Effect of Curcuma longa (Turmeric) on biochemical aspects of House Fly, *Musca domestica* (Diptera: Muscidae)

Rahul Pawar*

* JJT University, Rajasthan, India

Abstract- *Musca domestica* found in every habitation causing nuisance, diseases which results in public health problems. Conventional methods used for fly control caused several problems such as pest resistance, effects on non-target organisms, pest resurgence etc. To overcome these difficulties, it is important to search for new ecofriendly alternatives. In present work an effort has been taken to solve these problems. For this a medicinal plant *Curcuma longa* (Turmeric) selected for screening its efficacy as biopesticide. It has medicinal properties such as anti-inflammatory, spasmolytic, antiparasitic, antibacterial, antiarthritic, carminative, Laxative, Tonic, Diuretic etc. Studied biochemical aspects reveal that enzyme activities were decreased to o.22umole/ml/min in case of Amylase while 0.30 umole/ml/min decreased was observed in case of Invertase. While it also decreased carbohydrate and protein content significantly i.e. 9.26 and 22.01 mg/gm body weight. These results conclude that this plant has to be further investigated for developing a ecofriendly insect control pesticides which can used in IPM.

Index Terms- *Curcuma longa*,Musca domestica, Medicinal properties, Biochemical asspects, IPM.

I. INTRODUCTION

The Housefly *Musca domestica L.* is a worldwide known pest/vector causing public health problems (West, 1951). Their role as vectors of human and animal pathogens especially those responsible for enteric diseases are due to the habit of defecation and regurgitation on animal and human food (Howard, 1911). It spreads disease causing organisms, especially *E.coli, Shigella and Salmonella spp*. (Ahmad et al., 2007; Holt et al., 2007; Nayduch and Stuzenberger, 2001). Houseflies disperse to areas of human habitation and activity from areas commonly found around human and animal waste (Mian et al., 2002; Sulaiman et al., 2000).

Such notorious house flies known for their ability to develop resistance mechanisms to avoid and detoxify chemical insecticides. Resistance to DDT was detected in short duration after its introduction (Varzandeh et al., 1954; Perry, 1958). There flies also developed resistance to organophosphates, carbamate and pyrethroid insecticides (Boxster and Campbell, 1983; Plapp, 1984; Kaufman et al., 2001b; Butler et al., 2007) as well as growth regulators such as diflubenzuron and cyromazine (Shen and Plapp, 1990; Bloomcamp et al., 1987). Due to continuous use of pesticides resulted in efficacy losses (Sheppard et al., 1990) and development of cross resistance (Scott, 1989).

Plants are well known producers of diverse kind of chemical compounds and many products that are used for defend plant against different kinds of pests (Isman and Akhtar, 2007). Various properties such as killing and repelling pests, affecting insect growth and development, antifeedant and arrestant effects, antifungal, antiviral and antibacterial action against pathogens, were evaluated (Prakash and Rao, 1986, 1997). Acetyl cholinesterase inhibition and octopaminergic effects were detected after treatment of essential oils as fumigant (Isman, 2000). Also effects on behavior modification and contact toxicity for different life stages were evaluated by Koul et al. (2008). Palacios et al. (2009 a,b) studied the effects of 21 medicinal and edible plants against Housefly in which he detected limonene (92.5%) and 1,8-cineole (56.9%) as principle components of orange peel and eucalyptus leaves. Medicinal plants with pulegone, menthone, limonene and 1, 8-cineole were found most toxic to house fly. In another study 34 plants were evaluated for fumigant and toxicity efficiency by Pavela (2008). The principle components of peppermint oil were menthone and menthol (Palacios et al., 2009 b). The plant tissues extracted, climatic and growth conditions, variation in cultivation and the methods used for extraction and analysis affects the composition of oils from particular species. For this reason there have been considerable efforts to examine the effects on individual components that are common to those essential oils known to have insecticidal properties (Isman,2000; Koul et al,2008).

From all above it is evident that plant originated pesticides can prove great beneficial for pest/vector control. The present work aims at the assessment of bioactive potential of medicinal plant *Curcuma longa* (Turmeric) which found to have Anti-inflammatory, Spasmolytic, Antiparasitic, Antibacterial, Anti-arthritic, carminative, Laxative, Tonic, Diuretic properties (Warrier et al, 1994), against the Housefly. Data obtained was subjected to statistical analysis.

II. MATERIALS AND METHODS

1. Rearing Method:

M. domestica nucleus culture was obtained from Entomology Section, National Chemical Laboratory, Pune. Temperature maintained was 28±2^{o}C and 58-68% R.H. Adults of *M.domestica* were reared in plastic jars of 35 cm height and 15 cm width, covered with muslin cloth. A cotton swab soaked in milk powder; yeast dissolved in water was given to adults as food and was changed after every 24 hours. This cotton swab also served as substrate for oviposition. The eggs were transferred to another jar on medium containing finely crushed

groundnut with water. The eggs were allowed to develop in this medium only up to pupal stage and were collected to keep in another container for adult emergence. Fresh emergence was transferred to separate containers to know the exact age of adults which is required for various bioassays.

2. Bioassays:

All test oils were dissolved in A.R. grade acetone and serial dilutions were made as per requirement.

