



Effect of Feeding Earthworm Meal As an Alternative Protein Source Replacing Fish Meal on The Performance of White Pekin Ducks

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ABSTRACT

An experiment was conducted to study the impact of replacing fish meal with earthworm meal (EWM) on performance of White Pekin meat type ducks. 120 no. of day old white pekin ducks (40-52g) were randomly distributed to 3 equal groups (4 deep litter pens per group, 10 ducklings per pen). These were reared following standard management practices for a duration of 8 weeks. The EWM utilized in this investigation had been prepared from *Eisenia foetida*. The earthworms were grown using cow dung as biomass and mixture of duck litter. The matured earthworms were euthanized by dipping in warm water (50-60°C) and dried in hot air oven (50-60°C for 72 h), ground to powder and mixed in diet. Ducklings have been assigned to one of three treatments i.e. 1) Control without EWM; 2) Diet with 1 % EWM replacing fish meal; 3) Diet with 2 % EWM replacing fish meal. The EWM contained 55.76 % protein. Body weight gain and FCR improved significantly ($P < 0.05$) due to inclusion of EWM at 1 and 2% by replacing fish meal in the diets of white pekin ducks at 6th and 8th week of age. The feed intake increased significantly ($P < 0.05$) at both levels of inclusion of EWM during 6th and 8th week of age. The feed cost to produce kg body weight gain was significantly ($P < 0.05$) reduced due to inclusion of EWM in the diet at both levels at 6th and 8th week of age. It is concluded that 2 % EWM could be included in diet of white pekin ducks replacing fish meal of the control diet for better FCR, improved body weight gain, and reduction in price of feed for kg body weight gain.

KEYWORDS: Earthworm meal, Feeding cost, Performance, White Pekin ducks

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INTRODUCTION

Protein feed consumption is a crucial component of sustainable production methods, especially for intense production. Because of the associated availability, rising costs, and environmental impact, the real consumption of fish and soybean meal is not sustainable. Since lysine is 2nd limiting amino acid in diets based on soybean and corn meal, animal protein sources offer a more balanced amino acid profile (Chasmidari et al., 2021). Feed cost accounts for 70-80 % of the total cost of production in the intensive system of poultry production (Panda et al., 2024). To minimize the cost of production locally available alternate feed ingredients such as broken rice, azolla, tubercrop, insect meal and earthworm meal are used for feeding of ducks (Naik et al., 2023). Further, fish meal can be replaced with other important protein sources like soybean meal provided the diet is supplemented with 0.10 % methionine (Aziz et al., 2001). Thus far, there has been limited focus on

utilizing fresh earthworms or EWM as a protein feed for animals that are monogastric. In past 20 years, research centres and private companies have centered their attention on algae, insects, and other invertebrates. One way to achieve environmental sustainability through cleaner technology is to use earthworms as alternate protein source for poultry feed. Poultry production becomes more cost-effective, environmentally sustainable, and productive when EWM is utilized as a substitute source of protein (Parolini et al., 2020). Studies on utilization of EWM meal are fairly old, particularly those conducted in Europe, but some broad conclusions can be made for both fish and broilers, the parameters typically assessed are feed conversion rate, feed intake, growth rate and body weight gain; level of acceptability of EWM in broiler diet is less than 15 percent. Good productive performances can be achieved without compromising quality of finished food items when EWM is added to diets at an inclusion level below acceptability threshold. EWM

is a novel protein source (Kose and Ozturk, 2017) and could offer a feasible source of protein for poultry feed (Veldkamp et al., 2012; Khan et al., 2016) as it has rich protein content (73 percent) and can be manufactured commercially (Rumpold and Schluter, 2013) and increased concentrations of vital amino acids (Parolini et al., 2020).

Recently, substantial thought is given upon possible function of intensive vermiculture or earthworm culture (Loh et al., 2005), as an animal protein source. As EWM contains high protein 58-71 percent on dry matter basis and also good in amino acids, it is recommended for usage in fish, poultry, and household pet feed (Sabine, 1978). During late 70s and early 80s research work has been carried out on utilization of EWM as a source of protein for poultry and animals (Sabine, 1978; Mekada et al., 1979; Stafford and Tacon, 1984). The outcome of these studies suggests that EWM has potential to partially substitute fish and soybean meal as a source of protein. Results of another investigation suggest that EWM could replace soybean meal and fishmeal partially, i.e. up to 15 % in broiler diets (Loh et al.,

2009). Therefore, aim of this investigation was to investigate how performance of white Pekin ducks had been affected by partially substituting EWM for fish meal.

MATERIALS AND METHODS

Bird Management, Diet and Housing

120 day old white pekin ducks (40-52g) were randomly distributed to 3 equal groups (4 deep litter pens per group, 10 ducklings per pen). These were reared following standard management practices. EWM employed in this investigation had been prepared from *Eisenia foetida*. The earthworms were cultured using cow dung as biomass and mixture of duck litter. The matured earthworms were immobilized by dipping them in warm water (50-60°C) and dried in hot air oven (50-60°C for 72 h), ground to powder and mixed in diet. One of the 3 treatments has been allocated to ducklings i.e. 1) Control without added EWM; 2) diet with 1 % EM replacing fish meal; 3) diet with 2 % EM replacing fish meal (Table 1).

