DEVELOPMENT OF *CHRYSOMYA CHLOROPYGA* (WIED.) AND *MUSCA DOMESTICA* (LINN.) (DIPTERA: MUSCOIDEA) ON SOME ANIMAL FAECAL SAMPLES*

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Abstract

Cow, dog, goat and poultry faeces and the control medium of rice and fish supported the development of eggs in female *C. chloropyga* and *M. domestica*. Eggs of *C. Chloropyga* laid on the cow, dog goat and poultry as well as those of *M. domestica* laid on cow faeces did not hatch. Dog, goat and poultry faeces serve as useful nutrient for development of *M. domestica* and compete favourably with the control medium. Poultry faeces on which eggs were first laid by both species demonstrated its protein quality which contained 19.10 % crude protein while cow faeces with 3.81% crude protein least supported egg development. Mean total days of development was 11.00 ± 0.00 days in the control medium which was significantly different from that of dog, goat and poultry faeces which were 13.75 ± 0.63, 14.75 ± 1.31 and 13.50 ± 0.29 days respectively. Mean weights of first and second instar larvae of *M. domestica* from faecal samples were not significantly different but was significant when compared with the control. Mean weights of 3rd instar larvae were significantly different. There was no difference in the weights of newly emerged adult male and female *M. domestica* reared on control medium, dog, goat and poultry faeces. Sex ratios of emerging adult *M. domestica* from control, goat and poultry were 1:2 (male:female) and 1:3 (male:female) for those from dog faeces. It is therefore apparent that faeces of domestic animals including cow, dog, goat and poultry that litter our surrounding will proliferate blowfly *C. chloropyga* and housefly *M. domestica*.

Key words: Development, *Chrysomya chloropyga, Musca domestica*, feacal samples.

1. Introduction

Chrysomya chloropyga and *Musca domestica* belong to the order Diptera and are found in close association in their natural habitat. *M domestica* has been implicated in the spread of numerous diseases including Salmonella, Diphtheria, Tuberculosis and amoebic dysentry due to its habit of feeding on decaying matter and human wastes. (Crosskey and Lane, 1993 and Tan *et al.*, 1997). The economic importance of *Chrysomya* species is largely due to damage resulting from the feeding habit of the larvae (Knipling, 1956). The importance of protein in gonotrophic cycles of anautogenous blowflies (Diptera: Calliphoridae) was revealed by Stoffolano *et al.* (1995). Stoffolano (1989) earlier reported that *P. regina* matures eggs if fed long enough on various types of faeces. The need for further experiments, by breeding flies on different diets for several generations to test the factors that induce larvae to choose different food from those that are more frequently attractive to female flies to lay eggs or larvae have been suggested by D'Almeida and Salviano (1996). However there has been initially no study that investigated the development of *C. chloropyga* and *M. domestica* on cow, dog, goat and poultry faeces which litter our environment in Nigeria.

2. Materials and Methods

Rearing of Chrysomya chloropyga and Musca domestica

Adult *Chrysomya chloropyga* were collected with sweep net from Ile-Ife abattoir, along Ede road, Ile-Ife. *Musca domestica* were similarly collected from Obafemi Awolowo University incinerator, Ile-Ife, Nigeria. A laboratory colony of the two species were raised in a well lit insectary at temperature 28 ± 2 °C and 75 ± 5% relative humidity.

The adult male and female flies were kept in (40 x 30 x 30 cm^3) cages and provided continuously with sugar and a petridish containing cotton wool soaked in water. The larval culture medium for *C. chloropyga* and *M. domestica* consisted of grounded fish and rice and water in the ratio 1:1:1.5w/v (Anantiko *et al.*, 1982). After the eggs were laid on the culture media the entire media were removed and transferred to separate cages for larval

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development. The emerging adult males and females were subsequently used for development experiment of the two fly species to adult stage.

