Carcass Characteristics, Hematology, Serum Chemistry, and Enzymes in Broiler Chickens Fed Maggot Meal as a Protein Substitute for Fishmeal

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Abstract

Conventional protein sources used in poultry farming are extensively competed for, by livestock and humans leading to high prices and reduced returns. Focus on better utilization of available alternative feed resources with little or no negative impacts on the health of broilers and consumers is useful. The objective of this research was to assess the performance of carcass characteristics, hematology, serum chemistry, and enzymes in broiler chickens fed maggot meal as a protein substitute for fishmeal. 225 Tropical Broc day old chicks brooded for two weeks and fed the control diet, were distributed in a completely randomized block design with five treatments and three replicates each consisting of the starter and finisher phases and the experiment conducted for eight weeks. Diets were compounded with maggot meal (MM) replacing FM at 0

Index terms— maggot meal, hematology, serum chemistry, enzymes, carcass characteristics.

1 Introduction

roiler production is one of the main areas in animal farming that involves quite a large section of the population either skilled or unskilled. One important advantage in this is the fact that poultry meat is very rich in unsaturated fatty acids as against saturated fatty acids. Both turkey and chicken have about 30% saturated fatty acids, 43% monounsaturated fatty acids, and 22% polyunsaturated fatty acids. The ratio is a clear indication that poultry meat may stand a better position as a more healthful alternative for red meat (Encyclopaedia Britannica, 2014). Notwithstanding there are some challenges in areas of nutrition, health, and management (Awoniyi, 2004). Feeding alone accounts for 60-70% of the total production cost in modern poultry production systems ??Smith, 1990;Church, 1991; ??ilson and Beyer, 2000). Conventional protein sources used are extensively competed for, by other livestock and humans (Gadzirayi et al., 2012), thereby leading to very high prices and reduced returns. Any attempt to improve commercial poultry production and increase its efficiency, therefore needs to focus on better utilization of alternative but available feed resources. Knowledge of nutritional characteristics of these feeds and optimal levels of inclusion in rations and optimum combination of ingredients is useful (Kamalzadeh et al., 2008). Competition for conventional protein sources has prompted researchers to embark on research for alternatives like MM that are cheaply available and comparable to FM. The crude protein content of maggots is high (39-63%) (Aniebo and Owen, 2010) and akin to that of fish meal ??Veldkamp et al., 2012).

Even though MM may reduce competition between man and other livestock, there is very high need to investigate its health implications in broiler and humans as well the effects on performance of broilers (Awoniyi, 2004). A study of the carcass characteristics, blood indices and enzymes should correlate the benefits of MM as a protein source in poultry feed vis-à-vis the physiological status of the birds. The study of these B physiological parameters will serve to bridge the gap as work done in Cameroon on this aspect is scanty.

2 II.

3 Materials and Methods

4 a) Study area

The study was carried out at Muyuka Agro-Industrial Farm situated between latitudes 4?16? and 4?23?N and longitudes 9?21? and 9?28?E in the fourth agro-ecological zone of Cameroon (AEZ IV). Muyuka on the windward side of mount Cameroon, experiences very high temperatures ranging from 25°C during the rainy season (March to September) to about 30°C in the dry season (October to March). The climate is typical of the equatorial type. The monthly rainfall ranges between 9.2mm to 374.1mm, the lowest realized in January while the heaviest is in August.

5 b) Birds

Two hundred and twenty-five Tropical Broc day-old broilers used for the experiment fed on the control diet (Table 1) during the brooding period of two weeks. Coal pots provided heat supplementation and prophylactic measures employed. Daylight served as the main lighting source during the day and electric current at night; lanterns served as the illuminating source in cases of power outage.

6 c) Experimental design

The trial used a completely randomized block design (CRBD) in which two weeks old chicks were randomly allocated to 5 treatments, each containing 45 birds; and each treatment had three replicates with 15 birds each. Diets formulated using maggot meal (MM) substituted fishmeal (FM) at graded levels; 0%, 25%, 50%, 75% and 100% at both the starter and finisher phases. Mineral and vitamin premixes customary to poultry production, oyster shell, salt, and bone served as complements (Tables 1 and 2).

Birds lived on deep litter while enjoying natural ventilation, Feed, and water ad libitum. Broiler starter, 23% crude protein, sustained for four weeks followed by broiler finisher, 19% crude protein from the end of the 4 th week till slaughter (8 th week).

