# Evaluation Of Nutritional Value Of Wild Rice From Kaduna State, Central Nigeria.

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**ABSTRACT :** Wildrice samples obtained from Kaduna state, Nigeria were analysed for proximate, mineral and vitamin composition. The results of the proximate composition shows the moisture content of wild rice to be 8.66%; ash content 1.25 %, lipids content 0.67%, protein 13.80%; crude fiber is 0.67% and carbohydrate content to be 74.95%.The elemental analysis was carried out using atomic absorption spectrophotometer (AAS) and the results show that wild rice possessed high content of potassium and has low content of nickel. The vitamin contents of wild rice were also determined and the results show that it contains thiamin, riboflavin ($B_2$), niacin ($B_3$) with the following value 4.10mg/kg, 5.90 mg/kg and 57.00 mg/kg respectively. The antinutritional factors of the wildrice sample were also determined and the results are as follows; cyanogenic glycosides 4.10%, phytic acid 1.17%, oxalate 1.25%, saponins 7.90% and taninn 0.34%. The protein content of wildrice is relatively high for a cereal. Wild rice is a good source of the B vitamins – thiamin, riboflavin and niacin and contains common minerals in amounts comparable to those in other cereals. The values obtained for antinutritional factors for the wildrice sample are quite low and therefore can be tolerated by the body.

**Keywords:** Wildrice, Proximate Analysis, Antinuritional, Cyanogenic glycosides, Phytic acid, Oxalate, Saponins and Taninn.

## INTRODUCTION

Wild rice is an aquatic cereal grain that grows naturally in isolated lakes, river bed areas and marshes [1]. Wild rice is called Gu-rice [2] or Jiaobai-zi [3] in China. In ancient China it was called Diahu-rice, Yanshan, Anhu, Jiagshi and black rice.[4] It is also called Canada rice, Indian rice and water oats. It is from the genus *Zizania* and is of four species. It is mostly grown in North America, Indian, China and some parts of Nigeria (Northern Nigeria in partcular)[5]. In addition to its role as an important staple food for ancestral people, it has provided a unique habitat for fish and water fowls for thousands of years [1], [5]. Wild rice is a grain of reel-like aquatic plant *(Zizania aquatica)*, which is related to rice. The grains are long, slender and black with a distinctive earthy, nutty flavour. It is available in three different grades, giants, which is very long and the best quality, fancy, which is a medium grain and of lesser quality and select, which is a short grain. It is an annual grass which grows naturally[1]. *Zizania latifolia* (Griseb) is one of the species of wild rice peculiar to the Chinese people, is an age-old cereal. During the Zhou dynasty (11$^{th}$ century BC -256BC), the grain had become attribute food to be presented and eaten by the emperors and the nobles. It has been considered a Chinese medicine since the Tang dynasty. The North American wild rice namely *Zizania aquatica, Zizania palustris and Zizania Texana*[6]. is an aquatic plant that grows predominantly in the great lake regions. There are distinct strains differing in numbers of kernels per head, average kernel size and date of ripening. Chinese wild rice grain is smaller (about 10 mm in length and about 1mm in diameter) and lighter colour (green or brown) than the Northern American wild rice. The Northern Nigerian wild rice is similar to that of the Northern American wild rice.


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Wild rice is well known by all tribesof the Nigerian society.The Hausas call it shinkafa tsutsaye (i.e rice for the birds ), the Ibos calls it, rice for the spirit. Anderson in 1976 carried out proximate analysis of wild rice and concluded that it is richer in protein than any other selected grains, except oats [7]. Several reports on the nutritional composition of cultivated cereals all over the world are available, and the value reported for various cereal have been very useful in nutritional studies[7]. This substantial value of protein in wild rice will therefore makes it more nutritious than other cereals for consumption. There are four species of wild rice, three of these species are peculiar to the North America namely; Zizania*, palutris, Zizania aquatica, Zizania texana.* While the fourth species is native to Asia *Zizania latifolia or Zizania caducifolia* [1]. The three species found in Northern Nigeria are *Zizania palutris, Zizania aquatica*, and *Zizania texana.* To the best of our knowledge, no work has been reported on the nutritional and proximate analysis value of wild rice from Nigeria. This work will add to the data available on wild rice value from other parts of the world.

## EXPERIMENTAL

### Materials and methods

#### Materials

The sample were taken randomly from three location namely: Ankwa Barde, Kagoro, and Gure all in Kaduna state , Nigeria. All the reagents used were of analytical grades and were obtained from Aldrich Ltd, U.S.A. and British Drug House (BDH) Poole, England. The Chemicals were used with no further purification. Atomic Absorption Spectrophotometer and Uv-visible Spectrophotometer were used for the determination of minerals and vitamins respectively.

