Serum Biochemistry Profiles, Haematological Indices and Body Weight Gains of Albino Rats Fed Makurdi Rice Meals (MRM)

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Abstract*: In this study four parboiled rice varieties sold within Makurdi metropolis; Sipi, Mass, Tune 11 and foreign rice (Control) were purchased and coded A, B, C, and D respectively and subjected to proximate, microbiological and sensory quality analyses. Each of the rice samples were cooked, oven dried and milled into flour and used for the study. Thirty-six (36) Wister strain of albino rats were grouped into four groups of nine rats and fed with the rice samples for twenty-eight (28) days.** *Each of the experimental rats' group were daily fed with thirty (30)g of* **the four rice samples. Body weight measurement were taken and blood samples were randomly collected and subjected to** *Serum Biochemistry Profiles and Haematological Indices analyses daily in* **a statistical completely randomized design (CRD). The results of proximate composition analyses showed that the moisture contents ranged from 12,50-14.50% with Mass having the highest value (14.50%). The protein content of the rice samples ranged from 0.44-2.63% with mass having the highest value and foreign rice having the lowest protein content value of 0.44%. The rice samples had ash content that ranged between 2.50-3.20%, fibre content that ranged from 1.94-2.2% and fat content that ranged from 1.60-2.20% respectively. The carbohydrate content of all the Samples were significantly (P<0.05) different and ranged from 75.47-80.31%. The results of microbial count showed range of values of CFU/g from $3.8x10^5$-$5.3x10^5$ with Tune II and Sipi having the lowest and highest values respectively. The results of the sensory quality of different rice grain varieties showed that the texture of Sipi and the foreign rice had no significant (p<0.05) difference while mass and Tune II showed significant differences. For appearance there was no significant difference between the local rice varieties whereas there was a significant difference between the local rice varieties and the foreign rice with the highest value of 5.40. As for the taste/mouth and flavour, there was no significant (p<0.05) difference between the local rice varieties and the foreign. The result of the general acceptability showed that there was significant difference between Sipi and the foreign rice There was no significant difference between Mass and Tune II. The results of Serum biochemistry profiles, haematological indices and body weight gains (g) of rice varieties fed rats** *showed that* **Serum biochemistry profiles** *were* **not significantly affected (P > 0.05). These serum biochemistry profiles were; Cholesterol(mmol/L) Sipi 0.97, Mass 0.95, Tune II 0.94 and foreign 0.97; total protein(g/L) 9.60(Sipi,), 9.64 (Mass), 9.62 Tune II and 9.62(Foreign), alanine amino Transferase- ALT (iu/L) Sipi,, (0.91), Mass (0.93), Tune II (0.92) and Foreign (0.92). Aspartate amino Transferase- AST (iu/L) Sipi, (1.61), Mass (1.62), Tune II (1.60) and Foreign (1.60) were not affected significantly (P > 0.05) from all the rice varieties. Haematological indices included Packed Cell Volume (PCV), Red Blood Cell (RBC) and White Blood Cell (WBC). The Packed Cell Volume-PCV of rat fed rice meals Sipi, Mass, Tune II and Foreign respectively were Sipi, (41.56) Mass (41.54), Tune II (41.55) and Foreign (41.58). Red Blood Cell- RBC (10^{12}/L) of rat fed rice meals respectively were Sipi, (9.05), Mass (9.02), Tune II (9.07) and Foreign (9.01). White Blood Cell- WBC (10^9/L) of rat fed meals were Sipi (1.54), Mass(1.56), Tune II (1.53) and Foreign (1.55). The results were not affected significantly (P > 0.05) the Varieties. > 0.05). Body weight gains (g), 33.28, 33. 34, 33.27, and 33.27 of the albino rats fed rice** *meals of* **Sipi. Mass. Tune II** *and* **Foreign respectively were not significantly different (p > 0.05) from one another. The local and the foreign rice varieties were healthy and** recommended for*** **human consumption.**

Key words: **Albino rats, Serum Biochemistry profiles, Haematology indices, body weight gains Rice quality**

