

Original Research Article

THE EFFICACY OF *ZINGIBER OFFICINALE* (GINGER-ZINGIBERACEAE) CRUDE EXTRACTS APPLIED AS INDIVIDUAL AND MIXED (WITH *DENNETTIA TRIPETALA* (PEPPERFRUIT-ANNONACEAE)) AGAINST *MUSCA DOMESTICA* (HOUSEFLY) LARVAE.

ABSTRACT

Housefly, *Musca domestica* is one of the most common household insect pests, it feeds on human food thereby transmitting disease to man and livestock since it is a vector of many diseases. Crude extracts of *Zinigber officinale* was applied alone and mixed with *Dennettia tripetala* in equal proportion at various concentrations (200ppm to 1000ppm) to determine their toxic efficacy against freshly emerged larvae of *Musca domestica*. Each concentration was replicated twice. The bioassay was done by using dipping ing and feeding techniques under laboratory conditions and was monitored every 12 hours for 72 hours. Distilled ed water was used as control for the experiment. Mean mortality was recorded to obtain Median Lethal Concentration (LC₅₀) and Median Lethal Time (LT₅₀). The results showed that mortality was generally significant (P<0.05) as concentration increased from 200 ppm to 1000 ppm. Mortality was not significant with-over time (P>0.05) as duration of exposure increased from 12-72 hours when *Zingiber officinale* was applied alone, but when it (~~*Z. officinale*~~) was mixed with *D. tripetala* in equal proportion mortality was significant (P<0.05) with time as duration of exposure increased from 12-72 hours. The mixture of plant extracts (*Z. officinale* and *D. tripetala* in equal proportion) had the lowest LC₅₀ and LT₅₀ (0.2754 mg/ml (275.4ppm) and 30 hours). It was observed that dipping the insects in plant extracts caused more mortality when compared to feeding the insects with plant extracts. This result showed that plant extracts used for this study could be promising bioinsecticides especially when mixed in equal proportions and should-may be considered in integrated pest management (IPM).

Key words: *Zingiber officinale*, *Dennettia tripetala*, *Musca domestica*, LC₅₀ and LT₅₀.

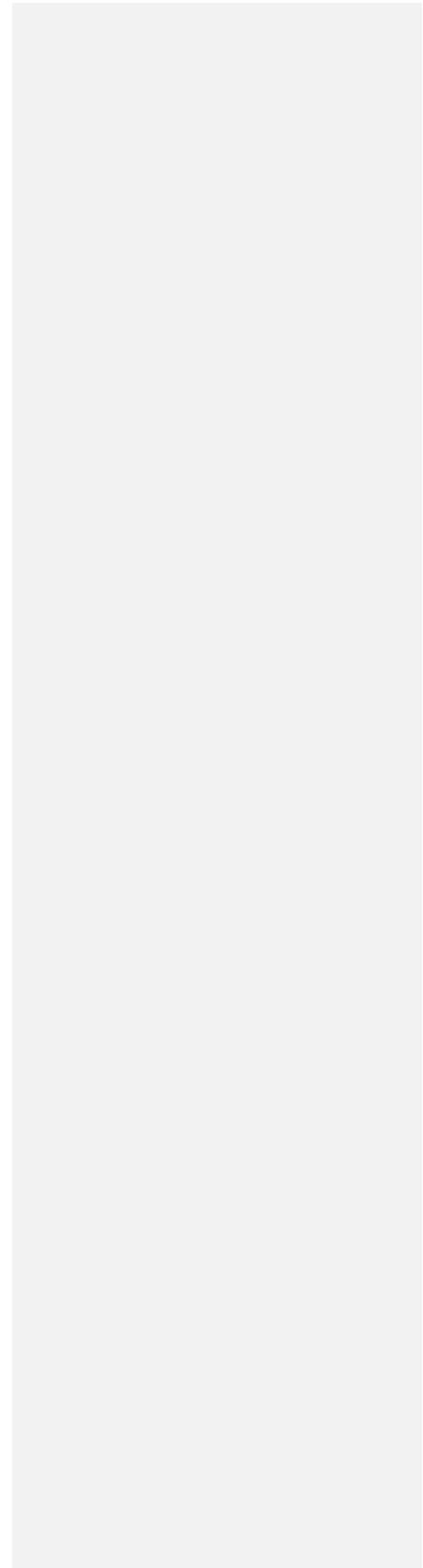
INTRODUCTION

Housefly is one of the most common household insect pests, ~~it~~ It feeds on human food thereby transmitting disease to man and livestock since it is a vector of many diseases such as typhoid, cholera, ~~dysentery~~, ~~salmonella~~, etc. ~~they~~ It also transmits the eggs of parasitic worms hence