#### Methods

The wild rice sample were harvested and dried for three days. The kernels were then removed from the stalk, and dehusked using mortar. This was followed by winnowing to remove the chaff .The wild rice was then ground into fine powder using blender and stored in a clean sample bottle.

**Determination of moisture content**

The determination of moisture content was carried out using the method described by AOAC [8]. Three crucibles were washed and dried in the oven at 100°C, to a constant weight and cooled in the desiccator and weighed ($W_1$). 6.0g of the grounded sample was weighed into the crucibles and weighed again ($W_2$). It was transferred into the oven at 60°C for two hours; the temperature was increased to 70°C and left over night. The sample was then removed and cooled in the desiccators and weighed. This process was repeated until a constant weight was obtained. Then the final weight was obtained as ($W_3$). Calculation for the moisture content in percentage was done thus:

Calculation:

$$\% \text{ Moisture} = \frac{W_2 - W_3}{W_2 - W_1} \times 100$$

**Determination of ash content**

This was determined using the method described by AOAC [8]. Three crucibles were washed, dried in the oven at about 105°C and weighed ($W_1$), 6.0g of the moisture free sample were weighed into the dried crucibles ($W_2$). This was heated in the muffle furnace at about 600°C for three hours. The crucibles were removed, cooled in a desiccator and weighed ($W_3$). Percentage ash was calculated as,

$$\%\text{Ash} = \frac{W_3 - W_1}{W_2 - W_1} \times 100$$

**Determination of overall protein concentration using Kjeldahl method.**

**Digestion**

The food sample was weighed into a digestion flask and then digested by heating with sulphuric acid (an oxidizing agent which digests the food), anhydrous sodium sulphate (to speed up the reaction by raising the boiling point) and a catalyst, such as copper, selenium, titanium or mercury (to speed up the reaction). Digestion converts any nitrogen in the food (other than that which is in the form of nitrates) into ammonia and other organic matter to $CO_2$ and $H_2O$. Ammonia gas is not liberated in an acid solution because the ammonia is in the form of the ammonium ion ($NH_4^+$) which binds to the sulphate ion ($SO_4^{2-}$) and thus remains in solution.

$$\text{N(food)} \longrightarrow (NH_4)_2SO_4$$

**Neutralization**

After the digestion has been complete\d, the digestion flask is connected to a receiving flask by a tube. The solution in the digestion flask is then made alkaline by addition of sodium hydroxide, which converts the ammonium sulphate into ammonia gas.

$$(NH_4)_2SO_4 + 2NaOH \longrightarrow 2NH_3 + 2H_2O + Na_2SO_4$$

The ammonia gas that is formed is liberated from the solution and moves out of the digestion flask and into the receiving flask – which contains an excess of boric acid. The low pH of the solution in the receiving flask converts the ammonia gas into the ammonium ion, and simultaneously coverts the boric acid to the borate ion.

$$NH_3 + H_3BO_3 \text{ (boric acid)} \longrightarrow NH_4^+ + H_2BO_3^- \text{ (borate ion)}$$

**Titration**

The nitrogen content is then estimated by titration of the ammonia borate formed with standard sulphuric or hydrochloric acid, using a suitable indicator to determine the end-point of the reaction.

$$H_2BO_3 + H^+ \longrightarrow H_3BO_3$$

The concentration of hydrogen ion (in moles) required to reach the end-point is equivalent to the concentration of nitrogen that was in the original food. The following equation can be used to determine the nitrogen concentration of a sample that weighs m grams using a xM HCl acid solution for the titration:

$$\%N = \frac{x \text{ moles}}{1000 cm^3} \times \frac{Vs - Vb}{mg} \times \frac{14g}{moles} \times 100$$

Where Vs and Vb are the titration volumes for the sample and blank, and 14g is the molecular weight of nitrogen N. A blank sample is usually run at the same time as the material being analysed to take into account any residual nitrogen which may be in the reagents used to carry out the analysis. Once the nitrogen content has been determined, it is converted to a protein content using the appropriate conversion factor.

