

# Serum Biochemistry Profiles, Haematological Indices and Body Weight Gains of Albino Rats Fed Makurdi *Dakuwa* Meal (MDM)

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**Abstract:**-Three samples of *Makurdi Dakuwa Meals (MDM)* purchased from Wurukum, Wadata and North Bank in Makurdi metropolis were subjected to proximate composition and microbiological analyses. The samples were also fed *albino rats* for twenty-eight (28) days in a feeding trial experiment and their blood samples were randomly collected and subjected to *Serum Biochemistry Profiles and Haematological Indices analyses*. Each of the experimental rats' group were daily fed with weighted thirty (30)g of *Makurdi Dakuwa Meal (MDM)* and their weight gain recorded and compared with their initial weight to determine body weight gain in a statistical completely randomized design (CRD). Each of the three groups was further subdivided into three replicates of three albino rats each. The results of the proximate composition of the *Dakuwa Meals (MDM)* samples from A (Wurukum), B (Wadata) and C (North Bank) showed that ash ranged from 2.4% - 3.2%, crude fibre 1.4% - 1.45% and carbohydrate by difference was 47.95% - 52.79% not significantly different ( $p > 0.05$ ) from one another. The moisture contents of the samples were between 10.5% - 11.5% with the samples from Wadata having significantly ( $p < 0.5$ ) higher moisture than those from Wurukum and North Bank. The protein content of the samples varied significantly ( $p < 0.05$ ) and was highest (19.69%) in the North bank sample and lowest (11.16%) in the Wadata sample. The fat content of the samples was also significantly different ( $p < 0.05$ ) with values ranging between 22% - 32%. The results of the microbiological qualities of the samples showed that the total bacterial counts of *Dakuwa Meal (MDM)* ranged from  $2.0 \times 10^4$ cfu/g -  $2.1 \times 10^4$ cfu/g. The total yeast and mould count of the samples were also significantly different ( $p < 0.05$ ) and the values ranged from  $2.0 \times 10^2$ cfu/g -  $6.5 \times 10^2$ cfu/g respectively. *Makurdi Dakuwa Meal (MDM)* did not significantly affected ( $P > 0.05$ ) the serum biochemistry profiles. Wister albino rats fed three respective meals A, B and C were (cholesterol(mmol/L) 1.76(A), 1.74(B), 1.73(C), total protein(g/L) 10.70(A), 10.75 (B) and 10.73(C) Alanine amino Transferase-ALT (iu/L) A(1.51), B(1.53) and C(1.52) and Aspartate amino Transferase- AST(iu/L) A(2.72), B(2.73) and C(2.70) were not affected significantly ( $P > 0.05$ ) by location of the *Makurdi Dakuwa Meals (MDM)*. Haematological indices: Packed Cell Volume-PCV(%) A(39.67) B(39.65) and C (39.66), Red Blood Cell- RBC( $10^{12}$ /L) A (7.07), B(7.04) and (7.09) and White Blood Cell- WBC ( $10^9$ /L) A (2.56) B(2.58) and C(2.55) of Wister albino rats fed three respective meals A, B and C were not affected significantly ( $P > 0.05$ ) by location of the *Makurdi Dakuwa Meals (MDM)*. ( $P > 0.05$ ). Body weight gains (g), 23.30, 23.36 and 23.29 of the albino rats fed three respective *Makurdi Dakuwa Meals (MDM)* from A (Wurukum), B (Wadata) and C (North Bank)

were not significantly different ( $p > 0.05$ ) from one another. *Makurdi Dakuwa Meals (MDM)* is healthy and recommended for human consumption.

**Key words:** *Dakuwa* Quality, Haematology, Serum Biochemistry, Albino Rats

## I. INTRODUCTION

*Dakuwa* like many snacks often contain substantial amounts of sweeteners, preservative, and other appealing ingredients. An increasing proportion of the household food budget in Nigeria is spent on snacks items in which convenience and quality attributes are perceived as most important. An indication of the growing importance of snack foods is evident from the fact that consumers complain bitterly about increases in the price of staples such as milk and bread. They however, willingly pay large sums money for snack items [1]. In developed countries, snacks are not eaten as meal but are taken as a stop gap measure to briefly check hunger, provide energy for the body and for enjoyment of their taste. [2] reported that snacks serve as a source of macronutrients and are used for refreshment and entertainment at homes and parties. Their production is a means of livelihood and employment especially for women in developing countries.

