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Larval susceptibility of *Aloe barbadensis* and *Cannabis sativa* against *Culex quinquefasciatus*, the filariasis vector

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Abstract: *Larvicidal potential of petroleum ether, carbon tetrachloride and methanol extracts of Aloe barbadensis and Cannabis sativa has been investigated against Culex quinquefasciatus. Among the extracts examined, Carbon tetrachloride extract (Cte) of Aloe barbadensis was the most effective with LC_{50} values of 15.31 and 11.01 ppm after 24 and 48 hr of exposure, respectively, followed by pertoleum ether extract (Pee) of A. barbadensis, Cte of C. sativa, methanol extract (Mee) of A. barbadensis, methanol and petroleum ether of C. sativa, LC_{50} being 25.97, 88.51, 144.44, 160.78 and 294.42 ppm after 24 hr and 16.60, 68.69, 108.38, 71.71 and 73.32 ppm after 48 hr of post treatment, respectively. Cte of both the plants exhibits potential larvicidal activity and can be used as ecofriendly alternative in the management of the filariasis vector, Culex quinquefasciatus.*

Key words: *Culex, Aloe barbadensis, Cannabis sativa, Larvicide, Filariasis vector*
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Introduction

Mosquitoes cause a major health hazard by transmitting vector borne diseases in tropical and subtropical countries. Filariasis is one of the major public health problem (Rahman *et al.*, 1989; Bansal and Singh, 2006). There was initial success in controlling the mosquito vector through synthetic insecticides (Sharma and Mehrotra, 1968; Bansal and Singh, 2007) but they have not yielded long lasting results due to development of resistance in vectors (Ranson *et al.,* 2001). Moreover, these pesticides are hazardous to the environment due to their propensity of bioaccumulation. Recently, stress is being laid on eco-friendly means of vector management. Insect larvicides of plant origin ought to be well defined and harmless to other non-target organism (Rajkumar and Jebanesan, 2004). Consequently, use of these botanical derivatives in mosquito control instead of synthetic insecticides could reduce the cost and environmental pollution. Preliminary laboratory evaluation of larvicidal activity of various plant extracts confined their broad-spectrum mosquito larvicidal properties (Sivagnaname and Kalyanasundaram, 2004; Thomas *et al.,* 2004; Cetin *et al.*, 2004; Ahmed and Hamshary, 2005; Shaleen *et al.*, 2005; Sharma *et al.,* 2006). For further enhancement of our knowledge about phyto-larvicides, an attempt has, therefore, been made to explore larvicidal potential of *Aloe barbadensis* and *Cannabis sativa* against the Filariasis vector, *Culex quinquefasciatus.* The insecticidal nature of *Aloe barbadensis* was reported by Pandey *et al.* (1977, 1979) and *Cannabis sativa* by Jalees *et al.* (1993).

Materials and Methods

The leaves of *Aloe barbadensis* and *Cannabis sativa* were collected from various places of Dayalbagh from May, 2004 to June, 2005. The leaves were washed thoroughly and dried in shade. Dried plant material (60 g) after manual crushing was extracted with petroleum ether, carbon tetra-chloride and methanol successively for 72 hr each in Soxhlet apparatus. These extracts were subjected for removal of the respective solvents in vacuum rotary evaporator. The pure crude extract residues were dissolved in ethanol or acetone to get the stock of desired concentrations ranging from 12500 ppm to 100,000 ppm and test concentrations were prepared by further diluting the stock with 200 ml of water. Twenty 3rd instar culicine larvae were exposed to the above prepared series of test concentrations. Experiments were conducted according to standard WHO (1975) procedure in triplicate with control, at 27±1°C temperature and 85% relative humidity. Mortality data were noted after 24 and 48 hr of exposure. LC_{50} was calculated from the data collected by applying Probit analysis (Finney, 1971), along with regression equation, heterogeneity and fiducial limits to find out the significance of experimental data at 95% confidence level.

Results and Discussion

The data reported in Table 1 reveal that carbon tetrachloride extracts of *A. barbadensis* (LC_{50} 15.31 and 11.01 ppm) and *C. sativa* (LC_{50} 88.51 and 68.69 ppm), after 24 and 48 hr of exposure were more effective as compared to their petroleum ether and methanol extracts. In all the extracts of *A. barbadensis* the larvicidal activity increases with increase in exposure period from 24 hr to 48 hr with decrease in LC_{50} values from 15.31 to 11.01 ppm (carbon tetrachloride extract), 25.97 to 16.60 ppm (petroleum ether extract) and 144.44 to 108.38 ppm (methanol extract). Similar trend was also observed in case of *C. sativa* with LC_{50} values 88.51 to 68.69 ppm (carbon tetrachloride extract), 294.42 to 73.32 ppm (petroleum ether extract) and 160.78 to 71.71 ppm (methanol extract) on increase in the exposure period. Further, it was observed that carbon tetrachloride extracts of both the plants were most toxic as compared to all the extracts examined against the culicine larvae (Fig. 1).