I. INTRODUCTION

In Nigeria, rice is a major contributor to internal and sub-regional trade. It is utilized mostly at the household level in Nigeria where it is consumed as boiled and fried with stew (Oko et al., 2012). African *(Oryza glaberrima)* and the Asian (*Oryza sativa)* have been the main local rice varieties cultivated in Nigeria. In recent times however, foreign rice varieties have also been introduced to consumers including inter specific hybrids between the African and Asian rice (Jones, 1995). Rice varieties generally consist of 75-80 % starch, 12 % moisture and only 7 % protein with full complement of amino acids especially lysine. Protein in rice is highly digestible with excellent biological value and protein efficiency ratio (FAO and WHO, 1998). Rice contains minerals particularly calcium, magnesium and phosphorus and traces of iron, copper, zinc and manganese (Yusufu, 1992). In addition to being a rich source of dietary energy, rice is a good source of thiamine, riboflavin and niacin. The nutritional values of rice vary with different varieties influenced by soil fertility, fertilizer application and other environmental conditions (Oko et al., 2012). This study was designed to evaluate the quality of foreign as compared to three local rice varieties; Sipi, Mass and Tune II sold in Makurdi Metropolis. The quality parameters of rice samples

investigated are usually and mainly the proximate composition parameters: moisture, crude protein, crude fat, and crude fibre and ash contents. Microbial counts in rice are relevant because different kinds of micro-organisms have been frequently found in uncooked rice, and heat resistant spores may also survive on cooking. If cooked rice remains at room temperature for a certain period then live spores will germinate into vegetative forms. The sensory characteristics of these rice varieties determined the texture, flavour, mouth feel, appearance and general acceptability. According to Ikya et. al.,(2019), the serum Biochemistry profiles, haematological indices and body weight gain of Wister Albino Rats Fed meals may be used to predict the safe status, nutrients quality, nutritive value of foods , tissue maintenance and cell growth. Similar study of Ikya et. al.,(2019) on Dakuwa meal sold in Makurdi metropolis provided useful information that might influenced consumer's acceptability for the product. Finding on Serum Biochemistry profiles, Haematological indices and body weight gain of animals that feed on rice sold in Makurdi Metropolis is lacking. This study evaluated the key quality parameters of local and foreign rice sold in Makurdi Metropolis and provided information on proximate composition, Microbial viable cell counts sensory quality and serum biochemistry profiles, haematological indices and body weight gain of albino rats that fed on the rice. The study is a new approach in Food Science and Technology that may also be applied as one of the measures for predicting nutritive values and safety of foods generally for human consumption such as rice varieties sold in Makurdi Metropolis.

II. MATERIALS AND METHODS

Three varieties of locally produced rice Sipi, Mass, Tune II and Foreign (Control) were purchased from Makurdi metropolis and subjected to analyses using standard methods.

Proximate Composition: Crude protein: The micro kjeldah method as described by AOAC (2005) was used to determine crude protein. Catalyst mixture (0.8g) was placed in a conical flask with few boiling chips. Each sample (0.2g) was weighed using a balance and transferred into the flask. Concentrated sulphuric acid (10ml) was added and the mixture heated on a heating mantle, initially gently until foaming has ceased and the content became completely liquefied. The flask was then cooled and the liquid is clear and free from black colour. The flask was then cooled and the content diluted with 25ml-distilled water. Distillation apparatus was connected, 5ml of boric acid solution was measured into a 100ml conical flask 2 drops of mix indicator was added. The flask was placed on the receiver so that the end of the delivery tube tips just below the level of the boric acid. Each digested sample (5ml) was pipette into distillation unit and 7-10ml of 50% or 40% NaOH solution was added. The unit was closed and the liberated ammonia was steam distilled into boric acid. The distillate (50ml) was collected and the tip of the delivery tube was rinsed with distilled water. The distillate was titrated with 0.1M HCl acid until the green colour changed to purple. The percentage of nitrogen in the sample was calculated using the formula: -

$$\% \text{ Nitrogen} = \frac{\text{Titre value (S - B) x 0.0014 x D x 100}}{\text{Weight of sample}}$$

Where S – B means sample titre value minus the blank,

D means dilution factor = 25/5, %crude protein = Nitrogen x 6.25.