Nigeria snack foods such as chin-chin, puff puff, fried maize cake and roasted maize have received less attention than bread even though they offer important advantages which include wide consumption, relatively long shelf life and good eating quality [1]. In Nigeria, snacks are mainly produced and consumed in their areas and production is based on art, not scientific knowledge. This leads to possession of variable characteristics [2]. Snacks vary with the culture of the people and geographical locations. Some of the problems associated with the local production of snacks include non-standardization of equipment, process and raw materials, inadequate hygiene during and after production. Finally, little or no packaging is used. These problems result in poor preservation techniques and high levels of contamination in the food resulting to food borne illness [2]. These problems are applicable not only to snacks but also to other traditional foods.

[1] reported that the production of fermented foods in Nigeria is still largely a traditional family art done in homes in a crude manner. Consequently, the production has not increased beyond cottage industry level. Among the various factors working against traditional fermented foods are inadequate raw material grading and cleaning leading to the presence of foreign matters (such as insects and stones) in final product; crude handling and processing techniques; lack of durability; lack of homogeneity; and unattractive presentation [3]. *Dakuwa* is a common snack food in Central and Northern Nigeria. It is produced from a mixture of maize and groundnut, ground pepper, ginger, sugar and salt. These ingredients are thoroughly mixed, pounded together and molded into balls that can be eaten without further processing. [4] reported that *Dakuwa* is also produced from cereals (maize, millet, sorghum), tiger nuts and groundnuts. The acceptability and health benefit, Serum Biochemistry Profiles, Haematological Indices, I and body weight gain of Albino Rats Fed Makurdi *Dakuwa* Meal (MDM) is a function of its flavour colour and ingredients used [3].

## II. MATERIALS AND METHODS

Three samples of *Dakuwa* were produced from a mixture of maize and groundnut, ground pepper, ginger, sugar and salt. These ingredients were thoroughly mixed, pounded together and molded into balls. The samples were purchased from Wurukum, Wadata and North Bank in Makurdi town and packaged in plastic containers. The samples were coded A, B and C respectively and transported to the laboratory for proximate composition and microbiological analyses.

### 2.1 Proximate Composition Analysis

**2.1.1) Crude protein:** The micro kjeldah method as described by [5] was used to determine crude protein. A catalyst mixture (0.8g) was placed in conical flask with few boiling chips. The sample (0.2g) was weighed using a balance and transferred into the flask. Concentrated sulphuric acid (10 ml) was added and the mixture heated on a heating mantle, initially gently until foaming has ceased and the content became completely liquefied. It was then heated vigorously until the liquid was 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 2% boric acid solution was measured into a 100ml conical flask and 2 to 3 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. 5ml of digested sample was pipette into distillation unit and 7ml to 10ml of 50% or 40% NaOH solution was added. The unit was closed and the liberated ammonia was steam, distilled into boric acid. 20ml to 50ml of the distillate was collected and the tip of the delivery tube was rinsed with distilled water. The distillate was titrated with 0.1ml HCL acid until the green colour change to purple. The percentage of nitrogen in the sample was calculated using the formula:

$$\% \text{ Nitrogen} = \frac{\text{titre values (S-B)} \times 0.0014 \times D \times 100}{\text{Weight of sample}}$$

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

D means dilution factor = 25/5.

$$\% \text{ Crude protein} = \% \text{ Nitrogen} \times 6.25$$

**2.1.2) Moisture:** The moisture content was determined by an air oven method as described in [5]. The test sample (2g) were weighed in duplicate into already weighed and cooled mixture dishes and these were transferred into a hot oven at  $105 \pm 2^\circ\text{C}$  for 2 to 3 hours. The samples were removed from the oven, transferred into desiccators and allowed to cool for 15 minutes 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.

$$\% \text{ Moisture} = \frac{\text{weight loss} \times 100}{\text{Weight of samples}}$$