Formatted: Font: Bold, Italic

UNDER PEER REVIEW

31 houseflies are seen as carries of easily communicable disease. Diseases are found on the legs and



hairs covering the body of houseflies. They come in contact with these pathogens when females lay their eggs on decaying organic matter. Houseflies transmit these pathogens to food substance or any surface they come in contact with within seconds. They are able to transmit these diseases because they liquefy solid food before feeding on them as they have sucking mouthparts and people get infested when they feed on it. Their presence in homes (around man) is irritating as they are considered as unhygienic insects. They tend to disturb men and livestock during leisure and work periods. Eliminating this insect pest totally maybe difficult, reducing its population below economic threshold and stopping its contact with human and livestock food and water is very necessary and a step to make homes and environment hygienic. Chemical insecticides which are usually used in controlling housefly (Bisseleua Herve *et al.*, 2008) have great adverse effects on the

ecosystem at large, as their residues left in the environment are hazardous. Chemical insecticides also make the insect pest become resistant (Scott, *et al*, 2000; Shono and Scott 2003). Thus researchers are in continuous search of alternative methods for controlling insect pests. Plants have been used in medicine even before man understood the cause of infectious disease (El-Sherbini and Hanykamel 2014) this has led to the use of bio insecticides in controlling insect pest because they are better alternatives to chemical insecticides. Ginger, Zingiber officinale Roscoe is a flowering

plant in the family Zingiberaceae whose rhizome or simply ginger is widely used as spice. It has gingerols and shogaol as its active constituents amongst other compounds (Gosh, 2011) which suffocate insects. *Dennettia tripetala* (pepper fruit) is an indigenous medicinal fruit tree of the family Annonaceae known to have β -phenylnitroethane (a nitro compound) as the compound responsible for its high insecticidal activity (Anyaele and Amusan, 2003). There are various works on the use of bioinsecticides in controlling housefly such the work of Asid *et al* (2015), Soonwera (2015), Meenakshisundaram *et al.*, (2014)) but less research has been done on the comparison of plant extracts applied individually and mixed in equal proportions. Thus, this work will be evaluating the efficacy of *Zingiber officinale* applied individually and mixed with *Dennettia tripetala* in equal proportions; their insecticidal strength will also be compared using dipping and feeding techniques.

MATERIALS AND METHODS

Insect collection and culture

Insects were collected near a garbage site by placing fresh fish in a small plastic plate inside the rearing cages. The fish served as a culture medium for laying eggs and larvae development. The cage (30x30x30xm) was built with wood, nets and wire gauze with a wooden door by its side, the floor was made with plywood. Freshly emerged larvae were used for the bioassay. The cage was placed on plastic stands which contained engine oil to prevent infestation of other insects and mites (Bisseleua Herve *et al.*, 2008). The larvae was transferred into petri dishes containing

larvae food (2ml of powdered milk mixed with distilled water) using fine art brush. This procedure was adopted from Bisseleua Herve *et al.*, (2008); Bosly (2013) and Ojianwuna *et al.*, (2011) with some modifications.

Comment [I1]: I will change the word VERY NECESSARY by ESSENTIAL

Comment [I2]: These references do not exist in the reference list. PLEASE VERIFY

Formatted: Font: Not Italic

Comment [I3]: Please verify is meters or cm

Comment [I4]: Please indicate the age of larvae

Formatted: French (France)

Formatted: Font: 12 pt

70 Preparation of test plant materials

71 The plants used for this study ~~was~~were purchased from a local market in Ukwuani Local
 72 Government
 73 area of Delta State and identified by a plant taxonomist in the department of botany Delta state
 74 university, Abraka. *Zingiber officinale* rhizome was sliced into tiny pieces while *Dennettia*
 75 *tripetala* skin was peeled off to obtain the seeds which were used for this study. They (*Z.*
 76 *officinale* and *D. tripetala*) were dried at ambient temperature ($28\pm 2^{\circ}\text{C}$) for four weeks,
 77 afterwards they were grounded with an electric blender (Philips) and sieved with 0.1mm mesh
 78 size sieve to obtain fine powder which was stored in an airtight container to prevent the active
 79 ingredients from evaporating and kept in a cupboard until the time for use. This procedure was
 80 adopted from Ojianwuna and Umoru (2010) and Ojianwuna *et al.*, (2011) with slight
 modifications.