Crude fat: The Soxhlet solvent extraction method outlined in AOAC (2005) was used in determining fat content of the samples. Each sample (2g) and the weight of the flat bottom flask with the extractor mounted on it were recorded. The thimble was held half way into the extractor and the weighed sample was carefully transferred into the thimble. Extraction was carried out using n- Hexane ether (boiling point 40-60°c) the thimble was plugged with cotton wool. Extraction was continuous for 8hours. At completion of extraction, the solvent was removed by evaporation on a water bath and the remaining part in the flask dried to 80°c for 30minutes in the oven to dry the solvent then cooled in a desiccator. The flasks were reweighed and percentage fat calculated as:

$$\% \text{ Fat} = \frac{\text{Weight of extracted fat}}{\text{Weight of sample}} \times 100$$

Crude fibre: The standard procedure AOAC (2005) was used in determination of the crude fibre content of the samples. Each sample (2g) was weighed into a 500ml beaker and boiled in 0.1M H_2SO_4 (1%) for 30minutes. The suspension was filtered and the residue washed vigorously with boiling water until it was no longer acidic. The sample residue was boiled in 200ml 0.1M NaOH solution for 30minutes. The dried residue was cooled in a desiccator and reweighed. The weighed sample was removed from the furnace when the temperature was 200°c. It was cooled in a desiccator and weighed. The loss in weight of the incinerated residue before and after incineration was taken as the crude fibre content. Percentage crude fibre was calculated as:

$$\%\text{Crude fibre} = \frac{\text{Total weight of fibre}}{\text{Weight of sample}} \times 100$$

Moisture: The moisture content was determined by an air-oven method as described in AOAC (2005). Each sample (2g) was weighed in duplicate into already weighed moisture dishes. These were transferred into an air oven at 105±2°c for 3hours. Each sample was covered in the oven, transferred into a desiccator and allowed to cool for 15minutes before weighing. The dishes were returned to the oven to reweigh until constant weights were obtained. The loss in weight was regarded as moisture content.

$$\%\text{Moisture} = \frac{\text{Weight loss}}{\text{Weight of sample.}} \times 100$$

Ash content: The procedure outline in AOAC (2005) was used in determining the ash content of the samples. The weights of the crucible dishes were taken. Each sample (2g) was added to each of the crucibles. The dish and content were placed on the furnace rack and the temperature was set to 500°C for 2-3hours until the sample was completely ashed. The ash in crucible dishes was reweighed and percentage ash was calculated as:

$$\%Ash = \frac{\text{Total weight of extracted ash}}{\text{Weight of sample.}} \times 100$$

Total carbohydrate: The standard method of Ikekoronye and Ngoddy, (1985) was used in determining the carbohydrate content. This was calculated by difference where

%Carbohydrate = 100- % (moisture + fat + ash + protein + crude fibre)

Microbial Count CFU/g: Preparation of samples by serial dilution: McCartney bottles were sterilized, arranged and labeled appropriately. Distilled water (9ml) was dispensed into the McCartney bottles. The test sample (1ml) was taken from the first bottle and transferred to containing distilled water and labeled 10^{-1}. Using another pipette, the content of the first dilution was taken and transferred to the second bottle and labeled 10^{-2}, this was repeated four times for all the four samples. Preparation of media for total plate count: **N**utrient agar powder (10g) was weighed and added into deionized water in a 250ml volumetric flask at 150ml. It was dissolved completely and then made up to 250ml with the deionized water, boiling the volume to mix thoroughly. It was gently heated to boiling and then sterilized in the autoclave at 15psi at 120°C for 15 minutes. Determination of total plate Count: The prepared sample (0.1ml) was dropped into a dish, 15mls solid agar medium was poured into petri-dish and allowed to form a gel, this was done in duplicate. The plates were incubated at 37°C for 24- 28 hours. The colonies were counted per plate using hand lens as described by Adegoke (2004).