Weight of samples

**2.1.3) Crude fibre:** The procedure outlined in [5] was used in determining the crude fibre content of the sample. 2g of the sample were weighed into a 500ml beaker and boiled in 200ml  $\text{H}_2\text{SO}_4$  (1%) for 30 minutes. 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 NaOH solution for 30 minutes, rinsed with hot water and dried in an oven. The dried residue was cooled in a desiccator and reweighed. The weighed sample residue was ashed in a muffle furnace at  $55^\circ\text{C}$  for 30 minutes. The sample was removed from the furnace when the temperature was  $200^\circ\text{C}$ . 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 collected as

$$\% \text{ crude fibre} = \frac{\text{total weight of fibre} \times 100}{\text{Weight of sample}}$$

Weight of sample

**2.1.4) Crude fat:** The soxhlet solvent extraction method outlined in [5] was used in determining fat content of the samples. 5g of the sample was weighed and the weight of the fat bottom flask taken. The thimble was held half way into the extractor and the weighed sample was carefully transferred into the thimble. Extraction was carried out using petroleum ether (boiling point  $40-60^\circ\text{C}$ ) the thimble was plugged with cotton wool. Extraction was continuous for 2-3 hours. At completion of extraction, the solvent was removed by evaporation on a water bath and the remaining part in the flask dried to  $80^\circ\text{C}$  for 30 minutes in the hot air oven to dry the flask then cooled in a desiccator. It was reweighed and percentage fat calculated as:

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

Weight of sample

2.1.5) *Ash content*: The procedure outlined in [5] was used in determining the ash content of samples. The weight of the crucible dish was taken 2g of sample were added to each of the crucibles. The dish and content were placed on the furnace rack and the furnace temperature was set to 500°C to 550°C for 2-3 hours to 4 hours until the sample was completely ashed. The ash in crucible dishes was weighed and percentage ash was calculated as:

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

2.1.6) *Total carbohydrate*: The procedure outlined by [6] was used in determining the carbohydrate content by difference.

## 2.2 Microbiological Analysis:

### 2.2.1) Preparation of Samples by Serial Dilution:

Macartay buffer were sterilized, arranged and label appropriately 9.0ml of peptone water was dispensed into the buffer. 1ml of the test samples was taken from the first bottle and transferred to another containing peptone water and labeled 10 using another pipette, the content of the first dilution was taken and transferred to the second bottle and labeled 1/100 or 10<sup>-2</sup>, this was repeated four times.

2.2.2) *Preparation of Media for Total Plate Count*: Seven (7) g nutrient agar powder was weighed and added to deionized water in a volumetric flask bringing the volume 250ml and mixed thoroughly. It was gently heated and heated to boiling and then sterilized in the autoclave at 121°C for 15 minutes.

Preparation Of media for mould And Yeast: Sabourand dextrose agar was prepared for the determined of mould and yeast. 14g of sabourand dextrose agar was suspended in 1 litre of deionised water and soaked for 10 minutes in a volumetric flask, swirled to mix sterilized by autoclave for 15 minutes at 12°C.

2.2.3) *Determination of Total Plate Count*: The prepared samples (1ml) was dropped into a Petri dish 15ml solid agar medium was poured into Petri dish and allow to form a gel, this was done in duplicate. The plates were incubated at 37°C for 24 to 48 hours. The colonies were counted per plate using hand lens as described by [7].

2.2.4) *Determination of Mould and Yeast*: One ml of the prepared serial dilution was dropped in a Petri dish and 15mls of sabourand dextrose agar was poured and allow to gel and then incubated at 37°C for 24 to 48 hours.

2.2.5) *Preparation of Pure Culture for Gram Staining*: A sterile wire loop was used to pick a colony after determination of total plate count, this was incubated in a Petri dish the inoculum was first spread evenly over a small portion and then towards the edge of the plate, the was again sterilized in a flame, cooled and used to make streaks in the Petri dish as described by [7].