Comment [15]: This reference does not exist in the reference list

81 Preparation of plant crude extract

82 The crude extracts were obtained by homogenizing 10g of dust (plant sample) with 100ml
 83 (80/20) of solvents (v/v) (hydro-ethanol) and left for 24 hours thereafter, it was filtered with a
 84 filter paper and the residue (active compound)–was evaporated over a water bath at 40°C . To
 85 obtain the final concentration, the extracts were dissolved in a known volume of distilled water;
 86 to
 87 obtain 200, 400, 600, 800 and 1000ppm, 0.2, 0.4, 0.6, 0.8 and 1.0 mg of extract was dissolved in
 88 a ml of distilled water. This method was adopted from Asid *et al.*, (2015).

88 Larvicidal Bioassay

89 Mortality and other effect on larvae were monitored every 12 hours of 72 hours and recorded.
 90 Two replicates of each concentration were made and the mean value was taken as the final result.
 91 Each group had 20 larvae and distilled water was used as control experiment. The concentrations
 92 used for study are 200ppm, 400ppm, 600ppm, 800ppm, 1000ppm.

93 The toxicity of crude extracts was tested by these methods:

94 Dipping Technique

95 The larvae of each group were carefully dipped into various concentrations of crude extracts with
 96 a dip net and allowed to stand in it for 40 seconds, and then introduced into petri dish with food.

97 Feeding technique

98 Various concentrations of the crude extract was added to larvae food in petri dish and the larvae
 99 were introduced into the petri dish. This method used was adopted from Asid *et al* (2015) with a
 100 slight modification.

Comment [16]: Please indicate the volume of the weight of food given to larvae as indicated in line 67

101 Statistical analysis of Data

102 The results obtained were recorded and statistical analysis was performed using two-way
 103 ANOVA (Ms Excel), Descriptive statistics and Probit Analysis (SARS). Significance was
 104 determined at $P<0.05$.

105 **RESULTS**

106 Table 1 shows the mortality observed within a period of 72 hours, percent mortality and probit
 107 mortality of *Zingiber officinale* on *Musca domestica* larvae using dipping technique. The result
 108 shows that mortality was significant ($P<0.05$) as concentrations increased from 200-1000ppm
 109 but mortality was not significant as duration of exposure increased from 12-72 hours. The LC_{50}
 110 and LT_{50} are 0.4898 mg/ml and 40 hours (Figures 1&2). No mortality was observed when the
 111 insects were fed with crude extracts but they (insect larvae) were weakened (their movement was
 112 sluggish and they ~~didn't~~ did not pupate.

113 Tables 2 and 3 shows the results obtained when *zingiber officinale* and *Dennettia tripetala* were
 114 mixed in equal proportions using dipping and feeding techniques. Mortality was generally
 115 significant as both concentrations and duration of exposure increased when the insects were
 116 dipped in crude extract and when they were fed with crude extract. When they were dipped in
 117 crude extract, a LC_{50} and LT_{50} of 0.2754 mg/ml and 30 hours was obtained (Figures 3 and 4)
 118 while LC_{50} and LT_{50} of 0.4786 mg/ml and 44 hours was obtained when they were fed with crude
 119 extract (Figures 5 and 6).

120 Table 1: percent mortality and probit mortality of *M. domestica* larvae exposed to *Z. officinale*
 121 for up to 72 hours by dipping
 method

122	Conc	Log	period of exposure_(hours)							percent	probit	
123	Mg/ml of	conc								mortality	mean	mortality
124	H ₂ O		12	24	36	48	60	72				
125	0.2	-0.6690	0	1	2	2	2	2	45	1.5		4.87
126	0.4	-0.3974	2	2	4	2	1	2	65	2.167		5.39
127	0.6	-0.2218	2	3	2	3	2	3	75	2.5		5.67
128	0.8	-0.0969	2	3	2	3	3	5	90	3		6.28
129	1.0	0.0000	3	3	4	3	3	4	100	3.33		8.71
130	Mean		1.8	2.4	2.8	2.6	2.2	3.2				

Comment [17]: It is OVERALL mortality after 72 hours of exposure. Please pay attention

Comment [18]: It is in fact The mean number of dead larvae per 12 hours

Comment [19]: This mean has no significance. I deals with different concentrations

