# Levels of Powdered Moringa oleifera Leaf Meal Supplement in Maiduguri, North – Eastern Nigeria

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**Abstract.** This research study was carried out to analyse the effects on performance fishing broiler chickens fed graded levels of *Moringa oleifera* leaf meal (MOLM) supplementation in Maiduguri. Qualitative phytochemical screening of aqueous extract of *Moringa oleifera* (*M. oleifera*) leaf part was conducted by using various techniques as described by AOAC, it revealed the presence of six phytochemicals (glycosides, flavonoids, polyphenols, reducing sugars, tannins and terpenoid). Finishers' feed was self-formulated in grams (g), 180 day-old broiler chicks were commercially obtained, completely randomized block designed method was used, brooded and allotted into four treatment groups. Fifteen birds per treatment and triplicated each. At finisher phase, were supplemented with graded levels of powdered MOLM; $T_1$ (0% or 0 g) served as control, $T_2$ (5% or 5 g), $T_3$ (10% or 10 g) and $T_4$ (15% or 15 g). Feeds and water were provided *ad – libitum*, for 6 weeks. Daily feed intake, weekly weight gain was recorded and obtained in g/bird. Results revealed the treatments mean initial weight ranged from 612 to 91.9, final weight (1,562 to 1,917), weight gain (762 to 1,216), feed intake (1,535 to 1,655), feed conversion ratio (1.4 to 2.2) and feed efficiency ranged from 2 to 2.4 approximately. The findings revealed that MOLM increased the finisher broiler chickens' performance when incorporated up to 10% or 100 g/kg in to the diets without any adverse effects on growth performance, it has positive effect on weight gain of broiler chickens and reduces oxidative stress associated with heat stresses. Therefore, we recommended that poultry farmers can supplement finisher broiler chickens feed with powdered *M. oleifera* leaf meal up to 10% or 100 g / kg inclusion level.

**Key words:** broiler chicken, conversion ratio, feed efficiency, feed intake, growth performance, *Moringa oleifera*.

## Introduction

Food security and biosecurity management have to be a source of concerned when considering food production and its management. Quality and large scale food production and management are paramount issues to be born in mind and should be highly emphasised for the wellbeing of human and animal needs, especially the animal feedstuff. The production of well-balanced animal feeds (ratio) for animal production in order to produce high quality animal products for human consumption with lesser cost and more highly maximise profit benefits is a welcome idea that have to be considered.

According to Abba et al. (2020: 67-73) who stated that, when dealing with food security, high quality and quantity of animal production for quality protein have to be considered. In the past several decades, a great effort has been taken in advances, in animal nutrition, production practices and genetics have kept animal production in line with a growing large population and increasing the consumer demand for high quality and numerous quantity sources of animal protein globally, particularly birds (Avian); include poultry production, especially broiler chickens.

Birds are natural creatures reared or hunted for useful purpose, belonging to a number of bird groups collectively known as poultry. They are domesticated and managed in the same principles as domestic fowl (avian), e.g., chicken, duck, guinea fowl, turkey, etc., as a means of meeting human nutritional needs as well as improving incomes of farmers and their standards of living (Bataille et al., 2011: 1327-1338; Akinde, 2014: 461-474; Vesco et al., 2015: 549-559). Chicken has many advantages over other domesticated animals, of which production is costly and highly demanded. It is also being affected by temperature, environmental diseases and lack of food at certain period of time (Awad et al., 2015: 2772-2777; Waldroup et al., 2005: 250-257). Akinde (2014) defines the term poultry as birds that are raised domestically by human being for the purposes of food and other reasons produced freely under intensive management and control.

For many decades, farmers and feed manufacturers have been facing the challenge of effectively reducing the cost of poultry production and produce quality products. Dietary management of energy intake has been reported to decrease the cost of production and improve product quality to a greater extent than the above mentioned factors (Kaneko, 1997: 932; Baker, 2009: 29-41). The addition of fat to diets, besides supplying energy, improves the absorption of fat-soluble vitamins, diminishes the pulverulence, increases the palatability of the rations, and increases the efficiency of the consumed energy (Baker, 2009: 29-41; Awad et al., 2014: 3166; Balnave, 2004: 5-14). The aim of any poultry producer is to feed the chickens with balanced diet at least cost and generate products that will attract premium prices in order to maximise profit objectively. Strategies for feeding broilers destined for the whole bird market will differ from strategies for broilers destined to be sold as pieces.

Furthermore, the nutrient intake of fast growing broilers must be carefully controlled to prevent metabolic diseases such as ascites and leg weakness (Corzo et al., 2005: 319-327; Awad et al., 2014: 3297; Aftab, 2006: 688-701). There is no single ingredient is able to supply all the necessary amino acid and other necessary compounds in the right level. Most feedstuff only indicate the percentage of protein, amino acids, crude protein, dry matter, fibre, minerals, and moisture content in a given feed for poultry (Bataille et al., 2011: 1327-1338; Ahmed et al., 2014: 3293; Bregendahl, 2002: 1156-1167; Belay and Teeter, 1993: 116).

Broiler chickens in its entire ramification represents one of the viable farming enterprises providing the much needed animal protein sources, especially meat production, to ameliorate the protein deficiency factor in Nigerian food crisis and also a means to alleviate poverty or sustain livelihood (Jabeen et al., 2008: 1358). There are two distinct poultry production systems in Nigeria, as in most developing countries of Africa and Asia. Each of these two systems is associated with features of scale, stock, husbandry and productivity that therefore, define the two distinct production system. The two systems are conventionally referred to as the commercial poultry and the rural poultry production system (Adene and Oguntade, 2006; Ocholi et al., 2006: 1-8).

In Nigeria, poultry industry is fast growing as the demand for chicken products is increasing. A report of UNISPAR / UNESCO sponsored projects carried out on raising healthier poultry, at the National Centre for Energy Research and Development, Nsukka, Nigeria, stated that, about 10% of Nigerian population is engaged in poultry production of varying sizes and it is one of the avenues that can be explored for poverty alleviation and eradication (NCERD, 2000: 70-76). In recent decades, there is significant progress in genetic selection for fast growing meat type chickens (Abioja, 2010: 144). This led to the production of broiler chickens that will weigh over 2 kg at six weeks of age with 3.5 kg of a balanced diet, compared with 2 kg in fourteen weeks with 10 kg of feed in 1930s (Smith,

1990: 1-63). However, poultry farmers especially, broiler chickens are faced with many problems on health management, such as veterinary drugs and mortality as a result of microbial infection. The plant *Moringa oleifera* (*M. oleifera*) possess antimicrobial and antioxidant effects as reported by some researchers, mentioned that the antimicrobial properties of *M. oleifera* may be due to lipophilic compounds (Adene and Oguntade, 2006; Mohammed et al., 2016: 77).

