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Utilization of Poultry Waste as Feed and Supplementary Feed For Fish Growth

***[1]USMAN, SO; [2]OGBE, KU; [3]OGUCHE JU; [3]MOMOH, TB; [1]OMALE, S**

[1]Department of Chemistry; [2]Department of Fisheries and Aquaculture, [3]Department of Plant Science and Biotechnology Kogi State University, P.M.B 1008, Anyigba, Kogi State, Nigeria
**Corresponding Author Email: Usman2great@gmail.com; Tel: +2347062184747*

ABSTRACT: This research work was carried out to evaluate poultry waste as a potential feed for fish growth. The poultry droppings were collected for analysis. The parameter determined to ascertain the potential of this poultry waste were proximate analysis (Moisture, dry matter, ash, crude protein, fat, crude fibre and carbohydrate contents) and mineral nutrient composition (calcium, potassium, magnesium, sodium, copper, zinc, iron and manganese). The proximate analysis determined estimated moisture content to be 9.62±0.02%, dry matter 90.38±0.03%, ash content: 28.83±0.29%, crude protein: 21.34±0.16%, fat content: 2.61±0.13%, crude fibre:16.09±0.04, and carbohydrate: 21.53±0.03. The minerals nutrient composition for metals analysed is as follows; calcium: 2349.9±56.57mg/kg, potassium: 6239±572.76mg/kg. Magnesium: 1075.0±141.42mg/kg, sodium: 292.3±10.61mg/kg, copper: 104.8±7.07mg/kg, zinc: 395.0±7.07mg/kg, iron: 519.7±7.07mg/kg and manganese: 257.5±10.61mg/kg. However, based on the result for proximate analysis of the poultry waste analysed and mineral nutrients estimated compared with the mineral nutrient requirement of fish the results were not adequate for direct use as feed for fish. Thus the poultry droppings could only serve as feed or supplement for the conventional fish feeds use for fish to give excellent growth rate.

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The use of poultry waste as manure and other farm animal manure as feed for fish is not a new method. Manuring of fish ponds is a means of increasing fish production was known in China in the fourth and fifth century B.C (Neess, 1949). Integration of fish culture with livestock and crop farming is an ancient practice in China. The importance of poultry waste in aqua-culture is relatively recent and the current interest in manure as a feedstuff is mostly due to the problem of waste disposal from intensive livestock and poultry operation. Also apart from this problem it has been recognized that large amounts of nutrient are wasted which this work seeks to evaluate (Qureshi, 1965). The reuse of manure is one way of creating edible protein from waste material which is disposed off uneconomically and also creates a nuisance (FAO 1991-2002).

However, poultry manure is a potential source of protein, it has attracted the attention of animal nutritionist all over the world because of its richness of protein, calcium (5.4%), phosphorus is K_2O and magnesium as MgO (0.335%) other minerals (Ranjhan, 1980; SPFG, 1994). A range of poultry by products are produced and re use in livestock feeds, including feather meal, blood meal, poultry litter meal etc. (Moller, 1980) and poultry waste are also used as fertilizer and soil conditioners. Also manure supply nitrogen and phosphorus for utilization by algae and provide a substrate for zoo plankton production (Wohifarth and Schrocder, 1979, Colman and Edward 1993; Mims *et al*., 1995). Poultry manure has been used widely in both fresh and brackish water aquacultures. Furthermore, research has shown that fish cultured under the integrated chicken-fish farming system are fit for human consumption (Adewumi *et al*., 2010). Therefore the objective of this paper is to analyse poultry wastes as a potential feed supplement for fish growth.

MATERIALS AND METHODS

*Description of Study Area***:** The study was conducted between March to April, 2018, at Chemistry Department Experimental Garden, University of Ibadan Oyo State, Nigeria. The site is located on 7°151N - 7°291N and 7°111E – 7°321E. The site is known with a suitable atmospheric condition, having an annual mean rainfall and temperature of 1250mm and 25°C respectively. The vegetation is typical of derived savanna with a sandy soil (Ifatimehin, 2012).

