The effect of fed maggot meal as a supplement in the commercial diets on the performance of finisher broiler chickens

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Abstract. An experiment was conducted for 30 days to evaluate the performance of finisher broiler chickens fed maggot meal as a supplement in the commercial diets on their performance of finisher broiler chickens. Maggot meal was analysed to contain 40.12% CP, 10.97% CF, 6.88% EE, 15.88% ash. The four treatments used in this experiment were: (1) T₀: commercial ration without maggot meal; (2) T₁: commercial ration with 75% maggot meal; (3) T₂: commercial ration with 50% maggot meal; and (4) T₃: commercial ration added with 25% maggot meal. Statistical analyses showed that the treatments did not affect (P<0.05) feed consumption. However, they did effect (P>0.05) daily weight gain and feed efficiency of the birds. Maggot supplementation could reduce 25% commercial ration fed to broiler chickens.

1. Introduction

The conventional sources of feed protein for monogastrics in the developing countries are fish and soybean meals. With an increasing number of large industrial farms in these areas, protein feed sources are greatly challenged to the extent that small and medium scale poultry enterprises are squeezed out of access to these resources. These farms are increasingly focusing attention on cheap, suitable and sustainable alternative or non-conventional protein feed source for their survival [1]. Insects have an important role in ensuring food and feed safety because several things, such as insects have a shorter life span then most of vertebrates, have the ability in feeding in almost all species of the plants and animals, insects have the capacity to colonize new niches, and are easily maintained in organic side streams (e.g. manure, compost, pork porridge and industrial products), independence of land resources that can be planted and not compete with the nutrition of human [4]. One of the most popular species which is covering around 70% of animal species is insects. Most of insects are originated from the tropical and subtropical regions in the world. Nevertheless, today insects are widespread in the tropical and warmer
regions [5]. There are more than 2,000 edible insect species that have been recorded as food and feed, and donate varies nutritional contribution between species and morphological stages (eggs, larvae, pupae and adults) [Figure 1 – (4)].

**Figure 1.** Recorded edible insect species being eaten by humans [4]

Nowadays, there are nine large insects that have promising prospects in the world of animal feed, namely (1) fly larvae of black warriors (Hermetia illucens), (2) maggots and cocoons of ordinary flies (Musca domestica), (3) yellow worms or beetle larvae (Tenebrio molitor) and blue bottles (Calliphora vomitoria), (4) termites and (5) fly flies. In addition, there are also several other insects such as (7) Blattodea Insects such as American orders (Periplaneta americana), (8) Germany (Blattella germanica) and (9) Asian cockroaches (Blattella asahinai) that have future prospects. Insects that have an important role in carrying out recycling activities in the form of waste and nutrient accumulation in the environment, namely crickets [4; 5]. They are in the semi-transparent stage of the Muscadomestica fly larvae (Figure 2 - 6)) and are then used to process maggot flour. Maggots are insects that are adaptable and live on animal manure or organic waste in a short 2-3 days. The percentage of their crude protein ranges from 39-65%, lipids 12.5–21%, and crude fiber 5.8–8.2%. They are also consist of a high phosphorus content, trace elements and vitamin B complex [1; 7]. The objective of this research was to examine the effect of meal flour as a supplement in the commercial diet on the performance of broiler finisher.
2. Materials and Method

2.1. Maggot meal production and chemical analysis
Production of maggots were conducted through the housefly larvae culture in media of cattle manure. They mature within 2-3 days then followed by harvesting, drying and milling process to form maggot meal. Determination of chemical composition was conducted using the proximate analysis method [8].

| Parameter     | Content (%) |
|---------------|-------------|
| Dry matter    | 96.77       |
| Crude protein | 40.12       |
| Crude fibre   | 10.97       |
| Ether extract | 6.88        |
| Total ash     | 15.88       |