2.1: Toxicity:

Larvicidal Assay:

Residual film technique was used to performed larvicidal assay (Tare, 1995). Uniform residual film was prepared on the Petri dish (4" diameter) both lower and upper dish. Ten prepupal larvae were introduced in each petri dish with desired concentration of the test plant oils while carrier solvent, acetone was used in control. Food was provided in all Petri dishes and mortality was observed after 24 hours. For each experiment five replicates were taken and each experiment was repeated five times. LC_{50} was calculated using log probit analysis. (Finney 1971). Data obtained was subjected to statistical analysis.

2.2: Biochemical Assay:

For all Biochemical assays prepupal larvae known weight were used. These larvae were exposed to LC_{20} concentration of test oil for 24 hours and then harvested and homogenized in 20ml of phosphate buffer of pH 6.8 and centrifuged at 8000 rpm in Ultra Centrifuge (Remi-CM12) for 10 minutes at 4^0C. The supernatant was used for biochemical assays.

a) Amylase activity:

DNSA Method was used to determined amylase activity (Plummer 1988, Sumner 1925). 0.5 ml substrate (1% Starch), 0.5 ml phosphate buffer (pH 6.8, 0.2 M) and 0.5 ml enzyme extract constituted the assay mixture. This mixture was incubated for 10 minutes and 1ml DNSA was added. The mixture was then kept in boiling water bath for 10 minutes. After this it was cooled, diluted to 10 ml and optical density (OD) was read at 540 nm on UV spectrophotometer (Systronics-Model 119 PC Based). The enzyme activity was calculated using standard curves for glucose. Each assay was carried out eight times and for each set three to five replicates were taken. Data obtained was subjected to statistical analysis.

b) Invertase activity:

Invertase activity was determined by DNSA Method (Plummer 1988, Sumner 1925) which was used to detect invertase activity. In this case 5% sucrose was used as substrate instead of starch. For each set three to five replicates were taken and the assay was repeated eight times. Data obtained was subjected to statistical analysis. Standard graph was plotted for determination of enzyme activity.

c) Estimation of Total Carbohydrate contents:

Carbohydrate was estimated using Anthrone method (Plummer, 1998).4 ml of anthrone reagent was rapidly mixed with 1 ml of a protein free supernatant. For ten minutes this mixture was kept in boiling water bath. The tubes were then cooled to read OD at 620 nm on UV spectrophotometer (Systronics-Model 119 PC Based) against the reagent blank. The amount of carbohydrate was calculated by using standard curve of glucose.

d) Estimation of Total Protein contents:

Protein estimation was determined according to Modified Lowry's method (Raghuramalu et al. 1983). Alkaline copper reagent, phenol reagent was prepared as per the method states. To 0.1 ml of larval extract, 0.5 ml of alkaline copper reagent was added in each tube, mixture was incubated at room temperature for 10 min which is followed by addition of 2 ml of phenol reagent. These tubes were heated for 5 minutes at 55°C and were cooled under running water. OD was measured at 650 nm on UV spectrophotometer (Systronics-Model 119 PC Based). Standard curve was used to calculate amount of protein using bovine serum albumin as standard. Amount of protein contents (mg) were calculated per gram body weight of larva. For each test minimum 10 replicates were taken. The test was repeated eight times. Data obtained was subjected to statistical analysis.

III. RESULTS AND DISCUSSION

Various plant products are used to kill or repel flies for several decades. Due to resistance problem caused by synthetic chemicals, research was focused on plant products so as to find alternative to these chemicals (Geden 2012).

The following result was obtained in the present study.

Table 1: Results of Biochemical Assays

Sr. No.	Assay	Control value	*Curcuma longa*
1.	Larvicidal Assay (ppm)	----	115.821 (0.269)
2.	Amylase Activity (µmole/ml/min)	0.51	0.73 (25.22*)
3.	Invertase Activity (µmole/ml/min)	0.46	0.76 (38.89*)
4.	Carbohydrate Content (mg/gm Body Weight)	25.89	16.63 (26.80**)
5.	Protein Content (mg/gm Body Weight)	68.39	46.38 (21.39*)
()=Chi Square, *=P<0.001:Very highly significantly different, **=P<0.05: significantly different			

Out of many plant products, some of them were found to be effective against insecticide resistant insects' pests (Ahn et. al., 1997; Assabgui, 1997; Jacobson, 1989; Miyakado et al 1983). *Z. officinalis* essential oil found effective bioactive agent against *M. domestica* possessing larvicidal activity, LC_{50} =137 ppm, repellency 84.9 and 98.1 % oviposition deterrence both at 1 % concentration, (Morey and Khandagle, 2012).

Selected plant oil, *Curcuma longa* showed good biochemical activities against *Musca domestica* i.e. it decreased the Amylase and Invertase activity by 0.22 and 0.30 µmole/ml/min. Significant decrease was also observed with respect to carbohydrate and protein content (9.26 and 22.01 mg/gm body weight respectively). These biochemical aspects can be correlated with the toxicity assays (Ishaaya and Casida, 1975). The results conclude that the plant Curcuma longa has some potential to be explored further for development of an ecofriendly pesticide/insecticide for control of House fly. It can be used with other plant products or chemicals for integrated pest management programs.

IV. CONCLUSION

Thus from above all results it can be concluded that, the plant oil *Curcuma longa* has potential to be used in ecofriendly pest management. It can also be used successively in the integrated pest management programmes.

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AUTHORS

First Author – Rahul Krishna Pawar, Ph.D Scholar, JJT University Rajasthan, rahul81015@gmail.com.