Growth Performance and Profitability of Broilers Supplemented with Vermi Meal under Free Range Management System

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ABSTRACT

Background: Poultry rearing systems and feeding have been the emphasis of broiler raisers in order to meet the customer demand for high-quality products. In this study, free range management was introduced that allows the birds to enjoy their natural habitat while utilizing vermi meal as supplemented to commercial feeds.

Method: Evaluated the growth performance and profitability of broilers fed with different levels of vermi meal. Treatments represent T1- 100% Commercial Feeds (CF), T2- 2% Vermi Meal (VM)+98% CF, T3- 3% VM+97% CF, T4- 5% VM+95% CF. Treatment means having significant differences were subjected to Least Significant Difference at 5% level of significance.

Result: Vermi meal did not influence the weight gain, feed intake, feed consumption and dressing percentage of broiler chicken. However, numerically, final weight and weight gain in T4 containing 5% VM was higher than T1 with commercial feed a difference of 66.66 grams and 67.60 grams respectively. Birds of T4 with 5% inclusion of vermi meal showed higher in most parameters compared to the group fed with commercial feed. Consequently, 5% level of vermi meal had an optimum result in final weight, gain weight, feed conversion ratio, feed consumption, live weight and carcass weight.

Key words: Broilers, Free range, Growth, Profitability, Supplementation, Vermi meal.

INTRODUCTION

Most remote parts of the Philippines raised broiler chicken (Gallus gallus domesticus) as a source of income and food. Poultry rearing systems have been the focus of scientific research for many years as a result of customer demand for high-quality products and legal poultry welfare requirements. Along with the fact that the poultry meat market is dominated solely by price competitiveness, this has radically transformed the market into one equally dominated by both price and quality competitiveness (Bogosavjevik-Boskovic et al. 2010).

Bancos (2010) outlined major advantages of organic poultry production over intensive production, including a lower risk for human health, higher welfare and better conditions for broilers, environmental preservation and cost-effectiveness. In the study of Bogosavljevic-boskovic S., et al. (2012) lower final body weight and poor feed conversion efficiency was observed in free-range systems compared to intensive rearing. Conversely, better meat quality traits, most notably in terms of chemical composition of meat, were observed in non-intensive and organic broilers.

The effect of free-range rearing on performance, carcass attributes and meat quality of broiler chicken were observed and found that, the higher body weight and lower mortality were characteristic of broiler reared indoors on deep litter compared to broiler reared in free range (Poltonwicz, K., and Doktor, J., 2011).

The meat of the birds reared under free-range system is preferred by the consumers due to better sensory quality attributes (Javid, A., et al 2019).

Stadig, L. M., et al (2017) revealed that free-range access for broiler chickens can benefit animal welfare because the birds have access to a more natural environment and more opportunities to perform natural behaviors than in indoor systems.

Some alternatives that can be utilized as substitute for soymeal, fishmeal and meat meal in poultry diet. One such potential alternative is vermi (Bahadori 2015 and Rezaepour, 2014). The diversity of vermi or earthworms from rice field recorded higher number followed by turmeric field. The investigation reveals the impact of different agricultural practices on the soil faunal diversity and its importance in the context of soil organic matter (Akilan and Nanthakumar, 2017).

Sultan et al., (2010) indicted that poultry diet has been put at 60-80% of total cost in production and high quality feed...
to remain competitive. Bahadori et al. (2017) emphasized that vermi or earthworm meal is superior to fish meal in terms of protein content.

The impact of its result for the development and growth of birds was noticed, that vermi meal had good potential as an animal feed in the basis of their protein amino acids, omega-3 fatty acid (Bahadori et al. 2017).

Fasila (2012) showed that powdering method of earthworm by using formic acid addition had higher amino acid balance than vermi or earthworm and the essential amino acid of vermi meal was dominated by histidine and isoleucine.

The results of proximate analysis showed that vermi or earthworm meal contained crude protein 66.88%, crude fiber 7.68%, ash 11.39%, ether extract 17.38%. Therefore, it can be concluded that vermi or earthworm can be replaced for basal diet of poultry feed as a source of protein (Kasye, 2016).

