Preliminary investigations on quantity and proximate quality of maggots produced from four different sources of livestock wastes

ABSTRACT:
Maggot, housefly larva was grown on four substrates namely: poultry (layer) droppings, cattle dung, pig dung, and whole cattle blood. Poultry droppings produced maggots with the highest wet and dry weight, while the lowest weights were recorded for pig dung. The values ranged between 58.73g and 8.18g for wet weight and 12.79g and 2.97g for dry weight respectively. Proximate compositions of the maggots were determined using standard methods. Results indicate that the crude protein content of the maggots ranged from 55.4% in maggots grown on pig dung to 57.42% in maggots grown on cattle blood. The crude fibre contents ranged between 0.32% and 0.21%. Maggots produced from pig dung and cattle blood recorded the highest ash content and the values were 11.09% and 11.20% respectively. Moisture content was highest (10.14%) for maggots produced from cattle dung. Fat content of the maggots produced from the different livestock wastes ranged between 21.06% and 22.66%. Significant differences (p<0.05) in the proximate composition of the maggots were only observed in the crude fiber, ash and moisture contents. The results from this study showed that the substrates used can produce substantial quantities of maggots with varying degrees of success.

Keywords:
maggots, proximate quality, livestock wastes

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INTRODUCTION

Feed is known to be the single most expensive factor in animal and aquaculture production of which protein is the feed constituent with the highest cost implications (Aniebo et al., 2008). Plant protein sources as alternative non-conventional protein have their limitations largely due to the presence of secondary metabolites such as alkaloids, glycosides, oxalic acids, phytates, protease inhibitors, haematoglutinin, saponins, cyanoglycosides and linamarin etc to mention a few. Plant protein sources have the advantage of low cost implications as well as rich nutrient levels (Sogbesan, 2006, Sogbesan et al., 2006). These anti-nutritional factors negate growth and other physiological activities at higher inclusion levels (Oresegun and Alegbeleye, 2001). Fish meal which is the guaranteed protein feed ingredient in animal diets and it costs as much as $2.1 per kilogram, approximately N300/kg which is about thrice the cost of soya bean meal and four times the cost of groundnut cake (GNC) (Aniebo et al., 2008). Consequently there is a drive to develop other protein sources too. Maggot meal has been reported to possess good nutritional value, cheaper and less tedious to produce than most other sources of animal protein. Housefly maggots have been used as protein ingredients in fish feeds (Aniebo et al., 2008), poultry feeds (Inaoka et al., 1999, Adeniji, 2007, Hwangbo et al., 2009) and crustaceans (Cao et al., 2012).

The housefly (Musca domestica Linnaeus 1758) is the most common fly species and belongs to the phylum Insect and order Diptera. The larval forms (maggots) of houseflies feed on decaying organic matter thereby giving them the ability to degrade wastes into valuable biomass that are nutrient (fat, protein etc) rich. Many studies (Akpodiete et al., 1993, Awoniyi and Aletor, 2002, Teguia 2005, Aniebo et al., 2008) have been conducted on the production of housefly biomass in simulated environments with a view in utilizing such as feed for farm animals.

Pig manure, wheat bran, cattle gut and rumen contents, fish guts and cattle blood are some of the substrates that have been reportedly used for the production of maggots (Viroje et al., 1988; Ekoue et al., 2000; Aniebo et al., 2008; Ossey et al., 2012; Zhu et al., 2012). However, there is a lacuna of information on the comparative advantage in quantity of production of these substrates. There is a dearth of information on the production potentials of different substrates for the production of maggots.

This study is aimed at a comparative evaluation of;
- The quantity of maggots harvested from poultry droppings, pig dung, cattle dung and cattle blood, without any additional fly attractants and without absorbents,
- The proximate quality of the maggot so produced from these livestock wastes (substrates).

MATERIALS AND METHODS

The experiment was carried out at the Teaching and Research Farm, Abia State University, Umuahia Location. The treatments consisted of 30 kg each of poultry droppings, cattle and pig dung; and congealed blood. These were replicated three times giving each replicate a weight of 10 kg and randomly placed in a roofed open space. The exposed substrates attracted houseflies which laid eggs that hatched into larva called maggots. Each substrate was sprinkled with half a liter of untreated borehole water for a period of four days to prevent desiccation.

