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Evaluation of Efficacy of Platy (*Xiphophorus maculatus*) as Larvivorous Fish to Control Mosquito Larvae

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ABSTRACT

A study on larvivoricity of platy (Xiphophorus maculatus) was carried out for 24 h. The experiment was carried out in aquarium tanks consisting of individual male platy (T1), individual female platy (T2), 2 male platy (T3), male and female platy (T4) and 2 female platy (T5). Each tank containing 24 h pre-starved fish were offered 600 numbers of mosquito larvae and the consumption rate/tank was recorded at 24 h. On an average, the tank holding 2 female fish (T5) consumed 579.3 number of mosquito larvae registering the highest consumption rate followed by T4 containing male and female fish consumed 427.3 no. of mosquito larvae, T2 containing individual female fish consumed 271.7 no. of mosquito larvae, T3 containing 2 male fish consumed 251 no. of mosquito larvae and T1 containing individual male fish with 124.7 no. of mosquito larvae. The mosquito larvae consumption rate was T5>T4>T2>T3>T1. The water quality parameters recorded during the study were well within the tolerable range for platy fish. The statistical analysis performed by One way ANOVA showed no significant difference between the group T2 and T3, but there was a significant difference among the groups T1, T4 and T5. The present study indicated that the platy may be used as potential larvivorous fish to control mosquito larvae. Further, the larvivoricity rate of female platy is higher than male.

Key words: *Mosquito larvae, Platy, Larvivorous, Xiphophorus maculatus.*

INTRODUCTION

The mosquito-borne diseases are the major problem in almost all tropical and subtropical countries[10]. The mosquitoes play a major role in transmitting many hazardous diseases that include malaria, dengue, filariasis, encephalitis, equine infectious anaemia, yellow fever and chikungunya[14, 16, 23, 31, 42]. The mosquitoes breed in stagnant waters and the larvae can be seen in small pits, drainage water, ornamental pools, water coolers, lakes, paddy fields etc.[15]. In order to check the spread of mosquito-borne diseases, mosquito larvae need to be controlled by employing chemical, physical and biological control measures. The chemical measures (pesticides) are the important components of mosquito control program worldwide.

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The repeated use of the pesticides to control mosquitoes resulted in the development of chemically resistant sub strains of mosquito, pollutes water and land resources[17]. The development of resistance to insecticides in mosquitoes along with emergence of different mosquito-borne diseases and damage to ecosystem by the use of insecticides necessitised the way to show interest in biological control techniques[25, 26]. The attempts have been made to use larvivorous fish species as biological controlling agents which are considered as the alternative methods against insecticides[14, 27, 33, 34, 43]. It has been reported that there are more than 253 species of fish which can be considered to control mosquito and its larvae throughout the world[13]. The use of fish as biocontrol agents has been proved effective towards the control of malaria mosquito larvae[19, 22]. It was also suggested that the larvivorous fish should be hardy, small in size and possess the capacity to live in shallow water bodies among thick weeds where mosquitoes breed and multiply[20]. The different larvivorous fishes like *Poecilia reticulate, Gambusia affinis, Colisa fasciatus, Aphanius disper, Aplocheilus panchax, Rasbora daniconius, Trichogaster fasciata, Trichogaster lalia, Notopterus notopterus, Esomus dandricus, Anabas testudines, Wallago attu* and *Chanda nama* can be used as biocontrol agents to control mosquito larvae [10, 21, 28, 29]. The present study was conducted to understand the potential use of platy as a larvivorous fish to control the mosquito larvae.