Collection of Samples: Poultry manure was collected from five different poultry farms at Ibadan, Oyo State, Nigeria.

**Corresponding Author Email: Usman2great@gmail.com; Tel: +2347062184747*

Sample Preparation: The samples were sun dried for two weeks at Chemistry Department Experimental Garden, University of Ibadan Oyo State, Nigeria to reduce the odour and also to prevent microbial contamination. After which the samples were pulverized in a cleaned pre-treated mortal. Thereafter, samples were sieved and packed in clean pre-treated polyethylene bags and were taken to the Department of Chemistry Laboratory, University of Ibadan Oyo State, Nigeria for the proximate and mineral composition analysis.

Proximate Analysis: Proximate analysis (moisture, dry matter, ash, protein, carbohydrate, crude fibre and fat content) and mineral nutrient composition (calcium, potassium, magnesium, sodium, copper, zinc, iron and manganese) were carried out based on dry matter of Micro-Kjeldahl Method, at Chemistry Department Laboratory, Kogi State University Anyigba, Nigeria.

D*etermination of Moisture Content*)*:* The weighing dishes were washes and dried in the moisture oven, then placed in the desicators to cool. The empty weighing where labelled, weighed and weight recorded as W_1. Then approximately 2g poultry manure (dried) were placed in the empty dishes weighed and recorded as W_2, then placed in the oven for 6 hours at 105ºC. Then removed from the oven and placed in the desiccators to cool and after cooling the dishes were weighed until constant weight was attained and recorded as W_3. The moisture content was determined from the formula below:

The moisture content was determined from the formula below:

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

W_1= Weight of empty porcelain dishes, W_2= Weight of empty porcelain dishes plus sample: W_3= Weight of sample after drying

Determination of Dry Matter: This was obtained by deducting the moisture content from 100

% Dry matter= 100-%moisture

Determination of Ash Content: Approximately 2g of the dried and finely pulverized sample (poultry waste) was weighed into Porcelain Crucible recorded and placed in Muffle furnace preheated at 600C for 2 hours (AOAC, 2000). Then transferred into the desiccators to cool and weighed immediately and weight was recorded.

The Ash content was determined using

$$\%(\text{ w/w})=\frac{Weight\ of\ Ash}{Weight\ of\ test\ sample}\times 100$$

*Determination of Crude Protein***:** The procedures involves three stages described below *Digestion stage***:** 0.2g of dried sample was weighed into a 50ml Kjeldahl flask, 10ml Concentrated H_2SO_4 was added and 1g Selenium was added as catalyst to speed up the digestion stage. The resulting solution was then heated for 2 hours for the digestion to be complete. During this stage, the organic matter in the sample was converted to carbon (iv) oxide and water as shown in the equation below:

Organic, C,H,N $\rightarrow CO_2+H_2O+(NH_4)_2SO_4$

After digestion was judged complete, the content of the flask were allowed to cool after which 10ml of distilled water was added slowly with swirling until undissolved materials were in suspension. The solution was then made up to mark with distilled water.

Distillation stage: In this stage, a 50ml receiver flask containing 5ml Boric acid-indicator solution was placed under the condenser of distillation apparatus such that the tips of the condenser was above the solution. 10ml of 40%ml NaOH solution was carefully poured down the side of Kjeldahl flask containing the digested and diluted sample to form a layer on its bottom. The Kjeldahl flask was then bought into the boiling and the distillated NH_3 was captured into the Boric acid indicator solution. The presence of the ammonia in the boric acid solution was indicated by a change in colour from wine to green. During the distillation stage, $(NH_4)_2SO_4$ formed in the distillation step was converted to NH_4OH resulting in the release of NH_3 gas.

