International Research Journal of Natural and Applied Sciences
ISSN: (2394-4077)
Impact Factor- 5.46, Volume 5, Issue 4, April 2018
Website- www.aarf.asia, **Email** : editor@aarf.asia , editoraarf@gmail.com

EFFECT OF HOUSEFLY (*MUSCA DOMESTICA*) MAGGOTS BIOMASS ON ROILER) FARMING

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Abstract

The search for alternative and sustainable proteins is an issue of major importance that needs viable solutions in the short term for cost effective and attractive feed option for poultry. The aim of the study is to examine the effect on the potentials of housefly maggot meal as suitable protein source on poultry feed. The specific objectives of the study were to determine the nutritional composition of maggot meal as suitable protein source and to determine the effect of housefly maggot meal as suitable protein source on poultry feed. Experimental research design was adopted in the study utilizing a poultry house of 50 cm by 100cm capacity wired with 8 points of Electricity to provide lighting in the poultry house and also during the brooding stage. The maggots were cultured in five different clean plastic paint buckets. They were harvested at the end of the culture period, processed by oven drying and grinding into powered form as maggot meal. The produced maggot meal was used to replace fishmeal in 8 compounded diets at levels of 0% (control diet); 10%; 20%; 30%; 40%; 50%; 60%; 70%. The diets were fed to 2 weeks day old chicks to determine the effects of maggot meal in comparison with fishmeal on the growth, nutrient utilization and body weight of birds. Highest mean gain, relative growth rate and specific growth rate was highest in birds fed with 50%, maggot meal diet and lowest in control diet. The result of the study showed that there is significant difference between fishmeal and maggot meal. Hence, the choice of maggot meal can be made in place of fishmeal for poultry farmer. Poultry farmers should be more enlightened to explore the various advantage of maggot meal was recommended

Keyword: maggot meal, protein source, livestock production

Introduction

Diary poultry meat and fish are the main sources of animal proteins, lipids and vitamins which are essential ingredients for human nourishment. However, with the growing world population and increasingly demanding consumers, the production of sufficient protein from livestock, poultry, and fish represents a serious challenge for the future especially, in the developing countries (Makinde, 2015). In developing countries like Nigeria the cost of commercial poultry farming have become very expensive accountings for over 60% of the recurrent overhead cost for poultry farming. This is due mainly to the fact that most of protein ingredients such as fishmeal are imported which locally available alternatives like soya beans and groundnut also serve as food for humans (Ayinla, 1988; Sogbesan et al., 2005) cited in (Makinde, 2015).

It is becoming increasingly important therefore to find alternative good quality renewable protein sources that can replace or substitute current protein sources used in animal nutrition. This provides opportunities to explore other possible means of protein production in animal nutrition. Scholars from different academic field have suggested several mechanisms that could be optimally used in poultry feeding thereby making poultry feeding inexpensive and relatively abundant nutrient rich substrates, to partially or completely replace the expensive components. Ugwumba, and Ugwumba, (2003) and Anyinla, (1988) at different time reported that maggots and other non-conventional insects like winged termites, earthworms and garden snails have been explored to check their nutrient contents, relative abundance, use and conversion into processed meals, incorporation into formulated diets and subsequent developments of technique(s) for on-farm mass production.

Studies on the use of multicellular organism to convert animal waste to useful products dates back nearly a century ago, where Linder (1919) was the first to report on the use of coprophagous insects, especially the housefly (*Musca domestica*) for the production of protein from waste. Maggots- the larval stage of flies of the order Diptera (Houseflies- Musca domestica) has been identified as a viable option to explore due to their short life cycle and production in large biomass (quantity) from materials regarded as waste. The ability of housefly maggots to grow on a large range of substrates make them useful to turn wastes into a valuable biomass rich in protein and fat.