Development from egg to adult

The development of *C. chloropyga* and *M. domestica* on each of the faecal samples were monitored using fifteen males and fifteen females put in (40 x 30 x30 cm^3) cages. Faecal samples of 15 g each were placed in the cages as larval culture medium. The cages were daily observed for egg laying. The age of the flies at egg laying were recorded. Faecal samples with eggs were removed into separate cages and hatching of eggs and development of larvae were monitored up to adult emergence. The following parameters were recorded at the different stages of the development: weight of each of the three larval instars, pupa weight, adult weight and sex ratio at emergence. The number of days for larval and pupal stadia were recorded and the total number of days from egg to adult emergence was also determined. Data were statistically analysed and graphs plotted using the SYSTAT 10.2 (2002) statistical package. Means were separated by the Mann Whitney U test at 5% probability level.

Protein determination

0.5 g of each sample was weighed into different Kjeldahl digestion flasks. Some quantity of digestion mixture which comprise of copper, selenium or mercury catalyst and 20 ml of concentrated tetraoxosulphate (VI) acid were added to the sample in each bottle. The mixtures were digested with a Kjeltec Digester for 2-3 hours. The ammonium sulphate formed at the end of the digestion was diluted to 50 ml. 50 ml of 40% sodium hydroxide was added to 20 ml of ammonium sulphate formed from each digested sample. 50 ml of 2% boric acid with indicator was poured in 500 ml conical flask and placed under the receiving tube of a Kjeltec Distilling unit. The sample mixture was distilled into the boric acid until it reached a volume of 250 ml. This was done for each sample. The distillates were titrated with standard hydrochloric acid of 0.097 molar concentration. Percentage crude protein in each sample was calculated (AOAC, 1987).

3. Results

Eggs of *C. chloropyga* and *M. domestica* laid on rice, fish and water (control medium) hatched within 24 hours (Fig. 1). Eggs of *C. chloropyga* laid on cow, dog, goat and poultry faeces as well as eggs of *M. domestica* laid on cow faeces did not hatch. Larval development in *M. domestica* was completed in 5 days but development of larva lasted 8.75 ± 0.75 days in *C. chloropyga*. Pupal development was completed in 5 days for *M. domestica* and 4.75 ± 0.25 days for *C. chloropyga*. There was no significant difference between the pupal development time for both species (Mann Whitney U test, $P > 0.05$) but larvae development time were significantly different (Mann Whitney U test, $P < 0.05$). Mean weights of first and second instar larvae from faecal samples were not significantly different (Mann Whitney U test, $P > 0.05$) but significantly different when compared with the control (Mann Whitney U test, $P < 0.05$). Mean weights of 3rd instar larvae were significantly different (Mann Whitney U test, $P < 0.05$). The first, second and third instar larvae that developed on the control medium had significantly higher weights of 0.00495 ± 0.0002 g, 0.00865 ± 0.001 g and 0.0145 ± 0.001 g respectively (Table 1). There was however significant difference in the weights of pupa emerging from the different faecal samples and the control (Mann Whitney U test, $P < 0.05$) with the control having the highest weight of 0.0157 ± 0.001 g. Table 2 shows that the mean weights of adult male and female *M. domestica* emerging from the control medium were significantly higher than those that emerged from the faecal samples (Mann Whitney U test, $P < 0.05$). Weights of adults reared on poultry closely followed those of the control. In the control and other three diets, there was no difference in the weights of newly emerged male and female. Table 3 shows that the sex ratios of emerging adults from control, goat and poultry were 1:2 (male:female) and sex ratio was 1:3 (male:female) for those from dog faeces. The number of adult male and female *M. domestica* that emerged from the control medium were significantly different from those that emerged from dog, goat and poultry faeces (Mann Whitney U test, $P < 0.05$). Eggs hatched within 24 hours on all the media except on goat faeces where it took 1.5 ± 0.29 days for hatching to take place. The larval development time in goat and poultry faeces were not significantly different (Mann Whitney U test, $P > 0.05$). Development time of larva was minimum with 5.00 ± 0.00 days in the control medium and was maximum in dog faeces (11.00 ± 0.41 days). Pupal development in dog faeces lasted 1.75 ± 0.25 days. In the control medium, goat and poultry faeces it ranged between 4.5 ± 0.29 days and 5.50 ± 0.29 days. There was no significant difference in the development time of pupa from the control, goat and poultry faeces. Pupal development time in dog faeces was significantly lower compared with other faecal samples and the control. The mean total number of days of development of *M. domestica* from egg to adult is shown in Table 5. Maximum number of days of development was 14.75 ± 1.31 days in goat faeces with the minimum in the control medium (11.00 ± 0.00 days). There was no significant difference in number of days of development when dog, goat and poultry were compared (Mann Whitney U test, $P > 0.05$). There was however a significant difference in the mean number of days when the