Feed conversion ratios were improved by 12.64% and 22.45%, when 3% and 5% vermi or earthworm powder, respectively. Supplementing the diet with 5% vermi powder had no negative effects on the growth of pullets and increased antioxidant enzyme activities in the liver. The dietary supplementation with 1%, 5% earthworm powder is safe for broiler pullets (Zang, et al., 2018).

Thus, the study was undertaken with an objective to evaluate the effect of vermi meal supplementation on growth performance and profitability of broiler under free-range management system.

**MATERIALS AND METHODS**

**Place and Time of the Study**

This study was conducted at Northwest Samar State University, Erenas Village, San Jorge, Samar, Philippines from March to April 2019.

**Housing of Broilers**

The brooding and growing cages were constructed based on the number of treatments and replicates. The free-range system was constructed with cages measured to 1.4 square feet per broiler in compartment. The free-range area was prepared by division using a net (each measured 2m x 6m per compartment) to access the broiler from outside for foraging using a short tunnel under the wall from indoor pens to grass.

**Vermi Meal Supplementation**

The powdered vermi meal was purchased based on the amount needed in whole duration of the study. Vermi meal were mixed to commercial feeds based on percentage requirements.

**Experimental Design**

A total of sixty broilers were used for this experiment. The broiler chicks were randomly selected and divided into twelve groups of replicates with 5 broilers each. The replicates were distributed using Complete Randomize Design (CRD) and assigned to each of the four treatments. The Following treatments were designated as follows.

- **Treatment 1 - Commercial Feeds**
- **Treatment 2 - 2% of vermi meal plus 98% commercial feeds**
- **Treatment 3 - 3% of vermi meal plus 97% commercial feeds**
- **Treatment 4 - 5% of vermi meal plus 95% commercial feeds**

**Statistical Analysis**

The data was subjected to an analysis of variance (ANOVA). Treatment means having significant differences were subjected to Least Significant Difference (LSD) at 5% level of significance. Statistical analysis was carried out using Statistical Tool for Agricultural Research (STAR) version 2.0:1 2014 by Biometrics and Breeding Informatics, PBGB Division International Rice Research Institute, Los Banos Laguna.

**RESULTS AND DISCUSSION**

**Water and Feed Consumption of Broilers**

The average water and feed consumption of broilers are shown in Table 1. The vermi meal supplementation of 2%, 3% and 5% did not significantly influence the rate of water and feed consumption. It showed that supplementation of
vermi meal at either 2, 3 or 5 percent were just comparable to each other. This result may be due to the percentage of feed mixture (commercial feed + vermi meal) wherein so close in terms of ration percentage, thus the overall palatability or quality of the feed mixture apparently similar as reported by Prayogi et al. (2011). The effect of feed with 2% 4%, 6% level vermi meal did not significantly affect the amount of feed intake. The supplementation of vermi meal in contiguous amount did not affect the feed palatability, hence it did not affect the feed consumption. This means that substitution of vermi meal in at a range of 2-6% result in same quantity of feed consumption.

According to the study of Nalunga A., (2019) birds with 3% vermi or earthworm had the highest body weight gain, followed by birds with 5%. The highest food consumption was with 0% vermi and 1% with the least food consumption with 7% vermi meal. There was a significant difference in the food consumption for week 4 and week 6.

**Initial weight and final weight of broilers**

The initial and final weight of broilers are shown in Table 2 and Fig 2. It showed that the experimental subjects were evenly distributed as attributed by its initial weight of sampled chickens were similar among treatments. The final weight of broilers was not affected by the supplementation of vermi meal at 2, 3 or 5% mixture. The comparable weight of the chickens can be directly correlated to the feed intake showed no significant differences on the feed consumption relative to the treatments tested. In addition, protein content of feeds is the major source nutrient for growth and developing tissue of the broilers. Rezaeipour et al. (2014) reported that protein efficiency percentage increased with level of earthworm meal at 5 to 10% numerically but was not significant. The study of Reaipour et al. (2014) found out that growth performance of broilers fed diets containing vermi meal is equal to that fed with fishmeal.