MATERIAL AND METHODS

The experiment was conducted in laboratory conditions with a total of 10 aquarium tanks in triplicates. The total 24 platy fish were procured form local aquarium shop. The length and weight of each fish were recorded and placed in different aquarium tanks (20 L), in the order of individual male platy (T1), individual female platy (T2), 2 male platy (T3), male and female platy (T4) and 2 female platy (T5). The fishes were acclimatized for one week and fed with artificial feed. After acclimatization fish were starved for 24 h before introduction of mosquito larvae as feed. Mosquito larvae were cultured near the experimental setup by mixing dry poultry manure with clean water at the rate of 0.25 grams/ltr in 5 fibber glass tank each containing 100 litre of water. The tanks were kept undisturbed in dark place for 7 days. So that mosquitoes can lay eggs and larvae can develop. After 7 days, the larvae in the 3rd instar stage were collected, washed with clean water, counted and fed to the fish. Each aquarium tank was provided with 600 numbers of mosquito larvae and consumption rate in each aquarium tank at 24th h was recorded.The water quality parameters were analysed just before commencement of experiment and at 24th h of experiment. The water samples were collected at 0th h (just prior to release of mosquito larvae) and at 24th h after release of mosquito larvae, and analyzed for water temperature, pH, dissolved oxygen (DO), free carbon dioxide and ammonia. Digital pH meter model LI 613 was used to record pH. Water temperature was recorded by using thermometer. Dissolved oxygen was estimated by Winkler's method. The ammonia and free carbon dioxide were determined according to the standard methods [3].The statistical analysis for the mean mosquito larvae consumption among all groups was performed by One way ANOVA: $p<0.05$, by using Tukey's HSD test.

RESULTS

The length and weight of all fishes were ranged from 3.8 cm to 4.3 cm and 1.25g to 1.75 g respectively. In the experimental period of 24 h, the rate of mosquito larvae consumption varied among the different groups (Fig 2). On an average, the tank holding 2 female fish (T5) consumed 579.3 number of mosquito larvae registering the highest consumption rate. The group of male and female fish (T4) consumed 427.3 number of mosquito larvae. The individual female fish (T2) consumed 271.7 number of mosquito larvae. The group of 2 male fish (T3) consumed 251 number of mosquito larvae and the individual male fish (T1) consumed 124.7 number of mosquito larvae.In the present

study, it was found that the prey consumption ability of fishes increased with the body size and dependent on sex. The female fish consumed more number of mosquito larvae than male fish. It was also observed that the larval consumption rate was increased with the fish kept in social condition compared to the fish kept in solitary state. In the present experiment, physico chemical analysis of water was also carried out and at the 0^{th} h, the water temperature, pH, DO, ammonia and carbon dioxide were ranged between 27.2-27.6 ^{0}C, 7.1-7.3, 7.27-7.67 mg/l, 0.007 - 0.012 mg/l and 1- 1.09 mg/l respectively. After 24^{th} h the water temperature, pH, DO, ammonia and carbon dioxide were ranged between 27.2-27.6 ^{0}C, 6.9 - 7.2, 5.03- 5.33 mg/l, 0.018 - 0.02 mg/l and 1.04 - 1.12 mg/l respectively. The statistical analysis performed by One way ANOVA ($p<0.05$) by using Tukey's HSD test. The mean mosquito larvae consumption among all the groups revealed that there was no significant difference between the group T2 and T3, but there was a significant difference among rest of the treatments T1, T4 and T5 (Fig 3).