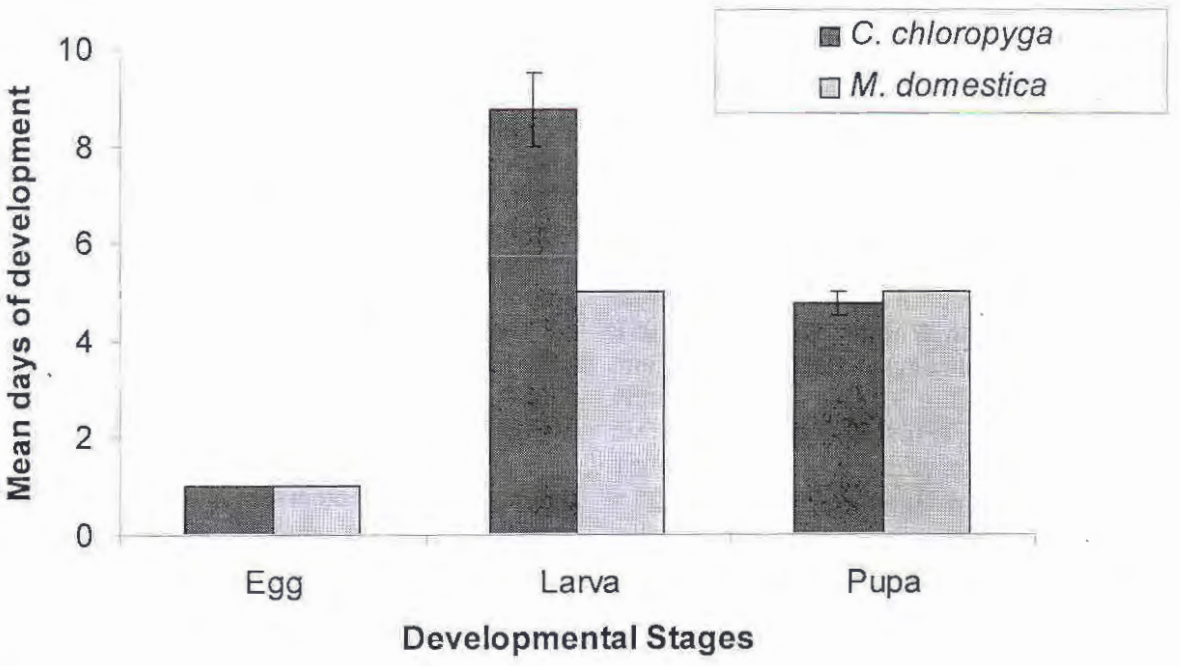

Fig. 1: Comparative development of *C. chloropyga* and *M. domestica* on control diet.

Table 1: Mean weight of larval instars and pupal of *M. domestica* on different faecal samples.

Faecal Sample	1st instar Larval Weight (g)	2nd instar Larval Weight (g)	3rd instar Larval Weight (g)	Pupal Weight (g)
Control	0.00495 ± 0.0002	0.00865 ± 0.001	0.0145 ± 0.001	0.0157 ± 0.001
Dog	0.000835 ± 0.0001	0.0018 ± 0.0001	0.0046 ± 0.000	0.0044 ± 0.000
Goat	0.00091 ± 0.0002	0.0029 ± 0.0007	0.0077 ± 0.000	0.0059 ± 0.000
Poultry	0.00075 ± 0.0002	0.002325 ± 0.0005	0.0071 ± 0.001	0.009 ± 0.001

Table 2: Mean weight and sex ratio of newly emerged adult male and female *M. domestica* on different faecal samples.