2.2.6) *Gram Staining*: A thin smear of the prepared pure culture was made on a clean grease-free microscope slide, a loop sterile distilled water was added onto the slide, mixed and used to make a small circle this was allowed to dry (air) then heat fixed by passing the glass slide carefully over a Bunsen burner flame. One or two drops of crystal violet were applied onto the solids, allowed to stain for 30 to 60 seconds. It was then washed gently under running tap water.

Mordant-iodine's iodine was applied for 30 seconds, washed under running tap water, then decolorized quickly by adding two drops of 95% ethanol. It was washed immediately under running tap water and counter stained with dilute safranin allowed to act for 20 to 40 seconds and then dried. One drop of immersion oil was added to increase the refractive index of preparation and thus facilitate recognition of stained material. It was examined under the microscope as described by [7].

2.2.7) *Feeding Trial Experiments*: The three Makurdi *Dakuwa* Meal (MDM) were fed Wistar albino rats for twenty-eight (28) days feeding trial following a modification of the method described by [8]. Twelve Wistar albino rats were randomly distributed to three cages with four animals per cage. Each of the experimental rats' group were daily fed with weighted thirty (30)g of Makurdi *Dakuwa* Meal (MDM) from Wurukum, Wadata and North Bank respectively and water ad libitum and their blood samples were randomly collected and subjected to Serum Biochemistry Profiles and Haematological Indices analyses. *Dakuwa* Meal (MDM) and their weight gain recorded and compared with their initial weight to determine body weight gain in a statistical completely randomized design (CRD). Each of the three groups was further subdivided into three replicates of three albino rats each.

2.2.8) *Weight gain Analysis*: Weight was monitored after every four days and initial weight and final weight of the animals were recorded to observe the changes at the end of the experiment using an Analytical weighing balance. (Ikya et al., 2013).

## 2.3 Haematological Profile Analysis

2.3.1) *Packed Cell Volume (PCV)*: After twenty days of feeding the rats with respective diets they were starved overnight and their blood samples were collected from the heart using needle and syringe into EDTA tubes for haematological analysis. Similarly, after the rats were subjected to anesthesia using ketamine injection some blood samples were collected from the heart using needle and syringe into Lithium heparinized bottles for serum biochemistry analysis. The blood samples were centrifuged at 3000rpm for five minutes and serum was harvested and analysed [9]. All the chemicals and reagents used were of analytical grade.

2.3.2) *Red Blood Cell (RBC)*: Material and instruments for this test include; Hayem's solution,

HgCl<sub>2</sub>0.05g, Na<sub>2</sub>SO<sub>4</sub>2.5g, NaCl0.5g 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. 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)[9].

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

2.3.4) *White Blood Cell (WBC):* 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 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. The diluents fluid for WBC is glacial acetic acid which lyses the red cells allowing a proper count of WBC. [9].

2.3.5) *Serum Biochemistry Indices Analyses:* Blood serum biochemistry indices analyzed were, Total protein, cholesterol, serum aspartate amino transferase (AST), alanine amino transferase (ALT)

2.3.6) *Total Protein:* 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°C for five minutes. The spectrophotometer was set at 540nm and was zeroed with reagent blank. The absorbance of each tube was recorded. Absorbance of Unknown X Concentration of Std/Absorbance of Std=Total Protein(g/dl)

2.3.7) *Cholesterol:* Cholesterol is the main sterol component in the body tissues occurring mainly in the brain and spinal cord. The use of the spectrophotometer makes cholesterol determination convenient. The analysis of cholesterol was performed directly in a cuvette at room temperature. Cholesterol is determined at 500nm after enzymatic hydrolysis and oxidation via the formation of the indicator quinoneimine in the presence of phenol and peroxidase. Cholesterol esterase 0.16U/ml, Cholesterol oxidase 0.11U/ml, 4- amino antipyrine 5mmol/l, Phenol 25mmol/l, and Peroxidase 5.5U/ml were used to determine the cholesterol content of the blood samples. Working reagent 1 ml which contained all the reagents above was added to two test tubes blank and sample (0.01ml) and water 0.01ml was added to blank and sample test tubes respectively. The

mixture was allowed to stand for 10 minutes at 25 °C and absorbance was recorded at 500nm.