131

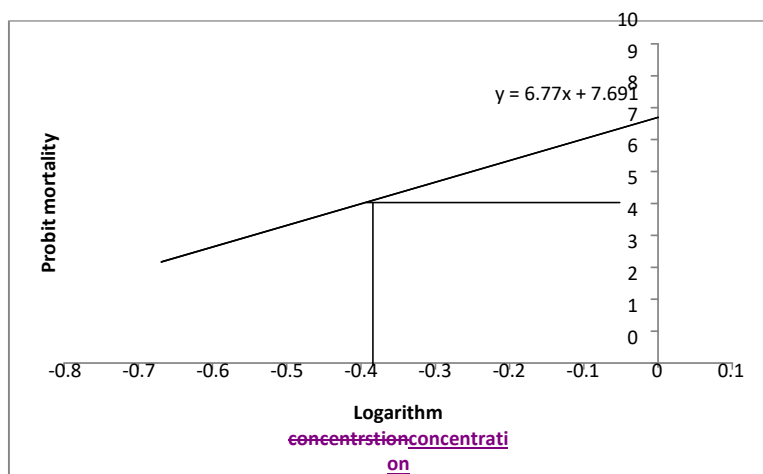


Figure 1: Relationship between probit mortality of housefly larvae and logarithm concentration to give ml concentration at (antilog) LC_{50} when larvae were dipped in *Z. officinale*.

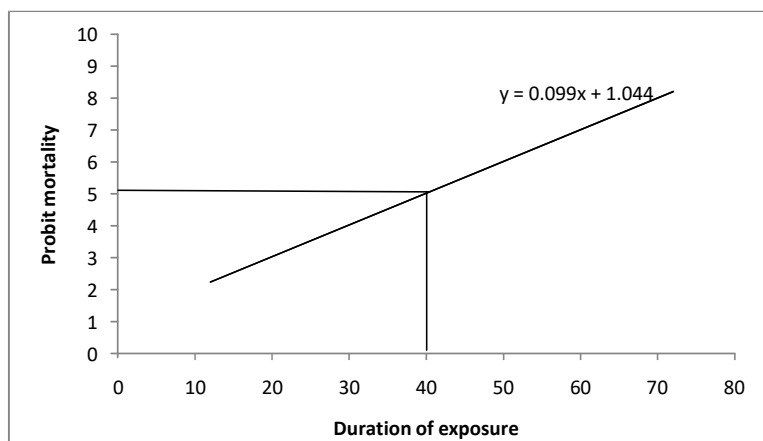


Figure 2: Relationship between probit mortality of housefly larvae and duration of exposure period to give time at LT_{50} when larvae were dipped in *Z. officinale*.

Table 2: Percent mortality and probit mortality of *M. domestica* larvae exposed to *Z. officinale* and *D. tripetala* in equal proportions for 72 hours by dipping method

Conc	Log	period of exposure(hours)						percent	probit	
Mg/ml of	conc							mortality	mean	mortality
H ₂ O		12	24	36	48	60	72			
0.2	-0.6690	0	0	2	2	3	3	50	1.667	5.00
0.4	-0.3974	0	1	2	3	4	3	65	2.1667	5.39
0.6	-0.2218	1	2	3	4	4	1	75	2.5	5.67
0.8	-0.0969	2	3	4	4	3	3	95	3.1667	6.64
1.0	0.0000	2	4	3	5	3	3	100	3.333	8.71
Mean		1	2	2.8	3.6	3.4	2.6			

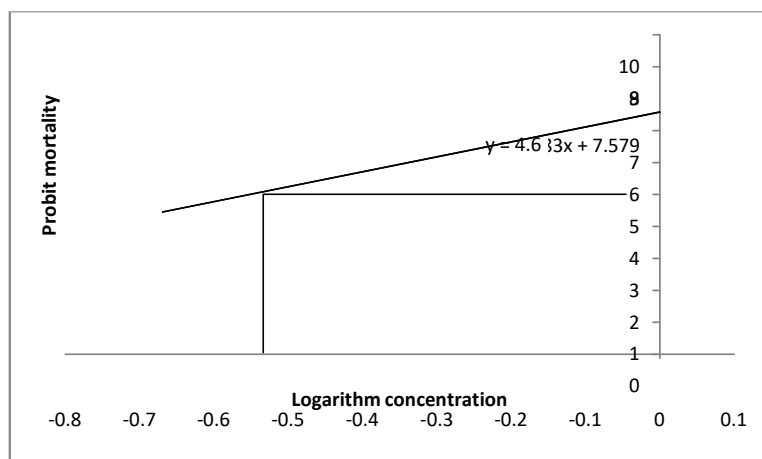
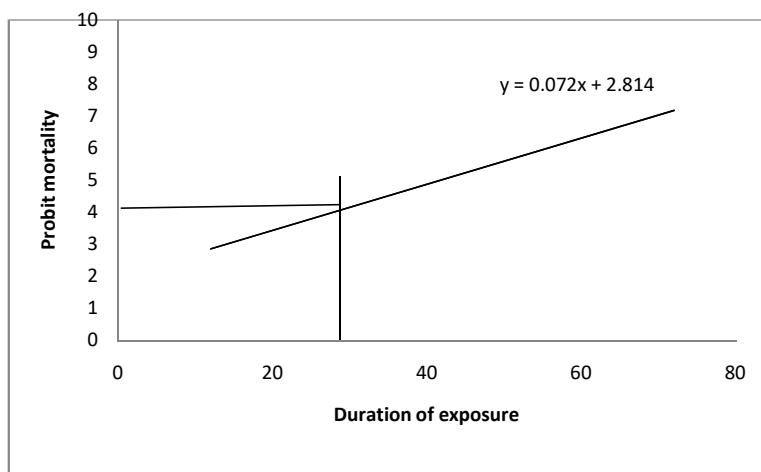


