Growth performance of broilers fed with Vermi meal under free-range management

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JOMEINO
ISSN:
2522-381X (Print)
2521-7054 (Online)
DOI: 10.31039/jomeino

Received 11 January 2020
Revised 23 February 2020
Accepted 17 April 2020

Citation: Bollido, M. E. (2020). Growth performance of broilers fed with Vermi meal under free-range management. *Journal of Management, Economics, and Industrial Organization, 4(2), 28-40.*
http://doi.org/10.31039/jomeino.2020.4.2.2

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Abstract

This study was conducted to evaluate the growth performance and profitability of broilers chicken fed with different level of vermi meal. Different treatments represent as T1- 100% Commercial Feeds (CF) or control, T2- 2% Vermi Meal (VM)+98% CF, T3- 3% VM+97% CF, T4- 5% VM+95% CF. The study showed particularly on weight gain, feed intake, feed consumption and dressing percentage of broiler chicken did not influenced with vermi meal supplementation. However, numerically, final weight and weight gain in T4 contains 5% VM was higher than T1 with commercial feeds a difference of 66. 66 grams and 67.60 grams respectively. The different levels of vermi meal, though they didn't have significant difference to each other, the 5% level of vermi meal was higher in numerical value compared to commercial feeds in terms of final weight, weight gain, feed conversion ratio, feed consumption, live weight and carcass weight. 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. The higher concentration of vermi meal supplementation has the higher cost in production, due to expensive imported vermi meal.

Keywords: Broilers, Growth, Free Range, Performance, Vermi Meal.

1. Introduction

Most parts of the Philippines raised broiler chicken (*Gallus gallus domesticus*) as source of income and food especially in remote areas. Poultry has been known to be prolific that can be generally expanded more easily than other livestock and considered as one of the fastest producers of meat among poultry species, especially the broiler. Raising of broiler chicken requires an intensive management and adequate feed nutritional level adjustment to improved production rates. These may include meat quality, broiler growth potential, and followed by increased performance and profits. Furthermore, Freitas et al. (2005) stated that parameters such as environmental and nutritional condition may influence the growth performance of broiler.

Farmers commonly raised broiler in total conventional management system that noticed in the Philippines. Aside from environmental factors causes a good or decreasing performance of broiler, the choice of rearing system is a highly important parameter in growth habits of broiler. According to Jones and Millis (2009), conventionally confine system lead to animal stress, resulting in physiological and behavioral responses (Marin et al. 2001) and reduce good performance. Agriculturists and some farmers find alternative changes in the raising system, which decrease stress condition and allowing selection of strains that may increase and bring welfare. The matter of animal welfare has led to studies in order to evaluate alternative housing systems to improve well-being (Silva et al. 2002). Alternative housing free-range system is one of the common practices in Samar. These methods of housing of broilers allow the broilers in a poultry house to have free access in pasture area for natural feeds (Mollen Horst et al. 2005).

Environmental management of broiler houses is an intricate process with the purpose of providing feed, water, heat, fresh air, and shelter in order to maximize broiler weight gains and minimize stress. Improper management of any of this factor might result in poor feed efficiency, low weight gains and increased mortality**.** Poultry rearing systems have been the focus of scientific research for many years as a result of costumer 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 been radically transformed the market into one equally dominated by both price and quality competitiveness (Bogosavjevk-Boskovic et al. 2010). Meanwhile, Pavlovski et al. (2009) reported increased consumer demands for poultry meat production resulting from less intensive production systems that involve comfortable rearing condition for broilers.

According to a survey by Fanatic et al. (2006), consumers highlighted higher health benefits of meat produced under these conditions compared to that from indoor reared broiler. Along with the laws adopted in many countries regarding broiler welfare, as well as on environmental protection, the above situation has stimulated interest in non-intensive poultry rearing system. Bancos (2010) outlined major advantage 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 of the use of this rearing system in rural environment. Generally, better meat quality traits, most in term of chemical composition of meat, were observed in non-intensive and organic broilers. The authors have stated that slaughter trait and dressing percentage can be affected not only by genetic factors but also a number of non-genetic factors.

Filho et al. (2005) observed that broilers comfort significantly affected productive performance in different rearing systems. They used four (4) strains of broiler chickens: two experimental strains (Caipirinha and Carijo) and two commercial lines (Embrapa and Paraiso Pedres) fed a standard two-phase diet. One group of broilers reared under a semi-intensive system was provided with a sheltered outdoor area for thermal comfort purposes, whereas the other broilers were kept on an open range. The results clearly showed statistically significant higher final body weights in broilers reared under sheltered free-range broilers owing to increased pasture coverage by high quality closer that was consumed by the chickens. However, feed conversion ratio did not show statically significant differences as compared to the non- free-range system.

