TRANSACTIONS OF THE ROYAL SOCIETY OF TROPICAL MEDICINE AND HYGIENE, VOL. 74, NO. 4, 1980

Brief Communications

Activity of precocenes on the Chagas's disease vector, *Panstrongylus megistus*

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The continued use of the organochlorine insecticides, HCH and dieldrin, for triatomine control is at present under review. Several organophosphorus, carbamate and pyrethroid insecticides are currently being tested and one, malathion, has already been introduced in the national vector control campaign in Argentina. It also has been suggested that juvenile hormone analogues (JHAs) may be used as control agents (GILBERT, 1976). However, as triatomine bugs are most susceptible to JHAs only during a few weeks of the fifth instar, their practical use is somewhat limited (PINCHIN *et al.*, 1978a). This may not be so for another class of compounds with insect growth regulatory activity—the plant-derived precocenes. In 1976, Bowers announced the discovery of such compounds with anti-juvenile hormone activity. Their principal effects on *Oncopeltus fasciatus* (Dallas) were the induction of precocious metamorphosis, and anti-gonadotropic and ovicidal activity (BOWERS 1976, 1977; BOWERS *et al.*, 1976). As we have noted some similarity in the structure-activity relationships for JHAs for *O. fasciatus* and *Panstrongylus megistus* (Burmeister), it was considered feasible that the precocenes might also exhibit anti-juvenile hormone activity on *P. megistus* and other triatomine bugs of importance in the transmission of Chagas's disease. We describe here the results of initial experiments with the precocenes and discuss their possibilities as future vector control agents.

Materials and Methods

The specimens of *P. megistus* used in these experiments were from a laboratory colony maintained at 27±2°C and 65±15% R.H. and given a weekly opportunity to feed on chickens. Acetone solutions of precocenes I and II (7-methoxy- and 6,7-dimethoxy-2,2-dimethylchromene, respectively) were applied topically, using a microsyringe, to the dorsal abdomen of each of the five nymphal instars, so that each insect received 100 μg of the compound. Insects in the control groups were treated with acetone (1 μl) only. The insects were then maintained in clean glass jars (700 ml capacity) fitted with filter paper roosts and closed with nylon netting. They were given a weekly opportunity to feed on chickens and their development was observed daily.

Similarly, third and fourth instars, one to seven days after ecdysis, were treated with precocene I, precocene II and precocene II plus *N*-(2, 5-dichlorophenyl)-3, 7-dimethyl-2, 6-octadienylamine a JHA effective in inducing juvenilization in *P. megistus* at 1·0 μg/fifth instar (PINCHIN *et al.*, 1978b) and 10 μg/fourth instar (Oliveira F., unpublished results), at the dosage given in Table II, and observed as before. The mortality , time taken to ecdysis and morphological characteristics of the subsequent instars were recorded.

Results and Discussion

Table I shows the results of topical application of precocene I and II to all the nymphal instars of *P. megistus*. Treatment of the third and fourth instars with precocene II resulted in high percentages of precocious adultoids at the next ecdysis. Precocene I, however, showed only weak activity on the fourth instar. The percentages, corrected (Abbott's formula) with respect to control group mortality, of apparently normal insects emerging upon the first moult after treatment, demonstrated the toxic effect of precocene II on the first and second instars and, to a lesser degree, of precocene I on the first instar. Furthermore, of all the insects which underwent ecdysis after treatment with precocene II, only one, a third instar which moulted to give an apparently normal fourth instar, moulted a second time. The resulting fifth instar died the day after ecdysis. Thus precocene II was 100% effective in blocking normal development when applied to the first to fourth instars. For precocene-treated *P. megistus*, a marked delay in moulting was observed in those insects which underwent precocious metamorphosis.

The precocious adultoids obtained had the appearance of adults in miniature, with the characteristic red and black coloration on the conexivium. The wings, though membranous and veined, were only partially developed, being small and curled up. The tarsi were, in general, two-segmented although some of the adultoids resulting from treated fourth instars had three-segmented tarsi. It had been

Table I—Effects of topical application on all nymphal instars on *P. megistus* treated with precocene I or II at 100 μg/insect

Compound	Treated instar	No. insects treated	After 1st moult			After 2nd moult
			No. precocious adultoids	% precocious adultoids /insects moulted	% apparently normal /insects treated	% apparently normal /insects treated
Precocene I	1st	90	0	0·0	22·2 (39·3)[1]	20·0 (43·6)[1]
	2nd	65	0	0·0	70·8 (92·7)	60·0 (94·6)
	3rd	50	0	0·0	82·0 (92·9)	66·0 (82·5)
	4th	50	4	9·3	78·0(100·0)	68·0(100·0)
	5th	50	0	0·0	70·0(100·0)	— —
Precocene II	1st	30	0	0·0	10·0 (17·7)	0·0 (0·0)
	2nd	25	0	0·0	8·0 (10·5)	0·0 (0·0)
	3rd	20	10	83·3	10·0 (11·3)	5·0 (6·2)
	4th	15	11	84·6	13·3 (18·9)	0·0 (0·0)
	5th	10	0	0·0	50·0 (83·3)	— —

[1] Numbers in parentheses correspond to the percentages corrected (using Abbott's formula) with respect to control group mortality.