Particularly, housefly larvae grown on poultry litter have shown to be used with great benefits as a potential protein source in poultry nutrition (Pretorius, 2011).In studies by Sheppard, (2002); Teguia et al., (2002) and Ogunji et al., (2006) maggot meal was reported to be a possible alternative to the expensive protein sources. Calvert *et al* (1971) and Teotia and Miler (1974) suggested utilization of maggot as a possible replacement source for some key ingredients in poultry feeds.

It has good nutritional value, cheaper, and less tedious to produce than other animal protein source. Again it is produced from waste which otherwise would constitute environmental nuisance. The production system thus serves the dual purpose of providing a nutrient rich source as well as source of waste transformation and reduction. The reported crude protein values range from 43 – 64% (Awoniyi, *et al*, 2003; Fasakin, *et al*, 2003; Hwangbo, *et al*, 2009; Odesanya, *et al*, 2011). Producing housefly maggot biomass in controlled conditions to feed farm animals has been investigated since the late 1960s (Calvert et al., 1969; Miller et al., 1969).

Various methods for producing and harvesting maggots have been described in the literature. Early experiments investigated pupae rather thanlarvae because pupae collection was believed to be easier (Calvert et al., 1969). However, the production system is yet to be commercialized (Teguia and Beynen, 2005) probably because its utility and value feed ingredients have not been elucidated and so previous studies on maggots as poultry feed (Dankwa, *et al*, 2002; Ekuo and Hadzi, 2000) were only done under experimental condition. Therefore, this work aims to examine the effect on the potentials of housefly maggot meal as suitable protein source on poultry feed.

Purpose of the study

The main objective of the study is to examine the effect on the potentials of housefly maggot meal as suitable protein source on poultry feed.

Objectives of the study

- To determine the nutritional composition of maggot meal as suitable protein source
- To determine the effect of housefly maggot meal as suitable protein source on poultry feed.

Review of Literature

The on-going increase in feed prices, especially protein sources (e.g. fishmeal) has placed more emphasis on the exploitation of alternative protein sources not only in Nigeria, but all over the world. In most documented studies the use of larvae meal was compared with other protein sources for the use in animal nutrition where the effect of larvae and pupae meal was evaluated as a replacement for other protein sources commonly used in animal feed (Newton *et al.*, 1977; Awoniyi*et al.*, 2003; Ogunji*et al*., 2006; Adeniji, 2007; Agunbiade*et al.*, 2007). Newton *et al.* (1977), Awoniyi*et al.* (2003), Ogunji*et al.* (2006), Adeniji, (2007) and Agunbiade*et al.*(2007) concluded in their studies that house fly larvae meal has a suitable nutritional composition and can serve as a replacement for fish meal as well as other protein sources normally used in animal nutrition.

Larvae meal production has the potential to be cost effective. Fashina-Bombata& Balogun (1997) in a comparative study on the cost of the larvae meal and fishmeal production revealed that the cost of harvesting and processing the larvae meal was less than 20% of the cost of a similar weight in fishmeal. Ajani *et al.* (2004) in a later study reported that the replacement of fishmeal with 50% and 100% larvae meal has led to a reduction in cost of tilapia production by 18% and 28% respectively. It therefore shows that an insect belonging to the order of Diptera has great potential as an alternative renewable protein source that can replace conventional protein sources used in animal nutrition. *Musca domestica* (common housefly) larvae meal has proven itself to be a suitable protein source that can be incorporated in the diets of broilers with no undesirable effects.

The effect of maggot meal supplementation is more visible after three weeks of age and this may be due to the difference in which adults and young broiler chickens utilize the maggot meal protein (Awoniyi et al., 2003). Furthermore, Teguia et al. (2002) studied the effect of maggot meal supplementation in broiler nutrition and its effect on performance and carcass characteristics in the starter, grower and finisher phases. The species of maggot used was not reported though. All the treatment diets were formulated to have similar nutritional values, but the control diet contained no maggot meal. Results showed that there was no significant effect (P>0.05) regarding weight gain when 10% of the fish meal was replaced with maggot meal as compared to the control group in the starter phase. This may be attributed to the lower crude protein concentration (22.65%) as compared to the other treatment diets in the starter phase. When 5% and 15% of the fish meal was replaced with maggot meal in the starter phase the weight gain was higher and this effect was found to be significantly better (P<0.05).