2.2. Experimental diets and management of experimental diets
Research conducted by dividing a total of sixty four (30-days old) broiler chicks into four groups, where each group consisted of sixteens birds. They were sub-divided into four replications of four birds for each treatment. After that, the birds were then appointed to the four diets randomly in a completely randomised design method. The four treatments used in this experiment were: (1) T₀ : commercial ration without maggot meal; (2) T₁ : commercial ration with 75% maggot meal; (3) T₂ : commercial ration with 50% maggot meal; and (4) T₃ : commercial ration added with 25% maggot meal. The experimental diet meal formulation and content which was fed to finisher broiler chickens are presented in Table 2. In this research, there were two indicators observed to prevent any disease outbreak i.e. hygiene and the routine.
medication. The study was conducted in 30 days, where the needed feed and water were offered _ad libitum_ during the study.

**Table 2. Composition of the experimental diets fed to finisher broiler chickens**

| Ingredients        | T0       | T1       | T2       | T3       |
|---------------------|----------|----------|----------|----------|
| Maize               | 58.00    | 58.00    | 58.00    | 58.00    |
| Soybean meal        | 20.60    | 20.60    | 20.60    | 20.60    |
| Fish meal           | 16.00    | 15.25    | 15.50    | 15.75    |
| Maggot meal         | 0.00     | 0.75     | 0.50     | 0.25     |
| Blood meal          | 3.50     | 3.50     | 3.50     | 3.50     |
| Oyster shell        | 1.00     | 1.00     | 1.00     | 1.00     |
| Premix              | 0.25     | 0.25     | 0.25     | 0.25     |
| Methionine          | 0.40     | 0.40     | 0.40     | 0.40     |
| Common salt         | 0.25     | 0.25     | 0.25     | 0.25     |
| Total               | 100.00   | 100.00   | 100.00   | 100.00   |

| Calculated analysis (%) |          |          |          |          |
|-------------------------|----------|----------|----------|----------|
| Crude protein           | 21.10    | 21.00    | 21.00    | 21.00    |
| Crude fibre             | 3.44     | 3.42     | 3.42     | 2.41     |
| Ether extract           | 6.60     | 6.63     | 6.64     | 6.65     |
| ME (Kcal/Kg)            | 2940.00  | 2930.00  | 2920.00  | 2910.00  |
| Calcium                 | 1.10     | 1.08     | 1.05     | 1.02     |
| Phosphorus              | 0.72     | 0.70     | 0.68     | 0.67     |
| Lysine                  | 1.25     | 1.20     | 1.25     | 1.18     |
| Methionine              | 0.90     | 0.85     | 0.84     | 0.83     |

2.3. Data collection and analysis

At the beginning of the experiment, individual body weight of each bird chicks was recorded and every week thereafter, then the feed intake was re-recorded every week. The weight gain and feed conversion ratio of the bird chicks were recalculated every week. Furthermore, the collected data were analyzed by the ANOVA procedure, where the significant differences then observed between treatment averages, they were separated by the Duncan multiple range test [10]. The difference in mean values between treatment groups was examined by Duncan's multiple range test. Statistical significance is expressed at probability p <0.05.

3. Results and Discussion

The nutrient content of dried maggots is summarized in Table 1. The reported crude protein in this study was 40.12% which was in the range of 39.16 - 65% of reported crude protein in recent studies [7]. In contrast, the reported ether extract in this experiment was 6.88% which was quite lower than the percentage report by [11] 20.70-25.30%. The analysis results for protein contents were different from those reported by these researchers, probably caused by the differences of the used analytical procedures employed or the medium. The differences in these nutrients have been reported to be dependent upon manure media, age at harvest, method of drying, and larval feed substrate [12]. In this study, production of maggots were conducted by housefly larvae cultur in the media of cattle manure. Regarding to the quality of protein, maggot meal can be compared to meat and bone meal as well as fish meal and were
superior to soybean meal [7]. No unusual ill health was recorded, and the appearance of the birds was normal and did not show anything unusual for broiler chickens fed maggot meal. Poultry and other birds insects which inherited the ability to do degradation process of maggot protein from their wild birds ancestors. This is consistent with previous studies where the birds were fed with the housefly Musca domestica as maggot meal suggesting that maggot meal supplements were reasonably good substitute of commercial prepared feed for broiler chickens [7, 11-12].