Feeding Trial Experiment: Thirty-six (36) Wister strain of albino rats purchased from National Research Institute Vom, Nigeria were divided into four groups and **e**ach of the groups was further subdivided into three replicates of three albino rats each. Sippi, Mass, Tune II and foreign varieties of rice of Makurdi metropolis for each group were fed a*lbino rats* for twenty-eight (28) days after which the rats were subjected to anesthesia using ketamine injection and blood samples collected from the heart using needle and syringe into Lithium heparinized bottles. The blood samples randomly collected were each centrifuged at 3000rpm for five minutes from which serum and cells harvested were subjected to serum Biochemistry profiles and haematological indices analyses respectively. Blood serum biochemistry profiles analysed were, Total protein, cholesterol, serum aspartate amino transferase (AST), alanine amino transferase (ALT) while those for haematological indices were; packed cell volume, red and white blood cells. Weight gains of each of the experimental rats' groups were monitored and determined before their blood samples were collected for serum and cell analyses by standard methods. **(Ikya *et. al.*, 2013, Ikya *et. al.*,2019, Dacie, and Lewis,1991).**

Determination of Total Protein:

Principle: Protein in serum forms a violet coloured complex when reacted with copper II ion in the presence of an alkali solution. The intensity of the violet colour is proportional to the amount of protein present in the serum when compared to the solution with known protein concentration.

Reagents: Sodium hydroxide 600mM, Copper II sulphate 12mM sodium potassium tartrate 32mM Potassium Iodide 30mM Non- reactive ingredients.

Procedure: Three test tubes were used for Standard, blank and sample. The working reagent 2.0ml was added to each tube. The standard 0,04ml and sample was added to appropriate tubes and mixed and allowed to stand at room temperature 25^{o}C for five minutes. The spectrophotometer was set at 540nm and was zeroed with reagent blank. The absorbance of each tube was recorded.

Calculation: Absorbance of Unknown X Concentration of Std/Absorbance of Std=Total Protein (g/dl) Expected values (6.2 to 8.5g/dl)

Determination of Cholesterol:

Principle: Cholesterol is the main sterol component in the body tissues occurring mainly in the brain and spinal cord. Cholesterol is determined at 500nm after enzymatic hydrolysis and oxidation via the formation of the indicator quinoneimine in the presence of phenol and peroxidase.

Reagents: Cholesterol esterase 0.16U/ml, Cholesterol oxidase 0.11U/ml, 4- amino antipyrine 0.25mmol/l, Phenol 25mmol/l, Peroxidase 5.5U/ml.

Procedure: The analysis of cholesterol was performed directly in a cuvette at room temperature. Working reagent 1 ml which contained all the reagents above was added to two test tubes, blank and sample each (0.01ml) Water 0.01ml was added to blank and sample test tubes respectively. The mixture was allowed to stand for 10 minutes at 25 ^{O}C and absorbance was recorded at 500nm. The use of the spectrophotometer makes cholesterol determination convenient. **Calculation:** Absorbance of Unknown X Concentration of Std/Absorbance of Std= Cholesterol (U/ml)

Determination of Serum Aspartate Amino Transferase (AST):

Principle: AST is an enzyme produced by body tissues, heart, muscles kidney, brain and lungs and the major cells type in the liver. The level of AST in the blood is caused by increased conditions of cell damage and death. When cells are damaged AST is released into the blood stream. The amount of AST in the blood is related to tissue damage. AST is measured by monitoring the concentration of 2,4- dinitrophenylhydrazine

Reagents 1: AST/Glutamic oxaloacetic transaminase (GOT), Phosphate buffer pH 7.5(95mmol/L), L-aspartate(200mmol/L), α-oxoglutarate (2mmol/L)

Reagents 2: Colour reagent, 2,4- dinitrophenylhydrazine (1mmol/L), Standard Pyruvate, Sodium hydroxide (0.4N)

Procedure: In both blank and sample test tubes 500µL of reagent1 was added and 100ml deionized water. The mixture was incubated exactly for 30 minutes at 37^{O}C.