$$\% \text{ protein} = F \times \%N$$

**Procedure**

This was carried out with some modifications as described in AOAC [8]. Exactly 2g of defatted sample was weighed into a digestion flask together with 5 glass beads, 4g of mixed catalyst, 30mls of concentrated sulphuric acid were added last, and the flask was then placed on a heating mantle in the fume cupboard. A few $cm^3$ of liquid paraffin was added. Digestion was carried out on low heat for about 3mins, until frothing subsides and the heat medium was then increased for 20-30mins, and finally full heating was applied until the digestion was completed. This was about five hours when a clear green colour was obtained. Continued simmering was done for just 45mins. Sample particles at the side of the cooled flask was washed down with $H_2O_2$. The solution was allowed to cool and then transferred into 500$cm^3$ round bottom flask which contained some boiling chips. 250 $cm^3$ of distilled water was added to the mixture. 70 $cm^3$ of 40% NaOH was added slowly by the side of the flask and three drops of 1% phenolphthalein indicator was added. 500 $cm^3$ conical flask was used to collect the ammonia that was liberated. 125 $cm^3$ of 4% boric acid was in the conical flask and 4 drops of mixed indicator was added into the conical flask. The distillation flask fitted with condenser was placed on a heating mantle. The conical flask was connected to the receiver's end of the condenser. The distillation was carried out at first with low heat and later the heat was gradually increased until 125 $cm^3$ of the distillate was collected into

the boric acid solution making it a total volume of 250 $cm^3$. The solution was titrated while hot with 0.5M of $H_2SO_4$. The acid was standardized just before use.

Calculations

$$\%N_2 \quad 14x \frac{M \times Vt \times Tv \times 100}{Wt \text{ of sample (mg)} \times va}$$

Where M = Molarity of the acid.

Tv = titre value.

Vt = total volume of diluted digest.

Va = aliquot volume distillate.

The nitrogen as used as index of the protein termed crude protein. The percentage crude protein was obtained by multiplying percentage nitrogen by a conversion factor of 6.25.

Crude protein = $\%N_2 \times 6.25$.

**Determination of Crude Fiber**

The method used in the determination of crude fiber content is as described in AOAC[8]. Exactly 3g of finely ground sample was weighed into a round bottom flask; 100ml of 0.5M $H_2SO_4$ solution was added to the mixture and boiled under reflux for 30mins. The hot solution was filtered under suction; the insoluble substance was washed severally with hot water until it was acid free. It was transferred into a flask and 100ml of hot NaOH solution was added, the solution was boiled under reflux for 30mins and it was filtered under suction. The insoluble residue was then washed with boiling water until it was base free. The insoluble residue was dried to a constant weight in the oven at 100°C, cooled in a desiccator and weighed $W_1$. The weighed sample W1 was incinerated in the muffle furnace at 550°C for one hour, cooled in a dessicator and weighed, $W_2$.

Calculation:

The loss in weight on incineration = $W_1 - W_2$.

$$\%\text{Crude fiber} = \frac{W_1 - W_2}{\text{Weight of original sample}} \times 100$$

**Determination of Total Lipid Concentration Using Solvent Extraction (Using Soxhlet Method).**

The soxhlet extraction method used is as described in AOAC [9]. A fat free thimble was weighed $W_1$. A clean 250$cm^3$ round bottom flask with some boiling chips was also weighed $W_A$. 6g of the sample was weighed into the thimble, $W_2$. This was placed in a soxhlet extractor; 200mls of petroleum ether was poured into the flask. The condenser was then connected to the extractor and the flask which was a heating mantle. The heat was then increased slowly until the solvent began to boil. The extraction was left to "run" through ten refluxes. (A reflux is when enough solvent has been collected in the soxhlet cylinder to be siphoned back into the round bottom flask). The thimble and its content were dried overnight in the oven at about 80°C. It was removed and cooled in the dessicator and later weighed, $W_3$. The flask containing lipid, boiling chips and solvent was heated in a water bath to evaporate the solvent and later dried and weighed $W_B$.

Calculations:

$$\%\text{ Lipid from thimble} = \frac{W_3 - W_1}{W_2 - W_1} \times 100$$

$$\%\text{Lipid from oil in the flask} = \frac{W_B - W_A}{W_2 - W_1} \times 100$$

**Determination of Carbohydrate**

Carbohydrate content was determined by difference, deducting the sum of the moisture content, ash content, protein content, lipid content crude fiber content from one hundred.

**Determination of Specific Mineral Content, Using Atomic Absorption Spectroscopy (AAS).**

The mineral content was determined using the method described by Suzanne Nielson [10]. Exactly 6g of the food was ashed by burning it in a muffle furnace at temperature of about $650^0$C. The resulting ash was dissolved in a 2% HCl. The solution was then aspirated into the instrument where it was heated to vapourized and atomized the minerals.

**Preparation of Stock Solution for Mineral Elements.**

**Zinc**

A stock solution containing 1000ppm of zinc ions was prepared by dissolving 1g of zinc ribbon in concentrated hydrochloric acid. The solution was evaporated near to dryness and dissolved in 250$cm^3$ of distilled water. From the solution, working standards of concentration 2.0, 4.0, 6.0, 8.0, 10.0ppm were prepared.

