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Tolerance of *Penaeus monodon* larvae to cupric sulfate added in bath

By

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The toxicity of copper ions to various kinds of organisms has been reported by a number of investigators (Ferguson-Wood, 1975; Wilber, 1971). Copper is used to deter the growth of bacterial, fungal and protozoan disease organism in fishes (Davis, 1973; Van Duijm, 1973) and in the prawns *Macrobrachium rosenbergii* (Fujimura, 1966) and *Palaemon serratus* (Delves-Broughton and Poupard, 1975). Larval *Penaeus monodon* are highly susceptible to many protozoan ectocommensals, to the fungus *Lagenidium* and other microorganisms. Effective control measures for these parasites have not yet been established. The response of larval *P. monodon* to cupric ions is not known and this paper presents preliminary results on the tolerance of various stages of *P. monodon* larvae to different concentrations of copper sulfate.

Zoeae (Z_1), myses (M_1) and postlarvae (P_1) were exposed to copper sulfate at concentrations of 0.025, 0.05, 0.75, 0.1, and 0.2 ppm from 24 to 96 hours. The number of surviving larvae were counted at the end of each 24-hour period and the percentage of survival is determined for each dose level. The LC_{50} for each of the larval stages was interpolated from the data whenever possible. Three trials with 2 replicates per trial were conducted. The physico-chemical characteristics of the bath taken before and at the end of the experimental period show insignificant differences between initial and final values in each trial (Table 2).

Table 1 shows the response of the different stages of *P. monodon* larvae to various levels of copper sulfate. Results indicate that mortality rates of all larval stages increased with exposure time and that mortality rates of the experimental group is higher than the control. Interpolation of the LC_{50} is possible only for the 48-hr and 72-hr exposure times for both zoeae and myses and for the 48-hr exposure time for the postlarvae. This is due to the high survival percentage of the 24-hr group and the low survival percentage below 50%) of the larvae exposed for 96 hours. The 48-hour LC_{50} for Z_1, M_1, and P_1 are 0.225, 0.350 and 0.125 ppm respectively (Figs. 1, 2, and 3). Postlarvae seem to be more sensitive than either of the 2 larval stages having a lower 48-hr LC_{50} and a low survival rate after 72 hours.

Observations were also made on some behavioral and physiological effects of copper sulfate on the treated larvae. The larvae were observed to lose their balance and were lethargic, producing few swimming movements so that they were mostly confined to the bottom of the aquaria. Moribund larvae observed under the microscope had a faster but weak heartbeat compared to healthy larvae. Slight or complete loss of feeding ability indicated by empty guts and delayed molting of Z_1 to Z_2 were also noted.

Copper sulfate is known to affect various physiological activities of animals. In fishes, $CuSO_4$ combines with mucus to cover the body and gills forming an insoluble compound which seriously interferes with respiration leading to death by asphyxiation (Ellis, 1937; Erichsen-Jones, 1964; Leonte, 1972). Damage to cellular membrances due to the formation of insoluble copper complexes with the lipide fraction of cell membranes has also been reported (Zeitoun et. al., 1969).

A cursory examination of the data reveals highly variable results for the individual trials indicating that copper sulfate exerts a wide spectrum of physiological effects which could lead to the death of the larvae. It should, however, be noted that although the LC_{50} values are important in assessing the effects of toxic chemicals such as copper sulfate on organisms, other workers suggest much lower concentrations (e.g. 0.01-0.05 of the LC_{50} values, Mount and Brungs, 1967) of these chemicals for the prevention or control of parasites and diseases. Further research such as the responses of organisms fed to the larvae to this chemical have to be undertaken since the toxic effects of copper may be repressed or heightened by the metabolic activities of these feed organisms.

Table 1. Tolerance of *Penaeus monodon* larvae to various levels of copper sulfate given in bath for 24 through 96 hours.