7 d) Ration formulation for experimental diets

The feed ingredients used in this study included: Yellow maize, fishmeal, maggot meal, groundnut cake, kernel cake, soybean cake, wheat bran, and premixes. Proximate analysis gave crude protein and ME values for maggot meal while the nutrient master plan (livestock feeds) provided those for other ingredients. Levels of inclusion of protein (maggot meal and fishmeal) and energy sources to meet the protein and energy requirements were manipulated using Pearson's Square method and the various percentages calculated as indicated in Tables 1 and 2 with the help of a nutrient master plan which gave the protein and energy contents of each ingredient.

After all the ingredients were measured and put together at the same spot on the cardboard paper, they were mixed with the hand, making at least three complete turns to ensure proper mixing, and then put into bags with treatment labels. Determination of carcass characteristics took place on the last day of the 8th week. After recording live weights of 30 randomly selected birds, two from each replicate, we slaughtered each bird and allowed to bleed for about two minutes before putting in hot water for almost a minute to soften the skin for easy plucking. Dressed weight represented the bulk after removal of the shanks, crop, entrails and other organs. The carcass parts consisted of head, neck, wings, breast, back, thigh and drumstick.

We discarded entrails and weighed eviscerated birds, livers, gizzards, and carcass parts. Then averages from each replicate statistically analyzed for any significant differences between treatments.

8 f) Studies of hematological parameters, serum chemistry, and enzymes

Studies of hematological parameters (hemoglobin, white and red blood cells), serum chemistry (total protein, albumin, and globulin), and enzymes (aspartate amino-transaminase and alanine amino-transaminase) were carried out at the end of the experiment. Blood was collected at the time of slaughter for carcass analysis into 30 tubes from 15 birds; fifteen tubes had the anticoagulant ethylene diamine tetraacetate (EDTA) to prevent clotting, and the rest of the cylinders had no anticoagulant. Two hoses (one with EDTA and the other without the anticoagulant) were used to collect blood from one bird per replicate.

9 g) Method of data processing and analysis

Data were organized in Microsoft Office Excel Version 2010 and analyzed using SPSS 17.0 (SPSS Inc, 2008). Data screened for exploration using Kolmogorov Smirnov and Shapiro Wilk tests revealed that the data departed from the normal distribution. The non-parametric test, notably Kruskal Wallis test, was then used to compare groups for significant differences (Nana, 2012) and the Dunnett T 3 test used for paired comparisons. We took measurements of central tendencies and dispersion, presented the data using statistical tables and charts, and discussed at the 95% CL (Alpha=0.05).

10 III.

11 Results and Discussion

12 a) The chemical composition of experimental diets

Table 3 reveals a drop in the CP value of analyzed components for all the treatments, except for the 100% MM. There was a reasonable increase in ME values, especially in 75% and 100% MM.

Table ?? shows a drop in the crude protein content of the control and 25% MM and a slight increase in the rest of the analyzed feed composition compared to the calculated feed composition. There was a considerable increase in ME values of the evaluated components compared to the premeditated constituents across the treatments.

The differences observed in the calculated and the analyzed compositions for both the starter and finisher diets may have been due to variations between the tabulated nutrient content values used in the calculations and the actual nutrient contents of the ingredients used in the experiment. Doing proximate analysis for all components before formulating and compounding the various feeds for the trial keeps this situation in check. Increase in ME with increasing maggot meal in the diets may be explained by the high fats in the maggots which release a lot of energy when oxidized (Adeniji, 2007).

