L. leucocephala is known to show high resistance to pests and diseases as only a few diseases have been recorded on this host[1-10]. So far, from India only one serious disease of foliage and stem causing gummosis due to *Fusarium semitectum* Berk. and Rav. has been recorded[9]. This is the first record of foliar infection of *L. leucocephala* from Kerala.

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TOXICITY OF INDUSTRIAL EFFLUENTS TO THE FRESHWATER CAT FISH *MYSTUS KELETIUS*

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IN India, large quantities of industrial effluents are discharged into the nearby water bodies, and fish and other organisms are seriously affected by prolonged exposure to diluted concentrations[1]. Toxicological reports of pesticides[2,3] and heavy metals[4,5] on fish mortality are plenty but information concerning the effects of industrial effluents is meagre[6]. The present investigation is a preliminary report dealing with mortality of the cat fish, *Mystus keletius* as a function of resistance time at different concentrations of distillery and textile mill effluents.

Healthy *M. keletius* (10 ± 2 g live weight) were acclimatized to laboratory conditions by feeding on beef slices *ad libitum* for a fortnight.

Feeding was stopped one day before the commencement of the experiment; static bioassay method[7] was followed to find out the toxicological effects of distillery and textile mill effluents. The test individuals were placed in a glass trough (capacity 15 l) containing dechlorinated tap water and served as control. Serial dilutions of the effluents were prepared using dechlorinated tap water[8]. Each concentration was treated in triplicate. Ten *M. keletius* were exposed to each concentration and the

