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Short Communication

Influence of some plant extracts on the ovi-position behavior of *Aedes fluviatilis* and *Culex quinquifasciatus*

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KEYWORDS

Ae. fluviatilis;
Cx. quinquifasciatus;
Plant extract;
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Abstract Alcoholic/acetone extracts of nine species of plants (*Allium tuberosum*, *Apium leptophylum*, *Carica papaya*, *Cymbopogon citratus*, *Euphorbia cotinofolia*, *Melia azedarach*, *Ocimum canum*, *Ricinus communis* and *Tagetes erecta*) were tested in respect to their influence on the ovi-position behavior of the mosquito, *Aedes fluviatilis* and *Culex quinquifasciatus* in concentrations of 100, 10 and 1 mg/L. Three days after mosquito females had fed on blood of anesthetized mice and pigeon respectively, experimental and control dishes were placed into cages for 24 h then number of eggs laid in each dish was counted. Alcoholic/acetone extracts of *C. papaya*, *C. citratus* and *T. erecta* at 100 mg/L; *E. cotinofolia* and *O. canum* at 100 and 10 mg/L were proved to be repulsive for ovi-position of *Ae. fluviatilis*. On the other hand, acetone extracts of *A. tuberosum* and *M. azederach* at 100 and 10 mg/L; *A. leptophyllum*, *O. canum*, *E. cotinofolia* and *R. communis* at 100 mg/L produced same effect on ovi-position behavior of *Ae. fluviatilis*. Alcoholic extracts *E. cotinofolia*, *R. communis* (100 mg/L) and *M. azedarach* (100 and 10 mg/L) were attractive to *Cx. quinquifasciatus*. Five acetone extracts (*A. tuberosum*, *A. leptophylum*, *C. papaya*, *C. Citrates* and *M. azedarach*) were repulsive for ovi-position at 100 mg/L. Acetone extract of *A. tuberosum* and *M. azedarach* at 10 and 1 mg/L and *C. citratus* at 10 mg/L maintained the same properties. Our results concluded that each plant extract has the potential to control ovi-position behavior of mosquito. The differences in obtained responses necessitate the adoption of deeper research to isolate the active principle of such plants for potential use in mosquito control program.

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1. Introduction

Mosquitoes are vector for many diseases including malaria, yellow fever and filariasis [1–3]. Chemical insecticides are among the most prevalent methods for controlling the mosquitoes worldwide. However, mosquitoes are reported to develop genetic resistance to such chemical insecticides [4]. Moreover, chemical insecticides are well known for its adverse effects

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on aquatic, terrestrial as well as aerial environment. Also, they are considered one major cause for endocrine disruption among aquatic animals, terrestrial animals and human [5]. Thus, an urgent search for safe, environment friendly and low cost insecticides has mandated the use of plant extracts to play such interesting potential roles [6].

Aedes fluviatilis species are widely distributed mosquitoes throughout both domestic and silvatic habitats. Experimentally, the species were confirmed to play a pivotal role in the transmission *Plasmodium gallinaceum* infection [7] and *Dirofilaria immitis* [8]. In addition, its biology compared to *Aedes aegypti* under many aspects, can be used as an experimental substitute for this species at the regions in- which the in vitro establishment of the colonies of yellow fever vector may cause risk for public health [9,10]. *Culex quinquifasciatus* is one of the species essentially domestic. It is the principle vector of *Wuchereria bancrofti* worldwide [11].

The selection of ovi-position seems to be the most important factor in determining breeding places in all mosquito species [12]. The present study was designed to measure the influence of ethanol and acetone extracts of nine plants on the ovi-position behavior of *Ae. fluviatilis* and *Cx. quinquifasciatus* at the laboratory.

2. Materials and methods

Mosquitoes *Ae. fluviatilis* and *Cx. quinquefasciatus* used in the study were maintained in the laboratory. Nine species of plants, *Allium tuberosum* (leaves), *Apium leptophylum* (leave stem and roots), *Carica papaya* (seeds), *Cymbopogon citrates* (leaves, stem and roots), *Euphorbia cotinofolia* (leaves and stem), *Melia azedarach* (leave stem and roots), *Ocimum canum* (leaves and stem), *Ricinus communis* (fruits and seeds) and *Tagetes erecta* (fruits and branches) were selected on the basis of its biological activity on mosquito or other organism, easy obtaining and abundance in nature and identified according to Marbberly [13]. Plant extracts were prepared by agitating the dried and ground plant parts in ethanol and/or acetone separately for 24 h followed by filtration and later recuperation of solvent using rotary evaporator.