Reagent2 (500µL) was added to both test tubes and mixed and allowed to stand for 20 minutes at 25 ^{O}C. NaOH(0.4N) of 5 ml was added to both test tubes.It was mixed thoroughly and the photometer analysed the samples af ter incubation for 5 minutes at 25 ^{O}C

Calculation: The concentration of AST(U/ml) was calculated from the standard curve.

Determination of Alanine Amino Transferase (ALT):

Principle: ALT is an enzyme produced in hepatocytes the major cells type in the liver. The level of ALT in the blood is caused by increased conditions of liver cell damage and death. When cells are damaged ALT leaks out and enter the blood stream.

Reagents 1: Glutamic Pyruvic Transaminase (GPT), Phosphate buffer pH 7.5(95mmol/L), L-alanine(200mmol/L), α-oxoglutarate (2mmol/L),

Reagents 2: Colour reagent, 2,4- dinitrophenylhydrazine (1mmol/L), Standard Pyruvate, Sodium hydroxide (0.4N)

Procedure: In both blank and sample test tubes 500µL of reagent1 was added and 100ml deionized water. The mixture was incubated exactly for 30 minutes at 37^{O}C.

Reagent2 (500µL) was added to both test tubes and mixed and allowed to stand for 20 minutes at 25 ^{O}C. NaOH(0.4N) of 5 ml was added to both test tubes.It was mixed thoroughly and the photometer analysed the samples af ter incubation for 5 minutes at 25 ^{O}C

Calculation: The concentration of ALT (U/ml) was calculated from the standard curve.

Determination of Haematological Indices:

Packed Cell Volume (PCV):

Principle: Determination of PCV was intended to measure the relative volume occupied by the red cells (erythrocytes) in the capillary or venous samples of whole blood. It is measured by means of centrifugation and is expressed as a decimal fraction.

Reagents apparatus: EDTA tubes, triangulation-type haematocrit reader tubes, needle and syringe centrifuge

Procedure: After twenty-eight (28) days of feeding the rats on respective diets were starved overnight and their blood samples collected from the heart using needle and syringe into EDTA tubes for PVC determination. The blood samples were well mixed and the tubes filled by three quarters of the total length and the distal dry, unfilled ends were sealed. The filled tubes were placed in the centrifuge and the position of each tube was recorded and centrifuge at 100000g for five minutes. The ratio of the length of the cell column to the total length of the column of blood was read using triangulation-type haematocrit reader. The test was done in duplicate.

Red Blood Cell (RBC):

Principle: This is one of the indices for anaemia. The RBC count measures the ability of the blood to carry oxygen to the tissues.

Reagents/apparatus: Material and instruments for this test include; Hayem's solution, $HgCl_2$ 0.05g Na_2SO_4 2.5g NaCl 0.5g and distilled water 100ml. RBC pipette, Haemocytometer(Neubauer's counting chamber) with cover slip, microscope, alcohol 70% pipette rotator and an aspirator connected to a faucet with running water.

Procedure: Using pipette blood was aspirated to 0.5 while the Hayem's solution was also aspirated to the 101 mark. The pipette was held horizontally and rolled with both hands between finger and thumb. The tip of the pipette was used to touch the surface of the counting chamber 45 degree. The chamber was placed on the stage of the microscope and allowed to stand for two minutes for the cells to settle. The counting area was scanned with 10X objective lens. Using 45X objective the cells were counted in five groups of 16 small squares (80).

Calculation: The total number of red cells= NX10, 000, N is the number of red cells found in 80 squares.

White Blood Cell (WBC): Principle: This test reflects the body's defence mechanism is also called leucocytes and are important part of the immune system. These cells help fight infections by attacking bacteria, viruses and germs that invade the body. The diluents fluid for WBC is glacial acetic acid which lyses the red cells allowing a proper count of WBC.

Procedure: The procedure for determining WBC count proceeds in the same way as that for RBC except that the dilution factor of 1:20 is used for WBC.

Calculation: The total number of red cells= NX10, 000, N is the number of red cells found in 80 squares.

Weight gain:

Principle: Weight gains measures the ability of any meal to support growth and maintenance of body tissues. It is also a measure of the nutritive value of foods.