DISCUSSION

In the present study, platy was considered as an efficient biocontrol agent against the mosquito larvae because of its small size and higher consumption of mosquito larvae. Small sized fish are suitable for mosquito control and it was detected by the calculation of predatory index of *Oreochromis mossambicus*[38]. In the present study, it was observed that female platy consumed more number of mosquito larvae compared to male platy. This may be due to the larger size of the female platy compared to male. This can also be seen in the study of Manna *et al.*[24] who reported that the prey consumption of the predator varied with the size of fish. Cavalcanti *et al.*[9] also found that the efficacy of larvivorus fish depends on its weight and sex. This is supported by Awoyemi *et al.*[5] and Saleeza *et al.*[35] who found that female guppies (*P. reticulata*) consumed more mosquito larvae than male guppies due their larger size.In the present study, it was observed that single female platy consumed more mosquito larvae than the group that contained two males. This may be because of the larger size of the female fish. This is also supported by findings of Elias *et al.*[12] who reported that female guppies consumed nearly double the quantity of *Culex* larvae than males. In the present study, higher mosquito larvae consumption rate was observed in the platy kept socially than kept alone. This may be due to the increased chance of predator-prey encounter rate which would encourage the predator to consume more prey[2, 37]. In the present study, female platy consumed more mosquito larvae compared to male platy. This may be due to higher requirement of food during growth phase of female compared to male. In the present study, it was found that fish consumed more larvae when two female or male fishes were exposed to prey than when only one male fish was exposed. This result is supported by the observations of Saleeza *et al.*[35] who reported that two male guppy fish consumed more mosquito larvae than single male guppy fish. Anogwih and Makanjuola[2] documented low foraging behaviour in guppies when a single guppy fish is exposed to the mosquito larvae. However, when two fish are exposed to mosquito larvae, competition between the two fish and increased chance of predator-prey encounter rate may contribute by increasing their foraging behaviour. In the present study, it was also observed that mosquito larvae feeding rate of single female platy was higher compared to the group contained two male platy. This may be due to larger size of female fish and also can consume nearly double the quantity of mosquito larvae than males[12]. It was also found that the single male and single female consumed an average of 124.7 and 271.7 mosquito larvae in 24 h respectively which was higher when compared to guppy as reported by Elias *et al.*[12] who observed that on an average, a female guppy consumed 54.9 mosquito larvae / day and male guppy consumed 27 larvae / day. The water quality is an important part of aquaculture system and any deterioration in water quality causes stress

in fish and that may lead to diseases[4]. In the present experiment, water quality parameters were analyzed at 0th h and at 24th h. The physico-chemical parameter such as water temperature ranged between 27.2 - 27.6 ^{0}C at 0th h and 27.2- 27.6 ^{0}C at 24th h. The water temperature was in the range that platy can tolerate because it is a eurythermal fish with a critical thermal maximum over 40 °C and critical thermal minimum of 9.6 °C[32]. The pH was in the range between 7.1-7.4 at 0th h and 7.0-7.2 at 24th h. There was a slight decrease in pH at 24th h, because metabolism in fish might released metabolites to water and decreased the pH. But the pH was in the range of 6.7-9.0 which is more suitable for fish culture [11, 36]. The DO was in the range between 7.67-7.27 mg/l at 0th h and 5.03-5.33 mg/l at 24th h. There was a decrease in DO at 24 h and this was because fish required DO for aerobic metabolism [40]. Bhatnagar *et al.*[7] reported that DO level >5ppm is essential to support good fish production and the desired concentration of DO in water should be in the range of 5 to 15 mg/l [8]. The ammonia was in the range between 0.007-0.012 mg/l at 0th h and 0.018-0.02 mg/l at 24th h. There was a slight increase in ammonia in all the tanks at 24 h because the quantity of ammonia released through fish metabolite is proportional to the feeding rate [41]. The values obtained in this study are within the safe range[6, 30, 39] and according to Abdalla & MacNabb[1] the lethal concentration of unionized ammonia for fish varies between 0.32 - 3.1 mg/l. The carbon dioxide (CO_2) was in the range between 1 - 1.09 mg/l at 0th h and 1.04 - 1.12 mg/l at 24th h. Fish consumed DO and released CO_2 during respiration and this might have contributed for an increase of CO_2 in all the tanks. The CO_2 values recorded during the present investigation were in the safer limit, as the free CO_2 in water to support good fish population should be less than 5 mg/l [6] and also fish can tolerate concentrations of CO_2 as high as 10 ppm provided DO concentrations are higher [39].The statistical analysis performed by One way ANOVA ($p<0.05$) by using Tukey's HSD test, for the mean mosquito larvae consumption among all the groups revealed that there was no significant difference between the group T2 and T3. This indicates that two male platy can consume nearly the same amount of mosquito larvae as single female platy. Thus, single large female platy is better in controlling mosquito larvae than using two small male platy. But there is a significant difference among rest of the treatments T1, T4 and T5 (Fig. 3).