Thirty-six experiments, three replicates were conducted in each case. For each replicate 1000 male and 1000 female of each species (4 and 5 days old) were kept into cages ($40 \times 40 \times 40$ cm) containing 5% honey solution. Three days after females of *Ae. fluviatilis* and *Cx. quinquefasciatus* had fed on blood of anesthetized mice (*Mus musculus*) and pigeon(*Columbia livia*) respectively, experimental and control dishes were placed into cages for 24 h, number of eggs laid in each dish was counted. For each experiment, concentration of 100, 10 and 1 mg/L in distilled water for each plant extract was used (150 ml/9.5 cm in diameter). Similar dish containing only distilled water was added as a control.

3. Results and discussion

Tables 1 and 2 show totals, means and standard deviation of eggs of *Ae. fluviatilis* laid in different concentration and in control dishes. All of 9 (100%) acetone extracts and five alcoholic extracts (*C. papaya*, *C. citratus*, *E. cotinofolia*, *O. canum* and *T. erecta*) 5 (55.6%) were repulsive for ovi-position of *Ae. fluviatilis* at 100 mg/L. Two alcoholic extracts (*E. cotinofolia* and *O. canum*) 2 (22.2%) and also, two acetone extracts (*A. tuberosum* and *M. azedarach*) at 10 mg/L maintained the same properties. The presence of plants or derived substances may be interfering with ovi-position behavior for repulsive or attractive effect of different plant extracts [6,14–16]. In concordance with our results, Angerilli [17] found that six fresh water vegetation extracts were repulsive, one extract was attractive and one extract did not show any effect on ovi-position behavior of *Ae. aegypti*. But Amonker and Reeves [18] observed that methanol extract of *Allium sativum* enhanced larval mortality against species of genus *Culex* and *Aedes*. Kamaraj et al. [19] studied the larvicidal activity of the acetone, chloroform, ethyl acetate, hexane and methanol leaf extracts of *O. canum* and *O. sanctum* against fourth instar larvae of *Ae. aegypti* and *Cx. quinquefasciatus*. Authors have discovered that all extracts showed moderate larvicidal effects and the highest larval mortality was found in methanol extract of *O. canum*, and acetone extract of *O. sanctum* against *Ae. aegypti* (LC (50) = 99.42, 94.43 and 81.56 ppm) and against *Cx. quinquefasciatus* (LC (50) = 44.54, 73.40 and 38.30 ppm), respectively. Interestingly, Warikoo et al. [20] revealed that the addition of 100% oil of *Ocimum basilicum*, *Cymbopogon nordus* and *Apium graveolens* caused complete ovi-position deterrence of

Table 1 Totals, means and standard deviations of eggs of *Ae. fluviatilis* laid in different concentration (mg/L) in alcoholic extracts and in control dishes.

Plants extracts	Concentration (mg/L)				Control			
	100		10		1			
	N	*X* ± *S*	*N*	*X* ± *S*	*N*	*X* ± *S*	*N*	*X* ± *S*
Allium tuberosum	8739.4	2913.1 ± 734.0	6825	2275.0 ± 1304.8	10473.3	3491.1 ± 878.3	9211	3070.3 ± 1123.7
Apium leptophylum	735.3	245.1 ± 257.4	1220.8	407.0 ± 409.3	3426.4	1142.1 ± 896.0	4702.6	1567.5 ± 278.5
Carica papaya	1165.2	388.4 ± 305.2*	6298	2099.3 ± 1013.4	9405.3	3135.0 ± 1501.8	9030.6	3010.2 ± 1387.0
Cymbopogon citrates	554.9	184.6 ± 118.0*	7907.1	2635.7 ± 693.6	9363.5	3121.2 ± 1529.7	8129	2709.7 ± 945.4
Euphorbia cotinofolia	27.7	9.2 ± 16.0*	4688.7	1563.0 ± 362.1*	11153.1	3717.7 ± 1635.6	13,761	4587.0 ± 985.0
Melia azedarach	2219.5	739.8 ± 165.5	1581.5	527.2 ± 215.3	2635.8	878.6 ± 548.7	2386	795.3 ± 541.9
Ocimum canum	41.6	13.9 ± 13.9*	3606.7	1202.2 ± 862.0*	8739.4	2913.1 ± 1058.0	10320.9	3440.6 ± 634.3
Ricinus communis	4355.8	1451.9 ± 696.5	7463.1	2487.7 ± 1434.2	8739.4	2913.1 ± 1664.7	10972.7	3657.6 ± 1056.5
Tagetes erecta	624.2	208.1 ± 291.3*	1553.7	518.0 ± 280.7	3481.9	1160.6 ± 517.2	4022.9	1341.0 ± 847.6

N = number of eggs in three replicates.
* Repulsive.