13 b) Carcass analysis

Table ?? indicates the effects of graded level inclusion of MM in broiler diets on carcass characteristics. Live weight, dressed weight, eviscerated weight, carcass characteristics and organs were all significantly different (P<0.001) between treatments except for the liver which was not significantly different (P>0.05). Generally, the weight of carcass parts increased from T0 to T4. This increase in weight agrees with the findings of Hwangbo et al. (2009). The general increase in bulk of the carcass parts with increase inclusion of MM in the diets may have been due to the live weight which also increased with increased levels of maggot inclusion. Agbede and Aletor (2003) found no significant change in all carcass characteristics and organs except for the relative weights of the neck and heart which were significantly higher in diets containing 7.24% of gliricidia leaf protein concentrate in place of FM. Awoniyi et al. (2003) The weight of the liver was not significantly different between the control and experimental diets, although higher (P>0.05) in treatment groups than in non-experimental diet. Hwangbo et al. (2009) and Okah and Onwujiariri (2012) also found no significance (P>0.05) in weight of the liver amongst treatments. This indifference in bulk of the liver may have been an indication that there was no infection in the maggot meal that could cause undesirable effects on the nutrition of broilers as indicated by Hwangbo et al. (2009) and Okah and Onwujiariri (2012). These results differed from those of Teguia et al. ??2002) who obtained proportional increases in weights of the liver and gizzard from the control through treatment groups and linked it to toxicity. Live and dressed weights were significantly higher (P<0.001) in treatment groups than in control. T 4 was, in turn, higher (P<0.001) than the rest of the treatment groups which didn't differ significantly (P>0.05) between themselves in live and dressed weights. Eviscerated weight in T 4 was significantly (P<0.001) higher than in the rest of the treatments which were, in turn, greater than the control though not significantly (P>0.05) Gadzirayi et al., (2012) using mature Moringa oleifera leaf meal as a protein supplement to soybean meal but goes contrary to the outcome of Yisa et al., (2013) who stated that complete withdrawal of FM implied poorer development of the meat yielding parts.

14 Table 5: Comparison of carcass parts between treatments

a, b, c, d, e, f, g, h, I, j Dunnett T 3 : Paired comparison between treatments and within weeks; pairs with the same letter are not significantly different at the 0.05 Level.

15 c) Hematology, serum chemistry, and enzyme studies

The results presented in Table 6 reveal that there was a significant difference (P<0.001) between treatments in the hematological parameters, serum chemistry, and enzymes studied, except for albumin which was the same throughout the control and treatment groups. T 2 recorded the lowest total protein and globulin and T 3 the highest. ALT was significantly lower (P<0.001) in control compared to the rest of the treatment groups and topmost in T 2 , but not significantly different (P>0.05) from the rest of the treatment groups.

16 Conclusion

Conclusions derived from this study follows thus: Better carcass characteristics in treatments with maggot meal is an indication that maggot meal is not inferior to fishmeal. Lower amounts of white blood cells in the treatment groups with maggot meal than in control indicate the absence of any infection in the system attributable to MM. The stable values of RBCs and Hb were an indication that the birds were not suffering from anemia, thereby indicating that MM did not upset the physiological status of the birds. The values of total protein, globulin, and enzymes studied did not show any defined trend in their variations between the various treatments. Given that broilers with the best carcass characteristics performance were those with 100% maggot meal inclusion and that physiological parameters were not deviated from normal values in birds fed experimental diets, it can be concluded from this study that maggot meal can entirely replace fish meal at 5% in broiler feed for better carcass characteristics, and a stable physiological profile. [1] [2]

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Year 2019 8 Volume XIX Issue I Version I D D D D) G (Medical Research Global Journal of

inclusion levels and chemical composition of experimental diets for broiler

Ingredients Soya bean cake(SBC) Maize	starter (weeks 1-4) Treatment Composition Control (T 0, 0%) T 1 (		
Fishmeal (FM) Maggot meal (MM) Groundnut cake (GNC) Palm kernel cake (PKC) Wheat bran (WB) Premix Bone meal (BM) Salt	5.00 0.00 17.00 5.00 10.50 0.75 0.50 0.25	3.75 1.25 17.00 5.00 10.50 0.75 0.50 0.25	2.50 2.50 17.00 5.00 10.50 0.75 0.50 0.25
Oyster shell	0.50	0.50	0.50
Total	100.00	100.00	100.00
Crude Protein (%CP) Metabolizable energy (ME) Kcal/Kg	23.20 2882.72	22.99 2888.25	22.79 2893.78

Figure 1: Table 1 :