Procedure: Each of the experimental rats group were daily fed for 28 days with weighted thirty (30)g of the four rice study samples **.** Changes in weights were monitored by using an analytical weighing balance after every four days and initial and final weights of each group of rats were recorded

to determine body weight gain in a statistical completely randomized design (CRD)

Calculation: **Weight gain=** final weights of each group – initial weights of each group .

III. RESULTS AND DISCUSSION

Table 1: shows the results of proximate composition analysis carried out on the rice grains . Moisture, crude protein, crude fat, crude fiber and ash contents were determined. the most important chemical components in rice are moisture, crude protein, crude fat, crude fiber and ash contents. According to Oko O.A et al., (2012) rice grain consists of 75-80% starch, 12% water and only 7-10% protein while freshly harvested rice grains contain about 80% total carbohydrates. Rice provides dietary fiber. One cup (160g) of cooked brown rice contains around 2.4 g of dietary fibre, which equates to 8 % and 9.6% of an average man's and woman's daily fibre needs respectively (FAO 2006). Pomeranz, (1992) reported that the chemical composition of rice differs according to the variety and processing method used. The results in **Table1** showed that the moisture content of the foreign rice was significantly ($P<0.05$) different from that of the local rice varieties. However, mass had the highest value of 14.50% moisture content although not significantly different from Tune II which had 14.00%. The values were high enough to encourage deterioration. The protein content of Mass 2.63% was the highest but there was no significant ($P<0.05$) difference between the protein content of Mass and sipi. The protein content of Tune II and foreign rice were not significantly different even though foreign rice had the lowest protein content value of 0.44%. The differences in the protein content of the rice samples may be because of extreme processing

Table 1: Proximate Composition of Local Rice Varieties in Makurdi Metropolis.

Rice variety	%moisture	%protein	%Ash	%Fat	%Fibre	%carbohydrate
A	13.00 ± 0.06^{a}	2.19 ± 0.08^{a}	2.50 ± 0.02^{a}	2.00 ± 0.10^{ab}	2.22 ± 0.06^{a}	78.09 ± 0.11^{a}
B	14.50 ± 0.08^{b}	2.63 ± 0.11^{a}	3.20 ± 0.11^{b}	2.20 ± 0.08^{a}	2.00 ± 0.10^{b}	75.47 ± 0.06^{b}
C	14.00 ± 0.10^{b}	0.88 ± 0.01^{C}	2.50 ± 0.08^{a}	1.80 ± 0.11^{b}	2.16 ± 0.08^{a}	78.66 ± 0.08^{C}
D	12.51 ± 0.11^{a}	0.44 ± 0.06^{c}	3.20 ± 0.10^{b}	1.60 ± 0.10^{b}	1.94 ± 0.11^{b}	80.31 ± 0.10^{d}
LSD	0.54	0.59	0.12	0.30	0.10	0.40

Values are mean± standard of triplicate determinations. Any two sample mean not followed by the same superscript in the same column are significantly different ($p< 0.05$)LSD= Least significant difference. A= Sipi, B= Mass, C=Tune II, D=Foreign (control sample

variability, genetic makeup, of different varieties and also influences like, soil fertility, fertilizer application and other environmental conditions (Oko et al., 2012). The low values indicate the need to supplement the rice samples with protein sources even though the protein efficiency ratio may be high (FAO and WHO, 1998).

The ash content was significant difference between Sipi and Tune II as both had the ash content value of 2.50%. There was also no significant difference between Mass and Foreign rice as both had the same ash content value of 3.20%. The fat content of Mass had the highest value of ash content 2.20% and was significantly different from the other samples where there was no significant difference ($P<0.05$) in Sipi, tune II and foreign rice. Fibre content of Sipi was the highest 2.20% although there was no significant ($P<0.05$) difference between the samples. The values are enough to show availability of mineral (Yousuf, 1992).

The carbohydrate content all the Samples were significantly ($P<0.05$) different from each other. Foreign rice had the highest value of 80.31% carbohydrate content. After carbohydrate, protein is the second most abundant constituent of rice (Probert, 1993).