Table 2 Totals, means and standard deviations of eggs of *Ae. fluviatilis* laid in different concentration (mg/L) in acetone extracts and in control dishes.

Plants extracts	Concentration (mg/L)				Control			
	100		10		1			
	N	*X* ± *S*	*N*	*X* ± *S*	*N*	*X* ± *S*	*N*	*X* ± *S*
Allium tuberosum	0	0*	83.2	27.7 ± 27.8*	1917.3	638.1 ± 369.4	4106.1	1368.7 ± 234.7
Apium leptophylum	263.7	87.9 ± 32.0*	2635.7	878.6 ± 308.4	2927	975.7 ± 224.7	3038	1012.7 ± 280.5
Carica papaya	2066.9	689.0 ± 375.4*	20,919	6973.0 ± 4368.2	13036.6	4345.6 ± 1337.8	13164.5	4388.2 ± 688.1
Cymbopogon citrates	277.4	92.5 ± 56.1*	2816.1	938.7 ± 461.4	4425.1	1475.0 ± 734.1	5160.4	1720.1 ± 487.7
Euphorbia cotinofolia	1318.6	439.5 ± 235.8*	7158	2386.0 ± 440.4	12623.6	4207.9 ± 1521.7	13552.9	4517.6 ± 1621.7
Melia azedarach	305.1	101.7 ± 152.8*	1858.8	619.6 ± 701.1*	8073.5	2691.2 ± 1880.3	11319.6	3773.2 ± 750.0
Ocimum canum	277.4	92.5 ± 136.9*	2829.9	943.3 ± 563.2	3800.9	1267.0 ± 142.3	4688.7	1562.9 ± 485.8
Ricinus communis	3093.5	1031.2 ± 1035.5*	8087.3	2695.8 ± 621.3	7754.5	2584.8 ± 1098.8	15286.9	5095.6 ± 515.6
Tagetes erecta	1095.9	365.3 ± 433.0*	7144.1	2381.1 ± 1305.6	11388.9	3796.3 ± 1781.4	9432.9	3144.3 ± 423.8

N = number of eggs in three replicates.
* Repulsive.

Ae. agypti L except in *A. graveolens* which resulted in 75% effective repellency.

Tables 3 and 4 show totals, means and standard deviation of eggs of *Cx. quinquefasciatus* laid in different concentration of ethanol and acetone extracts respectively and in control dishes. One alcoholic extracts (*O. canum*) 1 (11.1%) and five acetone extracts (*A. tuberosum*, *A. leptophylum*, *C. papaya*, *C. citratus* and *M. azedarach*) 5 (55.6%) were repulsive for ovi-position of *Cx. quinquefasciatus* at 100 mg/L. Two acetone extracts (*A. tuberosum* and *M. azedarach*) at 10 and 1 mg/L and the acetone extracts of *C. citratus* at 10 mg/L maintained the same properties. Three ethanol extracts of *E. cotinofolia*, *M. azedarach* and *R. communis* 3 (33.3%) were attractive for ovi-position at 100 mg/L. In addition to ethanol extract of *M. azedarach* was attractive at 10 mg/L. Those results indicated that each solvent and concentrations used were important in the selection of the places for ovi-position. The suitable location selected for ovi-position is an important in the distribution of mosquito species. The behavior of the females for selection of place may be influenced by numbers of physical, chemical and biological factors [21–23]. Coping with this facts, Arias and Hischmann [24] reported that the oil and ethanol extract of fruits of *M. azedarach* were repulsive for nymph of 4 stages of *Triatoma infestans*. Practically, Sharma et al., [25] recorded that 2% of the oil of *Azadirachta indica* mixture with oil of coconut when applied on the exposed parts of human body exhibited complete protection for 12 h against the bites of the species of anophelines. *A. indica* extract, was tested against larvae and pupae of *Culex pipiens* under laboratory conditions in Algeria. After treatment of larval stage, LC50 and LC90 values for Azadirachtin were 0.35 and 1.28 mg/L in direct effect and 0.3–0.99 mg/L in indirect effect, respectively. Also, after treatment of the pupal stage, the LC50 and LC90 in direct effect were measured as 0.42–1.24 mg/L and in indirect effect was 0.39–1.14 mg/L respectively. In addition, mosquito adult fecundity was decreased and sterility was increased by the Azadirachtin after treatment of the fourth instar and pupal stage. The treatment also prolonged the duration of the larval stage [26].