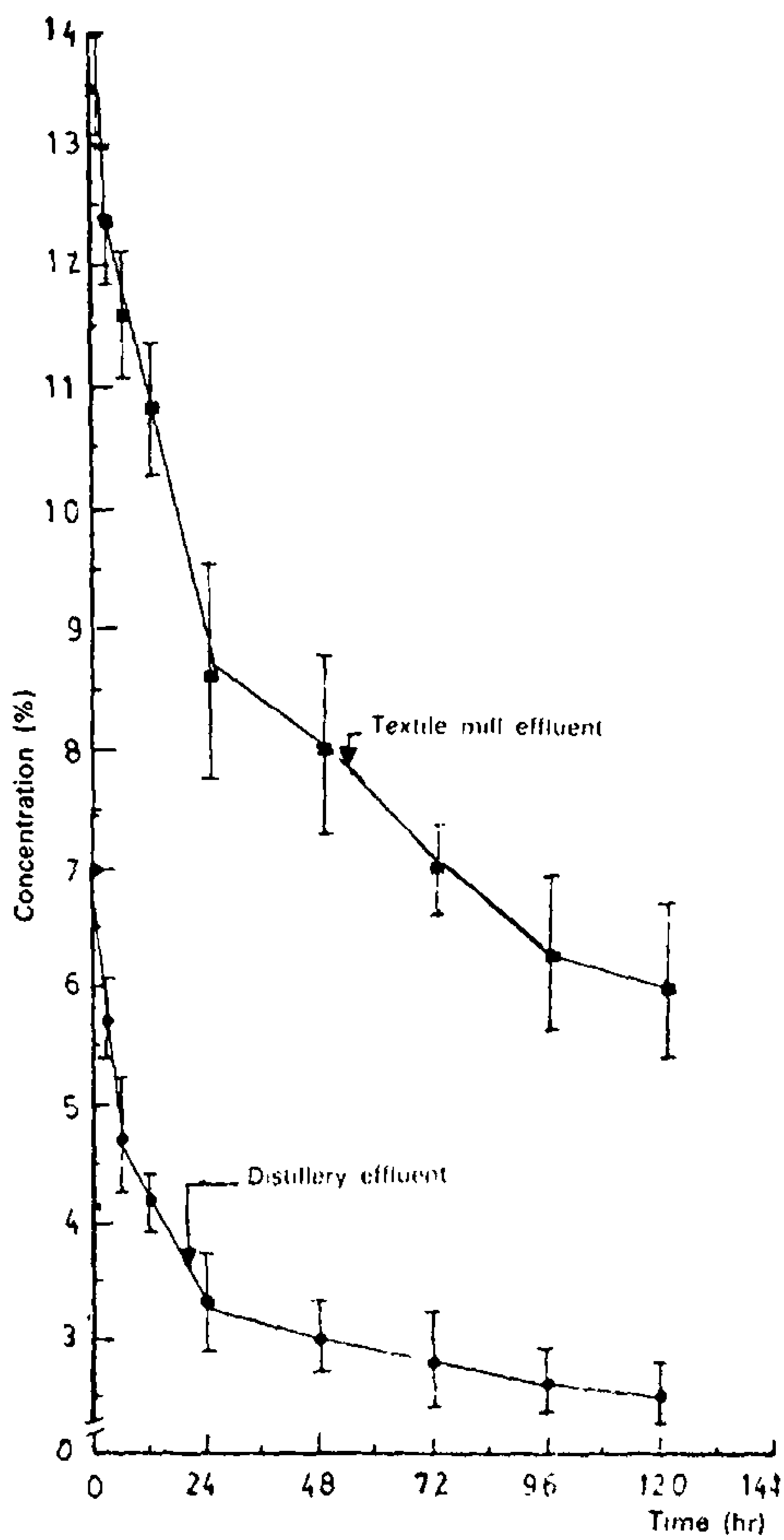

Figure 1. Mean LC_{50} with upper and lower confidential limits of Distillery and Textile mill effluents on *M. keletius*.

Table 1 Mean LC_{50} range, slope and relative toxicity of Distillery and Textile mill effluents on *M. keletius.*

Time (hr)		Distillery effluent Mean	UCL	LCL	Slope		Textile Mill effluent Mean	UCL	LCL	Slope	Relative toxicity*
			Concentration (%)					Concentration (%)			
	LC_{84}	8.2				LC_{84}	15.2				1.85
1	LC_{50}	7.0	7.4	6.62	1.19	LC_{50}	13.6	14.21	13.01	1.11	1.94
	LC_{16}	5.9				LC_{16}	12.38				2.09
	LC_{84}	6.8				LC_{84}	14.0				2.05
3	LC_{50}	5.7	6.04	5.38	1.23	LC_{50}	12.4	13.0	11.83	1.12	2.17
	LC_{16}	4.6				LC_{16}	11.2				2.43
	LC_{84}	5.7				LC_{84}	13.0				2.28
6	LC_{50}	4.7	5.17	4.27	1.21	LC_{50}	11.6	12.11	11.11	1.10	2.46
	LC_{16}	3.9				LC_{16}	10.8				2.76
	LC_{84}	5.3				LC_{84}	12.2				2.30
12	LC_{50}	4.15	4.44	3.88	1.21	LC_{50}	10.8	11.36	10.27	1.15	2.60
	LC_{16}	3.5				LC_{16}	9.2				2.63
	LC_{84}	4.3				LC_{84}	11.8				2.74
24	LC_{50}	3.3	3.73	2.92	1.31	LC_{50}	8.6	9.55	7.75	1.34	2.60
	LC_{16}	2.25				LC_{16}	6.6				2.59
	LC_{84}	3.8				LC_{84}	10.2				2.68
48	LC_{50}	3.0	3.35	2.70	1.29	LC_{50}	8.0	8.8	7.27	1.27	2.66
	LC_{16}	2.35				LC_{16}	6.3				2.68
	LC_{84}	3.5				LC_{84}	9.0				2.57
72	LC_{50}	2.8	3.28	2.39	1.28	LC_{50}	7.0	7.39	6.65	1.19	2.50
	LC_{16}	2.3				LC_{16}	6.2				2.26
	LC_{84}	3.3				LC_{84}	7.8				2.36
96	LC_{50}	2.6	2.86	2.36	1.29	LC_{50}	6.3	6.99	5.73	1.25	2.42
	LC_{16}	2.1				LC_{16}	5.0				2.38
	LC_{84}	3.11				LC_{84}	7.4				2.38
120	LC_{50}	2.5	2.77	2.27	1.28	LC_{50}	6.0	6.72	5.36	1.24	2.40
	LC_{16}	2.05				LC_{16}	4.78				2.33