The finding of this study showed a different trend where moisture was the most abundant constituent after carbohydrate. Freshly harvested rice grains contain about 80 % carbohydrates which include starch, glucose, sucrose, dextrin (Oko, et al., 2012). The findings in this study where foreign rice had the highest value of 80.31% carbohydrate content is in agreement with the result of (Oko et al., 2012).

Table 2: Showed that total plate count was carried out to determine the bacteria load on the cooked rice varieties used in this study. That is the bacteria viable cell count of the rice grains varieties. As shown in the Table2, Sipi had highest cfu/g of $5.3x10^5$ followed by Mass and foreign rice with cfu/g of $4.9x10^5$ and $4.6x10^5$ respectively. Tune II had the least viable cell count of $3.8x10^5$. The differences in the results could be as a result of source of water used in cooking the rice and the environment of placement and utensils used in cooking the rice varieties. These vegetative forms may multiply to produce low molecular weight toxins. The results of the counts indicate that good hygiene practices are advised for cooking and handling of rice sold in Makurdi metropolis.

Table3: showed the results of the sensory quality of different local rice grain varieties which were cooked and eaten as white rice by a panellist composed of 15 members which used a- 9-point hedonic scale method of sensory evaluation. Sensory evaluation is considered as the direct way of assessing rice eating quality and the test is based on the use of the human senses.

Table 2: Microbial Count (CFU/g) of Rice VarietiesSold in Makurdi, Metropolis**.**

Sample	CFU/g x10^5
Sipi	5.3^a±0.15
Mass	4.9^b±0.17
Tune II	3.8^c±0.16
Foreign	4.6^b±0.13

Values are mean± standard of triplicate determinations. Any two sample mean not followed by the same superscript in the same column are significantly different (p< 0.05)

The parameters analysed were texture, appearance, texture, flavour and the general acceptability of the local rice varieties. From the results obtained, the texture of Sipi and the foreign rice had no significant (p<0.05) difference while mass and Tune II showed significant differences. For appearance there was no significant difference between the local rice varieties whereas there was a significant difference between the local rice varieties and the foreign rice with the highest value of 5.40. As for the taste/mouth feel and flavour,and texture there was no significant (p<0.05) difference between the local rice varieties and the foreign. The result of the general acceptability showed that there was significant difference between Sipi and the foreign rice. There was no significant difference between Mass and Tune II. The highest value of 5.40 obtained by this study indicated that the rice varieties sold in Makurdi metropolis were acceptable by consumers.

Table 3: Sensory Quality Attributes of Local Rice Grains Variety Sold in Makurdi Metropolis.

Rice variety	Texture	Appearance	Mouth feel	Flavour	General acceptability
A	5.53^a	4.53^a	5.46	5.07^a	5.20^a
B	4.13^C	4.13^a	4.67^a	4.33^a	4.40^b
C	4.06^b	4.00^a	4.13^a	4.40^a	4.53^b
D	5.46^a	5.40^b	5.53^a	4.53^a	5.93^a
LSD	1.31	0.52	1.83	1.17	0.71

Any two sample mean not followed by the same superscript in the same column are significantly different (p< 0.05)

Table 4: Serum Biochemistry Profiles, Haematological Indices and Body Weight Gain of Albino Rats Fed Makurdi Rice Meal from Makurdi Metropolis

	Makurdi Rice Meals			
Feeding trial parameters:	***SIPI***	***Mass***	***TuneII***	Foreign
SBP				
Cholesterol (mmol/L)	0.97^a±0.11	0.95^a±0.11	0.94^a±0.14	0.97^a±0.13
Total protein(g/L)	9.60^a±0.15	9.64^a±0.15	9.62^a±0.16	9.62^a±0.12
ALT (iu/L)	0.91^a±0.17	0.93^a±0.17	0.92^a± 0.12	0.92^a±0.11
AST(iu/L)	1.61^a±0.16	1.62^a±0.16	1.60^a±0.12	1.60^a±0.16
Haematogical Indices:				
PCV (%)	41.56^a±0.13	41.54^a±0.13	41.55^a±0.14	41.58^a±0.18
RBC(10^{12}/L)	9.05^a± 0.17	9.02^a±0.17	9.07^a±0.14	9.01^a±0.12
WBC (10^9/L)	1.54^a±0.15	1.56^a±0.15	1.53^a±0.15	1.55^a±0.13
Body Weight Gains (g),	33.28^a±0.10	33.34^a±0.10	33.27^a±0.11	33.27^a± 0.13