The plant Drumstick or horse red or miracle tree is a tropical multipurpose tree that said to be originated and naturally grows well in India, Sub – Saharan Africa and South America and other part of the world. The scientific name is *Moringa oleifera,* locally called *Zogale* in Hausa and *Allam* in Kanuri languages, all parts are use as source of vegetable plant for food and medicinal or therapeutic purposes for both human and animal, especially the leaves part (Aning, 2006; Mohammed et al., 2016: 77). The tree is grown best in dry sandy soil and tolerate poor soil including coastal areas, which is grown in countries like; Nigeria, Ghana, Niger, etc. and use as vegetable in cooking soup or for salad locally (Azuonwu et al., 2016: 1-4; Yameogo et al., 2011: 264-268). *M. oleifera* belong to a monogenetic family of shrubs or trees, *Moringaceae*. This plant is used in the preparation of cosmetics, mechanical lubricant, biofuel production. It has many potential uses both in agricultural and industrial (Siddhuraju and Becker, 2003: 2144). The leaves are completely safe for consumption and have no known negative side effects or toxic element (Siddhuraju and Becker, 2003: 2144; Bhauger and Anwar, 2003: 52-96).

In many tropical and subtropical countries, various parts of *M. oleifera* (leaves, fruit, immature pod, flowers, stem and root part) are incorporated into the traditional food of humans and animals (Siddhuraju and Becker, 2003: 2144; Anhwange et al., 2004: 711; Abbas and Ahmed, 2012: 1-4; Dahot, 1998: 21-24; Olugbemi et al., 2010: 363). The leaves of *Moringa* tree the preferred part for use in animal diets as leaf meal, and a research had been conducted to study the effects of this meal on broilers' performance (Juniar et al., 2008: 238-242). The chemical analysis of *M. oleifera* on dry matter basis, revealed that it contained 27.2% protein, 5.9% moisture, 17.1% fat, and 38.6% carbohydrates (Azuonwu et al., 2016: 1-4). Anwar and Rashid (2007: 1443) noticed that on a dry matter basis, the essential amino acid contents of the leaves and sulfur containing amino acids were higher than the amino acid pattern of the FAO reference protein. Siddhuraju and Becker (2003: 2144) and Bassey et al. (2016: 61-76), mentioned that, regarding anti-nutritional factors (Phytochemicals) such as tannin, trypsin, and amylase inhibitors, lectins, and cyanogenic glucosides, glucosinolates, and saponins) concentrations were either undetectable or negligible in leaves powder.

Broiler chickens are one of the most profitable among the poultry farming. It represents one of the viable farming enterprises providing the much needed animal protein sources which reduces or minimize the protein deficiency factor in Nigeria food needs crisis, providing means of living, alleviate poverty and sustain means of livelihood amongst the population of Nigeria and the world at large. This entrepreneur practice, is facing with lot of problems, such as biosecurity, high cost and shortage of feeds and lack-up proper and healthy housing management, low profit, agro-vet drugs and high mortality rate. The addition of plant materials of known nutritional and medicinal values in calculated amount and appropriate, such as *M. oleifera* to the feeds could help in overcoming some of these problems. The aims and objectives of this research study are; to screen some of the phytochemical content of aqueous leaf extract of *M. oleifera* plant, to ascertain the effects of graded powdered *M. oleifera* leaf meal supplement fed to broiler chickens, evaluate feed intake and weigh gain as well as to ascertain the ideal inclusion levels of the powdered plants' part in broiler diet.

## Material and Methods

*Study Area and location*

Jere local government area is situated below 305 m above sea level, north of Maiduguri. It is located between latitude 110$^{o}$ 48' – 110$^{o}$ 58' N and longitude 130$^{o}$ 06' – 130$^{o}$ 20' E in the Sudan – savannah transition zone. Jere bowl fall within Jere LGA and it shares boundaries with some local government areas; to the north –east, it shares border with Nganzai and Mafa, while to the north-west and south-east shares border with Maiduguri and Konduga. The study area was selected based on its proximity, accessibility, relevance of the study and familiarity with the environment. Intensive irrigation activities take place all year round at the banks of the river (Gwana et al., 2013: 57-63; BSBLS, 2004).

*Materials*

All materials used in this research study were of highly grade and hygienically cleaned and lighted fit poultry house.

*Reagents Used*

Reagents used in this research study were of analytical grade and poultry diets were health-risks free or hazards free.

*Type of Feeds Used*

The type of feeds used in carrying out the experimental research study were commercially obtained starter feed (Animal Care brand feeds) and the feedstuff ingredients from which the finisher feed (Self / farm Formulated) was formed were also obtained commercially.

*Methods*

The experiments research study was conducted at poultry production unit of the teaching and research poultry farm of the Department Animal Health and Production Technology, Mohamet Lawan College of Agriculture, Maiduguri, in Jere Local Government Area, Borno State, Nigeria. The following methods were applied and standard operating procedures (SOP) and safety precautions strictly were observed as described by Abba et al. (2020: 67-73), Gwana et al. (2014: 238), Bassey et al. (2016: 14-25), AOAC (1990).

*Sampling and Sample Collection*

Procedures: At about 6.30 AM, in the early morning hours, the sample of leaves part of the plant of *Moringa specie* was collected and obtained by plugging the stalk of leaves compound on the main plant, from the *Moringa* plantation of the Department of Forestry Technology, College of Agriculture, Maiduguri. The fresh-green leaves part sample of *Moringa specie* that was collected packed in polythene bags and was transported Laboratory Unit, Department of Animal Health and Production Technology, Mohamet Lawan College of Agriculture. Maiduguri, Nigeria. The sample was unpacked and placed on a plastic mat on top of examination table. A little out of the whole sampled were collected into a polythene bag and was taken to the Department of Forestry Technology, of the same Institute for the identification and authentication of the plant part sample.

*Authentication and Identification of the Leaves Part*

The age of the plant was said to be 5 years old. The leaves plant part was identified and authenticated as the leaves part of *Moringa oleifera* by Shettima U. K. and Abubakar Aliyu of the same department. The leaves part of the *Moringa oleifera (M. oleifera)* were given authentication and identification with reference to the herbarium sheets (Voucher Number: *MOL-0025-19*), kept. Stored and placed at Herbarium of the Department of Forestry Technology, Mohamet Lawan College of Agriculture, Maiduguri. The name of

the plant, plant part, time, date and the year in which it was plugged written on the container as or for feature reference.