$$(NH_4)_2SO_{4(aq)} + NaOH_{(aq)} \rightarrow NH_4OH_{(aq)} + Na_2SO_4$$

$$NH_4^+{}_{(aq)} + OH_{(aq)} \rightarrow NH_{3(g)} + H_2O_{(l)}$$

$$NH_3(\text{Condensed}) \rightarrow NH_4^+{}_{(aq)} + H_2BO_4$$

Titration stage: After the distillation stage, the condensed tip was rinsed with distilled water and the content in the receiver flask was titrated to pink colour with 0.01N HCL. In This Stage, the NH_3 in the boric acid indicator reacted with HCL as shown below

$$(NH_4)H_2BO_{2(aq)} + HCL \rightarrow NH_4Cl_{(aq)} + H_3BO_{3(aq)}$$

Thus $\%N = \frac{(T-B)X\ N\ X\ R\ X\ 14.01}{Sample\ weight} x\ 100$

Where T = Sample titration (ml); B = blank titration; N = Normality of HCL; R= ratio of total digest volume to the volume distilled; 14.01 = molecular weight of Nitrogen; S = sample

The % Crude Protein was then obtained using formula below
% crude protein = %N x 6.25
Where 6.25 is Jones factor.

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Determination of Fat Content: 250cm pre-cleaned flask was dried in the oven at 105^0c for about 30 minutes, then transferred to the desiccators to cool. 1g of sample was accurately placed into the labelled extraction was assembled and allowed to Soxhlet apparatus thimble and cooled 250cm3 flask was also labelled and weighed recorded as W_1, the flask was filled with $300cm^3$ of petroleum ether (boiling pint 40^0c – 60^0c), the extraction thimble was plugged lightly with cotton wool, then the Soxhlet apparatus was assembled and allowed to reflux for about 6 hours. The thimble was removed carefully and the petroleum ether was collected in the top container of the setup and drained into another container for re-use. The flask was removed and dried again at 105^0C for one hour, transferred into the desiccators from the oven and allowed to cool, and weighed then was recorded as W_2. The % fat was derived using the formula below:

$$\% \, Fat - \frac{W_2 - W_1}{weight \; of \; sample} x100$$

W_1 = Weight of empty flask; W_2 = Weight of flask + Fat (g)

Determination of Crude Fibre: 0.5g of sample (dried) was weighed into 500ml conical flask. 100ml of trichloroacetic acid digestion reagent was added to the conical flask. The mixture in the conical flask was boiled and refluxed for 40 minutes. After refluxing, the flasks was removed from the beater and cooled under cold running tap of water. The cooled mixture in the flask was filtered through whatman filter paper and residue washed six times with hot water and once with methylated spirit. The residue was then transferred into a crucible, dried in an oven an 105^0C, cooled and weighed. The Crucible and content was transferred to a muffle furnace preheated at 600^0C and ashed for about 4 hours. After ashing was judged completed, the crucible was cooled in desiccators and weighed after cooling and weigh recorded as W_2. Thus the % fibre was then calculated using the formula below

$$\% \; Crude \; fibre - \frac{W_2 - W_1}{weight \; of \; sample} x100$$

W_1 = Weight of Crucible + content before ashing, W_2 = Weight of crucible after ashing.

*Determination of Total Carbohydrates***:** The total carbohydrates content in the sample was obtained by difference as follows. 100-(Weight in grams {protein + fat + water + ash} in 100g of sample).

Determination of Mineral Content (Na, K, Cu, Ca, Mg, Zn, Fe and Mn): 5g of already pulverized sample of poultry manure was weighed into pre-cleaned crucible. Then a few drops of HNO_3 were added as ashing aid. The sample was then dry-ash in a muffle furnace by stepwise increment of temperature for 4 hours (Crosby, 1977). Dry ashing was carried out in the sample before analysis to destroy all or most of the organic matter present in the sample so as to reduce matrix interference and concentrated most of the metals in a ready available form for analysis. Furthermore after ashing ash sample was cooled in the desiccators and dissolved in 5ml 1M Nitric acid, then the digested sample was filtered into 25ml volumetric flask and the crucible further rinsed with distilled water into the flask to ensure quantitative transfer. The digest was then made to mark with distilled water and store in a polyethylene bag for ready for analysis. Blank was also determined by taking distilled water through the whole process but omitting the sample and taking for analysis too. Concentration of mineral nutrient is derived from the formula below.

$$Concentration \; (mg/kg) = \frac{(C - B)x \; E}{S}$$

Where: C = the instrument concentration reading (mg/L), B = blank, E = extract volume which represent the final volume of digest used and S = Sample weight used.