Table 1: Details of average length (cm), weight (g) and number of larvae consumed by each group

Sl No.	Fish	Experiment	Average length (cm)	Average weight (g)	Average larvae consumed
1	Male platy	T1	4.03	1.31	124.7
2	Female platy	T2	4.13	1.58	271.7
3	2 Male platy	T3	3.9	1.19	251
4	Male platy with Female platy	T4	3.97	1.41	427.3
5	2 Female platy	T5	4.2	1.46	579.3

Table 2: Details of different water quality parameters recorded at 0th hour

0th Hour					
PARAMETERS	**Groups**				
	Male platy	Female platy	2 Male platys	Male platy with Female platy	2 Female platys
Temperature at 0 h (^{0} C)	27.2	27.4	27.4	27.3	27.6
pH at 0 h	7.3	7.1	7.1	7.2	7.1
Dissolve oxygen at 0 h (mg/l)	7.27	7.32	7.67	7.63	7.6
Ammonia at 0 h (mg/l)	0.012	0.009	0.009	0.008	0.007
Carbon dioxide at 0 h (mg/l)	1.09	1	1.03	1.02	1.04

Table 3: Details of different water quality parameters recorded at 24th hour

24th Hour					
PARAMETERS	**Groups**				
	Male platy	Female platy	2 Male platys	Male platy with Female platy	2 Female platys
Temperature at 24 h (^{0} C)	27.4	27.6	27.5	27.2	27.5
pH at 24 h	7.2	6.9	7	7.1	6.9
Dissolve oxygen at 24 h (mg/l)	5.1	5.2	5.33	5.15	5.03
Ammonia at 24 h (mg/l)	0.018	0.019	0.018	0.019	0.02
Carbon dioxide at 24 h (mg/l)	1.12	1.04	1.07	1.07	1.09