**Potassium**

Stock solution containing 1000ppm of potassium ions was prepared by dissolving 0.477 of potassium chloride in 250 $cm^3$ of distilled water. From the stock solution, standard working solutions of concentrations 10.0, 20.0, 30.0, 40.0, 50.0, 60.0, 70.0ppm were prepared.

**Nickel**

A stock solution containing 1000ppm of nickel ions was prepared from 4.95g of nickel sulphate dissolved in 1000cm3 distilled water in a volumetric flask. From the stock solution, standard solutions of concentrations 1.0, 2.0, 3.0, 4.0ppm were prepared.

**Iron**

A solution containing 1000ppm ferric ions was prepared by dissolving 1.207g of ferric chloride in 250cm $^3$ of distilled water. From the stock, standard solution of concentrations 2.0, 4.0, 6.0, 8.0, 10.0ppm were prepared.

**Calcium**

A stock solution containing 1000ppm of calcium ions was prepared by dissolving 2.77g of $CaCl_2$ in 1litre of distilled water. From the stock, standard solution of concentrations 2.5, 5.0, 7.5, 10.0, 12.5, 15.0, 17.5ppm were prepared.

**Copper**
A stock solution containing 1000ppm of copper ions was prepared from 3.80g of copper nitrate dissolved in 250cm3 distilled water. From the stock solution, standard solutions of concentrations 1.0ppm, 2.0ppm, 4.0ppm, 6.0ppm, 8.0ppm, 10.0ppm and 12.0ppm were made.

**Determination of Thiamine**
The method used to determined thiamine was described by Chopra and Kanwar [11]. 2g of the sample was weighed. 75cm$^3$ of 0.2N HCl was added; this was boiled for 30mins on a water bath. It was cooled and 5mls of enzymes solution was added and incubated at 37°C overnight. It was placed in 100cm$^3$ flask and made to volume with water. It was filtered and the filtrate was purified by passing it through silicate column. 5cm$^3$ of acidic KCl was used as eluate in a conical flask with addition of 3cm$^3$ of alkaline ferricyanide solution; 15cm$^3$ of isobutanol was added and shaken for 2 minutes. It was allowed to separate and the alcohol layer was taken. 2g of anhydrous $Na_2SO_4$ was added to the isobutanol extract. 5cm$^3$ of thiamine solution was poured in a 50cm$^3$ stoppered flask. Oxidation and extraction of thiochrome was also carried out as above.
Preparation of sample and standard blank was done taking 5cm$^3$ each 3cm$^3$ of 15% NaOH was used.

UV… Vis was used instead of flourimeter and it was read at 550nm

Caculation

Thiamine content = x/y x 1/5 x 25/v x 1/wt of sample.

x = (Reading of sample solution) – (Reading of blank)

y = (Reading of standard) – (Reading of standard blank)

v = Volume of solution used for test on the column.

**Determination of Riboflavin**
The method used to determine riboflavin is described by Chopra and Kanwar [11]. Exactly 2g of sample was weighed into a conical flask. 50mls of 0.2N HCl was added and boiled in a water bath for one hour. It was cooled and the pH was adjusted to 6.0 using NaOH. The pH was further lowered to 4.5 using 1N HCl. This was filtered into 100mls measuring flask and made to volume. To remove interferences, two tubes were marked 1 and 2. 1cm$^3$ of glacial acetic acid was added to each tube and mixed thoroughly. Then 0.5cm $^3$ of 3%$KMnO_4$ solution was added to the tubes. The tubes were kept for two minutes after which 0.5cm$^3$ of 3% $H_2O_2$ was added and mixed well.

UV… Vis was also used instead of flourimeter It was read at 525nm

Calculation:

$$\text{Riboflavin content} = \frac{x}{y-x} \times \frac{1}{W}$$

x = (Reading of sample 1) – (Reading of sample blank)

y = (Reading of sample + standard tube 2) – (Reading of sample + standard blank)