Values are means ± standard deviation of triplicate determinations. Means in the same row followed by the same superscript are not significantly

Table 4: Represents the results of Serum biochemistry profiles (SBP), haematological indices and body weight gains (g) of rice varieties fed rats. The results in the table 4; *showed that* Serum biochemistry profiles *were* not significantly affected (P > 0.05). These serum biochemistry profiles were; Cholesterol(mmol/L) 1.76 Sipi,1.74 Mass, 1.73 Tune II) and 1,76(foreign rice) Cholesterol is the main sterol component in the body tissues occurring mainly in the brain and spinal cord. Total protein(g/L) 10.70(Sipi,), 10.75 (Mass),10.73 Tune II and10.73(Foreign) Expected values should not be less than 6.2-8.5g/dl contributes to the amino acid pool and maintenance of body tissues. It is also a measure of the nutritive value of foods. (Ikya et. al.,2019). ALT is an enzyme produced in hepatocytes the major cells type in the liver. The level of ALT in the blood is caused by increased conditions of liver cell damage and death. When cells are damaged ALT leaks out and enter the blood stream. It is also a measure of the nutritive value of foods. Alanine amino Transferase- ALT (iu/L) Sipi,, (1.51), Mass (1.53), Tune II (1.52) and Foreign (1.52). AST is an enzyme produced by body tissues, heart, muscles kidney, brain and lungs and the major cells type in the liver. The level of AST in the blood is caused by increased conditions of cell damage and death. When cells are damaged AST is released into the blood stream. The amount of AST in the blood is related to tissue damage. It is also a measure of the nutritive value of foods. Aspartate amino Transferase-AST(iu/L) Sipi, (2.72), Mass (2.73), TuneII (2.70)and Foreign (2.70) were not affected significantly (P > 0.05) from all the rice varieties. Haematological indices included Packed Cell Volume (PCV), Red Blood Cell (RBC) and White Blood Cell (WBC). According to Dacie, and Lewis, (1991)**,** Packed Cell Volume (PCV) determination was intended to measure the relative volume occupied by the red cells (erythrocytes) in the capillary or venous samples of whole blood. It is also a measure of the nutritive value of foods. The Packed Cell Volume- PCV of rat fed rice varieties meals Sipi,,, Mass, Tune II. and Foreign respectively were (%)Sipi,, (39.67) Mass (39.65), Tune II (39.66) and Foreign (39.69).

Red Blood Cell (RBC) is one of the measurements of anaemia. The RBC count measures the ability of the blood to carry oxygen to the tissues. It is also a measure of the nutritive value of foods. Red Blood Cell- RBC(10^{12}/L) of rat fed meals respectively were Sipi, (7.07), Mass (7.04), Tune II (7.09) and Foreign (7.03).

White Blood Cell (WBC): This test reflects the body's defense mechanism.WBC is also called leucocytes and are

important part of the immune system. These cells help fight infections by attacking bacteria, viruses and germs that invade the body. It is also a measure of the nutritive value of foods. White Blood Cell- WBC (10^9/L) of rat fed meals were Sipi,, (2.56) Mass (2.58), Tune II (2.55) and Foreign (2.57). The results were not affected significantly (P > 0.05) the Varieties. > 0.05). Weight gains measures the ability of the rice meal to support growth and maintenance of body tissues. It is also a measure of the nutritive value of foods (Ikya *et. al.*,2019) Body weight gains (g), 23.30, 23.36, 23.29 and 23.29 of the albino rats fed ***meals*** Sipi**.** Mass**.** Tune II *and* Foreign respectively were not significantly different (p > 0.05) from one another.

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