Table 1. Ingredient Composition (kg or g/100 kg) of Experimental Diets

Ingredients	Diet 1	Diet 2	Diet 3
Wheat (kg)	60	60	60
Soybean meal (kg)	29	29	29
Fish meal (kg)	4.0	3.0	2.0
Earthworm meal (kg)	-	1.0	2.0
DORB (kg)	5.3	5.3	5.3
DCP (kg)	1.2	1.2	1.2
Shell grit (kg)	0.5	0.5	0.5
Tracemin mix (g)	100g	100g	100g
L-Lysine HCl (g)	50g	50g	50g
DL-Meth (g)	50g	50g	50g
AB ₂ D ₃ K (g)	20g	20g	20g
Vitamin B-Complex	20g	20g	20g
VitE & Se (g)	20g	20g	20g
Toxin Binder (g)	100g	100g	100g
Choline Chloride (g)	100g	100g	100g

The duration of experiment was 8 weeks. All the diets were isocaloric and isonitrogenous. Composition of EWM and experimental diets was analysed (AOAC, 2005).

Growth performance

The data on body weight was recorded on white Pekin ducks on weekly basis. Every day until the age of eight weeks, amount of feed consumed by each replicate was recorded. FCR had been computed as ratio of body weight gain at six weeks and eight weeks to feed intake. Feed cost per kg weight gain was computed by taking in to

consideration the feed cost (Rs) and FCR in each replicate at 6th and 8th week.

Statistical Analysis

Data were statistically analyzed utilizing one way ANOVA in Complete Randomized x Design (Snedecor and Cochran, 1994) and Duncan's multiple range test was utilized to compare the treatment means (Duncan 1955).

RESULTS AND DISCUSSION

In present study EWM contained 55.76 % protein (Table 2).

Table 2. Chemical Composition of Fish meal, EWM and experimental diets

Nutrients	T1 (Control diet)	T2 (1 % EM)	T3(2 % EM)	Fish Meal	Earthworm Meal
Nutrient Composition (Analysed values, %)					
Crude Protein	22.54	22.86	23.05	50.32	55.76
Ether Extract	3.26	3.37	3.44	4.78	5.68
Crude Fibre	4.23	4.16	4.08	3.52	4.32
Total Ash	10.07	9.34	9.18	20.45	13.73
NFE	59.90	60.27	60.25	20.93	20.51
Nutrient Composition (Calculated values)					
ME(kcal/kg)	2900	2900	2900		
Lysine	1.00	1.00	1.00		
DL-Meth.	0.40	0.40	0.40		

Similar protein % (55.87 %) of EWM was reported by previous workers (Istiquoma et al., 2017). Lower protein % (51.62) and higher protein% (65.6 %) of EWM were stated by Gunya et al., 2019 and Damayanti et al., 2008, respectively. Moreover, Palungkun (1999) reported higher level of protein i.e. 64-76 % in EWM. Similarly, the protein content

of *Eisenia foetida* was reported to be ranged from 58-71 percent on dry weight basis (Zhenjun et al., 1997; Tiroesele and Moreki, 2012). Body weight gain and FCR improved significantly ($P < 0.05$) due to inclusion of EWM at a level of 1 and 2% by replacing fish meal in control diet of white pekin ducks at 6th and 8th week of age (Table 3).

Effect of Earthworm Meal on Pekin Ducks

Table 3. Effect of feeding EWM by replacing fish meal on the performance of White Pekin ducks at 6th and 8th week of age

Treatments	Body weight gain (g)		Feed intake(g)		Feed Conversion Ratio		Feed cost (Rs)/Kg body wt. gain	
	6th Wk	8th Wk	6th Wk	8th Wk	6th Wk	8th Wk	6th Wk	8th Wk
T1	1429c	1966c	3737c	5960b	2.615b	3.032b	102.73a	119.10a
T2	1517b	2046b	3815b	6104a	2.515b	2.984b	97.99b	116.26a
T3	1624a	2144a	3875a	6109a	2.386a	2.850a	92.20c	110.43b
SEM	25.21	23.33	18.96	25.20	0.03	0.03	1.39	1.20
P value	<0.001	0.005	0.001	0.005	<0.001	0.001	<0.001	0.001

Means bearing different superscripts within a column differ significantly (P<0.05)

The feed intake increased significantly (P< 0.05) at both levels of inclusion of EWM at 6th and 8th week of age. Similarly, Loh et al. (2009) stated that inclusion of EWM at levels of 10 % or 15 % in the diet of broilers led to significant increase in cumulative live weight gain at 6th week of age. In another study, better growth and feed efficiency were reported in Japanese quails due to feeding of 10 % EWM (Prayogi, 2011). Inclusion of 5 % EWM in diet of broilers improved body weight gain (Gunya et al., 2019). Current findings are supported by fact that EWM from *E. foetida* may substitute up to 50 percent of fishmeal in broiler finisher diets (Hassan et al., 2020). Present findings in white pekin ducks where improved performance was recorded due to feeding of EWM replacing fish meal confirmed the earlier report in broiler chickens where it was observed that earthworm meal from *Eisenia foetida* is a rich protein source and can be incorporated into diets without affecting their efficacy (Chashmidari et al., 2021). Similar to results of this study, breast percentage, feed intake, broiler final body weight, and HDL level increased when 2% EWM had been added to diet (Gholami et al., 2016).

CONCLUSION

From the findings of present research, it is concluded that 2 % earthworm can be included in diet of white pekin ducks replacing fish meal of control diet for better FCR, improved body weight gain, and reduction in price (Rs) of feed for kg body weight gain.

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