**Determination of Niacin by Colorimetric Method.**
It involves a reaction between niacin (nicotinic acid) and cyanogens bromide, which under proper conditions forms a coloured compound with an intensity proportional to the niacin concentration. The method used in the determination of niacin is as described by Chopra and Kanwar[11]. Exactly 5g of sample was weighed (in calcium hydroxide) and it was saponifie\d for 45mins in ethanolic KOH solution containing sodium ascorbate and cooled rapidly. It was transferred into separatory funnel with sequential use of $H_2O$, EtOH and ether and shaken vigorously. The aqueous phase was transferred to second separatory funnel and extracted with 25/100cm$^3$ mixture of EtOH/pentane. The pentane fraction was placed into the first separatory funnel and aqueous into a third separatory funnel. The unit was washed with 10cm$^3$ pentane portions and this portion was added to the first separatory funnel, the aqueous phase was washed with 10cm$^3$ EtOH/pentane mixture, and pentane fraction was added to the first separatory funnel, then the pentane fraction was washed with 3% KOH in 10% EtOH portions followed by $H_2O$ portion until neutral pH was obtained. $H_2O$ traces are removed by adding filter paper to separatory funnel with shaking. This was transferred to a round bottom flask, 1cm$^3$ of 0.1% BTH hexane was added and evaporated to dryness. The residue was dissolved in a few cm$^3$ 5/95 toluene/hexane with the later containing 0.35% n-amyl alcohol and re-evaporate to dryness at room temperature under a normal stream, then 2.0 $cm_3$ was dissolved in the same solvent mixture. The mixture was cleaned up by passing 200µl through a 250 x 46mm column packed with 10µm sil-60D-10CN, using n-hexane containing 0.35% n-amyl alcohol as the mobile phase and 254nm UV detection at a flow rate of 1.0cm$^3$/min. The fraction was collected between 2mins before and 2mins after the vitamin D peak in a 10cm$^3$ volumetric flask. 1.0cm$^3$ of 0.1% BTH hexane was added and evaporated to dryness at room temperature under a normal stream, then take up in 2.0cm$^3$ 5/95 toluene/hexane. Chromatograph of 500µl extract was as follows: a 250 x 4.6 ID mm column containing 5 partwasil, a n-hexane containing 0.35% n-amylalcohol mobile phase, a UV detector set at 254nm and 0.008 AUFS, a 2.5cm$^3$/min flow rate

Calculations:

mg niacin/g sample = C x DF / WT

Where: C = concentration of niacin, µg/ml

DF = dilution factor, WT = sample weight, g.

## ANTINUTRITIONAL FACTORS DETERMINATION OF PHYTATE.

Phytate phosphorous was determined by extraction as described by AOAC [12]. Exactly 2.0g of the sample was extracted using 50cm$^3$ of 0.18M trichloroacetic acid and rigorously shaken for 1hr 30mins at room temperature. The suspension was then centrifuge. 4cm$^3$ of 0.036M of ferric chloride solution was added to 10ml of the aliquot and then

placed in a boiling water both for 50mins after which the precipitated ferric phytate was collected by centrifugation washed thoroughly with 30cm$^3$ of trichloroacetic acid and 50cm$^3$ of water. 3.0cm$^3$ of 1.5M NaOH in added to the precipitate obtained and diluted with 30cm$^3$ distilled water is obtained the resulting ferric hydroxide is coagulated by heating. Ferric hydroxide was centrifuge washed with distilled water and dissolve with 40cm$^3$ of 3.2M nitric acid and made up to 100cm$^3$ distilled water. The iron content was determined by an atomic absorption spectrophotometer. From the iron content, the phytate content was calculated assuming a constant 4:6 (iron, phosphorous) molecular ratio in the precipitate. Amount of phytate in sample is calculated as

Atomic weight of iron =55.85g

Atomic weight of phosphorous =31g

Molecular weight of phytate acid ($C_6P_6O_{24}H_{18}$) =660.8g

Iron in sample =X micrograms from standard curve converting micrograms to micromoles.

= x/55.85= Y micromoles of Fe.

Using molecular ratio of Iron phosphorous 4:6 phosphorous (p) = 6/4 x y = molecules P = Z

Thus PA= 660.8/185.82 x Z

N.B: 185.82 is x molecular weight of P.

Micromoles PA x molecular weight of PA = micrograms of PA.

The phytate content = 185.82/660.8 x micro PA = microgram phytate.

% Phytic acid content = microgram PA/microgram phytate x 100/1.

**Determination of oxalate.**

This determination was done using the method described by Oke [13]. Oxalate was determined by extracting 5.0g of the sample with 20cm$^3$ of 0.3M HCl. The extraction was done three times by warning it at 40$^o$C. The combined extract was diluted to 100ml with distilled water for total oxalate estimation.

**Oxalate estimation.**

5.0cm$^3$ of the extract was made alkaline with 5M ammonium hydroxide and three drops of phenolphthalein indicator was added.1ml of 5% $CaCl_2$ was then added and the mixture was allowed to stand for 3hrs after which it was centrifuged at 3000rpm for 15 minutes. The supernatants were discarded and the precipitates washed thrice with hot water 2.0cm$^3$ of 3M sulphuric acid was added and warmed in a water bath at 80$^o$C to dissolve the precipitate. It was then titrated with freshly prepared 0.01M $KMno_4$. The titration was carried out at normal temperature at first until it was colourless. The solution was then warmed to 70$^o$C and titrated until a pink colour persisted.