It is worthy to perceive that extract concentration and type of solvents for extraction are important when used to influence the ovi-position behavior. In conclusion, our results indicated that the plants used in the current study were rich source of valuable compounds. Therefore, screening of these plants will

Table 3 Totals, means and standard deviations of eggs of *Cx. quinquifasciatus* laid in different concentration (mg/L) in alcoholic extracts and in control dishes.

Plants extracts	Concentration (mg/L)				Control			
	100		10		1			
	N	*X* ± *S*	*N*	*X* ± *S*	*N*	*X* ± *S*	*N*	*X* ± *S*
Allium tuberosum	14	14.0 ± 3.0	50	16.7 ± 2.1	43	14.3 ± 8.4	82	27.3 ± 22.3
Apium leptophylum	10	3.3 ± 2.5	24	8.0 ± 4.6	32	10.7 ± 10.0	53	17.7 ± 13.7
Carica papaya	116	38.7 ± 5.1	115	38.3 ± 25.5	132	44.0 ± 11.5	145	48.3 ± 31.6
Cymbopogon citrates	16	5.3 ± 3.5	26	8.7 ± 6.4	16	5.3 ± 4.2	28	9.3 ± 5.5
Euphorbia cotinofolia	75	25.0 ± 20.1**	43	14.3 ± 11.0	10	3.3 ± 1.2	14	4.7 ± 4.7
Melia azedarach	41	13.7 ± 10.8**	68	22.7 ± 19.1**	17	5.7 ± 1.2	11	3.7 ± 0.6
Ocimum canum	12	4.0 ± 2.0*	48	16.0 ± 4.6	68	22.7 ± 13.9	63	21.0 ± 3.6
Ricinus communis	98	32.7 ± 10.3**	58	19.3 ± 7.5	40	13.3 ± 6.0	32	10.7 ± 5.0
Tagetes erecta	17	5.7 ± 2.3	45	15.0 ± 9.5	47	15.7 ± 15.9	37	12.3 ± 7.1

N = number of eggs laid in three replicates.
* Repulsive.
** Attractive.

Table 4 Totals, means and standard deviations of eggs of *Cx. quinquifasciatus* laid in different concentration (mg/L) in acetone extracts and in control dishes.

Plants extracts	Concentration (mg/L)				Control			
	100		10		1			
	N	$X \pm S$	N	$X \pm S$	N	$X \pm S$	N	$X \pm S$
Allium tuberosum	0	0*	46	15.3 ± 7.0*	79	26.3 ± 22.2*	248	82.7 ± 25.0
Apium leptophylum	1	0.3 ± 0.6*	24	8.0 ± 5.2	34	11.3 ± 12.9	103	34.3 ± 17.1
Carica papaya	29	9.7 ± 4.6*	47	15.7 ± 6.8	39	13.0 ± 3.6	83	27.7 ± 12.9
Cymbopogon citrates	7	2.3 ± 2.3*	15	5.0 ± 3.5*	30	10.0 ± 2.0	79	26.3 ± 6.7
Euphorbia cotinofolia	95	31.7 ± 13.8	93	31.0 ± 5.0	63	21.0 ± 9.5	157	52.3 ± 27.5
Melia azedarach	107	35.7 ± 9.7*	142	47.3 ± 16.4*	114	38.0 ± 10.0*	282	94.0 ± 33.9
Ocimum canum	37	12.3 ± 4.7	36	12.0 ± 3.6	41	13.7 ± 10.3	116	38.7 ± 33.7
Ricinus communis	215	71.7 ± 28.9	95	31.7 ± 11.6	84	28.0 ± 11.5	138	46.0 ± 35.4
Tagetes erecta	265	88.3 ± 41.9	95	31.7 ± 16.0	93	31.1 ± 16.6	387	129.0 ± 88.4

N = number of eggs laid in three replication.
* Repulsive.

be of great interest and further investigation should be undertaken to identify the biological active compound and their chemical structure.

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