Data Analysis: Data was analysed using analysis of variance, mean and Standard deviation.

RESULT AND DISCUSSION

Proximate Analysis: The result of proximate constituents for poultry waste as feed and supplementary feed for fish growth is presented in table 1. The result shows that dry matter recorded the highest proximate constituent (90.38±0.03), followed by ash (28.83±0.29), total carbohydrates (21.51±

0.03), crude protein (21.34±0.16), crude fibre (16.09±0.04), moisture content (9.62±0.02) and fat content (2.61±0.13) as the least proximate constituent.

Table. 1: Result of Proximate Analysis (%) of Poultry Waste

S/N	Constituents	Means ± SD
1	Moisture content	9.62±0.02
2	Dry matter	90.38±0.03
3	Ash	28.83±0.29
4	Crude protein	21.34±0.16
5	Fat content	2.61±0.13
6	Crude fibre	16.09±0.04
7	Total carbohydrates	21.51± 0.03

KEYS: Result expressed in Mean ± Standard Deviation of duplicate analysis

Mineral Nutrient Composition of Poultry Waste (mg/kg): The result of mineral nutrient composition for poultry waste as feed and supplementary feed for fish growth is presented in table 2. K recorded the highest mineral nutrient composition (6239.9±572.76), followed by Ca (2349.9±56.57), Mg (1075.0±141.42), Fe (519.7± 7.07), Zn (395.0±7.07), Na (292.3±10.61), Mn (257.5± 10.61) and Cu (104.8±7.07) as the least mineral composition.

Table 2: Mineral Composition of Poultry Waste (Mg/Kg)

S/N	Metals	Means ± SD
1	Ca	2349.9±56.57
2	K	6239.9±572.76
3	Mg	1075.0±141.42
4	Na	292.3±10.61
5	Cu	104.8±7.07
6	Zn	395.0±7.07
7	Fe	519.7± 7.07
8	Mn	257.5± 10.61

KEYS: Result expressed in Means ± Standard Deviation of duplicate analysis; Ca = calcium, Cu = copper, K = potassium, Fe = iron , Mg = magnesium; Mn = manganese, Na = sodium

Minerals are inorganic elements necessary in the diet for normal body functions. They can be divided into two groups (macro-minerals and micro-minerals) based on the quantity required in the diet and the amount present in fish. Common macro-minerals are sodium, chloride, potassium and phosphorous. These minerals regulate osmotic balance and aid in bone formation and integrity. Micro-minerals (trace minerals) are required in small amounts as components in enzyme and hormone systems. Common trace minerals are copper, chromium, iodine, zinc and selenium. Fish can absorb many minerals directly form the water through their gills and skin, allowing them to compensate to some extent for mineral deficiencies in their diet (Houlihan *et al.*, 2011). The mineral composition (Ca, K, Cu, Mg, Na, Zn, Fe and Mn) of the poultry waste were estimated and found to be as follows for each mineral element determined.

*Conclusion***:** This study offer insight into the nutritive value of poultry waste, which ordinary are disposed of thereby constituting environmental menace. However, form the evaluation of the poultry waste so far the nutrient level (Protein, Carbohydrate, fat content, crude fibre, ash content) are relatively satisfactory, also the mineral nutrients required by fish in traces were also satisfactory. Thus poultry waste with these level of nutrient value can serve as feedstuff supplemented with other conventional feeds to enhance fish growth.

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