APPENDIX

Abbreviations used in the thesis

1. N - nauplius
2. Pz - protozoea
3. M - mysis
4. PL - postlarva
5. mg/l - milligram per litre
6. ug/l - microgram per litre
7. ppt - parts per thousand
8. ppm - parts per million
9. ppb - parts per billion
10. ANOVA - analysis of variance
11. NS - not significant
12. C.D. - critical difference
ACUTE TOXIC EFFECT OF THE PESTICIDE MALATHION ON THE LARVAL AND POSTLARVAL STAGES OF THE BANANA SHRIMP *PENAEUS MERGUIENSIS* (DE MAN)

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ABSTRACT

Acute toxic effect of the pesticide malathion is demonstrated in the larval and postlarval stages of the banana shrimp *Penaeus merguiensis*. Malathion was found to be highly toxic even at very low concentrations. The lowest $L_C_{50}$ value was obtained for nauplius larvae and the highest for late postlarvae (PL 15). The order of relative susceptibility of the different larval and postlarval stages in nauplius > protozoea > mysis > early postlarvae > late postlarvae.

INTRODUCTION

The extensive use of pesticides to eradicate various agricultural pests and insects has been showing an upward trend over the years despite the global concern about the long standing adverse effects of pesticides on food chains and food webs. This leads to the increased production of pesticides. The growth rate of Indian pesticide industries is one of the largest in the world and India is the second largest manufacturer of pesticides (77,000 mt in 1993) in Asia (Vijayalakshmi, 1995).

Commonly used commercial formulations of chemical pesticides can be grouped as (1) organochlorines (2) organophosphates and (3) carbamates. Organochlorine pesticides are relatively more toxic than organophosphates. In India, there has been a general decline in the use of highly persistent organochlorines such as endrin and DDT due to their longer persistence and higher toxicity. Hence, in recent years, registration of some of the chlorinated hydrocarbons are suspended. Therefore, the organophosphates are finding increasing use in recent years. This group includes malathion, parathion, ekakus, rogar, fenitrothion, fenthion, gusathion etc. Organophosphates are biodegradable and therefore persist in the environment only for a short time. Because of its non-persistence, repeated application of these pesticides are being practiced for control of pests in agricultural fields and hence large quantities of these find their way into the rivers and ultimately into the sea.

Kali river originates in the Western Ghats, India, has a total stretch of around 200 km and receives pesticides from the agricultural fields all along its course.

The toxicity of organophosphate pesticides to several crustaceans has been tested in a number of studies. Malathion affects the survival and development of the mud crab *Rhithropanopeus harrisii* and the blue crab *Callinectes sapidus* at very low concentrations (Bookhout and Monroe 1977). Conte and Parker (1975) found that malathion which was aerially applied to flooded marshes in Texas caused 14 to 80% mortality in brown and white shrimps held in cages. Couch (1978) has cited that malathion causes hyper-activity, paralysis and death in penaeids at 14 ppb. Other noteworthy studies on the toxicity and adverse effects of organophosphate pesticides on prawns were conducted by Juares and Sanchez 1989; Rompas et al. 1989; Baticadose and Tendencia (1991). However, studies on the toxic effects of pesticides on crabacean larvae in general and shrimp larvae in particular are very less.

Therefore, in the present study an attempt was made to find out the effect of malathion on the relative sensitivity of larval and postlarval stages on the banana shrimp *P. merguiensis* which is abundant along the Karwar coast and has tremendous culture potential.

MATERIALS AND METHODS

The larval stage of *P. merguiensis* namely nauplius
protozoa, mysis and the postlarval stages namely early postlarvae (PL 5) and late postlarvae (PL 15) were produced in the backyard hatchery of the School of Ocean Sciences, Karwar. Uniform hydrological parameters (salinity 29 ± 1%, temperature 25 ± 0.5°C, pH 8.0 ± 0.2 and D.O. 3.8 ± 0.3 mg/l) were maintained at all stages of the experiment. The toxicity bioassay experiment was conducted as per the standard methods given in APHA (1980). The range of concentrations selected in this study were derived from a range finding test for each larval and postlarval stage. All the experiments were conducted in triplicate for 24 hours with 10 animals in each replicate and a control, free from toxicant was maintained.

The stock solution of malathion was prepared using 5% W/W malathion dust obtained from the Karnataka Agro Industries Corporation Ltd. Raichur. Acetone was used as a solvent to dissolve the malathion dust and this mixture was stirred in a magnetic stirrer for 2 hours to evaporate the dissolved acetone. The stock solution was diluted using distilled water to get the required test concentrations. A second control was also maintained simultaneously containing acetone.

The postlarvae were starved for 24 hours prior to the experiment. During the static bioassay, the animals were starved and no artificial aeration was supplied until the completion of the experiment. The animals were exposed to ten different concentrations of malathion ranging from 0.001 - 0.03 ppm for nauplius, 0.004 - 0.05 ppm for protozoa, 0.005 - 0.06 ppm for mysis, 0.008 - 0.08 ppm for PL 5 and 0.01 - 0.09 ppm for PL 15. Observations was done for every 3 hours and the dead animals were removed and recorded. Death criteria was the cessation of movement even after gentle prodding. The LC\textsubscript{50} values were determined by probit analysis (Anonymous 1987) and data were analysed as outlined by Litchfield and Wilcoxon (1949).

**RESULTS AND DISCUSSION**

The *P. merguiensis* larvae and postlarvae showed drastic behavioural changes in higher concentrations, contrast to the lower concentrations in which the larvae and postlarvae appeared to recover at later stages. In higher concentrations, postlarvae were hyperactive, trying to jump out of the water and were showing erratic swimming. Later, the postlarvae lost equilibrium swam upside down and finally sank to the bottom of the container. The movements of the appendages became more and more feeble followed by death of the animal. This agrees with the earlier studies conducted by Couch (1978), Pawar and Katdare (1984) and Reddy et al. (1985) who found an initial excitation followed by a return to apparent normalcy in prawns exposed to lower concentrations and hyperkinetic behaviour leading to paralysis and death at higher concentrations of pesticides.

The results of the present experiment are given in Table 1. The lowest 24 hour LC\textsubscript{50} value of malathion (0.0098 ppm) was obtained in the naupliar stages and the highest of 0.038 ppm was obtained in the late postlarval stage of *P. merguiensis*. Also, it was observed that the sensitivity decreases with increase in age of the larvae. This is in agreement with the earlier studies conducted by Mary et al. (1986) who stated that the difference in tolerance capacity of the freshwater prawn *M. lamarrei* to organophosphate pesticides was dependent on the size of the larva. The present study also agrees with the findings of the Chin and Chen (1989) who found that tolerance to pollutant increases with age in marine crustaceans.

The relative susceptibility of the different early stages of *P. merguiensis* to the pesticide malathion obtained in the present study, is of the order: nauplius > protozoa > mysis > early postlarvae > late postlarvae.

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REFERENCES