% oxalate composition = w/5 x 100

Oxalate content = $C_2O_4^{2}+8H^{+}+MnO_4^{2-} \rightarrow 2CO_2+4H_2O+Mn^{+4}$

The reacting ions ratio is 1:1

From $M_1V_1 = M_2V_2$

M = molarity of $KMnO_4$

$V_1$ = volume of extract (oxalate)

$M_2$ = molarity of extract

$V_2$ = volume of $KMnO_4$

M.W of $CaCO_3 \rightarrow$ 128.08

weight of oxalate in litre = $M_2$ x molecular weight = Xg. Weight of oxalate titrand (2ml) =X x 2g = y 100ml of oxalate extracted will be y/5 x 100g = W

**Determination of saponin.**

This was determined using the method described AOAC [12]. About 5.0g of the sample was extracted using soxhlet extraction method. The sample was exhaustively extracted to defat it for 3hrs and the solvent was distilled off. Another extraction was carried out using a pre weighed flask fitted unto the soxhlet apparatus. Methanol enough to cause a reflux was poured into the flask to extract saponin . The saponin was exhaustively extracted for 3hrs. The methanol was then evaporated and the flask re-weighed. The difference in weight is the weight of saponin extracted.

The percentage saponin is calculated below:

% saponin = wt of saponin / wt of sample x 100

**Determination of cyanogenic glycosides**

Cyanogenic glycosides was determined using the method described by AOAC [12]. Exactly 1.0g of sample was weighted in 250cm$^3$ volumetric flask, 200cm$^3$ of distilled water was added to it and this was allowed to stand for 2hrs. Distillation was done until 160ml of distillate was obtained. This distillate was collected in a 250cm$^3$ conical flask containing 20cm$^3$ of 2.5% NaOH. To the distillate that contains cyanogenic glycosides, 8cm$^3$ of 6M ammonium hydroxide and 2cm$^3$ of 5%KI was added. The mixture was titrated with 0.02M silver nitrate against a black background. Permanent turbidity shows the endpoint. Cyanogenic glycoside content (mg/100g) Titre volume /Aliguot volume x extract volume / sample weight x 100

**Determination of Tannin.**

This was determined using the method described by AOAC [12]. Exactly 1.0g of the sample was weighed into a conical flask and 50cm$^3$ of water was added to it. It was then allowed to stand for 1hr and filtered into 50cm$^3$ volumetric flask. The filter paper was rinsed with distilled water and the extract diluted to 100cm$^3$. 2.5cm$^3$ of the diluted extract was measured into 50ml flask followed by the addition of 1cm$^3$

of Folin-Denis reagent and 2.5cm$^3$ of saturated $Na_2CO_3$ (7g in 100cm$^3$), it was diluted to volume with distilled water. The mixture was allowed to stand for 30mins at room temperature and its wavelength measured at 700nm. Its absorbance was compared on a standard Tannic acid curve. Preparation of standard Tannic acid. Tannic acid standard was prepared by dissolving 0.1g of tannic acid in distilled water and this was then diluted to 100ml and various concentration were made. (0.2,0.4,0.6,0.8,1.0,1.2ppm). this solution were in 5cm$^3$ volumetric flask, 5cm$^3$ of Folin-Denis reagent and 10cm$^3$ saturated solution of $Na_2CO_3$ solution were also added in the flask and it was made to volume with distilled water. The solution was left to stand for 35mins and the absorbance was measured at 700nm. % Tannic content = Cmg x extract volume x100 / Aliquate volume x weight of sample

Cmg = concentration of tannic acid from the graph.

## RESULTS AND DISCUSSION

### RESULTS

**Table1: Showing the proximate composition of wild rice**

| Parameter | Composition (%) |
|---|---|
| Moisture | 8. 66 ± 1.0 |
| Ash | 1.25 ± 0.2 |
| Lipid | 0.67 ± 0.1 |
| Protein | 13.80 ± 1.0 |
| Crude fibre | 0.67 ± 0.2 |
| Total Carbohydrate | 74.95 ± 1.4 |

**Table 2: Showing the mineral composition of wild rice**

| Mineral | Composition (mg/kg) |
|---|---|
| Potassium | 103. 30 ± 1.0 |
| Zinc | 36.70 ± 0.5 |
| Iron | 38.30 ± 1 .0 |
| Nickel | 3.30 ± 0.6 |
| Calcium | 183.30 ± 1.0 |
| Copper | 14.50 ± 0.5 |