During the finisher phase, Teguia et al. (2002) replaced 50% and 100% of the fish meal with maggot meal respectively. These authors found that there was no significant effect (P>0.05) on weight gain when 50% of the fish meal was replaced with maggot meal when compared to the control diet. The weight gain was significantly better (P<0.05) when 100% of the fish meal was replaced with maggot meal when compared to the control diet. The overall inclusion levels of maggot meal were, however, very low and ranging between 0.23% and 2%. In a similar study, Okah and Onwujiariri (2012) investigated the effect of replacing fish meal with maggot meal on 0-35day old broilers. Diets were formulated such that maggot meal replaced fish meal at 0, 20, 30, 40 and 50%. The authors reported that maggot meal could replace 50% fish meal with higher performance and economic returns. They also reported that the 25% maggot meal diet yielded better live weights, feed intake and daily gain when compared to the 25% fish meal diet in the growth phase. Furthermore, Cadag et al. (1981) compared maggot meal with fish meal, meat and bone meal and soybean meal in a 0-21 day broilers, they reported that maggot meal could be included at up to 10% in the diet with no adverse effect on intake, body weight, feed conversion and palatability. The effect of maggot meal on egg production by laying birds has been extensively investigated by several authors with positive results. In a 7-month layer feeding trial, maggot meal replaced meat and bone meal and the results indicated that maggot meal increased egg yield and hatchability (Ernst et al., 1984).

Research Methods

Poultry House

Experimental research design was adopted in the study utilizing a poultry house of 50 cm by 100cm capacity wired with 8 points of Electricity to provide lighting in the poultry house and also during the brooding stage. The poultry house was covered with wire guase to prevent rodents and reptiles from entering the poultry house.

Brooding Stage

The 200 day old chicks were kept in a brooding room under a temperature of 35^{o}C at first 7 days and later reduced to 30^{o}C for 2 weeks. During the brooding stage the birds were fed with starter's marsh from Top Feed.

Figure 3.1: Plates of Birds at Brooding Stage

Production of Maggots

Musca domestica maggots were produced from cow dung and blood meal from abattoir at Mammi market slaughtering centre at Enugu Nigeria, in a 20 litre plastic container. The buckets were kept away from direct rays of the sun as maggots are known to be negatively photo-tactic (Ugwumba, *et al.,* 2001). All the 8 buckets were placed in an environment that will favour the growth of maggot.

Experimental Procedures

The 8 Culture buckets were set up for experiment. The plastic containers were kept away from sunlight and rain to avoid effect of rain and sunlight. Freshly collected cow dung and blood meal from abattoir was filled into the plastic buckets. The buckets were exposed to flies for egg-laying. The dung were moistened with half a litre of water every day to prevent them from drying up.The production was done in the poultry house constructed for the purpose of this research work.

Figure 3.2: Researcher Harvesting Maggot

Harvesting and Processing of Maggot

Maggots were harvested daily from the 8 20 litres plastic bucket. Harvesting of maggot was done with bare hand covered with latex glove. Harvested maggots were rinsed with water to remove any dung or blood meal on them and weighted .The maggot were then blenched with hot water and reweighted. The maggot were oven dried at 60° for 24 hour cooled and processed into powdery form as maggot meal using grinder. The maggot meal then packed into air tight plastic container and stored at 4°C till when needed.