Table -1 : Larvicidal activity of *Aloe barbadensis* and *Cannabis sativa* against culicine mosquitoes

Plants	Extraction solvents	Exposure periods (hr)	Heterogeneity	Regression equation	LC_{50} (ppm)	Fiducial limits	
						Upper	Lower
Aloe barbadensis	Petroleum ether	24	2.862	2.33+1.88X	25.97	26.33	25.89
		48	1.358	3.88+0.91X	16.60	16.92	16.52
	Carbon tetrachloride	24	1.849	1.48+1.61X	15.31	15.35	15.30
		48	1.163	2.67+1.14X	11.01	11.55	11.00
	Methanol	24	2.976	1.27+1.72X	144.44	144.97	144.40
		48	11.048	0.28+2.31X	108.38	108.83	108.34
Cannabis sativa	Petroleum ether	24	1.4993	1.14+1.56X	294.42	297.94	294.40
		48	9.2798	2.47+1.35X	73.32	73.74	73.26
	Carbon tetrachloride	24	17.547	-3.68+4.45X	88.51	88.95	88.46
		48	18.022	-2.99+4.35X	68.69	69.11	68.63
	Methanol	24	0.402	2.87+0.96X	160.78	161.25	160.74
		48	1.017	2.26+1.47X	71.71	72.13	71.65

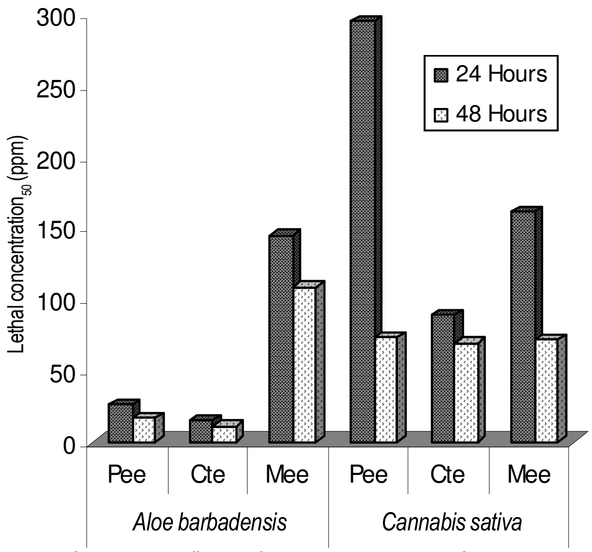

Fig. 1: Comparative efficacy of *Aloe barbadensis* and *Cannabis sativa* extracts against *Culex quinquefasciatus* larvae.
Pee = Petroleum ether extract, Cte = Carbon tetrachloride extract, Mee = Methanol extract

LC_{50} values of petroleum extracts of *Ageratum* conyzoides (LC_{50} 425.60 and 267.90 ppm after 24 and 48 hr) and fruit extract of *Calotropis procera* (LC_{50} 1501.60 and 346.33 ppm) after exposure of 24 and 48 hr were observed by Sharma *et al.* (2003), Batabyal *et al.* (2003) against *Culex quinquefasciatus* larvae, respectively. Prabakar and Jabanesan (2004) studied larvicidal efficacy of cucurbitaceous plants, *Momordica charantia, Trichosanthes anguina, Luffa acutangula, Benincasa cerifera* and *Citrullus vulgaris* with LC_{50} values 465.85, 567.81, 839.81, 1189.30 and 1636.04 ppm, respectively. Further, Bernard and De Xue (2004) observed the repellent activity of *Aloe vera* against *Aedes albopictus* and *Culex nigripalpus*. Sharma *et al*. (2005) reported crude acetone extracts of *Nerium indicum* (LC_{50} 209.00 and 155.97 ppm) and *Thuja orientelis* (LC_{50} 69.03 and 51.15 ppm) after 24 and 48 hr of post treatment against *Culex quinquefasciatus.* Mohan *et al.* (2005) have examined different fruit extracts of *Solanum xanthocarpum* against the larvae of *Culex quinquefasciatus* and among them petroleum ether extract was most efficient (LC_{50} 62.62 and 59.45 ppm after 24 and 48 hr of treatment, respectively) against the same vector species. Mohan *et al.* (2006) reported toxicity of different root extracts of *Solanum xanthocarpum*, among them petroleum ether extract with LC_{50} 41.28 ppm after 24 hr and 38.48 ppm after 48 hr of post treatment was the most effective against *Culex quinquefasciatus*. Mohan and Ramaswamy (2007), reported the larvicidal nature of leaf extract of *Agertina adenophora* with LC_{50} 227.02 ppm after exposure of 24 hr against the same mosquito species.

Thus, it is concluded that carbon tetrachloride extract of *Aloe barbadensis* has more efficacious larvicidal potential and can be exploited in future for managing filariasis vector population against *Culex quinquefasciatus*.

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