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Feeding Preference of *Chrysomya chloropyga* (Wied.) and *Musca domestica* (Linn.) on Some Animal Faecal Samples

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Abstract: Feeding preference of *C. chloropyga* and *M. domestica* on four animal faeces; cow, dog, goat and poultry faeces were studied in choice and no-choice experiments. The protein profile of the emerging adult flies was determined by electrophoresis. *M. domestica* was attracted to the four faecal samples but preference was shown for dog faeces throughout the choice experiment. Mean number of *M. domestica* that fed on either cow, dog or goat faeces however fluctuated with days of exposure, from days 4 to 20 in the no-choice experiment. *C. chloropyga* was attracted to all the faecal samples in the choice experiment with preference for poultry faeces on days 4 and 8, preference however shifted to dog faeces on days 12, 16 and 20. In the no-choice experiment, mean number of *C. chloropyga* that fed on dog faeces was consistently higher than those on cow, goat and poultry wastes on days 4, 12, 16 and 20. Electrophoresis of whole adult homogenate *M. domestica* emerging from the dog, goat and poultry faeces revealed the presence of heterogeneous proteins of different molecular weights including some that are similar in males and females reared on different diets. The different diets show a potential for supporting the development of the flies. Further experiments to study the development of the flies on these faecal samples and others in our environment is therefore recommended.

Key words: Feeding preference, *C. chloropyga*, *M. domestica*, electrophoresis

INTRODUCTION

Chrysomya chloropyga and *Musca domestica* belong to the order Diptera and suborder Muscoidea. The order consists more than 150,000 described species and has a worldwide distribution. It includes a large number of species of veterinary and medical importance (Gillot, 1991). *M. domestica* is widely regarded as an important pest species (Busvine, 1980; Chapman *et al*., 1988; Howard, 2001) and has been implicated in the spread of numerous diseases including Salmonella and Amoebic dysentry among others (Crosskey and Lane, 1993). *C. chloropyga* and *M. domestica* visit filthy environments and are found in buildings, toilets, garbage where they feed on exposed food, decaying organic matter and faeces of living organisms. Tyndale-Biscoe (1971) and Stoffolano *et al*. (1990) showed that males and females of many dipterous flies meet at dung for feeding and mating. Stoffolano *et al*. (1990) also questioned the possibility of both sexes of *Phormia regina* utilizing faeces found in nature as their source of protein required for sexual maturation. According to Zucoloto (1987) the larvae of fruit flies have receptors which draw them to particular types of food and enable them to identify the best diets that are rich in protein. It has also been demonstrated that although the sarcophagidae, *Ravinia belforti* is frequently bred in human and animal faeces, they have higher preference for mashed fish. This study was carried out to determine the preference of *C. chloropyga* and *M. domestica* for cow, dog, goat and poultry faeces and the protein profile of adults that emerge from these faeces.

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MATERIALS AND METHODS

Rearing of *Chrysomya chloropyga* and *Musca domestica*

This study was carried out between January and June 2006 in a well-lit insectary in Obafemi Awolowo University, Ile-Ife, Nigeria, at temperature 28±2°C and 75±5% relative humidity. Adult male and female flies were kept in (40×30×30 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* was a formulation by Anantiko *et al.* (1982), which consist of grounded fish and rice and water in the ratio 1:1:1.5 w/v. The culture medium was put into petri-dishes and placed into the cages for the flies to lay eggs after which they were separated into different cages to develop to adult. Adult males and females of *C. chloropyga* and *M. domestica* that emerged were subsequently used for the study.

Feeding Preference

Feeding preference was studied in Choice and No-choice experiments. Ten males and ten females of each species were placed in (40×30×30 cm^3) cages. They were exposed to 15 g of each faecal sample in petri-dishes separately, in the No-Choice experiment, while in the Choice experiment, they were exposed to the four faecal samples at once. The number of flies that perched on each of the faecal samples were counted and recorded within 4 min of exposure and at 4 days interval over a period of 20 days for both experiments. The experiments were replicated thrice. Data were statistically analysed and graphs plotted using the SYSTAT (2002) statistical package.