Faecal Sample	Adult (Male) Weight (g)	Adult (Female) Weight (g)
Control	0.02 ± 0.000	0.02 ± 0.000
Dog	0.0088 ± 0.001	0.0088 ± 0.001
Goat	0.0088 ± 0.001	0.0088 ± 0.001
Poultry	0.01± 0.000	0.01 ± 0.000

Table 3: Sex ratio of newly emerged adult *M. domestica* on different faecal samples.

Faecal Samples	Male	Female	Sex Ratio
Control	30.5 ± 2.47	59.0 ± 2.55	1:2
Dog	9.5 ± 1.19	24.25 ± 3.42	1:3
Goat	6.25 ± 0.85	14.0 ± 1.87	1:2
Poultry	9.0 ± 0.91	20.25 ± 1.32	1:2

control was compared with the three faecal samples (Mann Whitney U test, $P < 0.05$).

Fig. 2 shows the age at which adult *M. domestica* first laid eggs on exposure to the four different faecal samples and control. Adults fed on control medinm laid eggs at day 6 of exposnre while those exposed to poultry wastes laid eggs at day 8. The age at first egg laying for adults exposed to cow, dog and goat faeces were 23.25 ± 1.25, 15.5 0.87 and 20.25 ± 2.59 days respectively. There was significant difference in the age of flies at first egg laying when adults exposed to the control and other faecal samples were compared (Mann Whitney U test, $P < 0.05$). *C. chloropyga* also laid eggs in the control medium at 8 days of exposure (Fig. 3). This was significantly different from the age at first egg laying on the four faecal samples (Mann Whitney U test, $P < 0.05$). Egg laying was most delayed on cow faeces at 25 ± 1.29 days followed by on goat, dog and poultry faeces which were at 21.25 ± 1.65 days, 17 ± 1.47 days and 15.5 ± 0.87 days respectively. Rice and fish diet has the highest percentage crude protein followed by poultry with 7.21 %. Cow faeces had the lowest concentration of 3.82 % of crude protein (Table 6).

$$\%\text{Crude Protein} = \frac{\text{Volume of Acid} \times \text{Concentration of Acid} \times \text{Distillation factor } 0.014 \times 100 \times 6.25}{\text{Weight of Sample (0.5 g)}}$$

4. Discussion

The accumulation of nutrient deficient diets is probably responsible for the longer duration of development of *M. domestica* on dog, goat and poultry wastes compared to the control diet. According to Slansky and Rodriguez (1987), food consumption and utilization by animal species is crucial to provide satisfactory growth, development and reproduction. Thus, the amount consumed and the nutritional quality of food by an insect during its immature stages play a role in post embryonic development as well as in adult stage. Clark *et al.* (2006) reported that larvae of *Lucilia sericata* gave rise to larger adults when reared on pig compared to cow tissue and when reared on lung and heart compared to liver. Only the larvae and adults of *M. domestica* that emerged from the control diet had weights that were significantly higher than weights of larvae and adults from the faecal samples. The non-significant diffeence in the weights of larval instars and adults that developed from the faecal samples as well as in their total development time suggests that, though *M. domestica* preferred dog and poultry faeces to goat and cow faeces, there is obviously a slight difference in the nutritional quality of the faecal samples. Kaspi *et al.* (2002) reported that adult fly size and development time of *Ceratitis capitata* were related to the amount of protein and sugar in the larval medium. The higher the protein level in larval diet, the shorter the developmental time and the larger the size of the produced adult. Stoffolano *et al.* (1995) reported different amount of protein in different animal faeces and that the quality is important in the choice of diet for egg maturation as demonstrated in the present study for *M. domestica.*

