value of Koka has no significant different from that of Oko and Papaplantoro.

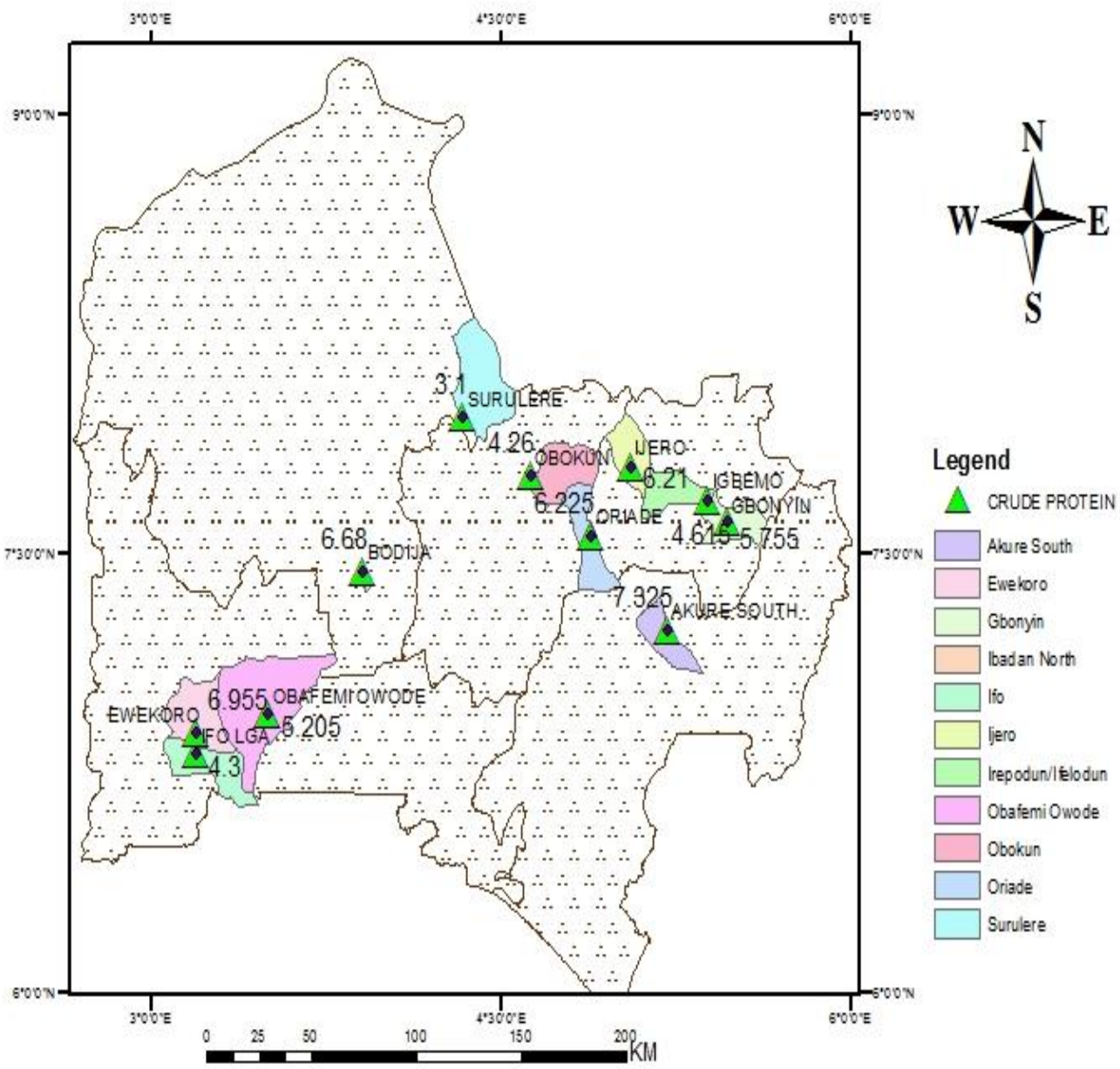

Figure-3: Map showing the amount of the crude protein in the sampled rice per location.