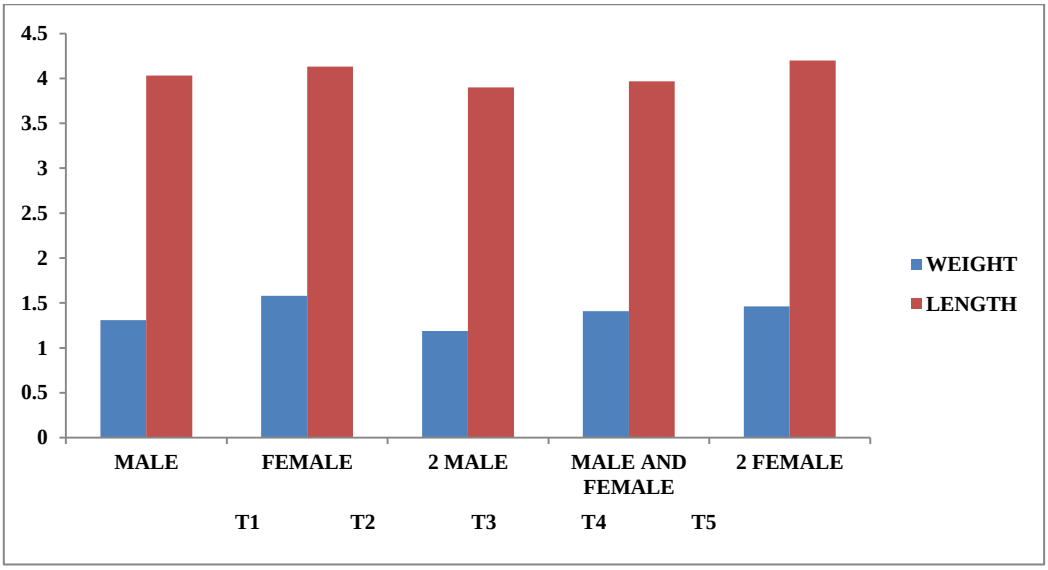

Fig. 1: Relationship between length and weight of platy fish

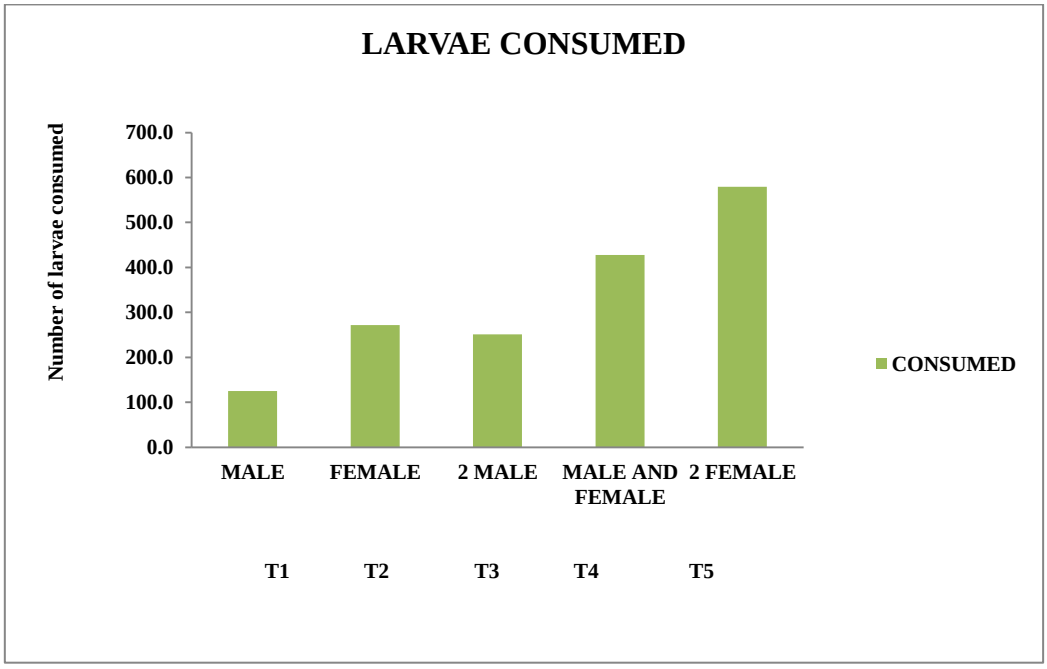

Fig. 2: Different groups and mosquito larvae consumption rate

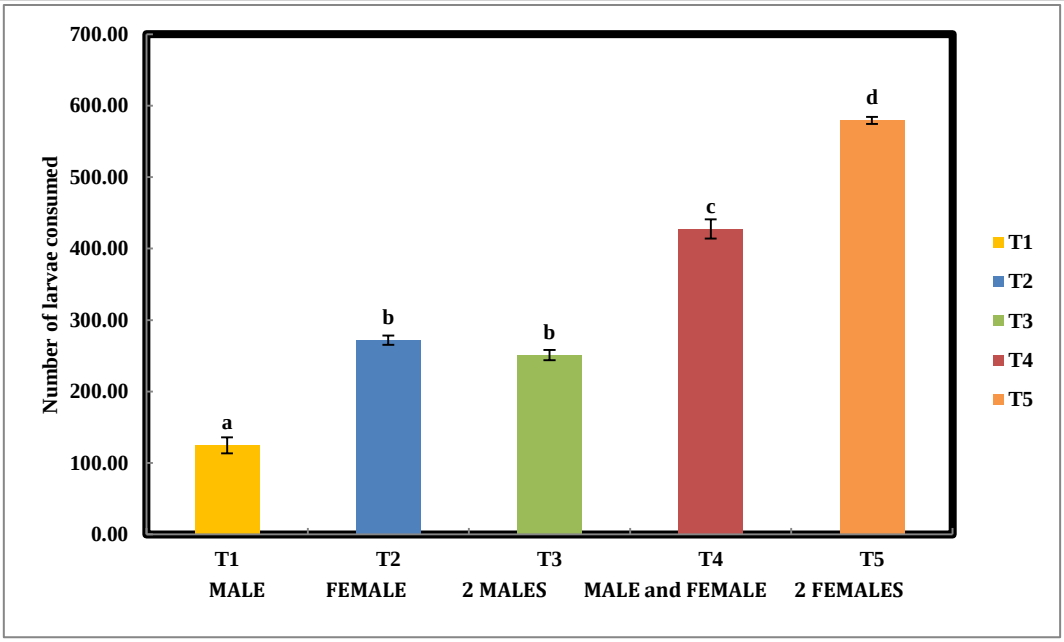

Fig. 3: Statistical representation of larval consumption among different groups. Different letters indicate the significant difference ($P < 0.05$) among the different treatments

CONCLUSION

In the present study, the mosquito larvae consumption trend was in the following manner T5>T4>T2>T3>T1. Thus, the present study demonstrates that platy can potentially be used as a promising biological control agent against the mosquito-borne diseases by controlling mosquito larvae effectively. Further, efficacy of female platy is higher compared to male in controlling mosquito larvae. Therefore, for successful control of mosquito larvae in water bodies, the populations of platy containing more females may be considered.

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REFERENCES

1. Abdalla, A. A. F. and MacNabb, C.D., Acute and sublethal growth effects of un-ionized ammonia to nile tilapia *Oreochromis niloticus. Prog. fish-cult.*, **58:** 117-123 (1998).