Santos et al. (2005) studied broilers under two rearing systems (with and without free- range access) and obtained results that were in complete disagreement with the findings of the already cited authors. They determined that free-range broilers reached a higher body weight at low feed consumption rate, leading to a more favorable feed conversion ratio at its control point measurement performed on days 21, 49, 77, and 105. The broilers were fed an adlibitum diets containing 28% crude protein (1-21 days), 18.7% crude protein (22-49 days), and (17.4crude protein until the end of the rearing period). Analysis of literature suggests, that rearing especially non-intensive and organic system, are an essential part of modern chicken reproduction technology.

Along with total confinement management system, which was considered to decrease rates in broiler performance, people were also facing nutritional complex as feed is expensive input for poultry diet. Sultan (2010) indicted that poultry diet has been put at 60-80% of total cost in production and high-quality feed to remain competitive.

Therefore, farmer's fed their animals with available feeds that have limited amount of amino acids. However, around the world has been driven a force to find some alternative feeds content of amino acids that can be used as a substitute feeds to lessen the cost in feeding. Bahadori et al. (2015) emphasized that vermi or earthworm meal is superior to fish meal in term of protein content.

Because vermi meal is a good source of amino acids, adequate amount of fatty acid and omega 3 which are needed in broiler diets. Aside for high protein content which constitute for about 32% crude protein (Mason et al. 1992), vermi or earthworm has a rapid population growth capacity and easy to culture. A considerable amount of new research information about the use

of vermi meal as avian feed is becoming available from ongoing research in most places. The impact of it result to the development and growth of an avian animal was noticed, that vermi meal have good potential as an animal feed in the basis of their protein amino acids, fatty acid and omega-3 (Bahadori et al. 2015).

Last few decades, the study of vermi meal and its effects as a protein source on growth performance, characteristics and meat quality of broilers was conducted. The protein content of a feed ingredient is a factor of great performance. Protein is the basic nutrient that cannot be compromised in the preference of ingredients for feed formulation and preparation (Sogbensan and Ugwamba, 2008) because it essential in poultry diets for growth and tissues repair. The nutritive potential and utilization of earthworm meal with an important high protein (32% crude protein) component are used to feed chickens, pig rabbits, and as dietary supplement for fish species.

Vermi meal contains an adequate mineral content and an excellent range of vitamins which are valuable component of poultry feed (Vielma et al. 2001). Essential elements such as copper (Cu), Manganese (Mn) and Zinc (Zn) are about one to six times higher in vermi meal than in soybean and fishmeal (Zhenjun et al. 1997). Furthermore, Zhenjum et al. (1997) had reported that the iron content of vermi meal fluid is ten times than that of soybean and fishmeal and the feature of earthworm fluid could be exploited to produce especial iron (Fe) supplementation for poultry feed production earthworm body is rich in vitamin A and vitamin B compounds 0.25 mg vitamin B1 and 2.3 mg vitamin B2 per 100 g. The earthworm meal can be used for mineral and vitamin supplementation in addition to protein supplementation in poultry feed.

Chicken supplemented with vermi meal have muscular fiber, fat and minerals. Most consumers prefer meat that is very muscular but very nutritious as meal from chicken fed on vermi meal earthworms. It has been found that vermi meal does not contain levels of lead and mercury. Hence, vermi meal protein could be used as a feed supplement in animal diets, which that can be consumed by human without risk contamination by infection agents or metals (Medina et al. 2003) Therefore vermi or Earthworm (*E. foetida*) then have many different nutritional applications.

This is an agreement with the result by Vu et al. (2009) who specified that the diet containing 2% vermi meal led to weight gain and increased the percentage of breast muscle and leg in broilers. This denotes that chickens fed by vermi had better muscle growth or muscle development, therefore, had the higher performance of meat production (Vu et al. 2009). It has been found that supplementing vermi meal in the diet resulted in higher carcass yield (Ton et al. 2009). It has been that the different inclusion levels of vermi or earthworm in diet supplementation have no effect on meat quality attributes such pH, color, drip loss and cooking loss. There are no negative effects of vermi meal that have been reported on chicken meat quality.

Fasila (2010) 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. In addition, Stafford and Tacon (2008) found that the vermi meal derived from the species *Eisenia foetida* was nutritionally evaluated as a replacement for herring meals in production diets of rainbow trout (*Salmo gairdneri)* and it was found that there was significant in the whole carcass of fish, fed containing dried vermi meal

Thus, this study aims to evaluate the effect of vermi meal supplementation in growth performance and profitability of broiler by mixing it in commercial feed, fed under free-range management system.

1.1 Objectives of the Study

This study generally aimed to determine the growth performance of broiler

fed with commercial feeds in varying amount of vermi meal under free-range management system.

This study specifically aimed to:

1.) Determine the growth performance of broiler fed with commercial feed with vermi meal.
   a. Gain Weight
   b. Water Consumption
   c. Feed Consumption
   d. Dressing Percentage

2.) Determine the profitability of broiler fed with commercial feed with vermi meal.
   a. Variable Cost
   b. Fixed Cost
   c. Total Cost
   d. Revenue
   e. Profit
   f. Return of Investment

2. Materials and Method

2.1 Housing of Broilers

One month before the conduct of the study, the brooding cage and growing cage were constructed based on the number of treatments and replicates. The free-range system was constructed with cages (each 1.4 sq. ft per broiler in compartment) which served for the rest time of broiler during nights, mid days and rainy days. 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.