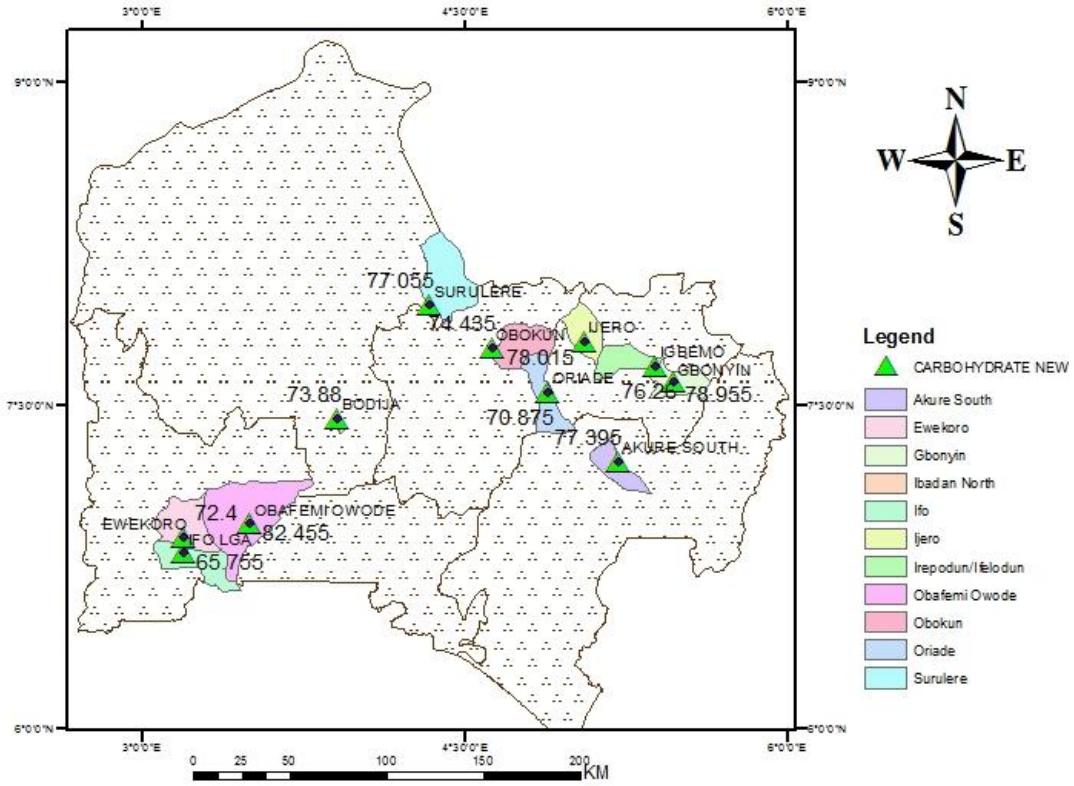

Figure-4: Map showing percentage of the carbohydrate in the sampled rice per location.