Dose (ppm) Stage	Exposure hr	Mean Survival 0.0	0.025	0.050	0.075	0.1	0.2	Interpolated LC_{50}
Z_1 1/	24	39.17	38.67	34.0	36.83	34.33	33.33	
	48	35.17	33.33	29.33	33.83	30.33	26.17	0.225
	72	29.0	30.3	24.5	24.8	22.17	13.7	0.0525
	96	23.16	23.0	18.6	14.83	15.5	2.66	
M 1/	24	40.83	36.33	39.5	41.16	41.67	38.5	
	48	33.67	33.67	30.17	32.50	34.5	28.8	0.350
	72	26.0	25.5	23.3	26.5	27.33	20.17	0.0575
	96	22.66	21.5	16.5	19.83	13.66	13.0	
P_1 1/	24	43.16	38.33	37.67	35.0	36.33	39.0	
	48	31.0	27.67	30.67	21.83	30.16	26.83	0.125
	72	21.83	17.5	24.33	18.5	23.67	18.33	
	96	14.33	12.16	17.83	15.0	16.33	14.66	

Table 2. Average range of water quality parameters in all trials conducted.

	Temp. (°C)	Salinity (ppt)	PH	DO (ppt)	Alkalinity (ppt)
Z_1 1/	26.5-28.45	25.8-26.0	8.4-8.44	7.4-8.25	154.8-171.5
M_1 1/	26.0-27.3	26.8-28.6	8.36-8.44	7.7-8.0	142.5-146
P_1 1/	25.8-28	27-32-29.48	8.38-8-41	5.35-8.2	157-177

1/Based on 6 trials·

Figure 1. Survival of *P. monodon* Z_1 in 5 levels of copper sulfate given in baths for 24 through 96 hours