2.3.8) *Determination of Serum Aspartate Amino Transferase (AST):* 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 an 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. AST/Glutamic oxaloacetic transaminase (GOT), Phosphate buffer pH 7.5(95mmol/L), L-aspartate(200mmol/L), α-oxoglutarate (2mmol/L) and Colour reagent, 2,4- dinitrophenylhydrazine(1mmol/L), Standard Pyruvate, Sodium hydroxide(0.4N) were used to determine AST content of blood samples. 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°C. 2 500µL was added to both test tubes and mixed and allowed to stand for 20 minutes at 25 °C. NaOH(0.4N) of 5 ml was added to both test tubes. It was mixed thoroughly and the photometer analysed the samples after incubation for 5 minutes at 25 °C. The concentration of AST(U/ml) was calculated from the standard curve.

2.3.9) *Determination of Alanine Amino Transferase (ALT):* ALT is an enzyme produced in hepatocytes the major cells type in the liver. The level of ALT in the blood is caused by an increased conditions of liver cell damage and death. When cells are damaged ALT leaks out and enter the blood stream. Glutamic Pyruvic Transaminase (GPT), Phosphate buffer pH 7.5(95mmol/L), L-alanine(200mmol/L), α-oxoglutarate (2mmol/L), Colour reagent, 2,4-dinitrophenylhydrazine(1mmol/L), Standard Pyruvate, Sodiumhydroxide (0.4N) were used to determine ALT levels in the blood. 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°C. 500µL was added to both test tubes and mixed and allowed to stand for 20 minutes at 25 °C. NaOH(0.4N) of 5 ml was added to both test tubes. It was mixed thoroughly and the photometer analysed the samples after incubation for 5 minutes at 25 °C. The concentration of ALT(U/ml) was calculated from the standard curve.

### III. RESULTS AND DISCUSSION

#### 3.1 Proximate composition of Makurdi Dankwa Meal (MDM)

The proximate composition of the samples from A (Wurukum), B (Wadata) and C(North Bank) are presented in Table 1. The range of contents were ash (2.4% - 3.2%) crude fibre (1.4% - 1.45%) and carbohydrate by difference was (47.95% - 52.79%) and these values were not significantly different (p > 0.05) from one another. The moisture contents of the samples were between 10.5% - 11.5% with the samples from Wadata having significantly (p<0.5) higher moisture than those from Wurukum and North Bank. This is probably

due to differences in local packing material adopted for the storage of samples in Wadata. The protein content of the samples varied significantly ( $p < 0.05$ ) and was highest (19.69%) in the North bank sample and lowest (11.16%) in the Wadata sample. The fat content of the sample was also significantly different ( $p < 0.05$ ) with values ranging between 22% - 32%. The significant difference in the protein and fat contents of the samples may be due to variations in the proportions of maize and groundnut used in producing the samples. [10]. Samples with significantly higher fat and proteins probably had higher groundnut content than those with significant lower protein and fat contents. This implies that under the same conditions, the samples from North Bank may be more prone to lipid oxidation than samples from Wurukum and Wadata.

3.2 Microbial quality of Makurdi Dankwa Meal (MDM)

The microbiological qualities of the ample are presented in Table 2. The total bacterial counts of *Dakuwa*

ranged from  $2.0 \times 10^4$ cfu/g –  $2.1 \times 10^4$ cfu/g. The total bacterial count for the samples were significantly different ( $p < 0.05$ ). The varying levels of bacteria present in the samples may be a reflection of the level of hygiene practiced by the producers. The total yeast and mould count of the samples were also significantly different ( $p < 0.05$ ) and the values ranged from  $2.0 \times 10^2$ cfu/g –  $6.5 \times 10^2$ cfu/g respectively. The differences in the yeastcount may also be due to the quantity of sucrose added to the samples. It may also be due to the fact that the source of raw materials was different and samples were processed without adopting standard methods.