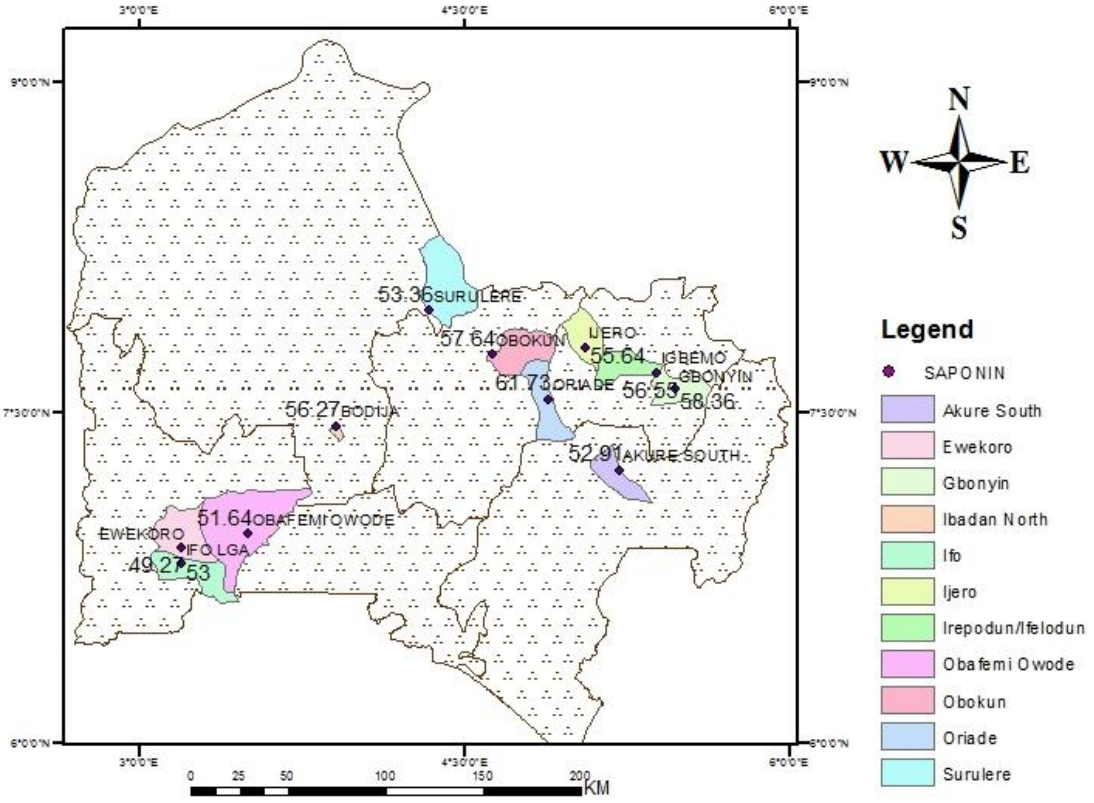

Figure-5: Map showing percentage of the crude protein in the sampled rice.

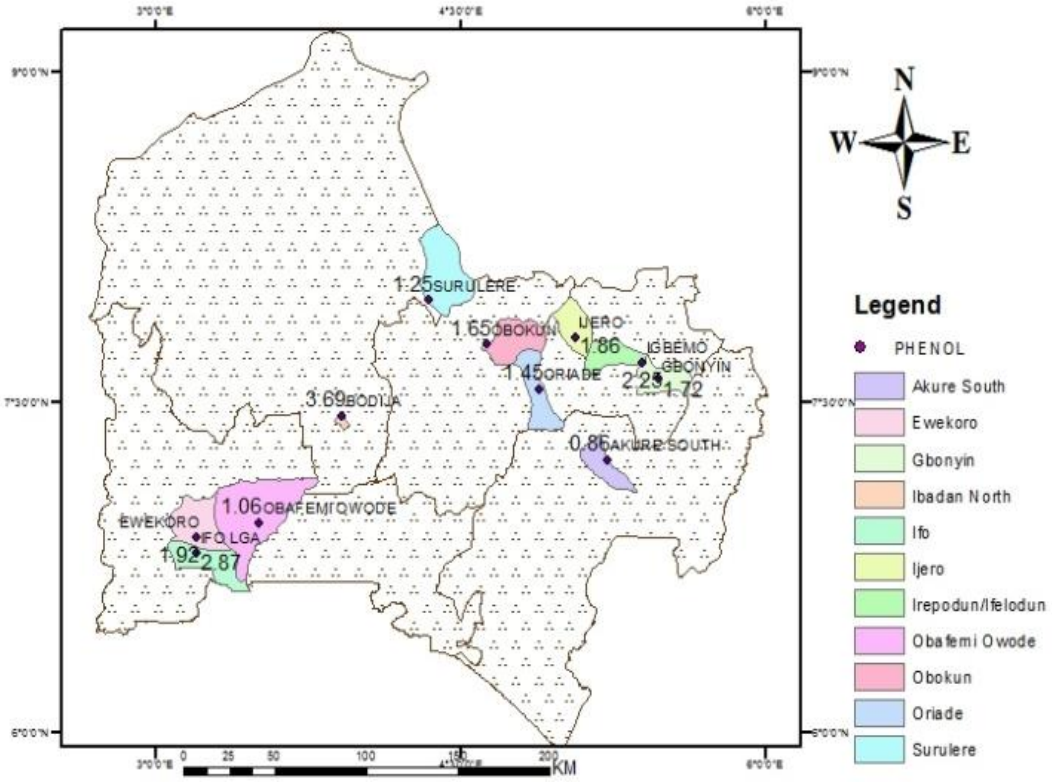

Figure-6: Map showing the amount of the Phenol in the sampled rice per location of collection.

Table-5: Anti-nutritional composition of local rice cultivar (*Oryza Glabberima*) in South-western (Towns) Nigeria.