Figure 3: Relationship between probit mortality of housefly larvae and logarithm concentration to give ml concentration at (antilog) LC₅₀ when larvae were dipped in crude extracts of *Z. officinale* and *D. tripetala*.



158

159 Figure 4: Relationship between probit mortality of housefly larvae and duration of exposure to
160 give LT_{50} when larvae were dipped in crude extracts of *Z. officinale* and *D. tripetala*.

161

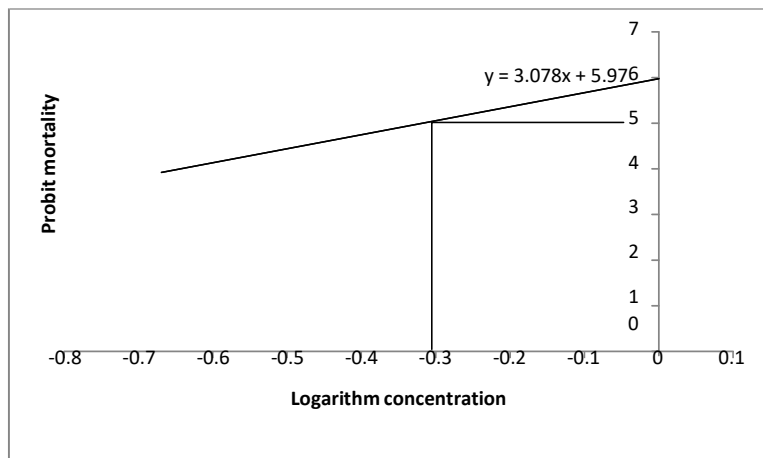
162 Table 3: Percent mortality and probit mortality of *M. domestica* larvae exposed to *Dennettia*
163 *tripetala* and *Z. officinale* in a 50:50 proportion for 72 hours by feeding method

164	Conc	Log	period of exposure(hours)						percent		probit
165	Mg/ml of	conc							mortality	mean	mortality
166	H ₂ O		12	24	36	48	60	72			
167	0.2	-0.6690	0	1	1	0	0	2	20	0.667	4.16
168	0.4	-0.3974	0	3	0	2	0	0	25	0.833	4.33
169	0.6	-0.2218	2	4	0	4	2	0	60	2	5.25
170	0.8	-0.0969	4	5	5	2	0	0	80	2.667	5.84
171	1.0	0.0000	5	5	4	3	0	0	85	2.833	6.04
172	Mean		2.2	3.6	2	2.2	0.4	0.4			

173

174

175



176

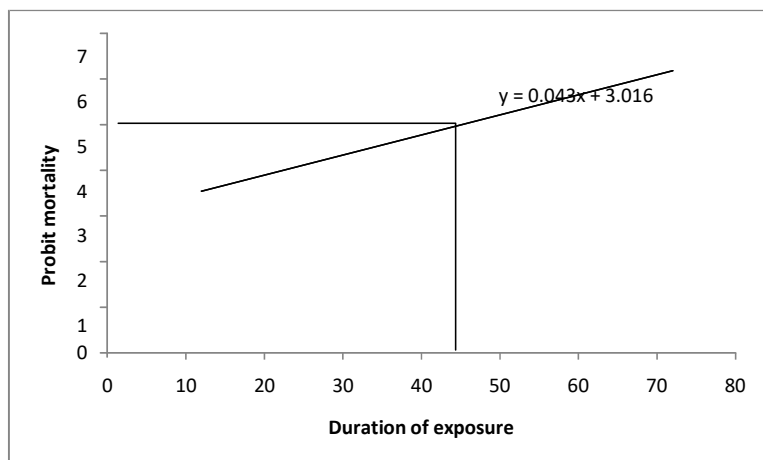
177

178

179

180

181



182

183

184

185

186

Figure 5: Relationship between probit mortality of housefly larvae and logarithm concentration to give ml concentration at (antilog) LC_{50} when larvae were fed with *Z. officinale* and *D. tripetala* in equal proportions.