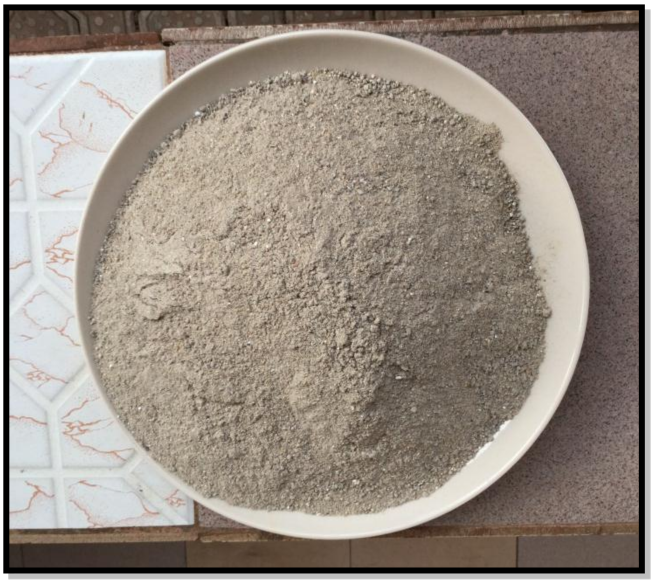
 

Figure 3.3a and 3.3b: Plates of Maggot Meal

3.6 Experimental Diets

The birds were fed with experimental diets in different proportion for a period of 10 weeks.

Table 4.1: Data Presentation

Ingredients	Experimental Diets							
	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5	Diet 6	Diet 7	Diet 8
Fish Meal (g)	25.80	23.00	22.00	20.00	18.00	16.00	12.00	10.00
Mag meal (g)	-	8.00	10.00	15.00	18.00	22.00	28.00	34.00
Maize Meal (g)	65	62.00	60.00	58.00	57.00	54.00	52.00	50.00
Vitamin Premix (g)	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Soya bean oil (g)	11.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
Cassava binder	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00
Calculated Crude protein %	35	35	35	35	35	35	35	35
Addition of Mag meal %	0	10	20	30	40	50	60	70

Source: *Researchers' Fieldwork, 2016*

Table 4.2: Descriptive Statistics

	DIET 1	DIET 2	DIET 3	DIET 4	DIET 5	DIET 6	DIET 7	DIET 8
Mean	16.73	17.09	16.93	17.09	17.09	16.93	16.93	17.26
Std. Dev.	25.61	23.45	22.50	22.50	21.03	20.02	19.90	20.17
No. of obs.	6	6	6	6	6	6	6	6

Source: *Extract from SPSS 22 Output*

The descriptive statistics above shows the centre as well as the spread of the diets of the birds. The means being close to each other indicates that a similar/close proportion of diets were given to the birds while standard deviation which measures the spread indicates a wide variation on the ingredients of the diets.

Table 4.3: Mineral Compositions of Processed House-fly Larvae and Pupae

Mineral Analyzed	Teotia & Miller., 1974	Fasakin*et al.*, 2003
Feed Substrate Stage of Harvest	Poultry manure pupae	Poultry manure (layer) Larvae harvested after 96 hours
Processing method	Dried at 65°C, overnight	Hydrolysed oven dried
Ash (% DM[1])	11.90	13.20
P (% DM)	1.43	-
Ca (% DM)	0.93	0.31
K (% DM)	0.88	0.50
Na (% DM)	0.56	0.29
Mg (% DM)	-	0.25
Mn (ppm[2])	370.00	47.38
Cu (ppm)	34.00	25.71
Zn (ppm)	275.00	48.87
Fe (ppm)	465.00	1317.34

([1]) DM – Dry Matter ([2]) ppm – parts per million

Table 4.4: The Fatty Acid Composition of Housefly Larvae and Pupae

Fatty Acid (%†)	**Hwangbo*et al.*, 2009**	**Calvert & martin, 1969**	**St-Hilaire *et al.*, 2007**
Stage of harvest	Larva (did not state age)	Pupae	Pupae
Feed substrate	Milk powder, sugar & layer manure	CSMA**	Cow manure
Lauric acid	-	-	0.18
Myristic acid	6.83	3.2	2.56
Palmitic acid	26.74	27.6	26.40
Palmitoleic acid	25.92	20.6	13.56
Stearic acid	2.32	2.2	4.77
Oleic acid	21.75	18.3	19.17
Linoleic acid*	16.44	14.9	17.83
Linolenic acid	-	2.1	-
α-Linolenic acid*	-	-	0.87
Arachidonic acid	-	-	0.07
Eicosapentaenoic acid	-	-	0.05
SFA	35.89	-	-
UFA	64.11	-	-