2. Anogwih, J. A. and Makanjuola, W. A., Predator-prey density of *Poecilia reticulata* (Guppy) under laboratory investigation. *The Zoologist*, **8:** 47-51 (2010).
3. APHA., Standard Methods for the Examination of Water and Wastewater. 19th Edition. Washington, DC. (1995).
4. Arulampalam, P., Yusoff, F. M., Shariff, M., Law, A. T. and Rao, P. S. S., Water quality and bacterial populations in a tropical marine cage culture farm. *Aquacult. Res.*, **29:** 617-624 (1998).
5. Awoyemi, O. M., Uwafili,P. N., Izegaegbe, J. I. and Fadeyi O. P., Analysis of the foraging behavior of guppy (*Poecilia reticulata*) in relation to its use as a biological method for the enironmental control of mosquito larvae. *Int. j. recent res. appl. stud.*, **21(3):** 103-113 (2014).
6. Bhatnagar, A. and Singh, G., Culture fisheries in village ponds: a multi-location study in Haryana, India. *Agriculture and Biology Journal of North America*, **1(5):** 961-968 (2010).
7. Bhatnagar, A., Jana, S. N., Garg, S. K., Patra, B. C., Singh, G. and Barman, U. K., Water quality management in aquaculture, **In:** Course Manual of summer school on development of sustainable aquaculture technology in fresh and saline waters, CCS

Haryana Agricultural, Hisar (India), 2004, pp 203- 210.