Towns	Anti-nutritional Content					
	Alkaloid (%)	Phenol (mg/g)	Phytate (mg/g)	Flavonoid (mg/g)	Saponin (mg/g)	Tannin (mg/g)
Erinoke	16.80±0.64bc	1.45±0.06bcd	6.59±0.64a	0.08±0.01c	61.66±0.03e	1.09±0.00e
Igbemo	26.08±0.58e	2.25±0.58e	9.06±0.00ab	0.01±0.00a	56.54±1.15cd	1.44±0.63h
Aisegba	19.95±0.01cd	1.7±0.05cd	11.12±0.00b	0.01±0.00a	58.36±0.01d	0.84±0.06c
Ijero	21.53±0.06de	1.86±0.06de	8.65±0.64ab	0.08±0.03c	55.63±0.06c	0.94±0.01d
Oko	14.53±0.64ab	1.25±0.00abc	9.06±0.00ab	0.01±0.00a	53.36±0.00b	1.33±0.00g
Koka	12.97±5.6ab	1.65±0.06cd	7.83±0.64a	0.05±0.00b	57.63±0.00cd	0.56±0.06a
Bodija	13.13±0.58ab	3.69±0.06g	11.12±0.00b	0.16±0.00d	56.27±0.00cd	0.64±0.06ab
Akure	9.98±0.00a	0.86±0.07a	8.24±0.00ab	0.01±0.00a	52.91±0.58b	1.28±0.00fg
Obafemi	12.25±0.00ab	1.06±0.00ab	6.33±3.15a	0.30±0.00ab	53.00±1.36b	0.71±0.00b
Ifo	33.25±0.01f	2.87±0.06f	14.42±0.58c	0.02±0.01ab	53.00±0.58b	1.20±0.00ef
Papalantoro	22.23±0.58de	1.92±0.00de	9.06±0.01ab	0.09±0.00c	49.27±0.00a	1.19±0.00de

Note: Means followed by the same letter in column are not significant different (p>0.05).

In the Table-5, the sampled rice contained anti nutrients when assessing them per town where they were collected. Alkaloids, Phenol, phytate, flavonoid, saponin and tannin are the examined antinutrients in the sampled rice. The alkaloid contents range from 9.98±0.00% to 33.25±0.01%. Ifo rice has the highest Alkaloid content (33.25±0.01%) followed by Igbemo rice (26.08±0.58) while Akure sunshine has the least mean value (9.98±0.00). There is a significant difference between the mean value of Ifo and other record from other towns sampled. Also no significant difference was recorded among Erinoke, Oko, Koka, Bodija and Obafemi. The phenol ranges from 0.86±0.07mg/g to 3.69±0.06mg/g. Bodija rice has the highest phenol content (3.69±0.06mg/g) seconded by Ifo rice (2.87±0.06mg/g) while Akure sunshine has the least (0.86±0.07mg/g). Statistically, there is a significant difference between the mean value of Bodija and the rest of the town where samples were taken. There was a significant difference between the mean from Ifo and the rest of the samples. Also, there is no significant different in Phenol mean value in Erinoke, Aisegba, Ijero,Koka and Papalantoro. Ifo rice has the highest Phytate contents (14.42±0.58) then Aisegba and Bodija (11.12±0.00mg/g) and Obafemi Owode contains the least phytate value (6.33±3.15mg/g). There is a significant different between mean value from Ifo and the rest of the sampled towns. There is no significant different among the mean values of Erinoke, Igbemo, Ijero, Oko, Koka, Akure, Obafmi and Papalantoro. The flavonoid content ranges from 0.01±0.00mg/g to 0.30±0.00 mg/g. Obafemi owode has the highest flavonoid content (0.30±0.00mg/g) followed by Bodija (0.16±0.00mg/g) and the least was recorded in Akure, Oko, Igbemo and Aisegba (0.01±0.00mg/g). There was no significant difference among Igbemo, Aisegba, Oko and Akure. There is no significant difference among Erinoke, Ijero and Papalantoro. The Saponin content ranges from 49.27±0.00mg/g to 61.66±0.03mg/g. Erinoke was recoded to have the highest saponin content (61.66±0.03mg/g) then Aisegba (58.36±0.01mg/g) while Papalantoro has the least value (49.27±0.00mg/g). There is a significant difference between the mean value from Erinoke and the rest of the samples. Also there is no significant difference among the value from Igbemo, Aisegba, Koka, and Ifo. The amount of tannin content ranges from 0.56±0.06mg/g to 1.44±0.63mg/g. Igbemo rice has the highest tannin content 1.44±0.63mg/g followed by Akure sunshine 1.28±0.00 while Koka has the least value 0.56±0.06. There is a significant difference between mean value of Igbemo and the rest of the sampled town. The mean value from Koka has no significant difference from Bodija.