3.3 Serum biochemistry profiles of Albino Rats fed Makurdi Dankwa Meal (MDM)

Makurdi *Dakuwa* Meal (MDM) did not significantly affected ( $P > 0.05$ ). The serum biochemistry profiles (cholesterol(mmol/L)1.76(A),1.74(B), 1.73(C), total

Table 1: Proximate Composition of *Dakuwa* Sold in Makurdi Metropolis

SAMPLE	Moisture	Ash	Protein	Fat	Fibre	Carbohydrate
A	<sup>a</sup> 10.50 ± 0.13	<sup>c</sup> 2.40 ± 0.13	<sup>c</sup> 15.75 ± 0.06	<sup>b</sup> 22.00 ± 0.10	<sup>c</sup> 1.40 ± 0.06	<sup>b</sup> 47.95 ± 0.10
B	<sup>b</sup> 11.50 ± 0.12	<sup>b</sup> 3.20 ± 0.11	<sup>b</sup> 11.16 ± 0.08	<sup>b</sup> 20.0 ± 0.11	<sup>a</sup> 1.35 ± 0.08	<sup>b</sup> 52.79 ± 0.11
C	<sup>a</sup> 10.00 ± 0.08	<sup>c</sup> 2.60 ± 0.08	<sup>c</sup> 19.69 ± 0.10	<sup>c</sup> 3.20 ± 0.13	<sup>a</sup> 1.45 ± 0.10	<sup>c</sup> 34.26 ± 0.13
LSD	0.18	0.08	1.32	0.68	0.18	1.65

Values are means ± standard deviation of triplicate determinations. Means in the same row not followed by the same superscript are significantly different ( $p < 0.05$ )

Table 2: Microbial Quality of *Dakuwa* Sold in Makurdi Metropolis

	Samples			LSD
	A	B	C	
Yeasts and Molds count	<sup>2</sup> <sup>c</sup> $2.0 \times 10 \pm 1.12$	<sup>3</sup> <sup>a</sup> $2.3 \times 10 \pm 0.2$	<sup>2</sup> <sup>b</sup> $6.5 \times 10 \pm 0.01$	0.0673
Total viable count	<sup>4</sup> <sup>a</sup> $2.0 \times 10 \pm 0.08$	<sup>4</sup> <sup>b</sup> $1.7 \times 10 \pm 0.32$	<sup>4</sup> <sup>c</sup> $2.1 \times 10 \pm 0.0$	0.1489

Values are means ± standard deviation of triplicate determinations. Means in the same row not followed by the same superscript are significantly different ( $p < 0.05$ )

Table 3: Serum Biochemistry Profiles, Haematological Indices and Body Weight Gain of Albino Rats Fed Makurdi *Dakuwa* Meals (MDM) from Wurukum(A), Wadata(B) and North Bank(C)

Feeding trial parameters:	Makurdi <i>Dakuwa</i> Meals (MDM)		
	Wurukum(A)	Wadata(B)	North Bank(C)
Serum Biochemistry Profiles			
Cholesterol(mmol/L)	1.76 <sup>a</sup> ± 0.11	1.74 <sup>a</sup> ± 0.14	1.73 <sup>a</sup> ± 0.13
total protein(g/L)	10.70 <sup>a</sup> ± 0.15	10.75 <sup>a</sup> ± 0.16	10.73 <sup>a</sup> ± 0.12
ALT (iu/L)	1.51 <sup>a</sup> ± 0.17	1.53 <sup>a</sup> ± 0.12	1.52 <sup>a</sup> ± 0.11
AST(iu/L)	2.72 <sup>a</sup> ± 0.16	2.73 <sup>a</sup> ± 0.12	2.70 <sup>a</sup> ± 0.16
Haematological Indices:			

PCV (%)	39.67 <sup>a</sup> ±0.13	39.65 <sup>a</sup> ±0.14	39.66 <sup>a</sup> ±0.18
RBC(10 <sup>12</sup> /L)	7.07 <sup>a</sup> ± 0.17	7.04 <sup>a</sup> ± 0.14	7.09 ±0.12
WBC (10 <sup>9</sup> /L)	2.56 <sup>a</sup> ±0.15	2.58 <sup>a</sup> ±0.13	2.55 <sup>a</sup> ±0.16
Body Weight Gains (g)	23.30 <sup>a</sup> ±0.10	23.36 <sup>a</sup> ±0.11	23.29 <sup>a</sup> ± 0.13