Electrophoresis and Molecular Weight Estimation in Adult *M. domestica*

Newly emerged adults of *M. domestica* that developed from dog, poultry and goat faeces were put in plastic bottles and immobilized in a freezer at -10°C for 30 min. Male and female homogenates from each of the samples were prepared by homogenizing 1 g of adult fly in 2 mL of Sodium Dodecyl Sulphate (SDS) sample buffer. The homogenates were centrifuged using a Beckmann Ultracentrifuge at 10,000 g for 30 min at 4°C. The supernatant was boiled for 4-5 min and then subjected to SDS polyacrylamide gel electrophoresis on 10% concentration of acrylamide gels as described by Weber and Osborn (1969).

RESULTS

Feeding Preference in *M. domestica*

M. domestica was attracted to the four faecal samples from day 4 in the Choice experiment (Table 1). Mean number of flies that fed on all the faecal samples on day 4 was more than on days 8, 12, 16 and 20 in the Choice experiment. On dog, goat or poultry faeces, the mean number of flies attracted decreased progressively from days 4 to 20. Preference was shown for dog faeces throughout the experiment with mean number of 7.67±1.20 *M. domestica* on day 4 ($F = 3.290$, $df = 3$, $p<0.05$), 3.67±0.88 on day 8 ($F = 3.146$, $df = 3$, $p<0.05$), 4.00±2.08 on day 12 ($F = 3.412$, $df = 3$, $p<0.05$), 3.00±0.58 on day 16 ($F = 4.878$, $df = 3$, $p>0.05$) and 1.67±0.33 on day 20 ($F = 0.744$, $df = 3$, $p>0.05$). The mean number of flies attracted to goat and poultry faeces was 4.00±0.58, respectively on day 4. The number of flies attracted to cow faeces was low compared to the other faecal samples throughout the Choice experiment with maximum of 2.00±0.58 on day 4. Mean number of *M. domestica* attracted to the different faecal samples were significantly different on day 12 ($F = 3.416$, $df = 3$, $p<0.05$) and on day 16 ($F = 4.878$, $df = 3$, $p<0.05$) but not significantly different on day 20 ($F = 0.744$, $df = 3$, $p>0.05$).

Table 1: Mean No. of *M. domestica* that fed on faecal samples in choice experiment at 4 days interval

Days	Cow faeces	Dog faeces	Goat faeces	Poultry faeces
0	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00
4	2.00±0.58	7.67±1.20	4.00±0.58	4.00±0.58
8	1.33±0.67	3.67±0.88	1.00±0.00	1.00±0.00
12	1.33±0.33	4.00±2.08	1.00±0.00	2.33±0.88
16	0.67±0.33	3.00±0.58	1.33±0.33	2.00±0.58
20	1.67±0.33	1.67±0.33	1.00±0.58	1.67±0.88

Table 2: Mean No. of *M. domestica* that fed on faecal samples in no-choice experiment at 4 days interval

Days	Cow faeces	Dog faeces	Goat faeces	Poultry faeces
0	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00
4	4.00±1.00	6.00±2.08	3.33±1.20	5.67±2.33
8	2.00±0.58	4.33±1.76	0.67±0.67	5.67±1.67
12	3.67±0.67	6.33±0.88	2.33±0.88	5.00±1.15
16	1.33±0.33	3.00±0.58	2.67±0.33	4.67±0.88
20	2.33±0.88	5.33±0.88	4.00±0.58	4.00±0.58

Table 3: Mean No. of *C. chloropyga* that fed on faecal samples in choice experiment at 4 days interval

Days	Cow faeces	Dog faeces	Goat faeces	Poultry faeces
0	1.00±0.58	1.00±0.58	0.33±0.33	0.33±0.33
4	0.33±0.33	1.33±0.33	0.67±0.33	2.33±0.88
8	1.33±0.88	1.00±0.00	1.67±0.67	3.33±0.88
12	1.33±0.33	2.67±1.20	0.67±0.33	2.00±0.58
16	2.00±1.53	2.33±0.88	1.00±0.58	1.33±0.33
20	1.33±0.33	4.67±1.45	1.67±0.33	3.00±0.58

Table 4: Mean No. of *C. chloropyga* that fed on faecal samples in no-choice experiment at 4 days interval

Days	Cow faeces	Dog faeces	Goat faeces	Poultry faeces
0	1.67±0.88	1.00±0.58	0.00±0.00	0.67±0.67
4	2.00±1.00	5.33±1.20	0.00±0.00	2.00±0.58
8	0.00±0.00	2.00±0.58	0.33±0.33	2.33±1.33
12	0.67±0.33	6.00±1.73	0.67±0.33	0.67±0.33
16	0.33±0.33	11.33±2.40	1.00±0.58	2.33±0.33
20	1.33±0.88	9.67±0.88	2.00±0.58	3.00±0.58