(*) Essential Fatty Acids

(†) % of Fatty Acids

(**) CSMA- Chemical Specialities Manufactures Association's fly rearing medium

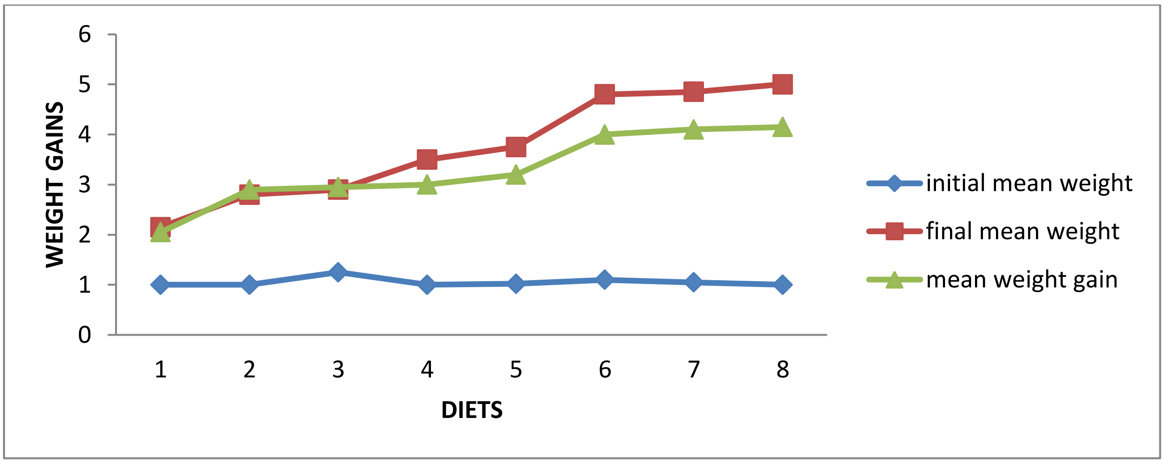
Table 2.7 shows the fatty acids composition of larvae and pupae meal. It shows that the most acceptable fatty acid profile was obtained when the larvae were fed with milk powder, sugar and layer manure. These essential fatty acids will be sufficient for broiler growth, since broilers require the essential fatty acid, linoleic acid, at levels of less than 0.20% of the total diet (Zornig*et al.*, 2001).

Table 4.5: Growth and Performance of Birds (Broilers) Fed with Maggot Meal Diet for 10 Weeks

Parameters	Diet A 0% mm	Diet B 10% mm	Diet C 20% mm	Diet D 30% mm	Diet E 40% mm	Diet F 50% mm	Diet G 60% mm	Diet H 70% mm
Duration (Days)	70	70	70	70	70	70	70	70
No of birds	44	44	44	44	44	44	44	44
No of birds survived	30	44	44	44	44	44	44	44
Initial mean weight (g)	1.00	1.00	1.25	1.00	1.02	1.10	1.05	1.00
Final Mean weight (g)	2.15	2.80	2.90	3.50	3.75	4.80	4.85	5.00
Mean weight gain (kg)	2.05	2.90	2.95	3.00	3.20	4.00	4.10	4.15
Relative growth rate	235.20	236.01	350.25	441.00	510.00	511.0	610.02	650.00
Specific growth rate	1.00	0.87	0.90	0.95	0.98	0.99	0.99	1.00
Protein intake	2.39	2.60	3.00	3.25	4.20	4.25	4.50	5.00
Protein efficacy	0.60	0.80	0.90	0.98	1.10	1.20	1.08	1.06
Protein production value	22	60	72	90	108	111	114	112
Foladx conversion ratio	1.90	1.95	0.95	0.85	0.88	0.76	0.78	0.90
Survival	90	100	100	100	100	100	100	100

Source: *Research Fieldwork, 2016*

Comparing the mean weight gain of the birds as fed with maggot meal



Source: *Ms-Excel*

Figure 4.3: Graphical comparison of the weight gains of the birds fed with maggot meal

The result of figure 4.3 above shows that the mean weight gain and the final mean weight gain are more associated than the initial mean weight gain. This indicates that the maggot meal has effect on the mean weight gain of the birds.