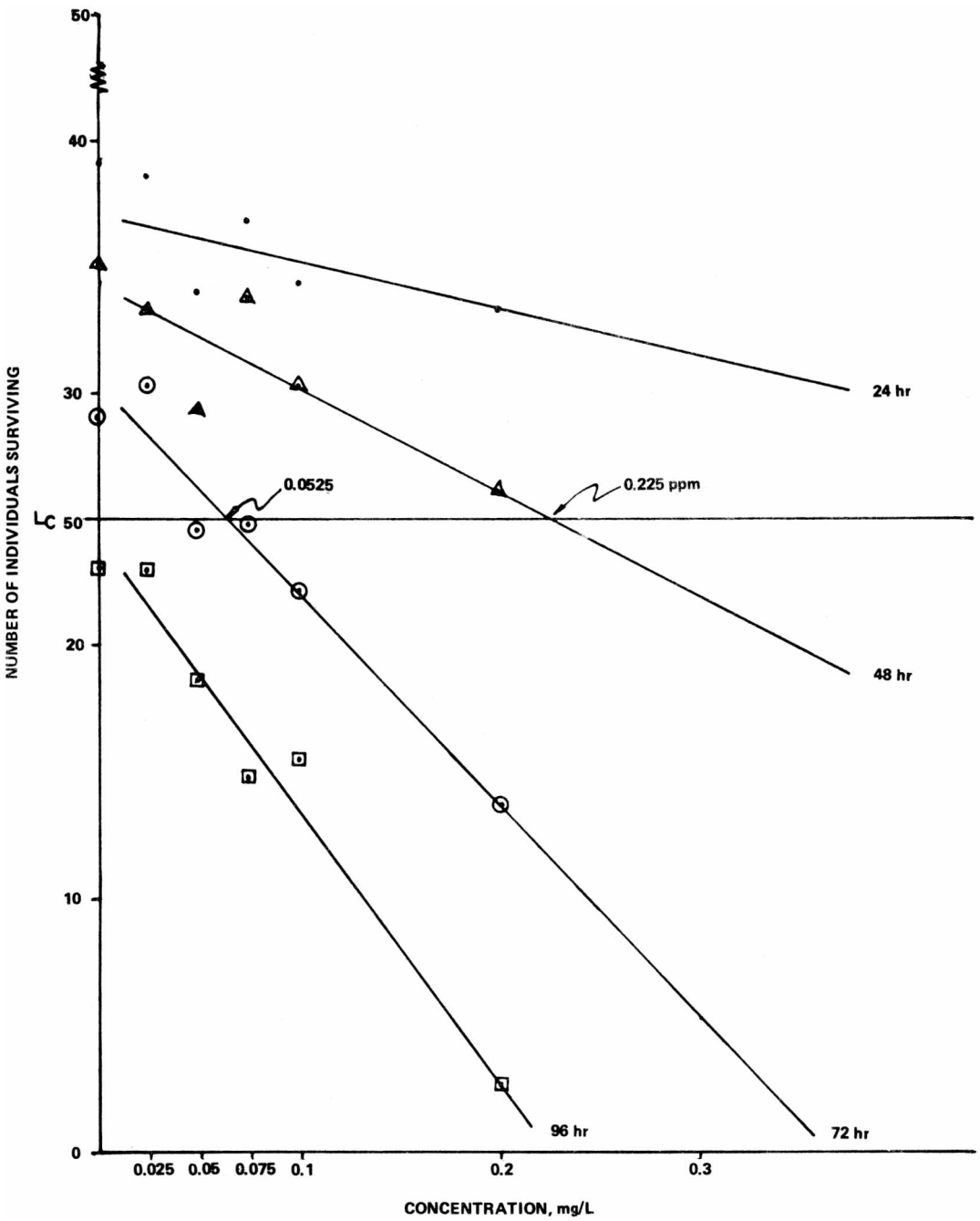


Figure 2. Survival of *P. monodon* M_1 in 5 levels of copper sulfate given in baths for 24 through 96 hours