*Natural Dehydration of the Leaves Part Sample*

Procedures: - In laboratory, the sample was placed on to the table, and the leaves were destalked from the compound part, chopped with plastic knife to reduce to pieces. It was collected and transferred in to large plastic bowl, washed with tap water several times in order to remove any dust and insects waste (if any). Then rinsed with distilled water and later with deionised water. This was done in order to avoid the contamination of the leaves sample with any element if present. It was then drained and spread on the polythene mat, air dried under room temperature (22 $^{O}$C – 25 $^{O}$C) to a constant weight and to remove its moisture for 14 days. The dried plant material (leaves part of *M. oleifera*) was collected and packed into plastic container and was ready for next processing as described in the methods applied by Bassey et al. (2016: 14-25).

*Pulverization of leaves parts of M. oleifera*

Procedures: - The chopped and reduced in to pieces, washed and at room temperature dried plant part sample was placed in to homogenizer (blending machine) and blended in to fine powder for 15 minutes, in order to have a powder of leaves plant part of *M. oleifera*. The *M. oleifera* leaves powder obtained was transferred in to large mouth plastic containers, screwed cap to covered. The containers containing the *M. oleifera* leaves powder were labelled with following information; name and type of plant, plant part material, nature, date with time, and person who prepared it were recorded. It was stored in cool and dry environment, away from light, and placed on the shelve for further usage.

*M. oleifera leaves Extraction*

*Procedure:* - To cleaned and sterile 1000 mls conical flask containing 250 mls of 70% Methanol (70 mls of Absolute Methanol and 30 mls sterile distilled water making the 70% Methanol solution) being dispensed. From the stocked of *M. oleifera* leaves powder being prepared, 40 g was weighed out and transferred in to the flask. This was shaken to mix and allowed to stand at room temperature (22 $^{O}$C-25 $^{O}$C) for 72 hours (3 days) in order to dissolved and dissociated in the fluid completely. After the mixture was been conditioned in these temperature and periods, the extract formed was obtained by separation techniques, and by filtering the mixtures separately using Whitman's No. 1 filter paper. The filtrates were collected in cleaned and sterile 500 mls beaker and heated at temperature of 60 $^{O}$C until it reduced to aqueous extract which was obtained. This was dispensed in to cleaned and sterile 100 mls conical flasks, corked, well labelled with the name of the extract (Aqueous extract of *M. oleifera* leaves powder), date of preparation, time and person who made the preparation and stored in refrigerator ready for the next phytochemical screening analysis.

*Phytochemical analysis of the Aqueous Extract of the plants' part*

The qualitative screening of some phytochemicals in *M. oleifera* leaves part aqueous extracts was carried out for the presence of terpenoid, polyphenol, alkaloids, reducing sugar, tannins, hydroxyl methyl anthraquinones, steroid, cardiac glycosides, flavonoid and saponins as in the methods described by Bassey et al. (2016: 14-25) and AOAC (1990).

*Test for Alkaloids*

Procedure: - Into a test – tube, 2 mls of the extract was added and this was heated for 20 minutes using water bath. The heated mixture was filtered and 1 ml of the filtrate was measured into a test-tube and 0.5 ml of Wagner's reagent was added to it and mixed.

A reddish brown colouration was observed which is an indicative of alkaloid as the method described by Harbone (1973: 126-131).

*Test for Anthraquinones*

Procedure: - In to a test-tube, 2 mls of the extract was shaken to mix with 5 mls of 10% ammonia solution. The presence of a pink red to violet colour in the ammoniac (lower) phase indicated the presence of anthraquinones as in the method described by Tease and Evans (1989).

*Test for Hydroxyl Methyl Anthraquinones*

Procedure: - In to a test-tube, 2 mls of the extract was shaken to mix with 5 mls of 10% ammonia solution. The formation of a red colour or precipitate indicates its presence as in the method described by Tease and Evans (1989).

*Test for Cardiac Glycosides*

Procedure: - In a test-tube containing 0.5 grams of the sample was dissolved in it, and 2 mls of chloroform solution. Then 2 mls of concentrated sulphuric acid was carefully added to form a reddish brown colour at the interface, which is an indicative of the presence of steroidal ring of a glycone portion of the cardiac glycoside as described in method applied by Sofowara (1993: 134-150).

*Test for Flavonoid*

Procedure: - In a test-tube containing 10 mls of distilled water, 3 mls of the extract was pipette out was added to it. It then was shaken and 1 ml of 10% Sodium hydroxide was added to the mixture. A yellow colouration was observed showing the presence of flavonoid as described in the method applied by Harbone (1973: 126-131).

*Test for Polyphenol*

Procedure: - To a test-tube, 5 mls of distilled water was dispensed and 2 mls of the aqueous extract of leaves part of *M. oleifera* was added and heated in a water bath for 10 minutes. 1 ml of ferric chloride was added to the mixture, followed by 1 ml of 1% Potassium Ferro Cyanide and mixed. The formation of a green – blue precipitate indicated the presence of polyphenol as in the method described by Tease and Evans (1989).

*Test for Reducing Sugar*

Procedure: - In a test-tube, 2 mls of the extract was dispensed, and added 5 mls of Fehling's solution and heated in a water bath at 80 $^{O}$C for 10 minutes. The presence of a brick red precipitate indicates the presence of reducing sugar as described in the method applied by Harbone (1973: 126-131).

*Saponins*

This test is divided into 2, the frothing test and the emulsion test.

*Frothing Test*

Procedure: - To a test-tube, 3 mls of the extract was pipetted and 2 mls distilled water was added to it and then it was shaken vigorously. A persistent frothing movement at least for 15 minutes was observed. This is an indicative for presence of Saponins as described in the method applied by Harbone (1973: 126-131).

*Emulsion Test*

Procedure: - In to a test-tube, 3 mls of the extract was pipette out in to it and 5 drops of Olive oil was added to mixed and shaken vigorously. Emulsification was observed. This is an indication of Saponins as described in the method applied by Harbone (1973: 126-131).

*Test for steroid*

Procedure: - In a test-tube, 1 ml of the extract was treated with 0.5 ml of acetic acid, 0.5 chloroform and 1 ml of concentrated $H_2SO_4$ and mixed. A reddish brown ring was

formed at the separating level of the two liquids. This is an indicating the presence of steroid as described in the method applied by Harbone (1973: 126-131).

*Test for Tannins*

Procedure: - In to a test-tube, 1 mls of the extract was measured and it was heated. A drop of 10% ferric chloride was added to it and mixed. The mixture shows a green colouration is an indication of the presence of tannins as in the method described by Tease and Evans (1989).

