Pakistan J. Sci. Ind. Res., Vol. 25, No. 3, June 1982

ACTION OF A JUVENILE HORMONE ANALOGUE, STAUFFER R–20458, INSECT GROWTH REGULATOR, ON THE MORPHOGENESIS AND ADULT ECLOSION OF THE LABORATORY REARED HOUSE FLY, MUSCA DOMESTICA (L.)

Shams Mohiuddin and S. A. Qureshi

PCSIR Laboratories, Karachi.

(Received April 8, 1981)

Hormonal activity induced by Stauffer R-20458 in each stage (egg, larva, pupa and adult) of the house fly has been studied. Bioassays of eggs, larvae and adults revealed that each stage was slightly responsive to JHA, but non was as susceptible as the newly ecdysed pupal stage. The period of maximum sensitivity to R - 20458 extended to 1–2 hr after cessation of larval feeding. This period of sensitivity decreased as the pupae became older. Adults did not emerge from the treated pupae. Dissections revealed a gradient of pupal - adult intermediates within.

INTRODUCTION

Active juvenile hormone (JHA) analogues do not have a broad spectrum of activity against insects of different orders and tend to be highly specific against individual species [1]. Early studies showed difficulty in demonstrating juvenilizing effects on any of the Diptera when treated with insect JH analogues. Recent papers have, however, reported considerable success against the dipteran flies [2-5] none of the previous workers treated all the developmental stages of the house fly in order to find the target-stage for the maximum activity of Stauffer R-20458 in *Musca domestica* (L.) We report here an in-depth evaluation of its biological activity against the eggs, larvae, pupae and adults of the house fly with an aim to find the developmental period most sensitive to this compound during metamorphosis.

MATERIALS AND METHODS

The JH analogue tested is Stauffer R-20458, 6,7 - epoxy - 1 - (p-ethylphenoxy) - 3,7 - dimethyl - 2 - octene. The juvenile hormone preparation in acetone was applied topically to the 3rd instar larvae (48 - 72 hr old), 3rd instar larvae (2 hr before pupation), pupae (0 - 15 min old), pupae (1 - 2 hr old) and pupae (3 - 4 hr old) by means of a micro-applicator. Twenty five individuals of each of the previously mentioned developmental stages were topically treated at doses ranging from 0.01 to 10 μg. The treatment of eggs (< 3 hr old) was by dipping method. After immersing the eggs for 20 sec in different concentrations of the hormone (0.001 - 1%), they were placed on moist filter papers for 24 hr to observe hatchability. Each replicated experiment was repeated three times at 27±2° and 70-75% R.H. with a photoperiod of 8 hr. The results are expressed in term of per cent inhibition of adult eclosion calculated by the formula:

$$IE = 100 - \left(\frac{T}{C} \times 100\right)$$

Where IE = inhibition of emergence
T = per cent normal emergence in treatment
C = per cent normal emergence in control.

At 8 days post-treatment, when the control insects had undergone pupal-adult apolysis, the treated pupae were dissected and checked for morphogenetic effects.

RESULTS

House fly pupae obtained from larvae reared in bran medium were sensitive to R - 20458 treatment for first few hours after pupation. At 10 μg dose within the first 1–4 hr of pual development, no fly could emerge from the puparia. However, with lower doses (1 - 0.5 μg/pupa– 20 to 50% normal flies could emerge. The data presented in Table 1 demonstrate that high degree of sensitivity is found only during the first 2 hr of pupal development.

The compound proved ineffective against 3rd instar larvae even at 10 μg/ larva. Approximately 15% larvae were killed by this dose. No larval-pupal intermediate, malform-

ed pupae and adults were noticed at this dose. Topical application of adult flies at a dose of 10 μg/ fly also proved ineffective. The treated flies were fertile and F_1 generation was normal.

The compound at lower doses (0.001–0.005%) had no ovicidal action. Midrange doses (0.01 – 0.1%) showed slight ovicidal action, while higher doses (0.5–1%) showed moderate ovicidal action. Hatchability on the other hand was affected only at higher range of doses, Table 2.

Table 2. Effect on hatch of 0–3 hr-old eggs of house fly treated topically with R-20458 (Averages of three replicates).

% Concentration	% hatch of eggs	% mortality of Ist instar larvae	% inhibition of adult emergence
0.001	92	2	20
0.005	97	2	21
0.01	93	1	47
0.05	82	15	82
0.1	87	41	84
0.5	68	68	100
1	55	55	100
Acetone	89	0	18
Control	98.34	0	–

DISCUSSION

Table 1 presents the results obtained when the test compound was applied topically to larvae and pupae of various ages of house fly. The fully developed dead adults within the puparia have been scored as pupal-adult intermediates in the present studies. Dissection of the pupae revealed a gradation in the morphogenetic effects depending upon the stage of pupae at time of treatment. Srivastava & Gilbert [6] Wright [7] demonstrated that the age of the dipteran pupae is of utmost importance because older pupae require a greater amount of material to arrest development during the pharate adult stage. Therefore, the pupal-adult intermediate may reflect arrested growth during the early or late stages of this period. The maximum number of such intermediates were derived when pupae were treated within the first 1–4 hr of pupal development and the highest degree of sensitivity was noticed during the first 2 hr of pupa] development. Bioassays of eggs, larvae and adults of the house fly revealed that each stage was slightly responsive to JHA, but none was as susceptible as the newly ecdysed pupal stage. These observations are in line with the report of Wright and Spate [8]. The reason for the greater degree of sensitivity at the early pupal stage may be due to the absence of the endogenous corpus

Table 1. Juvenile hormonal activity based on the suppression of pupal-adult ecdysis in the house fly, *Musca domestica* (L.).

Treated stage	Juvenile hormone activity* at indicated dose (μg/insect)							
	10	1	0.5	0.25	0.1	0.05	0.025	0.01
3rd instar larvae (48–72 hr)	1	1	1	1	–	–	–	–
2 hr before pupation	3	3	2	1	1	1	1	–
White pupae (0–15 min)	4	4	3	3	3	3	1	1
1–2hr old pupae	4	4	3	3	3	3	3	1
3–4 hr old pupae	4	4	3	3	3	3	2	1

*4 = 80–100% suppression, 3 = 40–79% suppression, 2 = 20–39% suppression, 1 = 1–18% suppression.

allatum hormone and on action of other hormones of the neuroendocrine system.

In embryonic development the duration of the sensitive period to juvenoids is commonly limited to the first third of the egg development [9-10]. In diptera the sensitive period of embryogenesis is sometimes reported to occur before oviposition, this could explain for the limited effect of the test compound on the freshly deposited eggs.

REFERENCES

1. K.Slama, Annu. Rev. Biochem., **40**, 1079 (1971).
2. J.E. Wright and G.E. Spates, J.Econ. Entomol., **65**, 1346 (1972).
3. J.E. Wright, H.E. Smalley, R.L. Younger and H.R. Crookshank, J. Med. Entomol., **11**, 385 (1974)
4. J.E. Wright. Mosquito News, **34**, 160 (1974)
5. J.E. Wright and H.E. Smalley, Archives Envir. Cont. and Toxicology, **5**, 191 (1977)
6. U.S. Srivastava and L.I. Gilbert, Science, **161**, 61 (1968).
7. J.E. Wright, J. Econ. Entomol., **67**, 878 (1970).
8. J.E. Wright and G.E. Spates, J. Agr. Food Chem., **19**,289 (1971).
9. K. Slama and C.M. William, Nature, **210**,329 (1966).
10. W.F. Walker and W.S. Bowers, J. Econ. Entomol., **63**, 1231 (1970).