Newly ecdysed *M. domestica* did not feed on any of the faecal samples in the No-Choice experiment. There was fluctuation in the mean number of flies that fed on either cow, dog or goat faeces with days of exposure, from days 4 to 20 ($F = 3.621$, $df = 5$, $p>0.05$) (Table 2). Mean number of flies that fed cow, dog and goat faeces was high on day 4, decreased on day 8 and increased again on day 12. The mean number of flies that fed on day 20 was more than those on day 16. Mean number of flies that fed on poultry waste was maximum at day 4 and thereafter decreased progressively up to day 20 of exposure.

Feeding Preference in *C. chloropyga*

C. chloropyga was attracted to all the faecal samples in the Choice experiment. Newly emerged *C. chloropyga* fed on the faecal samples with mean maximum of 1.00±0.58 flies each on cow and dog faeces. Preference was shown for poultry faeces on days 4 and 8 with 2.33±0.88 and 3.33±0.88 flies attracted respectively (Table 3). However, preference was shifted to dog faeces on days 12, 16 and 20 with 2.67±1.20, 2.33±0.88 and 4.67±1.45 mean number of flies respectively. There was no significant difference in the mean number of *C. chloropyga* that were attracted to the faecal samples on day 0 ($F = 0.667$, $df = 3$, $p>0.05$), day 4 ($F = 2.800$, $df = 3$, $p>0.05$), day 8 ($F = 2.148$, $df = 3$, $p>0.05$), day 12 ($F = 1.481$, $df = 3$, $p>0.05$), day 16 ($F = 0.417$, $df = 3$, $p>0.05$) and day 20 ($F = 3.444$, $df = 3$, $p>0.05$).

In Table 4, the *C. chloropyga* had the highest preference for dog faeces compared with the other faecal samples in the No-Choice experiment. At days 4, 12, 16 and 20 of exposure ($F = 8.564$, $df = 5$,

Table 5: Approximate molecular weight (Da) of proteins of newly emerged male and female *M. domestica* separated from various diets

	Dog faeces		Goat faeces		Poultry faeces	
No.	Male	Female	Male	Female	Male	Female
1	84,000	89,000	100,500	71,000	100,000	63,000
2	66,000	71,000	95,000	26,000	81,000	49,500
3	56,000	56,000	84,000	20,000	74,000	43,000
4	51,000	49,500	76,000	15,000	64,000	36,500
5	42,000	42,000	70,000	13,000	56,000	26,000
6	30,000	35,000	60,000	11,000	51,000	22,000
7	24,500	29,000	51,000		36,500	
8	20,000	24,500	41,000		25,000	
9	17,500	21,500	38,500		22,500	
10	15,000	15,500	24,000		19,500	
11	13,500	13,000	16,500		16,000	
12			10,000		11,500	

$p<0.05$), mean number of *C. chloropyga* that fed on dog faeces was consistently higher than those on cow, goat and poultry wastes. In dog, cow and poultry faeces, feeding of flies fluctuated with days of exposure, except for goat faeces where mean number of flies increased with days of exposure.

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 develop to adult. *M. domestica* however completed development to adult on dog, poultry and goat faeces. Adult male and female *M. domestica* that emerged from goat and poultry faeces had 12 and 6 protein fractions with molecular weight range of 10,000 to 100,500 and 11,000 to 71,000 for males and females emerging from goat and poultry faeces respectively (Table 5). There were 11 protein fractions in male *M. domestica* emerging from dog faeces and 12 fractions in the females, with molecular weight ranges of 13,500 to 84,000 and 13,000 to 89,000, respectively. The number of protein fractions in the females that emerged from the goat and poultry faeces were fewer than the number of protein fractions in the males. The protein fraction of molecular weight of 49,500 was specific to female *M. domestica* emerging from dog and poultry faeces. Other protein fractions of approximate molecular weight of 13,000 and 71,000 were also specific to females that emerged from dog and goat faeces. The protein fraction of between 20,000 and 22,000 were present in females reared in dog, goat and poultry faeces. There were more similar proteins in females than in males. Protein fraction of approximate molecular weight 51,000 was specific to males emerging from dog, goat and poultry faeces. Fractions 16,000 to 17,500 were also common to the males from the three media. Females from dog faeces had 11 protein fractions while those from poultry and goat had 6 fractions each.