Table 4.6: Inferential comparison of the weight gains of the birds fed with maggot meal (paired t-test)

	Mean	Std. Deviation	Std. Error Mean
Final mean weight	3.7188	1.07668	.38066
Initial mean weight	1.0525	.08730	.03087

Test variable	Mean	Std. dev.	t-stat	df	p-value
Final mean weight − Initial mean weight	2.67	1.09	6.95	7	0.000

Source: *Extract from SPSS 22 Result*

The results above shows that there is a significant difference in the mean weight gain of the birds which indicate that maggot meal has a significant influence on the growth and performance of the birds.

Discussion and Findings

The result showed that the mean weight gain and the final mean weight gain are more associated than the initial mean weight gain. This indicates that the maggot meal has effect on the mean weight gain of the birds. The result shows a significance difference in the mean weight gain of the birds which indicates that maggot meal has a significant influence on the growth and performance of the birds. It is important to note that the broiler chicks fed with supplemental dried maggot's meal showed greater weight gains than the control group chicks fed with fishmeal this is because the maggot containing feed had an enhanced nutrient composition as compared to fishmeal feed, especially for essential amino acids. It also had greater protein and essential amino acid digestibility (Facasim*et al*, 2004). It is therefore considered that maggots, which are the secondary product of biologically processed cow dung and blood meal using housefly, are an appropriate source of protein and energy to boost growth and weight gain of broiler chicks. It is also expected that the utilization of maggots in feed could help to solve environmental pollution problems that emanate from successive accumulation of cow dungs in slaughtering houses. Thus that if much effort is put into the harvesting and process of maggot into meals, high opportunities lies ahead in its inclusion in poultry feed to reduce cost of production. This is similar to a study by (Nzamujo, 1999), that mass production of maggot has solution to the high cost of livestock production and at the same time solves some environmental pollution problem

Conclusion

The search for alternative and sustainable proteins is an issue of major importance that needs viable solutions in the short term, making maggot meal an increasingly attractive feed option for poultry. It is concluded from this literature review that insects belonging to the order Diptera show great potential as an alternative renewable protein source that can replace conventional protein sources used in animal nutrition. *Musca domestica* (common housefly) larvae meal has proven itself to be a suitable protein source that can be incorporated in the diets of broilers with no undesirable effects. Housefly larvae meal has a high crude protein content ranging from 37.5% to 63.1% and a crude fat content ranging from 15.5% to 25.3%. The larvae meal also has a good amino acid profile that compares to that of fish meal. Differences were observed between larvae and fish meal when the ideal amino acid profile required by broilers were compared. These shortcomings can be overcome by adding crystalline amino acids or by feeding larvae meal in combination with other protein sources in broiler diets to obtain the ideal amino acid profile required. The performances of broilers were not affected when other protein sources (fish meal, soya and groundnut oil cake meal) were replaced with larvae meal in the diets of broilers. Some authors reported that performance (feed intake and live weight) of broilers were better with some degree of larvae meal supplementation. Housefly larvae meal has a high total tract protein (98.8%) and amino acid (94.8%) digestibility that is higher than that of sunflower and soya oil cake meal. No adverse effects were found regarding carcass characteristics of larvae fed broilers.

Recommendation

- Poultry farmers should be more enlightened to explore the various advantage of maggot meal
- Further research should examine the possible ways to improve the nutritional composition of maggot meal

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