* Effect of distillery effluent is compared with that of textile mill effluent.

mortality was observed at different intervals. The tolerance limit (50% i.e. LC_{50}) was determined by plotting percentage of mortality on X axis and concentrations on Y axis on a log probit paper. The point at which the line of best fit crossed 50% mortality was taken as the resistance time in X axis to know the medium resistance time. Slope function(s) and upper and lower confidential limits for LC_{50} (UCL and LCL) of the two effluents were calculated by Litchfield and Wilcoxon[9] formula.

No mortality was observed in the control *M. keletius*. The behavioural response of the test fish varied in accordance with the concentration and type of effluent. Increase in concentration of effluent caused behavioural changes such as erratic movements, increased opercular movements and rapid jerky movements.

The acute toxicity range for distillery and textile mill effluents at different time intervals is reported in table 1. From the values of slope function and mean LC_{50}, LC_{16} and LC_{84} were determined. *M. keletius* died more rapidly at concentrations above 5% distillery effluent and 10% textile mill effluent. The lowering concentration in 120 hr LC_{50} values (2.5% and 6%) when compared with the one hr (7% and 13.6%) ones in both distillery and textile mill effluents suggests the decrease in resistance of *M. keletius* with increase in experimental time and supports the previous observations of Cairns and Scheier[10], Rita and Nair[11] and Sheila Sushan Jacob *et al*[12]. The higher LC_{50} values (6 to 13.6%) at different intervals in textile mill effluent denote the greater resistance of *M. keletius*. The present results clearly indicate that distillery effluent is comparatively more toxic than textile mill effluent. For instance LC_{50} in distillery effluent at different intervals ranged between 2.5 and 7% and the same in textile mill effluent ranged from 6 to 13% (figure 1). Distillery effluent was 1.9 to 2.7 times more toxic than textile mill effluent when LC_{50} and LC_{84} were considered and 2 to 2.8 times greater for LC_{16}. When compared with the textile mill effluents, the toxic effect in distillery effluent was greater due to its very high BOD (50,000 > 3,000* mg/l) COD (1,20,000 > 15,000* mg/l) and the total dissolved solids (70,000 > 15,000* mg/l) but the comparative effect is more or less the same irrespective of percentage mortality.

Thre is not much variation in the slope as a function of effluent type but its function increased with increase in exposure time. Similar findings were earlier reported for pesticides[13,14]. Since information on the impact of industrial effluents on fish mortality in general is still fragmentary, supporting evidence for the present work has been taken from pesticides reports.

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SEXING LARVA AND PUPA OF *OPISINA ARENOSELLA* WALKER (LEPIDOPTERA: CRYPTOPHASIDAE)

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SEXING insects at larval and pupal stages is often necessary for laboratory studies and for mass rearing. Determination of sex is also necessary for studies involving mating behaviour. During our studies on *Opisina arenosella* Walker, which is a major pest of the coconut palm, we felt the need for sexing the larva and pupa of this animal in the colony.

The required larvae and pupae were taken from a colony of *O. arenosella* maintained in the laboratory as described earlier[1]. Field collected larvae and pupae were also studied for comparison.

This animal possesses eight larval instars[1]. Male and female larvae are of the same size. In the last (VIII) instar male larva a round cuticular depression is present on the mid-ventral surface of the anterior margin of the IX segment (figure 1). This depression is also visible in VI and VII larval instars. The female does not possess this depression. This character cannot be utilized to distinguish sexes in the larvae of earlier stages.