*Test for Terpenoid*

Procedure: - *In a 20 mls test-tube*, 5 mls of extract was dispensed and mixed with 2 mls of chloroform. 3 mls concentrated $H_2SO_4$ was carefully added to the mixture, of which, then forms an interface of reddish brown colouration. This is an indication of the presence of terpenoid as described in the method applied by Sofowara (1993: 134-150).

*Farm - Formulated Finishers' Feed*

Procedures: - The finisher feed was formulated locally by adding together the calculated amount (weight of the individual ingredients in grams), mixed thoroughly and homogenously. The feed ingredients were; maize, wheat bran, soya beans, groundnut cake, bone meal, fish meal, premix, methionine, lysine and common salt. These were contained in each feed of experimental treatments (T), and the quantity of *M. oleifera* leaves powder varies within the treatments. The powdered *M. oleifera* leaf were added with graded levels of 0 g to treatment $T_1$, which served as control. The weight of 5 g, 10 g, and 15 g were added to $T_2$, $T_3$ and $T_4$ respectively. The feeds were then packed in to a sack for each experimental treatment separately and labelled with the necessary information; type of feeds, content and constituents, date and time of production, and names of persons who supervised the production of the feed were also recorded.

*Cleaning and Disinfecting the Poultry House*

Procedures: - The poultry house was swept and cleaned, dust were swept and traces of cobwebs were cleared. The floor was also washed with water of which detergent and disinfectant was added, spread all over the floor. The cleaned and disinfected house was left opened to air dried and ventilated for 3 days. Then hygienically, wood shavings were randomly and evenly spread all over the floor of the house and fumigated with 40% Formaldehyde solution and allowed to rest for another 7 days. After which, it was ready for stocking the day old broiler chicks as in the method described by Abba et al. (2020: 67). Finally, date and time of cleaning and hygienic measures were recorded.

*Experimental Stocking and Management of the Birds*

Procedures: - A total of 180 day-old broiler chickens were purchased from Animal-Care, Maiduguri. They were transported to the poultry house unit of Mohamet Lawan College of Agriculture, Maiduguri. The method used in this experimental design study was randomized complete block designed. The birds were fed with broiler starter and brooded for the period of two weeks. After brooding, the birds were divided in to four groups, as follows; $T_1$, $T_2$, $T_3$ and $T_4$ with 15 birds per treatment and with their triplicates each. They were then fed with growers feed for two weeks. Finally, fed with the experimental diets (Finishers' feed); in which powdered *M. oleifera* leaf supplement were added with graded levels of 0 g to treatment $T_1$, which served as control, weight of 5 g, 10 g, and 15 g were added to $T_2$, $T_3$ and $T_4$ for two weeks. Feeds and water were provided *ad – libitum*, for 6 weeks. Now the birds are ready for the table sizes and ready the next analysis. Initial and final weight of birds in all of the experimental treatments were taken. Each treatment was weighed in gram per bird and the mean weight were later calculated, weight gain, feed intake, feed conversion ratio, feed efficiency or utilization were also obtained.

1. Feed intake is calculated by offering a known quantity of feed to each treatment group and subtracting the leftover feed from the initial offered.

Mathematically expressed,

⇨ F I = FO – FLO

Where FI = feed intake, FO = feed offered and FLO = feed left over.

2. Mean weight gain of bird in each treatment = mean final weight - Mean initial weight,

Mathematically expressed,

⇨ WG = FW – IW

Where WG = weight gain, FW = final weight and IW = initial weight respectfully.

3. Mean feed conversion ratio in each Treatment = mean feed intake ÷ mean weight gain,

Mathematically expressed,

⇨ FCR = FI ÷ WG

Where FCR = feed conversion ratio, FI = feed intake and WG = weight gain.

*Data Analysis*

The data obtained in this research study were analysed by using analysis of variance (ANOVA). The mean between the treatment were separated using least significant difference (LSD) at 5% of probability.

*Calculated Feed Ingredients*

In the composition of experimental feed formulation, the calculated feed ingredients were performed as shown in Table 2.

**Results**

Table 1 and Fig. 1 showed the results of the qualitative screening analysis of some phytochemicals in plants' part of *M. oleifera* leaves powder; among the twelves (12) plant's chemical (alkaloids, anthraquinones, hydroxyl methyl anthraquinones, cardiac glycosides, cyanogenic glycosides, flavonoids, polyphenol, reducing sugar, saponins, steroids, tannins and terpenoid) screened for, only six (6) (cyanogenic glycoside, flavonoids, polyphenol, reducing sugar, tannins and terpenoid) were present. And amongst the present ones, only cyanogenic glycosides were moderately present, but the rest were present in scanty or in traces.

Table 1. Qualitative Screening Analysis of Some Phytochemicals in Aqueous Plant's part of *M. oleifera* leaf Extract

| Type of Plant Part | Crude Extract Appearance | Types of Phytochemical | Method of Test | Type of Extract |
|---|---|---|---|---|
| | | | | Aqueous |
| Leaf | Light green solid | Alkaloid | Harbone, (1973) | - |
| ,, | ,, ,, ,, | Anthraquinones | Tease and Evans, (1989) | - |
| ,, | ,, ,, ,, | Cardiac glycoside | Sofowata, (1993) | - |
| ,, | ,, ,, ,, | Cyanogenic glycoside | Sofowara, (1993) | ++ |
| ,, | ,, ,, ,, | Flavonoids | Harbone, (1998) | + |

| | | | |
|---|---|---|---|
| ,, | ,, ,, ,, | Polyphenol | Tease and Evans, (1989) | + |
| ,, | ,, ,, ,, | Reducing sugar | Harbone, (1973) | + |
| ,, | ,, ,, ,, | Saponins (Frothing) | Harbone, (1973) | - |
| ,, | ,, ,, ,, | Saponins (Emulsion) | Harbone, (1973) | - |
| ,, | ,, ,, ,, | Steroids | Harbone, (1973) | - |
| ,, | ,, ,, ,, | Tannins | Tease and Evans, (1989) | + |
| ,, | ,, ,, ,, | Terpenoid | Sofowara, (1993) | + |
| Keys: + = slightly presence, ++ = moderately presence, - = absent. | | | | |