Harvesting

Harvesting was done on the 4th day using the sedimentation technique. Each replicate was mixed with 7-10 liters of water and allowed to stand for 10 minutes to completely separate the maggots from the substrates. Upon mixing, the substrates sank while the maggots floated and were collected using a 3mm sieve. Harvested maggots were taken to the laboratory for weight measurements and chemical analyses.
Data Collection, Sample and Data Analysis

Maggots from each replicate were weighed to the nearest 0.1g when wet and then weighed after drying to a constant weight at 35°C in an oven using a digital weighing balance. Dried maggots from each treatment were blended into a smooth paste in a 3.8 L kitchen-type blender (Warning Products, New Hartford, CT) which was thoroughly cleaned and dried between samples. Triplicate determination was made for each treatment. Samples were analysed for crude protein (CP), crude fiber (CF), ash, nitrogen free extract (NFE), and moisture using methods described by AOAC (1995). All data were subjected to Analysis of Variance (ANOVA) using SPSS version 17 and differences in means were separated using Duncan’s Multiple Range Test (Duncan, 1955).

RESULTS AND DISCUSSIONS

The wet and dry weights of maggots produced from the four different wastes are presented in Table 1. The result from this study shows that 1kg each of poultry manure, pig dung, cattle dung and congealed blood yielded a mean wet weight of 58.73, 8.18, 12.92 and 21.77 g of maggot. Similarly, the dry weight of maggot yield from the 1kg of the four substrates were 12.7 g from poultry droppings, 2.97 g from pig dung, 4.18 from cattle dung and 7.79 g from congealed cattle blood. These results showed that there were significant differences (p>0.05) in the weights of maggots (wet and dry) produced from the wastes. The trend in the quantity of maggot production was as follows: Poultry droppings > Cattle blood > Cattle dung > Pig dung. Insects have been shown to exhibit marked preferences for particular substrates for oviposition (Zvereva and Zhemchuzhina, 1988). Similarly, sites for oviposition can be influenced by many factors among which are moisture, nutritive value of the substrate and the presence or absence of an oviposition attractant. In this study poultry manure characterized by high ammonium levels produced the highest quantity of manure. (Pastor et al., 2011) have shown that ammonia, is an effective oviposition attractant.

The results obtained in this study compared favorably with some literature reports on maggot production (Akpodiete et al., 1993, Awoniyi and Aletor, 2002). It is important to note that the quantities of maggot produced in this study were generally lower than those reported in Aniebo et al., (2008). Aniebo et al., (2008) used absorbent material namely wheat brain, rice dust and saw dust and these may have accounted for the higher harvests of maggots. These report however (Akpodiete et al., 1993, Awoniyi and Aletor, 2002, Aniebo et al., 2008) agree that the quantity of maggot produced was primarily dependent on the nature of the substrate.

Other factors such as moisture control and inadequate aeration of substrates may influence the quantity of maggot yield from the substrates (Calvert et al., 1971). Aniebo et al., 2008 reported that high density of substrates decreased aerobic conditions which could adversely affect the development and survival of both of eggs and hatched larvae.

Table 2 summarizes the proximate composition of maggots produced from the different livestock wastes. Crude protein content ranged between 55.54% in maggots produced from pig dung to 56.25% in maggots produced from poultry droppings and did not indicate any significant difference (p>0.05) amongst the various

### Table 1: Weight of maggots produced from different livestock wastes

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Mean Yield (g) per Kg (N=3)</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Wet Weight</td>
</tr>
<tr>
<td>Poultry Droppings</td>
<td>58.73±0.34(^a)</td>
</tr>
<tr>
<td>Pig dung</td>
<td>08.180±0.22(^d)</td>
</tr>
<tr>
<td>Cattle dung</td>
<td>12.920±0.16(^c)</td>
</tr>
<tr>
<td>Cattle Blood</td>
<td>21.770±0.31(^b)</td>
</tr>
</tbody>
</table>

Means in the same column with different superscripts are significantly different (p<0.05).
The crude protein content of housefly maggots has been shown by various workers to vary between 40 and 60% (Inaoka et al., 1999, Heuzé and Tran; 2013). Hwangbo et al., (2009) recorded a protein content of 63.99% in maggots grown on chicken droppings sprinkled with powdered milk and sugar. Lower protein regimes of 45% - 48% were reported by Fasakin et al., (2003). It is possible that higher protein values in maggots may be attributed to the higher nutritional content of the substrate.

Table 2 also shows the ether extract content of maggots produced from various substrates. This parameter ranges from 27.06-22.66% and did not vary significantly (p>0.05) with the substrate type. Inaoka et al., (1999) recorded crude fat content of 20% in maggots while some other authors have reported a highly variable lipid contents ranging between 9-25% (Heuzé and Tran; 2013). The results of this study on the fat content of maggot produced from different substrates were in tandem with those of other authors. Drying methods (sun drying and oven drying) have been shown to influence the ratio of protein to fat ratio (Aniebo and Owen, 2010). Heuzé and Tran (2013) observed that fatty acid profiles of maggots are largely influenced by the substrates on which they are grown and this may account for the high variability in fat content reported by various authors (Inaoka et al., 1999, Hwangbo et al., 2009, Aniebo and Owen, 2010).