Discussion: Rice samples from the South west Nigeria are rich in nutritional values. It contains reasonable values of substances like Moisture content, Crude fat, crude protein, crude fat, Ash and carbohydrates. The rice sample contained high quantities carbohydrates ranging from 71.54% to 79.10%. This is falls between the range of result of Oko *et al.*[22] but higher than (75.37-76.37%) reported by Edeogu *et al.*[23] who analysed the proximate composition of staple food crops in Ebonyi state. The higher percentage of carbohydrate contents of the rice cultivar show that rice is a good source of energy. The ash content of a food sample gives an idea of the mineral elements present in the food sample. The rice collected from Osun State has the highest Ash percentage (2.36%) while sunshine rice from Ondo has the lowest ash content (0.35%). Among the collected rice cultivars Ogun State rice has the highest crude protein (6.74%) while Ondo State has the least (3.10%). The percentage of the fibre range from 0.45 to 2.0%. This is in line with the work of Oko and Ugwu who report of 1.5 to 2.0% of the fibre content in five rice sample in Abakaliki South East Nigeria. This result was contrary to the result obtained by Edeogu *et al*. on the Proximate compositions of staple food crops in Ebonyi state[23]. The process of milling rice generally decreases the fibre content of rice. The Oyo rice has the highest moisture content. The higher moisture content may be attributed to low drying temperature and prolong parboiling[23]. Oko and Onyekwere reported that the moisture content of rice also affects its storage[24]. The rice sampled at Papalantoro has the highest moisture percentage this could lead to a short-term storage of this cultivar because the higher moisture content of a commodity the lesser the day it can be stored. Obafemi owode rice has the lowest moisture percentage and it can store for a long time. According to a previous study rice was investigated as a potential source of fiber and carbohydrates, protein and lipids. It was reported that increase in fiber content in rice may improve the human health by lowering the plasma cholesterol[25].

Presence of fibre in the sampled rice make it a relevant in the health of the humans. Fibre plays a role in human health. Singh *et al*. reported that higher consumption of fibre may has a positive effect on the health of the people by reducing the presence of cholesterol in the food[26].

Production of cultivar of rice from Ifo, Oko, Obafemi owode, papalantoro and Igbemo should be increases since they could offer rice with high protein values. Rice which are in higher protein contents should be more valued. Good genetic factors and environmental factor will help in producing high protein quality rice[23] Akure sunshine has the least crude protein which may be as result of genetical, edaphic and climatic factors[23].

Ifo rice has the highest crude fibre, this gives a promising result since it has been reported that rice is source of insoluble fibre which eventually reduce constipation[22]. Any food commodity may have a detrimental effect on human especially in cities where citizen are dependent on processed food[22]. Akure sunshine rice was reported to have the least crude fibre.

Apart from the nutritional composition, rice sampled in Southwestern Nigeria contains antinutrients. Alkaloid, Phenol, phytate, flavonoid, saponin and tannin were present in the sampled rice[27]. These are secondary metabolites produced by plant to protect themselves from insects, pathogens, herbivores and for adaptation in unfavorable conditions.

Various report as showed that consumption of some antinutrients may cause physiology disorder to man although their concentrations and types also determined the expected effects. Apart from the common adverse effects of antinutrients in man and other organisms they also played positive roles such as anticancer, antimicrobe and containing functional foods exhibit beneficial effects against lethal diseases, such as cardiovascular, diverticulosis, diabetes and colon cancer etc. Various method (in processing) could help to reduce the concentration and quantity of the antinutrients found foods[28].

Physical methods such as dehulling, cooking, smoking, roasting, soaking, autoclaving or biochemical processing (like enzyme process, fermentation, germination) could be used to reduce antinutrients. Report also ascertains that total removal of antinutrients which may not easily possible will have a detrimental effect on the plants growth and yield which will later affect the plants feeders. In removing antinutrients from grains many methods should be employed. For example, saponin in food commodity especially grains can be removed by soaking and cooking. The report shows that abrasion and cooking reduce 100% quinoa saponin. Industrial processing like canine, pasteurization, fractionation, isolation of proteins is good in removing antinutrients, although care must be taken to reduce addition of unwanted substance (such as volatile aldehydes, ketones etc.) and reduction of wanted substances (nutritional values like protein and minerals)[28].

Conclusion

It is clearly observed from the result of the work that that Southwestern Nigeria is endowered with very nutritional rich rice cultivars. The government can focus on the production of rice locally in Nigeria since the country rice farmers are capable of producing good quality rice that can compete with any other production in the world. The nutrition values of these sampled rice make them of good quality that can be produced, processed and packaged in large quantity for local and international communities. The crude protein of these rice cultivars especially that of Ifo, Oko, Obafemi owode, papalantoro and Igbemo shows that they are source of crude protein which could add to the bank of plant protein recommended food. The sampled rice also contained antinutrients which help them to build internal defense against microbes, pathogens and insect attack.

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