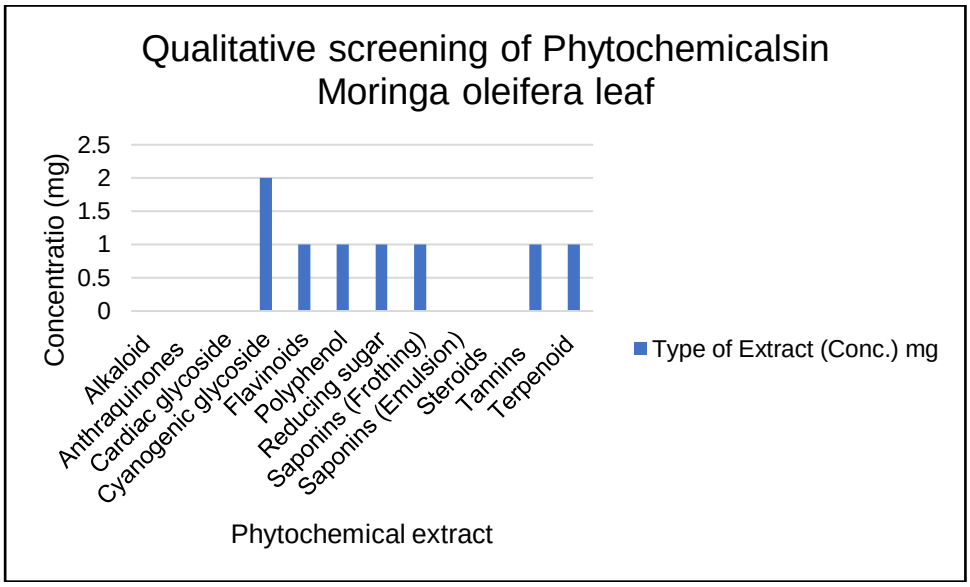


Fig. 1. Graphical Presentation of the Qualitative Screening Analysis of Some Phytochemicals Plant's part of *Moringa oleifera* leaf

Table 2 and Fig. 2 showed the composition of the experimental diets (feeds) in each treatment that were self-formulated with the following composition in gram, for treatment one ($T_1$); maize (53.00), wheat offal (11.00), soya beans meal (22.00), groundnut cake (5.00), bone meal (3.00), fish meal (5.00), premix (0.25), methionine (0.25), lysine (0.25), salt (0.25) and *M. oleifera* leaves powder with 0.00 grams, that is the leaves powder was not added to it, which served as control given a total of 100.00 grams. For the treatment two ($T_2$); maize was 50.10 g, wheat offal was 14.00 g, soya beans meal was 17.00 g, groundnut cake (5.00 g), bone meal (3.00 g), fish meal (5.00 g), premix (0.25), methionine (0.25), lysine (0.25), salt (0.25) and *M. oleifera* leave powder of which 5.00 g was added, totaling to 100 g. For the treatment three ($T_3$); maize was 48.10 g, wheat offal (14.00 g), soya beans meal (14.00 g), groundnut cake (5.00 g) groundnut cake (5.00g), bone meal (3.00 g), fish meal (5.00 g), premix (0.25 g), methionine (0.25 g), lysine (0.25g), salt (0.25 g) and *M. oleifera* leave powder of which 10.00 g was added, totaling to 100 g. Finally, treatment four $T_4$; maize had 45.10 g, wheat offal was 14.00 g, soya beans meal had

12.00 g, groundnut cake had 5.00 g, groundnut cake had 5.00g, bone meal had 3.00 g, fish meal was 5.00 g, premix had 0.25 g, methionine had 0.25 g, lysine had 0.25g, salt was 0.25 g, and *M. oleifera* leave powder of which 15.00 g was added, totaling to 100 g respectively.

Table 2. Composition of the Experimental Diets (Feeds)

| Experi-mental Treat-ments (T) | Types of Ingredient (grams) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | M. | WO. | SBM. | GC. | BM. | FM. | Pr. | MT. | Ly. | St. | MOLP. | Total |
| $T_1$ | 53.00 | 11.00 | 22.00 | 5.00 | 3.00 | 5.00 | 0.25 | 0.25 | 0.25 | 0.25 | 0.00 | 100.05 |
| $T_2$ | 50.10 | 14.00 | 17.00 | 5.00 | 3.00 | 5.00 | 0.25 | 0.25 | 0.25 | 0.25 | 5.00 | 100.00 |
| $T_3$ | 48.10 | 14.00 | 14.00 | 5.00 | 3.00 | 5.00 | 0.25 | 0.25 | 0.25 | 0.25 | 10.00 | 100.00 |
| $T_4$ | 45.10 | 14.00 | 12.00 | 5.00 | 3.00 | 5.00 | 0.25 | 0.25 | 0.25 | 0.25 | 15.00 | 100.00 |
| Keys: T = treatment, M = maize, WO = wheat offal, SBM = soya bean meal, GC = groundnut, BM = bone meal, FM = fish meal, P = premix, MT = methionine, L = lysine, S = salt, MOLP = *M. oleifera* leave powder | | | | | | | | | | | | |

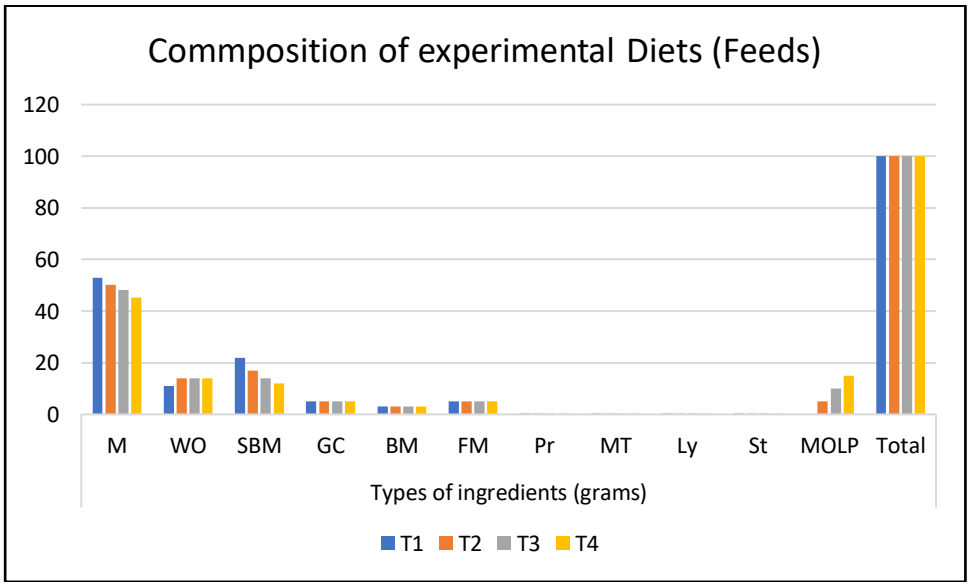


Fig. 2. The Graphical Presentation of the Composition of the Experimental Diets (Feeds)