The male pupa of the laboratory colony weighs 17.73±0.93 mg and the female, 22.18±0.99 mg. Males are smaller (body length 8.6±0.58 mm) than the

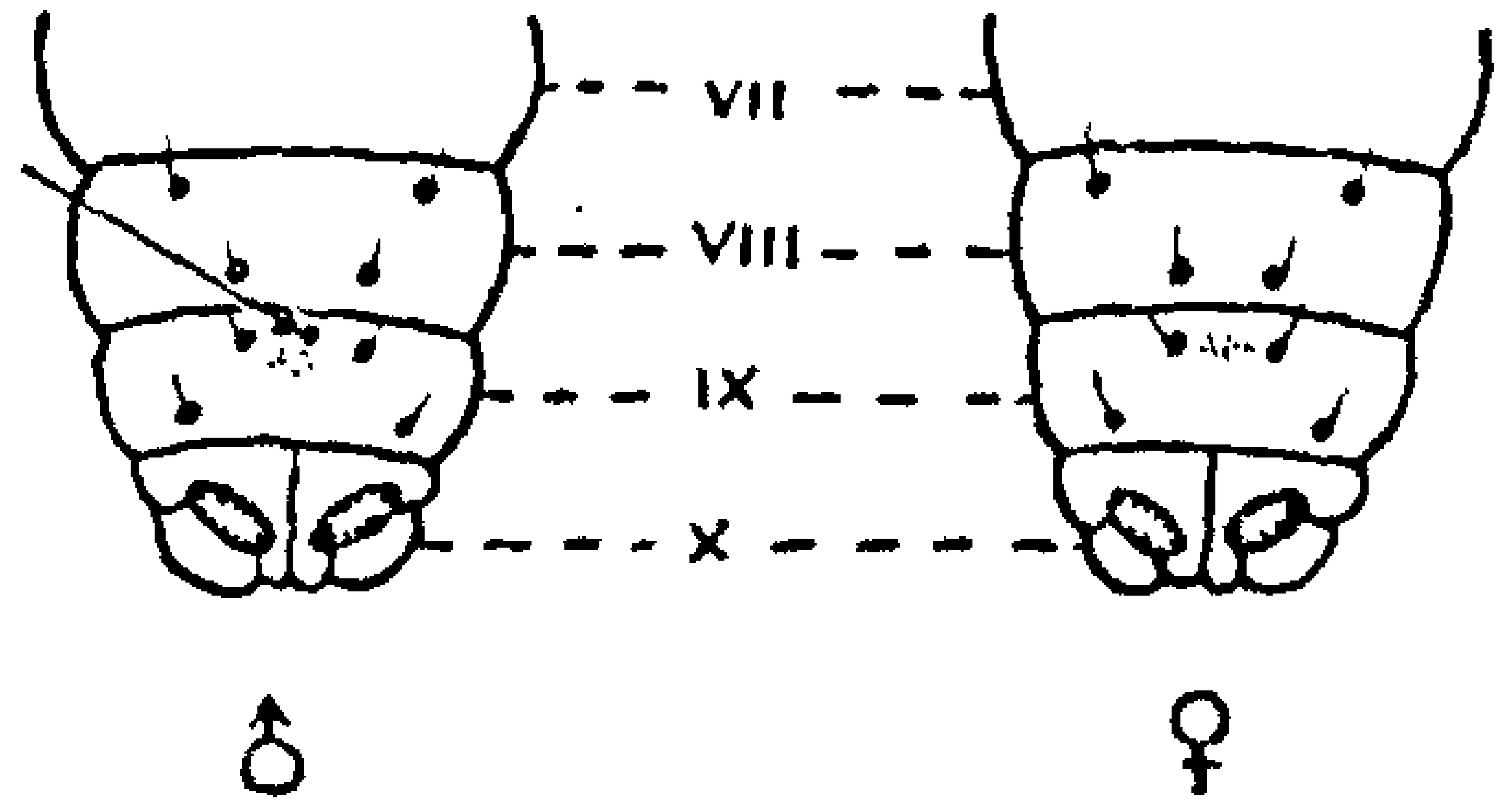

Figure 1. Ventral view of abdominal segment of *O. arenosella* larva. The depression is indicated by an arrow in the male; in the female there is no depression.