Eggs laid by *M. domestica* and *C. chloropyga* on all the faecal samples seems to indicate the presence of some proteins in the faecal samples that snpports egg maturation in female *M. domestica* and *C. chloropyga.* Proteins have been reported to play important role in metabolic processes and also influence insect growth and fecundity (Hagen *et al.*, 1984). JM d'Almeida (1989) quoted by J M d'Almeida and R J B Salviano (1996) reported that the Sarcophagidae *Ravinia belforti* is frequently bred in human and animal faeces. The quality of each faecal sample as protein source was however shown by the feeding time required before egg maturation on each faecal sample. Poultry faeces on which eggs were first laid is a demonstration of the quality of its protein content and cow faeces seems to have scanty protein content since egg laying was least supported. Stoffolano *et al.* (1995) reported that because chicken, cat, poultry and sheep faeces are relatively low in protein, relatively longer exposure time by female *P. regina* may be necessary for egg maturation. The quality of protein in cow faeces is reflected in the age at which egg was first laid by *M. domestica* and *C. chloropyga.* Protein content of cow faeces was rather low that it was unable to support development of *M. domestica* from egg to adult. Cattle dung has low-quality protein for egg maturation in *M. vetustissima* (Vogt and Walker, 1987). Huges *et al.* (1972) also showed that inadequate food during either the larval or adult life of the female could reduce the number of eggs produced in each ovarian cycle.

The significantly higher number of adult male and female *M. domestica* emerging from the control medium than from dog, goat and poultry faeces further confirms the low nutritive value of the faecal samples in supporting the development of *M. domestica.* Sex ratios of emerging adults from the faecal samples and the control were in favour of females. Some environmental factors have been identified to be responsible for sex ratio being in favour of males or females. Herms (1928) studied the effect of different qualities of food during the larval period on the sex ratio and size of *Lucilia sericata* and observed that the flies become increasingly larger as the feeding period increased. Sex ratio was reversed from a large preponderance of males in the underfed to a proponderance of females in the longer feeding periods. Smith (1931) reported that the sex ratio of *L. sericata* and *L. cuprina* were found to be nearly 1:1 and he also observed that starvation had no effect on the sex ratio.

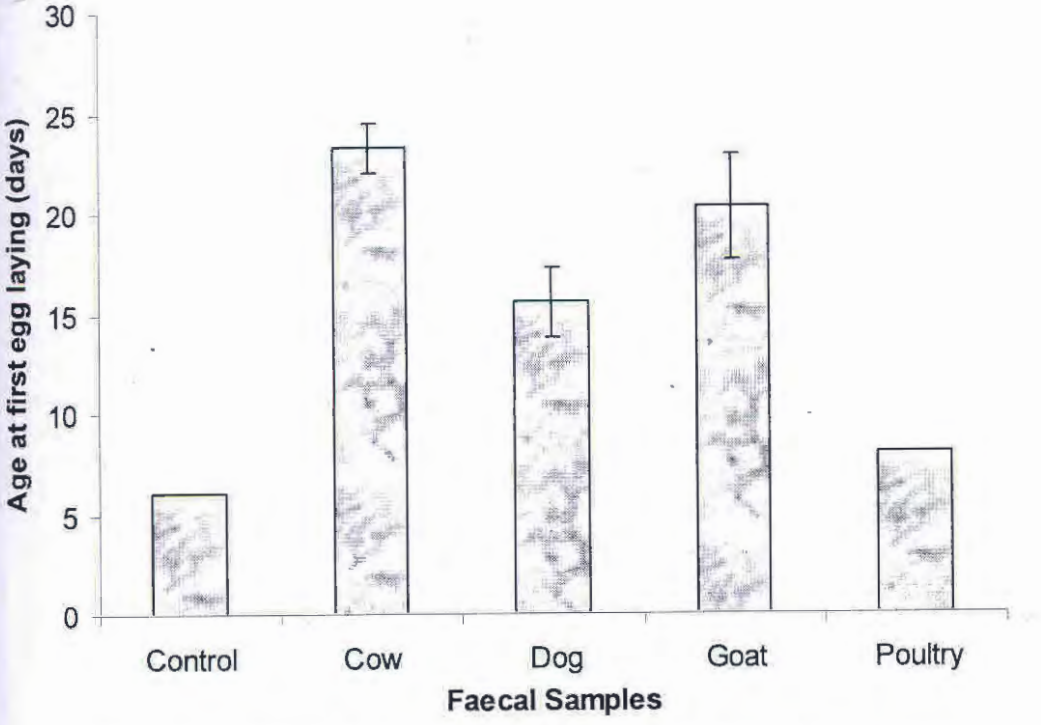

Fig. 2: Age (days) of *M. domestica* at first egg laying on different faecal samples.