Table 3 and Fig. 3 showed the performance of finishers' broiler chickens fed graded powdered *M. oleifera leaf* supplement in grams per bird (g / bird); in treatment one, $T_1$ who was the control the initial weight was 912.85, final weight was 1675.00, weight gain was 762.15, feed intake was 1654.59, feed conversion ratio was found to be 2.17 and feed efficiency was 2.07 g / bird. For the treatment two ($T_2$), initial weight was 611.80, final weight was 1569.00, weight gain was 957.20, feed intake was 1636.51, feed conversion ratio was 1.71 and feed efficiency was found to be 2.22 g / bird. For the treatment two ($T_3$), initial weight was 863.55, final weight was 1562.00, weight gain was 957.45, feed intake was 1535.00, feed conversion ratio was 2.20 and feed efficiency was found to be 2.38 g / bird and for the treatment two ($T_4$), initial weight was 701.45, final

weight was 1917.00, weight gain was 1215.55, feed intake was 1638.85, feed conversion ratio was 1.35 and feed efficiency was found to be 2.31 g / bird. The standard error of means or the standard means error (SME); For the initial weight was 4.31, final weight was 10.57, weight gain was 0.91, feed intake was 37.31, feed conversion ratio was 41.0 and feed efficiency was found to be 0.07 g / bird respectively. The mean in the same raw having different superscript differ significantly, $P < 0.05$.

Table 3. Performance of Finishers' Broiler Chickens Fed Graded Powdered *M. oleifera Leaf* Supplement

| Experi-mental Treat-ments (T). | Parameters (Grams per Bird) | | | | | | |
|---|---|---|---|---|---|---|---|
| | Molp | Initial weight | Final weight | Weight gain | Feed intake | Feed conversion ratio | Feed efficiency |
| $T_1$ | 0.0 | $912.85^{a}$ | $1675.00^{a}$ | $762.15^{b}$ | $1654.59^{a}$ | $2.17^{c}$ | $2.07^{b}$ |
| $T_2$ | 5.0 | $611.80^{b}$ | $1569.00^{b}$ | $957.20^{a}$ | $1636.51^{a}$ | $1.71^{a}$ | $2.22^{ab}$ |
| $T_3$ | 10.0 | $863.55^{a}$ | $1562.00^{ab}$ | $698.45^{b}$ | $1535.00^{b}$ | $2.20^{a}$ | $2.38^{a}$ |
| $T_4$ | 15.0 | $701.45^{ab}$ | $1917.00^{a}$ | $1215.55^{c}$ | $1638.85^{a}$ | $1.35^{b}$ | $2.31^{a}$ |
| SME ± | - | $4.31^{*}$ | $10.57^{*}$ | $0.91^{*}$ | $37.31^{*}$ | $41.0^{*}$ | $0.07^{*}$ |
| Keys: MOLP = *M. oleifera* leaves powder, SME = Standard Error of Means, $^{abc\ /\ *}$ = Mean in the same row having different superscript differ significantly ($P < 0.05$), * = Means significant ($P < 0.05$) | | | | | | | |

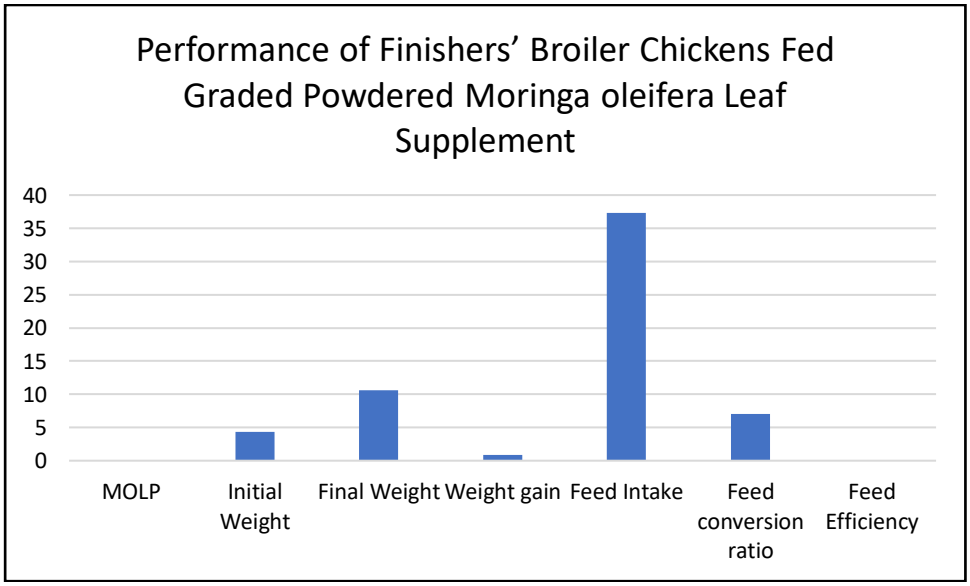


Fig. 3. The Graphical Presentation of the Performance of Finishers' Broiler Chickens Fed Graded Powdered Moringa oleifera Leaf

*Supplement*. The feed conversion ratio (CFR). The lower the CFR value, the better the efficiency of utilization

**Discussion**

The plant *M. oleifera,* all of its parts are being used worldwide because of it medicinal and nutritional values. The leaves part of the plant is edible by both human beings and animals as food or for medicinal and therapeutics purposes. They are also used in the

preparation of cosmetics, mechanical lubricant, potential biofuel and the seeds and the leaf are used for wastewater treatment, especially in many tropical and subtropical countries, e.g. Nigeria. Siddhuraju et al. (2003:2144) and Anhwange et al., (2004: 711-715), reported that various parts of *M. oleifera* leaves, fruits, immature pods, and flowers are incorporated in to the traditional food of humans. Juniar et al. (2008: 238-242) and Olugbemi et al. (2010: 363-367) also reported that the leaves of *Moringa* tree are preferred part for use in animal diets as leaf meal. Yameogo et al. (2011: 264-268) stated that the chemical analysis of *M. oleifera* on a dry matter basis revealed that *M. oleifera* leaves contained 27.2% protein, 5.9% moisture, 17.1% fat and 38.6% carbohydrates. In addition, Anwar and Rashid (2007: 1443-1453) who noticed that on a dry matter basis, the essential amino acid contents of the leaves part of the plant were higher than the amino acid pattern of the FAO reference protein. Many Researchers such as Dei et al. (2007: 611-624), Mutayoba et al. (2011: 350-357), Juniar et al. (2008: 238-242), few to be mentioned had conducted research studies on the nutritional, minerals, phytochemicals and anti-nutrient compositions of *M. oleifera* leaves part of the plant.