8. Boyd, C. E., Water quality for pond aquaculture. Research and Development Series No.43. International center for Aquaculture and Aquatic Environments, Alabama Agricultural Experiment Station, Auburn University, Alabama (1998).
9. Cavalcanti, L. P., Pontes, R. J., Regazzi, A. C., de Paula Júnior, F. J., Frutuoso, R. L., Sousa, E. P., Dantas Filho, F. F. and Lima. J. W., *Efficacy of fish as predators of Aedes aegypti larvae, under laboratory conditions. Rev. Saude. Publica.*, **41(4):** 638-644 (2007).
10. Chandra, G., Bhattacharjee, I., Chatterjee, S. N. and Ghosh, A., Mosquito control by larvivorous fish. *Indian J. Med. Res.*, **127 (1):** 13-27 (2008).
11. *Das, S., Bhattacharya, B. K. and Goswamy, U. C.,* Effect of extreme pH on survivability of *Indian* major carps fry. *J. Inland. Fish. Soc. India, **27(2): 97-99** (1995).*
12. Elias, M., Islam, M. S., Kabir, M. H. and Rahman, M. K., Biological control of mosquito larvae by Guppy fish. *Bangladesh Med. Res. Counc. Bull.*, **21**: 81-86 (1995).
13. Gerberich, J. B. and Laird, M., Larvivorous fish in the biocontrol of mosquitoes, with a selected bibliography of recent literature, ***In:*** Integrated mosquito control methodologies, Vol. 2. Academic Press, London, 1985, pp. 47–76.
14. Ghosh, S. K., Tiwari, S. N., Sathyanarayan, T. S., Sampath, T. R. R., Sharma, V. P., Nanda, N., Joshi, H., Adak, T. and Subbarao, S. K., Larvivorous Fish in Wells Target the Malaria Vector Sibling Species of the *Anopheles Culicifacies* Complex in Villages in Karnataka, India. *Trans. R. Soc. Trop. Med. Hyg.*, **99(2):**101-105 (2005).
15. Gosh, A., Mandal, S., Bhattacharjee, I. and Chandra, G., Biological control of vector mosquitoes by some common exotic fish predators. *Turk J. Biol*., **29:** 167-171 (2005).
16. Haas, R. and Pal, R., Mosquito Larvivorous Fishes. *Bull. Entomol. Soc. Am.*, **30(1):** 17-25 (1984).
17. Hardin, J. A. and Jackson, F. L.C., Applications of natural products in the control of mosquito –transmitted diseases. *Afr. J. Biotechnol.*, **8(25):** 7373-7378 (2009).
18. Homski, D., Goren, M. and Gasith, A., Comparative Evaluation of the Larvivorous Fish *Gambusia affinis* and *Aphanius dispar* as Mosquito Control Agents. *Hydrobiologia.*, **284:** 137-146 (1994).
19. Howard, A. F. B., Zhou, G. and Omlin, F. X., Malaria mosquito control using edible fish in western Kenya: preliminary findings of a controlled study. *BMC Public Health*, **7:** 199-204 (2007).
20. Job, T. J., An investigation of the nutrition of the perches of the Madras Coast. *Rec. Mind Mus.*, **42**: 289-364 (1940).
21. Kim, H. C., Kim, M. S. and Yu, H. S., Biological control of vector mosquitoes by the use of fish predators, *Moroco oxycephalus* and *Misgurnus anguillicandatus* in the laboratory and semi field rice paddy. *Korean J Entomol.*, **24 :** 269-284 (1994).
22. Kweka, E. J., Zhou, G., Gilbreath, T. M., Afrane, Y., Nyindo, M., Githeko, A. K. and Yan, G., Predation efficiency of *Anopheles gambiae* larvae by aquatic predators in western Kenya highlands. *Parasit. Vectors*, **4(1):** 128 (2011).
23. Lichtenberg, E. R. and Getz, W., Economics of rice-field mosquito control in California. *Bioscience*, **35:** 292-297 (1985).
24. Manna, B., Aditya, G. and Banerjee, S., Vulnerability of the mosquito larvae to the guppies (*Poecilia reticulata*) in the presence of alternative preys. *J. Vector Borne Dis.*, **45(3):** 200-206 (2008).
25. Matias, J. R. and Adrias, A. Q., The use of annual killifish in the biocontrol of the

aquatic stages of mosquitoes in temporary bodies of fresh water: a potential new tool in vector control. *Parasit. Vectors,* **3:** 46 (2010).