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Ingredients	Control (T 0 0%)	Treatment Composition T 1 (25%) T 2 (50%)		T 3 (75%)	T (10
Maize	48.00	48.00	48.00	48.00	48.0
Soya bean cake(SBC)	9.00	9.00	9.00	9.00	9.0
Fishmeal (FM)	5.00	3.75	2.50	1.25	0.0
Maggot meal (MM)	0.00	1.25	2.50	3.75	5.0
Groundnut cake (GNC)	10.00	10.00	10.00	10.00	10.0
Palm kernel cake (PKC)	15.00	15.00	15.00	15.00	15.0
Wheat bran (WB)	10.00	10.00	10.00	10.00	10.0
Premix	0.75	0.75	0.75	0.75	0.7
Bone meal (BM)	1.00	1.00	1.00	1.00	1.0
Salt	0.25	0.25	0.25	0.25	0.2
Oyster shell	1.00	1.00	1.00	1.00	1.0
Total	100.00	100.00	100.00	100.00	100
Crude Protein (%CP)	19.53	19.36	19.12	18.91	18.
Metabolizable energy (ME) Kcal/Kg	2811.57	2817.10	2822.63	2828.16	283
e) Carcass characteristics					

Figure 2: Table 2 :

3

Ingredients	Control (T 0 0%)	T 1 (25%)	T 2 (50%)	T 3 (75%)	T 4 (100%)
Maize	48.00	48.00	48.00	48.00	48.00
Soya beans cake (SBC)	12.50	12.50	12.50	12.50	12.50
Fishmeal (FM)	5.00	3.75	2.50	1.25	0.00
Maggot meal (MM)	0.00	1.25	2.50	3.75	5.00
Groundnut cake (GNC)	17.00	17.00	17.00	17.00	17.00
Palm kernel cake (PKC)	5.00	5.00	5.00	5.00	5.00
Wheat bran (WB)	10.50	10.50	10.50	10.50	10.50
Premix	0.75	0.75	0.75	0.75	0.75
Bone meal (BM)	0.50	0.50	0.50	0.50	0.50
Salt	0.25	0.25	0.25	0.25	0.25
Oyster shell	0.50	0.50	0.50	0.50	0.50
Total	100.00	100.00	100.00	100.00	100.00
Calculated composition					
Crude Protein (%CP)	23.20	22.99	22.79	23.58	22.37
Metabolizable energy (ME) Kcal/Kg	2882.72	2888.25	2893.78	2899.31	2904.85
Analyzed composition					
Crude Protein (%CP)	20.4	18.9	20.4	20.7	22.4
Metabolizable energy (ME) Kcal/Kg	3114.9	3121.7	3121.5	3359.8	3205.5

Figure 3: Table 3 :

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Ingredients	Control (T 1 0%)	T 2 (25%)	T 3 (50%)	T 4 (75%)	T 5 (100%)
Maize	48.00	48.00	48.00	48.00	48.00
Soya beans cake (SBC)	9.00	9.00	9.00	9.00	9.00
Fishmeal (FM)	5.00	3.75	2.50	1.25	0.00
Maggot meal (MM)	0.00	1.25	2.50	3.75	5.00
Groundnut cake (GNC)	10.00	10.00	10.00	10.00	10.00
Palm kernel cake (PKC)	15.00	15.00	15.00	15.00	15.00
Wheat bran (WB)	10.00	10.00	10.00	10.00	10.00
Premix	0.75	0.75	0.75	0.75	0.75
Bone meal (BM)	0.50	0.50	0.50	0.50	0.50
Salt	0.25	0.25	0.25	0.25	0.25
Oyster shell	0.50	0.50	0.50	0.50	0.50
Total	100.00	100.00	100.00	100.00	100.00
Calculated composition					
Crude Protein (%CP)	19.53	19.36	19.12	18.91	18.70
Metabolizable energy (ME) Kcal/Kg	2811.57	2817.10	2822.63	2828.16	2833.70
Analyzed composition					
Crude Protein (%CP)	17.1	16.0	20.4	19.0	20.0
Metabolizable energy (ME) Kcal/Kg	3253.4	3166.6	3015.7	3418.1	3296.6

Figure 4: Table 4 :

no significant effect on the relative length, breadth or weight of muscles of key economic importance in chickens. His report is similar to that of Quinton (2011). Amal et al., (2013), Meseret et al., (2012) and Bello et al., (2012) found no significant (p>0.05) differences between all treatments groups in Live weight, eviscerated weight of carcass cuts, dressing percentage, edible inner organs (liver, gizzard, and heart).

Year 2019
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Volume XIX Issue I Version I
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Figure 5:

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Figure 6: Table 6 :

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