In this research study, the qualitative screening analysis of some phytochemicals plant's part of *M. oleifera* revealed that, the leaf contained some phytochemicals such as glycosides in more traces and some flavonoids, polyphenols, reducing sugars, tannins and terpenoid in traces amount. That is, this research study revealed and detected about six phytochemicals in the leaves aqueous extract of *M. oleifera* plant when used various qualitative techniques. The results of the analysis agree with the findings of most authors; such as Azuonwu et al. (2016: 1-4), Bassey et al. (2016: 61-76) are amongst others.

In this research study, which was carried out to in order ascertain and evaluate the effects of finishers' boiler chickens fed graded levels of *M. oleifera* leaf powder supplementation. The study reveals the feed intake and weigh gain of the finishers' broiler chickens and ascertained the ideal inclusion levels of the powdered plants' part in broiler diet. Finishers' feed was formulated, 180 day-old broiler chicks were commercially obtained, brooded and allotted in to four treatment groups. Fifteen birds per treatment and were in triplicated each. At finisher phase, the various treatments ($T_S$), were supplemented with graded levels of powdered *M. oleifera* leaf in feedstuff given; $T_1$ (0% g) which served as control, $T_2$ (5%), $T_3$ (10%) and $T_4$ (15%) respectively.

In the treatment one ($T_1$), no supplement of *M. oleifera* leaves meal was added to it, this served as control treatment. While in treatment two ($T_2$), 5% of *M. oleifera* leaf meal was added, 3% of maize (source of carbohydrate) was removed, 3% of wheat offal (source of carbohydrate) was added and 5 % of soybean meal (source of protein) was reduced when compared to treatment $T_1$ which were 0%, 53%, 11%, and 22% for *M. oleifera* leaf meal, maize, wheat offal and soybean meal, but rest of components of the feed being formulated.

To the treatment three ($T_3$), 10% of *M. oleifera* leaf meal was added, 5% of maize (source of carbohydrate) was removed, 3% of wheat offal (source of carbohydrate) was added and 8% of soybean meal (source of protein) was reduced when compared to treatment $T_1$ which were 0%, 53%, 11%, and 22% for *M. oleifera* leaf meal, maize, wheat offal and soybean meal, but rest of components of the feed being formulated.

For the treatment four ($T_4$), 15% of *M. oleifera* leaf meal was added, 8% of maize (source of carbohydrate) was removed, 3% of wheat offal (source of carbohydrate) was added and 10% of soybean meal (source of protein) was reduced when compared to treatment $T_1$ which were 0%, 53%, 11%, and 22% for *M. oleifera* leaf meal, maize, wheat offal and soybean meal, but rest of components of the feeds being formulated respectively. These are how the treatments diets were being formulated.

The effects on finishers' broiler chickens fed graded levels of *Moringa oleifera* Leaf powder supplement were observed in each treatment and the performances of the birds fed with the plants part material were analysed based on their respective treatment. The parameters observed were initial weight (Iwt), final weight (Fwt), weight gain (Wg), feed intake (Fi) all given in unit of gram per bird (g / bird), feed conversion ratio (FCR) and feed efficiency (FE) respectfully.

It was observed that in treatment $T_1$ (being the control treatment), the mean initial weight approximately was 913.00 g / bird, mean final weight was 1675.00 g / bird), mean weight gain was 762.2 g / bird, mean feed intake was 1655.00 g / bird, mean feed conversion ratio was 2.17 and mean feed efficiency was 2.1. This results revealed that, the final weight was more than initial weight, thus, result the yielded tremendous values in weight gain with higher value of feed intake. There was high feed conversion ratio of 2.17 and the feed efficiency was found to be 2.1 respectively.

Also, observation was made in treatment $T_2$, the results revealed that, the mean initial weight was found to be approximately 612 g / bird, and 1569.00 g / bird, 957.2 g / bird, 1637.00 g / bird, 1.71 and 2.2 for mean final weight, mean weight gain, mean feed intake, mean feed conversion ratio and finally mean feed efficiency. It revealed that, there was a greater value in weight gain and with high value of feed intake. It was observed that, there was a moderate value in feed conversion ratio (1.17) with feed efficiency of 2.2.

In consideration to treatment $T_3$, the result obtained revealed that the mean initial weight was 864 g / bird, and 1562.00 g / bird, 698.5 g / bird, 1535.00 g / bird, 2.20, 2.4 for mean final weight, mean weight gain, mean feed intake, mean feed conversion ratio and finally mean feed efficiency. It revealed that, there was high value in weight gain and with lower value of feed intake than the other treatments. It was observed that, there was a higher feed conversion ratio of 2.20 with feed efficiency of 2.4 approximately.

It was observed that the results obtained in treatment $T_4$, it revealed an approximate mean initial weight value of 701.5 g / bird, mean final weight (1917.00 g / bird), mean weight gain (1215.6 g / bird), mean feed intake (1638.9 g / bird), mean feed conversion ratio was 1.35 and 2.3 was for mean feed efficiency. This results revealed high final weight more than the other treatment groups. Thus, the result yielded tremendous values in weight gain with higher value of feed intake. There was low value in feed conversion ratio of 1.35 and the feed efficiency was found to be higher with 2.3 respectively.

With regard to the parameters being weighed within the treatment groups when considered; the initial mean weight was found to be highest in treatment $T_1$ (control group), then followed by treatment $T_3$, then treatment $T_4$ and the least was in treatment $T_2$. When these are presented in descending order of their magnitude of weight, were as follow; $T_1 > T_3 > T_4 > T_2$. The mean final weight (g / bird) was found to be highest in treatment $T_4$, then followed by treatment $T_1$, then treatment $T_2$ and treatment $T_3$ being the least. When these treatment groups are compare and arrange with accordance to their magnitude of weight in descending order, were as follow; $T_4 > T_1 > T_2 > T_3$.

The mean weight gain (g / bird) revealed that treatment $T_4$ was the highest among the treatment groups with the mean value of 1215.6 g / bird, then followed by $T_2$ which had the mean value of 957 g / bird, followed by $T_1$ (control treatment) with the mean value of 762.1 g / bird and the least was found to be $T_3$ had the mean value of 698.5 g / bird approximately. When these values are arranged sequentially, in descending order of their magnitude of mean weight obtained, were; $T_4 > T_2 > T_1 > T_3$ respectively.