**Weight Gain and Feed Conversion Ratio (FCR) of Broilers**

Vermi meal supplementation of feeds at lower concentration (2, 3, or 5%) did not significantly increased the average gain of weight of broiler and were comparable to control (pure commercial feeds) consequently the feed conversion ratio was also not significantly different among treatments (Table 3). As Rezaeipour et al. (2014) revealed that among 5 and 10% earthworm meal, the protein consumption at 5% level of earthworm meal was minimal. Prayogi (2011), also stated that vermi meal inclusion by 0, 5, 10 percent in broiler diet, was no significant effect in the body weight gain

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**Table 1:** Average Water and feed consumption of broilers in 35 days.

| Treatments     | Water consumption (ml) | Feed consumption (g) |
|----------------|------------------------|-----------------------|
| T1- control    | 6231.00                | 2009.93               |
| T2- 2% vermi meal | 6216.00               | 2126.47               |
| T3- 3% vermi meal | 6165.33               | 2091.53               |
| T4- 5% vermi meal | 6221.67               | 2195.37               |
| CV (%)         | 4.94                   | 7.05                  |

Means in a column with or without common letter designation were not significantly different, based on LSD Test at p<0.05.

**Table 2:** Effect of dietary treatments vermi in broilers in 35 days.

| Treatments     | Initial weight (g) | Final weight (g) |
|----------------|--------------------|------------------|
| T1- control    | 49.07              | 1326.67          |
| T2- 2% vermi meal | 45.00              | 1314.00          |
| T3- 3% vermi meal | 48.33              | 1324.67          |
| T4- 5% vermi meal | 48.13              | 1393.33          |
| CV (%)         | 4.29               | 4.09             |

Means in a column with or without common letter designation were not significantly different, based on LSD Test at p<0.05.

**Table 3:** Average gain weight and average feed conversion ratio (FCR) in 35 days of broilers.

| Treatments     | Gain weight (kg) | Feed conversion ratio (Kg) |
|----------------|------------------|----------------------------|
| T1- control    | 1277.60          | 1.62                       |
| T2- 2% vermi meal | 1269.00          | 1.61                       |
| T3- 3% vermi meal | 1276.33          | 1.60                       |
| T4- 5% vermi meal | 1345.20          | 1.63                       |
| CV (%)         | 4.34             | 3.3                        |

Means in a column with or without common letter designation were not significantly different, based on LSD Test at p<0.05.

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Fig 2: Weighing upon arrival and weighing during harvesting of broiler chicken.
of broilers, but the use of 15% give a significantly effect in compared to the other treatment due to protein intake and protein efficiency as mention in body weight of broilers. Furthermore, Sofyan et al. (2010) showed that vermi significantly led to gain weight and improved feed conversion ratio in broiler chicken.

**Live weight, Carcass weight and Dressing percentage of broilers**

The effect of commercial feeds supplemented with varying levels of vermi meal on live weight, carcass weight and dressing percentage of broilers are shown in Table 4. The results indicated that vermi meal supplementation at lower concentration had no significant effects due to the similarity of carcass, live weight and dressing percentage relative to each treatment (0%, 2%, 3% and 5% vermi meal). According to Prayogi, (2011) vermi or earthworm increase protein on gizzards which make them gain weight. The feed that is rich in protein causes a definitely higher acidity in the gizzard than the food lower in protein.

The comparative effects can also be correlated on the feed-water consumption of chickens that were comparable among treatments as it confers that growth and development of broilers depends on the nutrient consumed.

**Production Cost and Net Income**

The cost of production per broiler described that vermi meal has the highest cost in all expenses (Table 5). It is shown that 43.06% was part of vermi meal in overall cost of the study due to its import purchased and followed by feed cost (33.55%).

Similarly, the cost of production keeps increasing as a result of the cost of feed ingredients particularly in protein sources and about 70% of total cost can be attributed to feeding cost (Donkoh et al. 2016).

In variable cost, it was found that dietary mixtures with vermi meal has the higher cost than control. The highest cost among treatments was obtained by T4 (5% vermi meal) and more than three times higher than control, followed by T3 (3% vermi meal) and T2 (with 2% vermi meal). This implies that more percent of inclusion of vermi meal, higher the cost of production. The profit per broiler was relying on selling price of dressed chicken (140 pesos per kilo), internal parts, drumstick and feet were included in selling. The higher revenue was noted in T3 (235.57 pesos) compared to other treatments which may be due to dressed chicken that higher than T4, T2 and control that shown in (Table 5), although the carcass weight was comparable in each treatment. T1 was the second higher

### Table 4: Live weight, carcass weight and dressing percentage of broilers in 35 days.

| Treatments          | Live weight (kg) | Carcass weight (kg) | Dressing percentage (%) |
|---------------------|------------------|---------------------|-------------------------|
| T1- control         | 1.52             | 1.14                | 74.96                   |
| T2- 2% vermi meal   | 1.45             | 1.09                | 75.09                   |
| T3- 3% vermi meal   | 1.55             | 1.15                | 74.27                   |
| T4- 5% vermi meal   | 1.54             | 1.12                | 72.75                   |
| CV                  | 3.13             | 2.44                | 4.11                    |

Means in a column with or without common letter designation were not significantly different, based on LSD Test at p<0.05.