2.2 Vermi Meal Preparation

The powdered vermi meal was purchased base on the amount needed in whole duration of the study. After the maturity of compost, the adult worms were collected and washed thoroughly to remove the soil particles sticking on the body. Then they were left in clean containers containing wet cellulose material such as wastepaper. The containers are covered tightly to prevent the worms from crawling out. When the worm start excreting the paper alone indicating the gut clearance (of soil and organic materials). Earthworm were dried up to 90% and then pulverized.

2.3 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

2.4 Broiler and Experimental Procedure

One-day-old broiler chicks were placed in brooding cage pens with free access to a grass paddock during 35 days of experimental period. The chicks had adlibitum access to water during the experimental period, and feed based on treatment according to diets. A three-phase diet regime consisting of chick booster, chick starter and finisher diet were formulated. A feeding strategy of 50g chick booster for the broiler allowed for the first two weeks, the third and fourth week broiler were allowed 80g of chick starter, and 120g finisher for the last week of experimental period. During the brooding stage, 25 watts were given to the chicks.

Figure 1. Feeding and brooding broiler chicks

2.5 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 Baños Laguna.

3. Results and Discussion

3.1 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% VM did not significantly influenced 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. The result probably 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. (2017) on the effect of vermi meal 2,4, 6 % level in dietary on broiler performance did not significantly affect the amount of feed intake. It was presumed that 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 dietary at either 2-6% give the same effect to the feed consumption. In addition, the chickens can scavenge for extra source of food around the vicinity of the experimental area either on the soil and insects, given that broiler were raised in semi-free-range set-up which could perhaps suffice the nutrient differences in each treatment.

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 $p<0.05$

3.2 Initial Weight and Final Weight of Broilers

The initial and final weight of broilers are shown in Table 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. Likewise, Nguyen and Ulfert (2009) showed that using vermi meal in broiler's diets increased protein and energy efficiency compared to the control group. Tuan and Focken (2009) replace 30%, 70% and 100% earthworm meal instead of fish meal in common carp diet and reported that protein and energy efficiency increases.

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 $p<0.05$

Figure 2. Weighing of broilers upon arrival and during harvesting

3.3 Gain Weight 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 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 from 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 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. Generally, if the feed consumption decreased, the energy and protein consumption is also low, and normally it is correlated ultimately could probably decreased the body weight gain.

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 $p<0.05$

3.4 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). 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.

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 $p<0.05$

3.5 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 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 described that those dietary mixtures with vermi meal has the highest 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 is implied that the more percent mixture of vermi meal the higher the cost in production, and the lesser percent of vermi meal the lower the cost in production. The revenue of the study per broiler was relying on selling price of dressed chicken (140 pesos per kilo), internal parts (heart, gizzard and liver), drumstick and feet were included in selling. The higher revenue was noted in T3 (235.57 pesos) compared to the other treatments may be its correlated due to dressed chicken that higher than T4, T2, and control that shown in (table 7), although the carcass weight was comparable in each treatment. T1 was the second higher revenue, followed by T5, and the lowest revenue was described in T2 (172.64 pesos) among treatments.

3.6 Net Income

The profit of each treatment per broiler also shown in table 8. It described that T1 (100% commercial feeds) has the highest net income compared to other treatments. Treatments that supplemented with vermi meal has deficit net income. It was also showed that the higher mixture with vermi meal in feeds has the higher deficit net income in production due to expensive imported purchased of vermi meal.

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

Cost item (PhP)	Treatments				Percentage of cost
Variable 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	128.96	207.26	246.58	325.12	97.59
Fixed cost under depreciation					
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	134.09	212.39	251.71	330.25	100
Selling Price:					
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 175/kg)	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	

4. Conclusion and Recommendation

4.1 Conclusion

Supplementation of vermi meal did not significantly influenced the growth performance of broilers particularly to the feed consumption, body weight gain, feed conversion ratio (FCR), carcass weight and dressing percentage of broilers. However, numerically the final weight and weight gain T4 contains 5% VM was higher than T1 commercial feeds with a difference of 66. 66 grams and 67.60 grams respectively. In three (3) different levels of vermi meal, though they didn't have significant difference to each other, the 5% level of vermi meal was higher in numerical value compared to commercial feeds and showed in terms of final weight, gain weight, feed conversion ratio, feed consumption, live weight and carcass weight. 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.

4.2 Recommendation

Due to limited facilities of the researcher, other study maybe conducted of vermi meal supplementation using high concentration up to 10, 15, and 20% to evaluate the growth performance and profitability of broiler chicken. Vermi must be cultured by researcher to avoid high cost in acquiring imported vermi meal. Using vermi meal as supplementation could be utilized from local markets and farmers can easily culture vermi to lessen the cost of production, since vermi or earthworm (*Eisenia foetida*) is available in any places and has rapid population growth and could be easily culture.

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