Table II—Effects of treatment of 3rd and 4th instar *P. megistus* (1 to 7 days old) with precocene I, II or II plus the JHA *N*-(2, 5-dichlorophenyl)-3, 7-dimethyl-2, 6-octadienylamine

Treated instar	Compound	Dose μg/nymph	No. insects treated	After 1st moult			After 2nd moult		
				No. precocious adultoids	% precocious adultoids/insects moulted	% apparently normal/insects treated	No. precocious adultoids	% precocious adultoids/ insects moulted	% apparently normal/insects treated
3rd	Precocene I	100	30	0	0·0	73·3 (84·4)[1]	0	0·0	70·0(86·6)[1]
	Precocene II	100	30	19	100·0	0·0 (0·0)	—	—	— —
	Precocene II	10	30	9	47·4	33·3 (38·2)	2	22·2	23·3(28·8)
	Precocene II	1	31	0	0·0	71·0 (81·4)	0	0·0	58·1(71·9)
	Prec. II + JHA	100+10	30	0	0·0	46·7 (53·5)	12	100·0	0·0 (0·0)
4th	Precocene I	100	20	0	0·0	90·0(100·0)	0	0·0	55·0(64·9)
	Precocene II	100	20	19	100·0	0·0 (0·0)	—	—	— —
	Precocene II	10	20	0	0·0	85·0 (94·0)	0	0·0	75·0(88·5)
	Prec. II + JHA	100+10	20	0	0·0	70·0 (77·8)	6	42·8[2]	40·0(47·2)

[1] Numbers in parentheses correspond to the percentages corrected (using Abbott's formula) with respect to control group mortality.
[2] Adultoids not precocious because they moulted from the 5th instar.

noted previously that if precocious metamorphosis occurs from the fourth instar, either with precocene application to third-instar *O. fasciatus* (Bowers *et al.*, 1976) or to fourth instar *Rhodnius prolixus* (Stal), as described by Tarrant & Cupp (1978), the tarsi in the resultant fifth instar adultoid are three-segmented, as in a normal adult.

The adultoids were unable to copulate with each other or with normal adults and oviposition did not occur. They were also apparently unable to feed. Life expectancy was short, averaging $20 \cdot 9 \pm 4 \cdot 2$ days for fourth-instar adultoids that moulted from treated third instars; adult female *P. megistus* can live under laboratory conditions for five months and males for even longer (Szumlewicz, 1976). Consequently these fourth and fifth instar adultoids can be considered to have very low vector potential.

Table II shows the results of the treatment of third and fourth instars with the precocenes at various dosages, and with precocene II plus a potent JHA for this insect. The slight difference in response to the precocenes for the insects aged up to one week (Table II) and those of undefined age (Table I) can be attributed to the fact that some individuals of the latter group had several opportunities to feed before treatment, and hence the physiological processes involved in development and ecdysis would already have been initiated in some insects.

Precocene II, applied to the third instar at 10 μg/insect, caused the emergence of precocious adultoids upon both the first and second moults after treatment.

As expected, concurrent treatment with a JHA counteracted the effects caused by precocene. The third and fourth instars, treated with precocene II and a JHA (100 and 10 μg/insect, respectivly), after passing through an intercalary instar, gave rise to fifth and sixth instar adultoids respectively All the fifth and 50% of the sixth instar adultoids were similar in appearance to the precocious adultoids described above, although the sixth instar adultoids cannot strictly be termed precocious. However, the other sixth instars were characteristic of the partially juvenilized adultoids (Pinchin *et al.*, 1978b) which result from the application of JHA alone. Thus precocene apparently does not block the JH-receptor centres and probably inhibits JH production. This agrees with the results obtained for *O. fasciatus* (Bowers, 1977), in which females sterilized by precocene, upon receiving a dose of JH III, resumed oocyte development.

Evidently compounds with anti-juvenile hormone activity may have a future as control agents. Contrary to JHAs, they have the advantages of shortening the life-cycle of triatomine bugs and inducing the appearance of sterile adultoids with negligible vector potential. At present it seems unlikely, however, that either JHAs or precocene analogues will completely replace insecticides in control campaigns, although they could well be useful as complementary pesticides in integrated control programmes.

Acknowledgements

We are indebted to the Ministry of Planning (FINEP), the National Research Council of Brazil (CNPq), and the Research Council of this University (CEPG/UFRJ) for financial assistance.

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Accepted for publication 31st August, 1979.