Table 3. Effects of different levels of maggot meal as a supplement in the commercial diets on performance of finisher broiler chicks.

| Parameters          | Treatments |
|---------------------|------------|
|                     | T0         | T1         | T2         | T3         |
| Feed intake (g/bird)| 2810.10a   | 2801.25a   | 2804.75a   | 2801.35a   |
| Body weight (g/bird)| 1315.35a   | 1206.68a   | 1007.97b   | 807.95c    |
| FCR (g:g)           | 1.80a      | 1.78a      | 1.60b      | 1.52c      |

Notes: Means with different superscript within a column are significant different (P<0.05).

Result of variance analysis showed that maggot meal had no significant effect (P> .005) on the consumption of chicken ration. The absence of the effect of treatment on ration consumption of broiler chickens may be due to maggot larvae is quite palatable and naturally the chicken likes to consume maggot meals. It has been reported that maggot meal had no significant effect (P>0.05) to the intake feed [13] and this is in accordance with the results found by [7]. These authors substituted the fish meal by the maggot meal at levels of 25%, 50%, 75% and 100%, respectively with no significant effect to the intake of the feed (P>0.05). This is also in agreement with [14], who stated that poultry and other birds insects which inherited the ability to do the degradation process of maggot protein from their wild birds ancestors.

The body weight of broiler chickens fed T0, T1, T2, and T3 were 1,315.35; 1,206.68; 1,007.97 and 807.95 g/bird, respectively.

Our chickens at 30 days of age produced general body weights recommended by [16], who reported that under condition of a high-energy diet and good husbandry, at 35 days of age, a 1.40-kg broiler needed around 3.22 kg of feed. However, the body weight of broiler chickens was significantly (P<0.05) lower in birds fed the maggot meal diets of 50% (T2) and 25% (T3), except for the 75% maggot meal group (T1) compared to the control (T0). This is supported by research results of [8], who use the maggots as a substitute for fish meal as much as 0.33,66 and 100% in broiler ration and found that the decreasing level of maggot meal will reduce broiler body weight. The FCR value of broiler chickens fed T0, T1, T2, and T3 were 1.80, 1.78, 1.60, and 1.52, respectively. These results showed a similar pattern as previous studies of [7, 10], which showed a significant differences (P<0.05) regarding to the supplementation of maggot meal on the ratio of feed conversion of broiler chickens. Our findings indicated that the treatment gives negative feedback to the efficiency of the ration, where the lower the commercial ration supplemented with maggot meal gives the lower the value of the ration efficiency. The weigh of a modern broiler was about 2.5 kg at 39 days of age, with the ratio of live-weight feed conversion of 1.6 kg of feed per kilogram of body weight gain [14]. Poultry that have a low FCR are considered efficient users of feed. Result showed that the 25% of fish meal protein diet then substituted with the maggot meal (T3) was the most efficient treatment in terms of FCR average. The performance of three to nine weeks-old broiler chickens, fed by five isonitrogenous and isocaloric maggot meal diets replaced 0%, 25%, 50%, 75% and 100% of 4% fish meal diet. The substitution of maggot meal (from diet with 25% fish meal) was recorded as the most efficient treatment regarding to the FCR average weekly [15].
4. Conclusions
Feeding broiler chickens with maggot meal can lead to poor growth because these insect meals do not provide all the nutrients required for optimal growth in broiler chickens. Maggot supplementation could reduce 25% commercial ration fed to broiler chickens. However, maggot meal should be used as only as a supplementary food as a replacement for highly priced fishmeal in broiler feed formulation because they are rich in protein.

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