**Table 3: Showing the vitamin composition of wild rice**

| Vitamins | Composition (mg/kg) |
|---|---|
| Thiamin | 4.10 ± 0.5 |
| Riboflavin | 5.90 ± 0.6 |
| Niacin | 57.00 ± 1.0 |

**Table 4: Showing the antinutritional factors**

| Antinutritional factors | Percentage content |
|---|---|
| Cyanogenic glycoside | 4.10 ± 0.5 |
| Phytic acid | 1.17 ± 0.2 |
| Oxalate | 1.25 ± 0.4 |
| Saponins | 7.90 ± 0.8 |
| Tannin | 0.34 ± 0.1 |

### DISCUSSION

**Moisture Content**

The moisture content of a sample is defined as the total water content of that sample. It is one of most commonly measured properties of food material. The appearance, texture and the stability of food depends on the amount of water it contained and also the ability of microorganism to grow in food depends on the water content, for this reason some food are dried below the critical moisture content [10]. The percentage moisture obtained for wild rice is 8.66%. The value agreed with the average value reported in most literature for wild rice and for white rice. The moisture contents of any sample depends on the age, freshness and agronomic practice during cultivation. The result shows that wild rice can be stored for a long time without been damaged by pests or affected by microbial activities.

**Ash Content**

Ash is the inorganic residue remaining after the water and the organic matter have been removed by heating in the presence of oxidizing agents, which provides measure of the total amount of minerals in foods. The percentage ash obtained from wild rice sample is 1.25%. This value agreed with the average value reported by Anderson for wild rice and other related cereals. [7] The obtained shows that the ash content of wild rice are edible making it an important to the body.

**Lipids**

Lipids are one of the major constituents of foods. Lipids are usually defined as those components that are soluble in organic solvents (such as ether, hexane or chloroform) but are insoluble in water. This group of substances includes triacyglycercols, diacyglycercol, monoacyglycercols, free fatty acids, phospholipids, sterols, caretonoids and vitamins A and D. The percentage lipid from this wild rice is 0.67% which agrees with the average reported value FAO for white rice [14].The lipids determination shows the overall physical characteristic, such as texture, flavour, mouth feel and appearance, the result implies that wild rice taste is as good as that of white rice.

**Protein**

Proteins are polymers of amino acids. Twenty different types of amino acids occur naturally in proteins. Proteins are different from each other according to type, number and sequence of amino acids that make up the polypeptide backbone [7],[15]. The wild rice contains high yield of protein which is 13.80% this makes it more nutritious than any other rice.

**Crude Fiber**

Dietary fiber can be defined as the lignin an plant polysaccharides that cannot be digested by human because they do not have the required enzymes to disassemble it. Dietary fibre when consumed liberally help to prevent gastrointestinal problems such as constipation. It helps to prevent colon cancer and also helps to normalize blood lipids. Wild rice contains low percentage of crude fiber which is 0.67% and this agreed with the reported values [7],[15]. This result shows reasonable amount of crude fiber which is beneficial to health.

**Carbohydrates**
Wild rice is very rich in carbohydrate just like other cereals. The percentage carbohydrate obtained is 74.95% which is very high. This shows that wild rice can give the energy the human body requires for normal growth.

## MINERAL COMPOSITION

The results of mineral composition of wild rice is as shown in Table 2. Wild rice is rich in potassium, calcium, iron, zinc and low in copper and nickel, wild rice is richer in minerals than other reported cereals [12]. Potassium is an extremely important mineral. It helps in reducing high blood pressure and helps to prevent stroke. Calcium helps in formation of strong bones and teeth. Iron is essential for metabolism and DNA synthesis. Zinc also helps in the formation of bone and teeth, protein synthesis in the body.

## VITAMINS

**Vitamin $B_1$ (Thiamin)**
The result of vitamins content of wild rice is shown in Table 3. Wild rice is very rich in vitamins $B_3$ and also contains vitamins $B_1$ and $B_2$. *Thiamin ($B_1$)* – Thiamin is essential for several body functions. Thiamin is a coenzyme for the decarboxylation of pyruvate and the oxidation of alpha keto-glutamic acid. Thiamin aids the nervous system and is essential for the functioning of important enzymes. These enzymes have vital roles in the process that makes energy available in the body. It is also essential for the transmission of certain types of nerve signal between the brain and the spinal cord. Depression, poor memory, muscle weakness and stiffness, nerve tingling, burning sensation and numbness, tiredness, headache, loss of appetite and nausea are symptoms and signs of thiamin deficiency. Wild rice contains 4.10 ± 0.5 mg/kg of thiamin which agreed with the reported values.