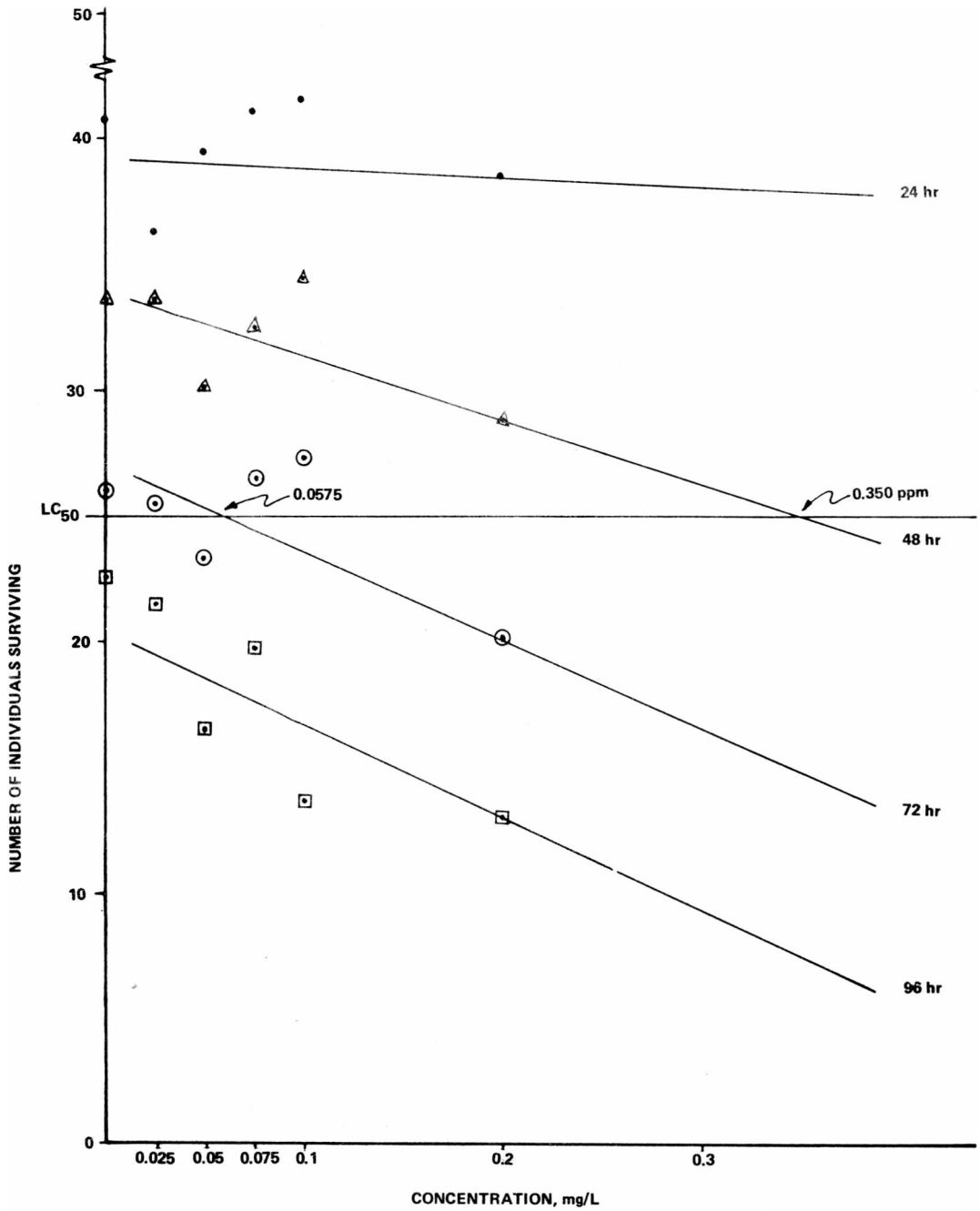
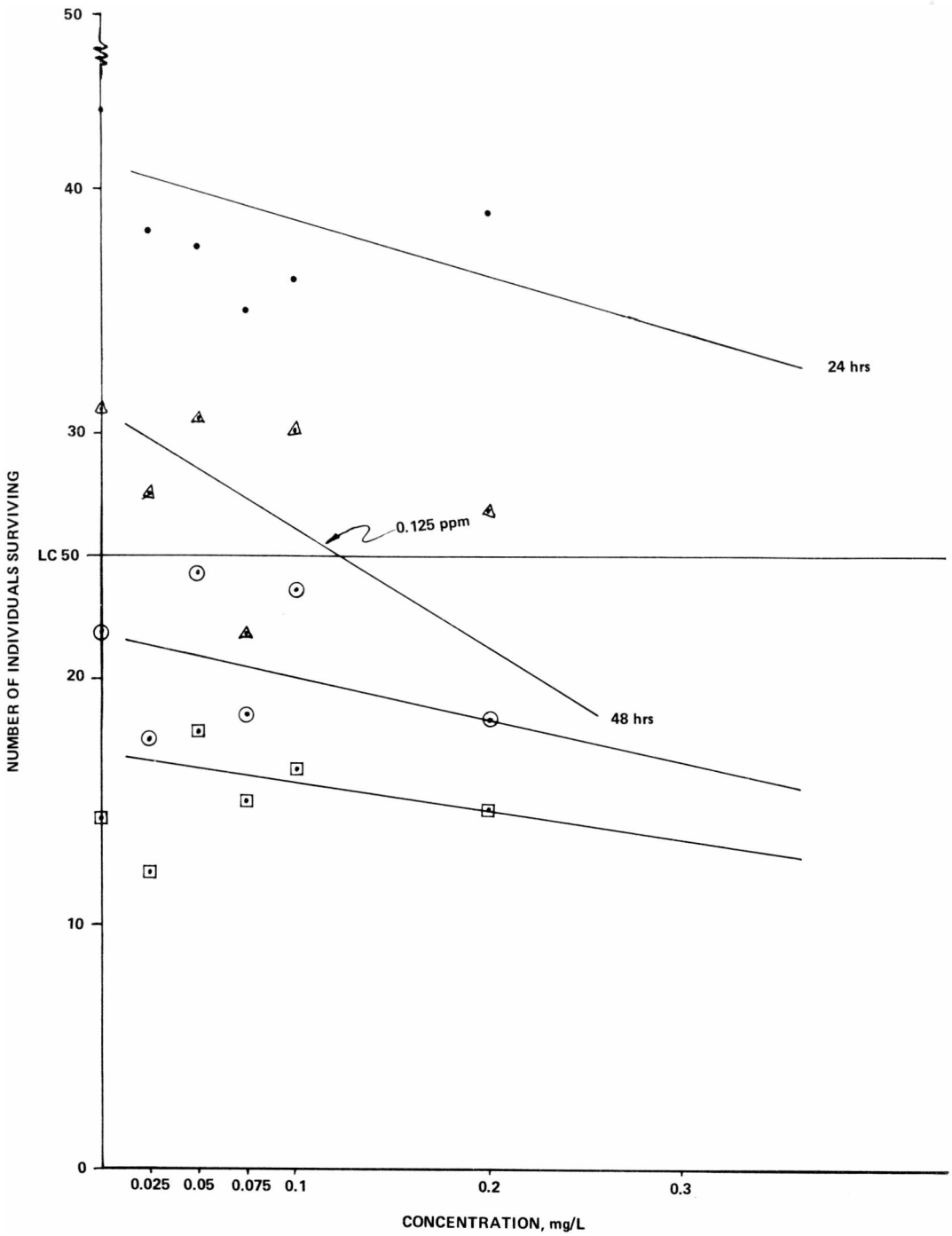


Figure 3. Survival of *P. monodon* P_1 in 5 levels of copper sulfate given in baths for 24 through 96 hours



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