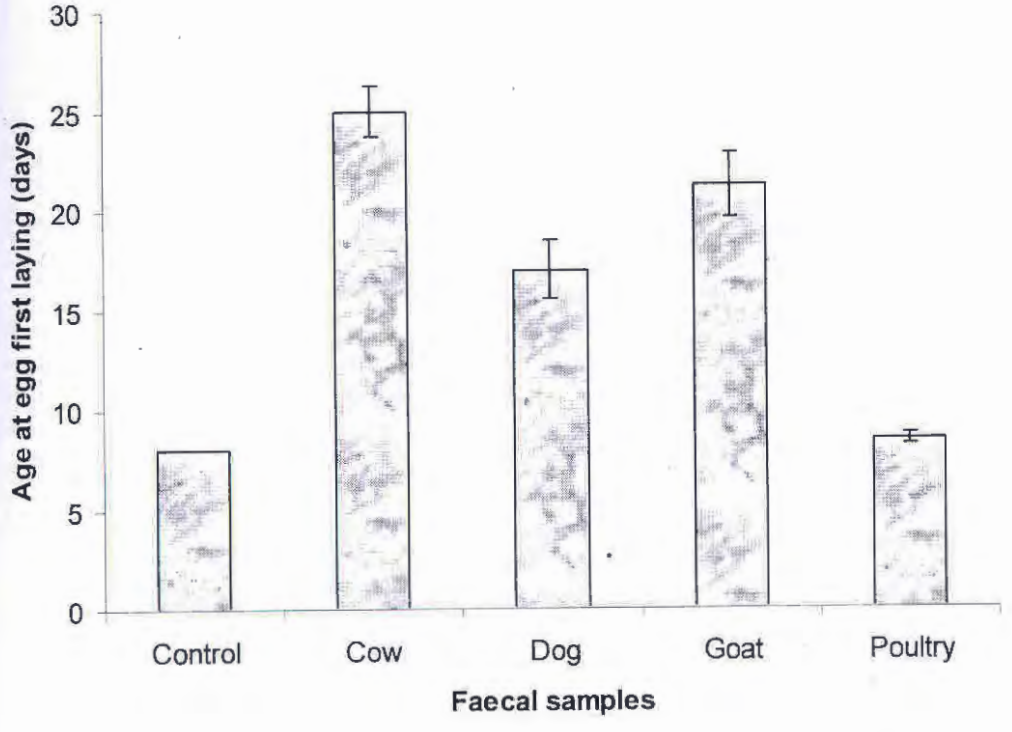

Fig. 3: Age (days) of *C. chloropyga* at first egg laying on different faecal samples.

Table 4: Mean duration (days) of development of *M. domestica* on different faecal samples.

Faecal Samples	Egg	Larva	Pupa
Control	1.00 ± 0.00	5.00 ± 0.00	5.00 ±0.00
Dog	1.00 ± 0.00	11.00 ± 0.41	1.75 ± 0.25
Goat	1.5 ± 0.29	7.75 ± 0.75	5.50 ± 0.29
Poultry	1.00 ± 0.00	8.50 ± 0.29	4.50 ± 0.29

Table 5: Mean total days of development of *M. domestica* from egg to adult.

Faecal Samples	Days
Control	11.00 ± 0.00
Dog	13.75 ± 0.63
Goat	14.75 ± 1.31
Poultry	13.5 ± 0.29

Table 6: Protein content of Faecal Samples

Faecal Samples	% Crude Protein
Control (Rice and Fish)	19.10
Cow faeces	3.82
Dog faeces	6.80
Goat faeces	6.37
Poultry faeces	7.21

The four faecal samples support the development of eggs in *C. chloropyga* and *M. domestica* while dog, goat and poultry faeces serve as useful nutrient for *M. domestica* and compete favourably with the control medium. From the present studies, it is apparent that faeces of domestic animals including cow, dog, goat and poultry that litter our surrounding will proliferate blowfly *C. chloropyga* and housefly *M. domestica*. It is therefore recommended that they are properly disposed to minimize the presence of the flies in our environment.

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