**Riboflavin (Vitamin $B_2$)** –
Riboflavin supports energy metabolism and biosynthesis of a number of compounds through its coenzymes form, flavin adenine dinucleotide (FAD) and flavin adenine mononucleotide (FMN).riboflavin is also required for activation and support of activity of vitamin $B_6$, folate, niacin and vitamin K. Riboflavin is important for normal reproduction, growth, repair and development of body tissues including the skin, hair, nails, connective tissues and immune system, severe riboflavin deficiency is rare and often occurs with other B vitamin deficiencies. Riboflavin content of the wild rice sample is 5.9 ± 0.6 mg/kg. Consequently, consumption of wild rice can be a good source of riboflavin in the body as it helps to maintain good health.

**Niacin (Vitamin $B_3$)**
Vitamin $B_3$ also known as niacin, niacinamide or nicotinic acid, is one of the eight water – soluble B vitamins. Vitamin $B_3$ is required for cells respiration, helps in the release of energy and metabolism of carbohydrate, fats and proteins. Proper circulations and healthy skin, function of the nervous system and normal secretion of bile and stomach fluids. Vitamin $B_3$ or niacin plays an important role in getting rid of body toxin and harmful chemicals. It also helps the body make various sex and stress – related hormones in the adrenal glands and other parts of the body. The wild rice sample was found to be very rich in niacin about 57.00 ± 1.0 mg/kg which agreed with the reported values.

## ANTINUTRITIONAL FACTORS

**Cyanogenic glycosides**
This is a group of O- glycosides formed from decarboxylated amino acids. The cyano group comes from alpha carbon atom and amino group. Cyanide is a constituent of our daily diet. It is from root crops, legumes, and cereal. The human blood contains cyanide at low concentration which is less than 12 Micro mol and it is normal.The percentage cyanogenic glycosides content of wildrice is 4.10%.This is quite normal for the human body to accommodate without any harm to the body.

**Phytic acid**
Phytate affect digestibility by chelating with calcium or binding with substrate or proteolyticenzymes and it also increases the cooking time in most grains and legumes. It interferes with the absorption of minerals from the diet .The percentage pytate content of wild rice is 1.17 %. The phytate content is low, therefore wild rice when consumed will be easily digestable.

**Oxalate**
Oxalate is a dicarboxylic acid anion. It is produced and accumulated in many crop plants and vegetables. Oxalate could be present in plants as soluble sodium, potassium or as insoluble calcium oxalate. High oxalate content in diets can cause the risk of renal calcium absorption. Oxalate poisoning is not too harmful or hazardous. The percentage oxalate obtained from wildrice sample is 1.25%. This is quite low the body is able to tolerate it without any harmful effect.

**Saponins**
Saponins are group of steroids or triterpenoid glycosides. This are characterized by astringent and bitter taste, also their haemolytic effects on red blood cells. The are distributed widely in the plant kingdom over 500 Genera. Some plant saponins (eg from oat and spinach) may enhance nutrient absorption and aid in animal digestion. However, saponins are often bitter to taste, and so can reduce plant palatability. ( e.g in livestock feeds ), or even imbue them with life threatening animal toxicity. The percentage saponin content 0f wildrice sample is 7.90%. The result shows that wild rice is not toxic to the body when consumed since the saponin content is low.

**Tannins**
Tannins are polyphenols that form complexes with proteins, making them insoluble and inactivating their enzymatic activity. The y may also bind to other micromolecule such as starch, causing a reduction in the nutritional value of food. Tannins can decrease protein quality by decreasing digestibility. Tannins when absorbed through the gut can be carcinogenic. But tannin plays a major role in plant defense against fungi and insects. The percentage tannin obtained in this wild rice sample is 0.34%.The content of tannin in

wild rice is very low which makes it more nutritious than any other cereals.

## CONCLUSION

Wild rice has almost gone into extinction in Nigeria. Many people and farmers are not aware of the nutritive value of wild rice. Therefore, the urge to take care of those that grow in the wild or to even cultivate it is not there. The nutritional value of wild rice from the results shows that wild rice is rich in protein as compare to other convectional or the normal rice we are used to. Wild rice is found to be more nutritious than any other rice. Wild rice like most cereals is not a complete diet; however, it does have some desirable nutritional attributes. The protein content of wild rice is relatively high for a cereal. Wild rice is a good source of the B vitamins – thiamin, riboflavin and niacin and contains common minerals in amounts comparable to those in other cereals. The values obtained for Antinutritional factors for the wildrice sample are quite low and therefore can be tolerated by the body.

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