DISCUSSION

The attraction of *M. domestica* and *C. chloropyga* to dog, poultry, goat and cow faeces suggests the reception of the flies to wide variations of organic matter for food. According to Blackith and Blackith (1993) adult flies visit faeces to lay eggs, to feed or to drink in dry weather. Tyndale-Biscoe (1971) and Stoffolano *et al.* (1990) showed that males and females of many dipterous flies meet at dung for feeding and mating.

Among the four faecal samples, dog and poultry faeces were strongly preferred probably owing to protein content and odour. Dipterous flies including *M. domestica* and *C. chloropyga* use their olfactory organ to determine the substrate on which eggs are laid. They lay their eggs on proteinous materials which provide larvae with food on hatching (Richard and Davies, 1977). According to Zucoloto (1987) and Canato and Zucoloto (1992) the larvae of the fruit fly *Ceratitis capitata* can discriminate diets with higher nutritional value with the aid of some receptors they possess. It is

interesting to know that newly emerged *M. domestica* did not feed on the faecal samples. This supports the report of Jones and Walker (1973) that newly emerged *Musca vetustissima* usually do not feed on protein for about 2 days. Smaller flies, which emerge from unfavourable larval feeding conditions which therefore leave them with a relatively greater protein deficit to make up, develop an interest in protein sooner than larger flies. Newly emerged flies also did not feed probably because emergence is associated with hardening and tanning of cuticle in the first few hours after emergence. The final process in the metamorphosis of dipteran flies is the escape of the adult from the puparium (eclosion) and medium in which pupation occurred, expansion of the cuticle including the wings and hardening and tanning of the cuticle (Fraenkel, 1935; Cottrell, 1962a, b). The fluctuation in the number of flies feeding at different days of exposure demonstrate the infrequent manner with which they feed. Once there is full engorgement of food, flies may perch on any substrate in the vicinity and probably digest the food in the gut. Stoffolano *et al*. (1995) showed females of *P. regina* exposed to homogenized liver for a 4 h feeding period consumed and stored enough protein in the crop to develop a normal compliment of eggs. Despite the continuous feeding on dog, goat, cow and poultry wastes, eggs laid by *C. chloropyga* as well as *M. domestica* eggs on cow dung did not develop to adult. This suggests the insufficiency of nutrient in the dungs for complete development especially for *C. chloropyga*. Blood protein from cow liver was reported to be the best source of protein for egg maturation in the female blowfly *Phormia regina* than dog, chicken, cat, sheep and pig faeces (Stoffolano *et al*., 1995). Stoffolano *et al*. (1990) also questioned the possibility of both sexes of *Phormia reginia* utilizing faeces found in nature as their source of protein required for sexual maturation.

Sodium dodecyl sulphate-polyacrylamide gel electrophoresis shows that male and female *M. domestica* emerging from dog, goat and poultry faeces contain several protein fractions of a wide range molecular weights, an indication of different protein constituents of males and females reared on different diets, which may also affect viability and sex ratio of emerging adults. According to Slansky and Scriber (1985), proteins are essential for the formation of sexual glands, pheromones and sexual performance of male insects. Protein fractions in males were generally more than those in females irrespective of diets. It seems males emerged with full complement of proteins while females probably accumulate more proteins with feeding and development of reproductive structures. Males have the same quantity of protein fractions but different quality at emergence which appears to be affected by the rearing media. Males also have limited number of similar proteins with diet compared to their female counterparts. This shows that there are more dissimilar proteins in males which may be responsible for the transfer of genes of different qualities to females at mating. Hendrichs *et al*. (1991) and Krainacker *et al*. (1987) showed that larval diet greatly affects adult qualities such as size, energetic reserves and fecundity and therefore the different genes in males as suggested in this investigation. Diet of blood have been shown to increase protein in the fat body, haemolymph and ovaries of female *Stomoxys calcitrans* as tested with sodium dodecyl sulphate-polyacrylamide gel electrophoresis (Houseman and Morrison, 1985). The use of SDS-PAGE for whole body homogenate of *M. domestica* has also demonstrated different quality of protein in flies reared on different non-blood media in this study.

CONCLUSION AND RECOMMENDATION

This study has established the preference of *M. domestica* and *C. chloropyga* for dog and poultry faeces among the four faecal samples tested, which indicates that the faecal sample support the reproductive development of the flies. Therefore, the need for proper disposal of the faeces to reduce incidence of the flies in our environment.

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