There were significant differences (p<0.05) in ash content of maggots reared on various substrates. Ash content of maggots reared on pig dung was 11.09% and those reared on cattle blood was 11.20%. These values were significantly lower (p<0.05) than the ash content of maggots reared on poultry manure (10.8%) and pig dung (11.09%). These results on ash content of maggots differ from a value of 2.74% reported for larvae of dung beetle (Aphodius rufipes) (Paiko et al., 2012) but are in tandem with those published by Hwangbo et al., (2009). Ash content is an indication of the mineral content of feed materials.

The crude fiber content of the maggots from all the substrates were all less than 1%. Similarly, there were significant differences in the crude fiber content. These low values indicate that maggot meal is not a good source of fiber. Similar low values ranging between 0.16% for cattle blood and 0.61% for pig dung were recorded for nitrogen free extracts (NFE). There were no significant differences (p<0.05) in the values obtained for this parameter.

### CONCLUSION AND RECOMMENDATION

In this study, maggots of housefly larvae were grown on four substrates namely: poultry (layer) droppings, cattle dung, pig dung, and whole cattle blood in a roofed open space. The findings from this experiment showed that poultry droppings produced maggots with the highest wet and dry weights and this

<table>
<thead>
<tr>
<th></th>
<th>Poultry droppings</th>
<th>Pig dung</th>
<th>Cattle Dung</th>
<th>Cattle Blood</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crude Protein</td>
<td>56.25±0.21&lt;sup&gt;a&lt;/sup&gt;</td>
<td>55.54±0.15&lt;sup&gt;a&lt;/sup&gt;</td>
<td>56.00±0.00&lt;sup&gt;a&lt;/sup&gt;</td>
<td>57.42±0.00&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Crude fibre</td>
<td>00.32±0.08&lt;sup&gt;b&lt;/sup&gt;</td>
<td>00.26±0.05&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>00.21±0.01&lt;sup&gt;b&lt;/sup&gt;</td>
<td>00.29±0.06&lt;sup&gt;ab&lt;/sup&gt;</td>
</tr>
<tr>
<td>Ash</td>
<td>10.80±0.17&lt;sup&gt;b&lt;/sup&gt;</td>
<td>11.09±0.15&lt;sup&gt;a&lt;/sup&gt;</td>
<td>10.90±0.12&lt;sup&gt;b&lt;/sup&gt;</td>
<td>11.20±0.11&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Ether Extract</td>
<td>22.32±0.09&lt;sup&gt;a&lt;/sup&gt;</td>
<td>22.64±0.07&lt;sup&gt;a&lt;/sup&gt;</td>
<td>22.66±0.21&lt;sup&gt;a&lt;/sup&gt;</td>
<td>21.06±0.19&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Nitrogen Free Extract</td>
<td>00.17±0.04&lt;sup&gt;a&lt;/sup&gt;</td>
<td>00.61±0.07&lt;sup&gt;a&lt;/sup&gt;</td>
<td>00.07±0.01&lt;sup&gt;a&lt;/sup&gt;</td>
<td>00.16±0.07&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Moisture content</td>
<td>10.12±0.11&lt;sup&gt;b&lt;/sup&gt;</td>
<td>09.84±0.12&lt;sup&gt;b&lt;/sup&gt;</td>
<td>10.14±0.21&lt;sup&gt;a&lt;/sup&gt;</td>
<td>09.86±0.16&lt;sup&gt;b&lt;/sup&gt;</td>
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*abc: Means along the same row with different superscripts are significant (p<0.05).*
result may be due to the presence of ammonia in poultry dropping. This study further strengthens the observation that the quantity of maggot produced by a substrate is primarily dependent on the nature of the substrate.

With the exception of the crude protein and fat contents, the ash, nitrogen free extract and moisture composition were affected by the type of substrate used in the study. The protein content in the maggots produced from poultry (layer) droppings, cattle dung, pig dung, and whole cattle blood were comparable to literature reports on maggots grown on other substrates. The high protein content in the maggots would greatly encourage and promote livestock production and fish production bringing about economic affordability of the much needed animal protein. The results also show that maggot meal is not a good source of fiber. This study also further strengthens the role of maggots in biodegradation of livestock/animal wastes and its importance in the management of wastes in the industry. In all, this work has provided vital information on the chemical composition of maggot meal which would facilitate its incorporation into animal and fish feeds.

REFERENCES


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