Figure 6: Relationship between probit mortality of housefly larvae and duration of exposure to give LT_{50} when larvae were fed with *Z. officinale* and *D. tripetala* in equal proportions

187 DISCUSSION AND CONCLUSION

188 From the results obtained, crude extracts of *Z. officinale* and *D. tripetala* are toxic to freshly
 189 emerged larvae of *Musca domestica*. The high insecticidal activity and post application effect of
 190 these crude extracts ~~is-as-a~~ are results of their constituent compounds; the volatile nature of the
 191 constituent compound could have also increased larvae mortality and insecticidal activities. It
 192 was also observed that test plant materials may have synergistic effects when they were mixed in
 193 equal proportions which led to its lower LC₅₀ and LT₅₀. Similar findings have shown that when
 194 extracts are mixed together, there may be synergistic effects. Akunne *et al.* (2014) reported that
 195 *Piper guineense* and *Zingiber officinale* had additive effects against *Callosobruchus*
 196 *maculatus* when mixed in a 50:50 proportion. Ojianwuna and Umoru, (2010) also reported
 197 that *C. citratus* and *O. suave* had additive effect against *C. maculatus* in cowpea when they
 198 were mixed in a 60:40 proportion. Dawudo and Ofuya (2000) reported that the mixture of
 199 fruit powders of *Piper guineense* and *Dennettia tripetala* in equal proportion (50:50) had
 200 additive effects on *C. maculatus* and significantly caused their mortality, reduced their
 201 oviposition and adult emergence. Ojianwuna *et al* (2011) reported that *Ocimum suave* (wild
 202 basil) leaf oil had a LC₅₀ value of 0.09ml/50ml of water and LT₅₀ value of 4.40 hours when they
 203 studied toxicity of *Ocimum suave* leaf oil on adult housefly. They also reported that there was
 204 significant difference (P<0.05) as both concentrations increased from 0.05-0.20ml/50ml of
 205 water and duration of exposure increased from 1- ~~to~~ 6 hours. Soonwera (2015) also reported that
 206 the LT₅₀ and LC₅₀ values of *S. aromaticum* oil is 27.05 hours and 9.83% while *C. nardus* oil has
 207 LT₅₀ value of 38.99 hours and LC₅₀ value of 13.60% and *C. odorata* oil has LT₅₀ value of
 208 52.08 hours and LC₅₀ value of 29.36% respectively when he
 evaluated larvicidal and oviposition deterrent activities of essential oils against housefly.

209 Dipping technique was observed to cause higher mortality than feeding technique as shown in
 210 the results obtained, this could be because larvae inhaled the extracts which may had acted as
 211 fumigants and contact poison to cause mortality. The potency of the extracts may have reduced
 212 when the food (mixed with plant extracts) came in contact with the digestive enzymes in the
 213 larvae. The larvae may have also been repelled and may not have fed on the food (mixed with
 214 plant extracts). This might be the reason why the dipping technique caused more mortality and
 215 had lower LC₅₀ when compared to the feeding method. This result is in accordance with the
 216 result obtained by Asid *et al* (2015) when he treated housefly larvae with *Citrullus colocynthis*
 217 (50% and 10%) using dipping and feeding method and observed that dipping method had more
 218 mortality and effects on larvicidal activity. Sripongpun (2008) also observed that dipping
 219 method was very effective when he evaluated the contact toxicity of crude extract of Chinese
 220 star anise fruits to housefly larvae and their development. But it is contrary to the observation of
 221 Ghamdi *et al* (2014) when they carried out potential studies of non-conventional chemicals
 222 against housefly larva; their study revealed that feeding method had more effects on
 223 larvicidal activity than dipping method. The difference in results could be because of differential
 224 mode of action of plant extracts and their effective concentration.