### Table 5: Production cost and net income per broilers in 35 days.

| Cost item (PhP) | Treatments | Percentage of cost |
|-----------------|------------|--------------------|
|                 | 1          | 2                  | 3                  | 4                  |
| Feed cost       | 79.8       | 78.3               | 77.42              | 75.96              | 33.55             |
| Vermi meal powder | 0         | 79.8               | 120                | 200                | 43.06             |
| Broilers        | 45         | 45                 | 45                 | 45                 | 19.39             |
| Housing disinfectant | 0.83   | 0.83               | 0.83               | 0.83               | 0.16              |
| Electric bill   | 3.33       | 3.33               | 3.33               | 3.33               | 1.43              |
| Total variable cost | 207.26 | 246.58             | 325.12             |                     |                   |
| Fixed cost under Depreciation | 128.96 |                     |                     |                     | 97.59             |
| Housing/cages and labour | 4.2    | 4.2                | 4.2                | 4.2                | 1.81              |
| Weighing scale  | 0.93       | 0.93               | 0.93               | 0.93               | 0.40              |
| Total fixed cost | 5.13     | 5.13               | 5.13               | 5.13               | 2.21              |
| Total cost      | 212.39     | 251.71             | 330.25             | 100                |                   |
| Selling Price:  | 134.09     |                     |                     |                     |                   |
| Dressed chicken 140/kg | 159.6   | 152.6              | 217                | 156.8              |                   |
| drumstick and feet 100/kg | 6.39    | 6.36               | 6.43               | 6.51               |                   |
| Internal parts: |           |                     |                     |                     |                   |
| Gizzard 175kg)  | 4.79       | 6.11               | 4.85               | 5.17               |                   |
| heart and liver 175kg) | 7      | 7.57               | 7.29               | 6.23               |                   |
| Revenue          | 177.78     | 172.64             | 235.57             | 174.71             |                   |
| Profit           | 43.69      | -39.73             | -16.14             | -155.54            |                   |
| ROI (%)          | 32.58      | -18.71             | -6.41              | -47.10             |                   |
revenue, followed by T5 and the lowest revenue was described in T2 (172.64 pesos) among treatments.

**Net Income**

The profit of each treatment per broiler also shown in table 5. It is described that T1 (100% commercial feeds) has the highest net income compared to other treatments. Treatments that supplemented with vermi meal has lower net income. In the study of ÖZTÜRK, E., and KÖSE, B., (2017) Poultry farming, approximately 70% to 75% of the operating costs is from feeds, of which about 15% are animal proteins. The protein requirement of poultry is provided by feed stuff. Limited production opportunities and price increases have led to the need to use alternative feed additives that can be substituted for these products. The study suggests that earthworms, rich in essential amino acids and a high digestible protein source can be used as substitutes as a source of alternative protein. From the study, it was found that higher import charges of vermin meal resulted in higher feed cost, which ultimately lowered the net income in groups supplemented with vermi meal.

**CONCLUSION**

The supplementation of vermi meal did not significantly influenced the growth performance of broilers particularly the feed consumption, body weight gain, feed conversion ratio (FCR), carcass weight and dressing percentage of broilers. However numerically, final weight and weight gain in T4 containing 5% VM was higher than T1 with commercial feeds with a difference of 66.66 grams and 67.60 grams respectively. Consequently, 5% level of vermi meal had an optimum result in final weight, gain weight, feed conversion ratio, feed consumption, live weight and carcass weight.

Further research on the vermi meal supplementation using high concentration of vermi meal up to 10, 15 and 20%. Next study vermi must be cultured by researcher to avoid purchasing vermi meal. Using vermi meal as supplementation could be utilized from local markets and could be cultured by farmer to lessen the cost of production.

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