The results of the analysis of performance revealed that, the feed conversion ratio (FCR) among the treatment groups, treatment $T_3$ (2.20 of FCR) was the highest, then

followed by $T_1$ which had the mean value of 2.17 FCR, followed by $T_2$ with the mean value of 1.71 FCR and the least was $T_4$ which had the mean value of 1.35 FCR approximately. When these values are arranged sequentially, in descending order of their magnitude of mean FCR obtained, we will have the following; $T_3 > T_1 > T_2 > T_1$ absolutely.

Finally, the feed efficiency among the treatment groups, treatment $T_3$ had the highest value of 2.4, followed by treatment $T_4$ with the value of 2.3, followed by treatment $T_2$ had the value of 2.2, and the least was treatment $T_1$ which was the control treatment had the value 2.1 approximately. These values obtained when arranged sequentially, in descending order of their magnitude of mean values obtained, were followed as; $T_2 > T_3 > T_4 > T_1$ respectfully.

The results of the research study also revealed that treatment T1 had the highest mean feed intake 1654.6 g / bird than the other treatment groups, then followed by treatment $T_4$ which had value of 1638.9 g / bird, followed by treatment $T_2$ which had 1636.5 g / bird and the least was treatment $T_3$ with 1535 g / bird approximately. When these are presented sequentially, in their magnitude of weight in descending order, were as follow; $T_1 > T_4 > T_2 > T_3$.

The results obtained in this research study revealed that the performance of broiler finisher chickens fed powdered of *M. oleifera* leaf meal (MOLM) were significant ($P < 0.05$) differences within the various treatment ($T_2$, $T_3$ and $T_4$) diets when compared with the control experiment ($T_1$). But there were no significant ($P > 0.05$) difference down the various treatment groups of powdered MOLM inclusion except treatment $T_4$ (15% or 15 g of MOLM) that showed significant ($P < 0.05$) differences among the treatment.

Meanwhile, the initial weight of chickens fed MOLM showed significant ($P < 0.05$) difference at the inclusion rate of 5% or 5 g of MOLM ($T_2$) was the lowest value, while the highest value was recorded in initial weight from 0% inclusion of MOLM in control treatment ($T_1$) with 612 g / bird and for $T_2$ 913 g / bird, $T_3$ and $T_4$ were 864 g / bird and 701.5 g / bird approximately. Likewise, the final weight was found to be significantly ($P < 0.05$) different in treatment $T_4$ (15% or 15 g of MOLM) the inclusion leaf meal which had the highest value, but, treatment $T_3$ (10% or 10 g of MOLM) had the lowest with value of 1917 g / bird and 1562 g / bird approximately. While the -control treatment $T_1$ (0% or 0.0 g of the inclusion of MOLM) and treatment $T_2$ (5% or 5 g of MOLM) had 1675 g / bird and 1569 g / bird were found to be the highest. These gave the total weight gain of 1216 g / bird in treatment $T_4$ had inclusion of 15% or 15 g of the powdered MOLM and found to be the highest against treatment $T_3$ with the value of 698.5 g / bird which was found to be the least value in the experiment in respect to weight gain. The research study also revealed the values which were recorded in respect to control treatment $T_1$ had 762.2 g / bird and treatment $T_2$ which had 957 g / bird respectively. These results that were obtained of the weight gain comparisons between the treatment groups that it was significant ($P < 0.05$) at room temperature groups ($T_0$, $T_2$, $T_3$ and $T_2$) as compared with high ambient temperature. The results obtained in this research study also coincides with the study conducted by Abbas and Ahmed (2012: 1-4), who reported that, poultry fed enriched with powdered plants part of *Moringa oleifera* feeds shows a significant increase in weight gain when compared to those birds that were not being supplemented.

It was observed in this findings of the research study that were obtained, the feed conversion ratio (FCR) and the total feed intake (TFI) both gave similar parameters which were significant ($P <0.05$) difference across the treatment groups as the control treatment $T_1$ had the highest value of 1655 g / bird (0% or 0.0 g of MOLM supplement) order than treatment $T_3$ (5% or 5 g of MOLM supplement) which had the value of 1535 g / bird, while the rest of the treatments $T_2$ and $T_2$ gave the values of 1637 g / bird and 1639 g / bird

approximately. While the feed conversion ratio (FCR) computed values was that the lower the value, the better the efficiency of utilization. The highest was treatment $T_3$ with value of 2.2 when compared with the treatment $T_4$ that had the least value of 1.35. Both the values of 2.17 and 1.71 were computed FCR for control treatments $T_1$ and $T_2$. This results obtained support of the most authors' works. The overall feed conversion ratio was the lowest at treatment $T_1$ (0% or 0.0 g of the inclusion supplement) while the highest was recorded in treatment $T_3$ (10% or 10 g of the inclusion supplement) 2.20 showed that the supplementation increased conversion rate of feed intake to meat. With regard of feed conversion efficiency (FCE), revealed no significant ($P > 0.05$) difference but, best result was obtained from treatment $T_1$ with the FCE of 0.48, while 0.42 was recorded in treatment $T_3$ as the least value, while others as 0.45 and 0.43 were revealed for the treatments $T_2$ and $T_4$ respectively. The feed efficiency on the other hand, gave the highest value at 10 g supplement of powdered MOLM of 0.36 but recorded the lowest of 0.25 at control treatment $T_1$ respectively. Hence, the lower the feed conversion ratio (FCR), the better the sufficiency of utilization.

## Conclusion

This concluded that the results obtained in this research study revealed that powdered *M. oleifera* leaves contained in its aqueous extract, some phytochemicals such as glycosides in more traces and some flavonoids, polyphenols, reducing sugars, tannins and terpenoid in traces amount. Hence, the qualitative phytochemical screening of *M. oleifera* leaf part of the plant detected and revealed about six phytochemicals in the leaves aqueous extract of *M. oleifera* plant when used various qualitative techniques. It also revealed that powdered *M. oleifera* leaves meal (MOLM) showed that inclusion of MOLM increased the finisher broiler chickens' performance. This could be incorporated up to 100 g / kg in to the diets of finisher broiler chickens without any adverse effects on growth performance. However, this research study revealed that *M. oleifera* leaf powder has positive effect on weight gain of broiler chickens and reduces oxidative stress associated with heat stresses.

Based on this findings, the research study therefore recommended that poultry farmers can supplement finisher broiler chickens feed with powdered *Moringa oleifera* leaf meal up to 10% or 100 g / kg inclusion level. Also recommended that a further study should be carried out using other species of avian in order to ascertain if higher inclusion levels can yield optimum good results without having any effects on the birds or it haemocytometry and serum biochemistry parameters.

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