Comment [I10]: Again this reference does not exist

Comment [I11]: This reference does not exist in the list of references

Asid *et al.*, (2015), observed that *Citrullus colocynthis* with 50% concentration against *M. domestica* larvae caused larva mortality, pupa mortality and inhibit adult emergence. Bosly, (2013), observed that *Mentha piperita* and *lavandula angustifolia* essential oils have great insecticidal effect on *M. domestica* larvae; the extracts had mortality, prolonged larva and pupa duration and reduced adult emergence. Islam and Aktar, (2013) reported that *Calotropis procera*, *Piper longum* and *Polygonum hydropiper* had synergistic (additive) effects against *M. domestica* larvae and seven vital life-history traits of *M. domestica* such as fecundity, percent egg hatch, larva duration, numbers of pupae and adults, female ratio and adult longevity. Meenakshisundaram, *et al.*, (2014) evaluated the effect of Sweet Flag Rhizome (*Acorus calamus*) extract for Biological activity against housefly and observed that the extract had high mortality against housefly and offers an alternative source for the control of houseflies. From the results obtained, plant extracts were toxic especially when mixed in equal proportions (50:50). Thus they can be considered as bioinsecticides and could be useful in integrated pest management (IPM) as the results obtained are promising. Although, bioinsecticides are not as active as synthetic insecticides and do not act as fast as them—(synthetic insecticides), they (bioinsecticides) are better alternatives because they are cost effective, environmental friendly and readily available. Bioinsecticides are prophylactic measure of protection against insects.

REFERENCES

- Ahmed, S., Malik, H., Riaz, M. A. and Akthar, M. (2013). Influence of plant extracts on the Life History and Population Development of Housefly, *Musca domestica* L. *J. Zoology* **45** (2), 345-349.
- Akunne, C. E., Afonta, C.N., Mogbo, T.C., Ononye, B.U. and Ngenegbo, U.C. (2014). Evaluation of the Efficacy of Mixed Powders of *Piper guineense* and *Zingiber officinale* against *Callosobrochus maculatus* (F.) (Coleoptera: Bruchidae). *American Journal of Biology and Life Sciences*, **2**(2), 63-67.
- Alan and HuiMeng, (2008). Life cycle of housefly. www.vtaide.com. Retrieved on 28th of June, 2015.
- Al-Ghamdi, Kh. M., Saleh, M. S., Mahyoub, J.A., Asid, A. N., Al-Najada, A. R., Mamdouh, I. N. and Alfarhan, B. Z. (2014). Potential Studies of Non-Conventional Chemicals against Housefly Larvae *Musca domestica* L. *Journal of Life Science* **11**(12), 1046-1048.
- Ande, A. T. (2001). Biological Activities of some Plant Materials against the Housefly – *Musca domestica*. *J. Biological Science* **1**(4), 293-296.
- Anyaele, O.O. and Amusan, A.A.S. (2003). Toxicity of Hexanolic Extract of *Dennettia tripetala* (G. Baxa) on Larvae of *Aedes aegypti* (L). *African Journal of Biomedical Research*, **6**, 49-53.

Comment [I12]: This reference does not exist in the text

Comment [I13]: This reference does not exist in the text

Comment [I14]: This reference does not exist in the text. Please verify

UNDER PEER REVIEW

- 261 Asid, A. N., Al-Ghamdi, Kh. M., Mamdouh, I. N. and Mangoud, A. (2015). Assessment of Bitter
262 Apple, *Citrullus colocynthis* Extracts on the Housefly, *Musca domestica* L. *Journal of*
263 *Advances Environmental Biology*, **9**(8), 72-78.
- 264 Begum, N., Sharma, B. and Pandey, R. S. (2010). Evaluation of Insecticidal Efficacy of
265 *Calotropis procera* and *Annona squamosa* Ethanol Extracts against *Musca domestica*. *J.*
266 *Biofertilizers and Biopesticides* **1**(1), 1-6.
- 267 Bosly, A. H. (2013). Evaluation of Insecticidal Activities of *Mentha piperita* and *Lavandula*
268 *angustifolia* Essential Oils against Housefly, *Musca domestica* L. *Journal of*
269 *Entomology and Nematology*, **5**(4), 50-54.
- 270 Buczacki, S. (2002). Housefly. www.arkive.org/house-fly/musca-domestica. Retrieved on 25ths
271 of April, 2015.
- 272 Dawudo, E. O. and Ofuya, T. I. (2000). Effects of Mixing Powders of *Piper guineense* Schum
273 and Thonn and *Dennettia tripetala* Baker on Oviposition and Adult Emergence of
274 *Callosobruchus maculatus* (F), Infesting Cowpea Seeds in Storage. *Appl. Trop. Agric.*, **5**
275 156-160.
- 276 El-Sherbini, T.G. and Hanykamel O.N. (2014). Insecticidal Effects of *Fortunella crassifolia*
277 Essential oil used against Housefly (*Musca domestica*). *Int. J. Current Microbiology and*
278 *Applied Sciences*, **3**(6), 1-9.
- 279 Gosh, A.K. (2011). *Zingiber officinale* a Natural Gold. *International Journal of Pharma and*
280 *Biosciences* **2**(1), 283-294.
- 281
282 Bisseleua H. Herve², B. D. B., Gbewonyo, S. W. K. and Obeng-Ofori, D. (2008).
283 Toxicity, Growth
Regulatory and Repellent Activities of Medicinal Plant Extracts on *Musca domestica* L.
Diptera: Muscidae. *African Journal of Biotechnology* **7**(24), 4635-4642.
- 284 Idoko, J. E. and Adebayo, R. A. (2011). Effect of *Dennettia tripetala* Powder on Reduced Rates
285 of Pirimiphos – Methyl Singly and Combined in Management of *Callosobruchus*
286 *maculatus* (F). *International Journal of Biology* **3**(2), 174-178.
- 287 Ihemeje, A., Ojiannaka, M. C., Obi, K. C. and Ekwe, C. C. (2013). Biochemical Evaluation of
288 Pepper fruit (*Dennettia tripetala*) and its use as Substitute for Ginger in Zobo Drink
289 Production. *Int. J. Academic Research* **4**(6), 513-521.
- 290 Islam, M. S. and Aktar, M. J. (2013). Larvicidal Efficacies of some Plant Extracts and their
291 Synergistic Effects with Cypermethrin on the Life-History Traits of *Musca domestica* L.
292 *International Journal of Innovations in Bio-Sciences* **3**(3), 92-103.
- 293 Keiding, J. (1986). Division of Vector Biology and Control. *J. World Health Organisation*