26. Milam, C. D., Farris, J. L. and Wilhide, J. D., Evaluating mosquito control pesticides for effect on target and non-target organisms. *Arch. Environ. Contam. Toxicol.,* **39:** 324-328 (2000).
27. Mohamed, A. A., Study of larvivorous fish for malaria vector control in Somalia, 2002. *East. Mediterr. Health J.,* **9*:*** 618–626 (2003).
28. Morton, R. M., Beumer, J. P. and Pollock, B. R., Fishes of a Subtropical Australian Saltmarsh and their Predation upon Mosquitoes. *Environmental Biology of Fishes*, **21(3):** 185-194 (1988).
29. Neng, W., Shusen, W., Guangxin, H., Rongman, X., Guangkun, T. and Chen, Q., Control of *Aedes aegypti* Larvae in Household Water Containers by Chinese Cat Fish. *Bull. World Health Organ.,* **65:** 503-506 (1987).
30. OATA (Ornamental Aquatic Trade Association), Water Quality Criteria-ornamental fish. Company Limited by Guarantee and Registered in England No 2738119 Registered Office Wessex House, 40 Station Road, Westbury, Wiltshire, BA13 3JN, UK, (2008).
31. Pant, C. P., Rishikesh, N., Bang, Y. H. and Smith, A., Progress in Malaria Vector Control. *Bull. World Health Organ.,* **59:** 325-333(1981).
32. Prodocimo V. and Freire C.A., Critical thermal maxima and minima of the platyfish, *Xiphophorus maculatus* (Poeciliidae, Cyprinodontiformes), a tropical species of ornamental freshwater fish. *Revta. bras. Zool.,* **18 (Supl. 1):** 97-106 (2001).
33. Raghavendra, K. and Subbarao, S., Chemical Insecticides in Malaria Vector Control in India. *ICMR. bull*., **32:** 1-7 (2002).
34. Ritcher, S. A. and Laidlaw bell, C., Do Fish Repel Oviposition by *Aedes taeniorhynchus*? *J. Am. Mosq. Control Assoc.,* **10:** 380-384 (1994).
35. Saleeza, S. N., Rashid, Y. N. and Azirun, M. S., Guppies as predators of common mosquito larvae in Malaysia. *Southeast Asian J. Trop. Med. Public Health,* **45(2):** 299-308 (2014).
36. Santhosh, B. and Singh, N. P., Guidelines for water quality management for fish culture in Tripura, ICAR Research Complex for. NEH Region, Tripura Center, Publication no.29 (2007).
37. Sih, A., Antipredator responses and the perception of danger by mosquito larvae. *Ecology,* **67(2):** 434-441(1986).
38. Surendran, S. N., Kajatheepan, A., Jude, P. J. and Ramasamy, R., Use of tilapia, *Oreochromis mossambicus*, for the control of mosquito breeding in water storage tanks in the Jaffana district of Sri Lanka. *Trop. med. health,* **36(2):** 107-110 (2008).
39. Swann, L. D., A Fish Farmer's Guide to Understanding Water Quality. Aquaculture Extension, Illinois- Indiana Sea Grant Program. Purdue University, Fact Sheet AS-503 (1997).
40. Timmons, M. B., James, M. E., Fred, W. W., Sreven, T. S. and Brian, J. V., Recirculating Aquaculture Systems. NRAC publication, No.01- 002 (2001).
41. Tucker, C. S. and Boyd, C. E., Water quality **In:** Channel Catfish Culture. (ed. *Tucker, C. S.*), Elsevier, Amsterdam, The Netherlands, 1985, pp 135-277.
42. Walker, K., A review of control methods for african malaria vectors. *Environmental Health Project*, **2 (**2002**).**
43. Yildrim, O. and Karacuha, A., A preliminary study on determination of *Aphanius chantrei*'s feeding behaviour on mosquito larvae. *Acta trop.,* **102:** 172-175 (2007).