Values are means ± standard deviation of triplicate determinations. Means in the same row followed by the same superscript are not significantly different ( $p > 0.05$ ) from one another.

protein(g/L) 10.70(A), 10.75 (B) and 10.73(C) Alanine amino Transferase- ALT (iu/L) A(1.51), B (1.53) and C(1.52) and Aspartate amino Transferase- AST(iu/L) A(2.72), B(2.73) and C(2.70) were not affected significantly ( $P > 0.05$ ) from all the Makurdi *Dakuwa* Meals (MDM). Haematological indices included Packed Cell Volume (PCV), Red Blood Cell (RBC) and White Blood Cell (WBC). 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. The Packed Cell Volume- PCV of rat fed meals from Wurukum(A) Wadata(B) and North Bank (C) respectively were (%) A (39.67) B (39.65) and C (39.66).

### 3.4 Red Blood Cell (RBC) count of Albino Rats fed MDM

This is one of the measurements of anaemia. The RBC count measures the ability of the blood to carry oxygen to the tissues. Red Blood Cell- RBC(10<sup>12</sup>/L) of rat fed meals from Wurukum(A) Wadata(B) and North Bank (C) respectively were A (7.07), B(7.04) and C (7.09) and White Blood Cell (WBC) which was a test that reflected the body's defence mechanism also called leucocytes are important test of the immune system of the experimental rats. These cells help fight infections by attacking bacteria, viruses and germs that invade the body. White Blood Cell- WBC (10<sup>9</sup>/L) of rat fed meals from Wurukum(A) Wadata(B) and North Bank (C) respectively were A (2.56) B (2.58) and C (2.55). The results were not affected significantly ( $P > 0.05$ ) by location of the Makurdi *Dakuwa* Meals (MDM). ( $P > 0.05$ ).

### 3.5 Body weight gains (g)

23.30, 23.36 and 23.29 of the albino rats fed Makurdi *Dakuwa* Meals (MDM) from A (Wurukum), B (Wadata) and

C (North Bank) respectively were not significantly different ( $p > 0.05$ ) from one another. Makurdi *Dakuwa* Meals (MDM) is healthy and recommended for human consumption.

## REFERENCES

- [1]. Lasekan, O.O. and Akintola, A.M. (2002). Production and nutritional evaluation of puffed soy-maize snack. Nigerian food Journal 20:15-19
- [2]. Ingbian, E.K and Akpapunam, M.A (2005). Appraisal of traditional technologies in the processing and utilization of mumu, a cereal based local food product. African Journal of Food, Agriculture, Nutrition and development 5 (2): 11-15.
- [3]. Nout, M.J.R. (1985). Recent developments in Tempe research. In: Achi, O.K. (2005) The potential for upgrading traditional fermented foods through biotechnology. African Journal of Biotechnology 4 (5): 375-380.
- [4]. Nkama, I. and Gbenyi, D.I. (2001). The effect of malting of millet and sorghum on the residual phytates and polyphenols in *Dakuwa* – a Nigerian cereal-legume snack food. Nigerian J. Tropical Agric. 3:270-27
- [5]. AOAC (2005). Official Method of Analysis of the Association of Analytical Chemists International. 18<sup>th</sup> Edn., Gathersburg, M D U.S.A of Official Method, August.
- [6]. Ihekoronye, A. I. and Ngoddy, P.O. (1985). Integrated Food Science and Technology for the tropics, Macmillan Press, London Pp 266 – 270
- [7]. Adegoke, G.O. (2004). Understanding Food Microbiology. (2<sup>nd</sup> Ed.). Shalom Press Ibadan, Nigeria. Pp 1-216.
- [8]. Ikyia, J.K., Gernah, D.I. and Sengey, I. A. (2013). Proximate composition, nutritive and sensory properties of fermented maize and full fat soy flour blends for *agidi* production. African Journal of Food Science Volume 7(2): 446-450. International Academic Journals.
- [9]. Dacie, J.V. and M.S. Lewis, 1991. Practical Haematology. 7th Edn., ELBS Churchill Living Stone, England
- [10]. Belitz, H.D. and W.Grosch. 2009. Food Chemistry. Second Edition. Springer Berlin. Berlin