Comment [I15]: This reference does not exist in the text. Please verify

Comment [I16]: This reference does not exist in the text. Please verify

UNDER PEER REVIEW

- 294 Meenakshisundaram, T. J., Harikrishnan, N. R. and Anna, T. (2014). Evaluation of Extract from
295 Sweet Flag Rhizome for Biological Activity against Housefly. *Journal of Advanced*
296 *Veterinary Science and Technology* **3**(1), 140-144.
- 297 O'Toole, C. (2002). The New Encyclopedia of Insects and their Allies. [www.arkive.org/house-](http://www.arkive.org/housefly/musca-domestica)
298 [fly/musca-domestica](http://www.arkive.org/housefly/musca-domestica). Retrieved on 25th of April, 2015.
- 299 Ojianwuna, C. C., Edafemakor, A. G. and Iloh, A. C. (2011). Toxicity of *Ocimum suave* (wild
300 basil) Leaf Oil on Adult Housefly (*Musca domestica*). *Journal of Agricultural Science and*
301 *Soil Science* **1**(10), 417-420.
- 302 Palacios, S. M., Bertoni, A., Rossi, Y., Santander, R. and Alejandro, U. (2009). Efficacy of
303 Essential Oils from Edible Plants as Insecticides against the House fly, *Musca domestica*
304 L. *Molecules* **14**, 1938-1947.
- 305 Pangnakom, U. and Kanlaya, S. (2014). Efficiency of Wood Vinegar Mixed with Some Plants
306 Extract against the Housefly (*Musca domestica*L.). *Journal of Biological, Food,*
307 *Veterinary and Agricultural Engineering*, **8**(9), 1-4.
- 308 Sinthusiri, J. and Soonwera, M. (2010). Effect of Essential Oils against Larvae, Pupae and Adults
309 of Housefly (*Musca domestica*). *Journal of Agricultural Technology*, 639-642.
- 310 Soonwera, M. (2015). Larvicidal and Oviposition Deterrent Activities of Essential Oils against
311 Housefly (*Musca domestica* L.). *J. Agricultural Technology* **11**(3), 657-667.
- 312 Sripongpun, G. (2008). Contact Toxicity of the Crude Extract of Chinese Star Anise Fruits to
313 Housefly Larvae and their Development. *J. Science and Technology* **30**(5), 667-672.
- 314 Stuart and Bennett, (2003). "Housefly" <http://www.thepiedpiper.co.uk/~th6a.htm>
- 315 Urzúa, A., Santander, R. I., Echeverriai, J., Cabezasi, N., Palacios, S. M. and Rossi, Y. (2010).
316 Insecticide Properties of the Essential Oils from *Haplopappus foliosus* and *Bahia*
317 *ambrosoides* against Housefly, *Musca domestica* L. *Journal of Chilean Chemical Society*
318 **55**(3), 392-395.
- 319 www.britannica.com/plant/ginger. Retrieved 28th June, 2015.
- 320 www.healthtype.com/houseflydiseasestypes-spread-and-prevention.html. Retrieved 4th
321 February. 2016.
- 322 [www.qpm.ca/structure of housefly](http://www.qpm.ca/structure%20of%20housefly). Retrieved on 28th of June, 2015.
- 323 www.wikipedia.com/housefly. Retrieved on 28th of June, 2015.