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Acute toxicity of unionized ammonia to milkfish *(Chanos chanos* Forsskal) fry

Nepheronia A. Jumalon

The toxicity of ammonia to fish is well-studied (Smith and Piper, 1975; Robinette, 1976). This toxicity depends on the amount of unionized or free ammonia in solution rather than the dissociated form, as demonstrated by Wuhrmann and Woker (1948 in Hazel *et al.*, 1971) and Downing and Merkens (1955).

Mortality of milkfish fry under culture condition is sometimes attributed to toxic levels of ammonia, but no evidence has been given to prove this. A study on the effects of varying concentrations of ammonia to milkfish fry, would, therefore, contribute important information which can be used in the maintenance of good water quality to insure maximum survival.

Two runs of static 96h bioassays (refer to APHA, 1971) were conducted at the Sabalo Laboratory, SEAFDEC, Iloilo to determine the median lethal concentration (LC 50) of unionized ammonia (NH_3) to milkfish fry. Test concentrations were based on exploratory 24h and 48h bioassays and were made in three replicates. Reagent grade ammonium chloride (NH_4Cl) was used to adjust the level of unionized ammonia.

One liter beakers were randomly distributed and each was filled with 800 ml seawater of varying NH_3 concentrations and provided with gentle aeration before the fry were stocked at a rate of 100 per beaker. Fry were obtained from the coasts of Nanga, Guimbal and were acclimated without feeding in 20-liter aquarium filled 3/4 with conditioned seawater two days prior to the experiment. Length and weight of fry averaged (n=100) 12.58 mm and 3.92 mg, respectively, with ranges of 11.00-14.55 mm and 1.60-6.86 mg. In all runs, mortality observed during the acclimation period was either zero or less than 1%.

Mortality in the different test concentrations was recorded every hour and fry were removed immediately when they die. Dead fry were preserved in 10% buffered formalin and submitted to the Micro-technique Laboratory for histological sections of the gills. Sections were cut at 6-8u and stained with haematoxylin and eosin.

The following physico-chemical parameters were monitored every morning: temperature (using a lab. thermometer) salinity (using an AO refractometer) and ammonia concentration using the Indophenol Blue Method (FAO, 1975). The following, on the other hand, were analyzed before and at the end of the experiment: dissolved oxygen using the micro-winkler titration method (based from APH, 1971), pH (using a TOA ph meter) and total alkalinity using the tritration method (APHA, 1971).

Surviving fry from 26.08 to 31.28 ppm were taken at the end of the 96h bioassay, and kept in recovery aquaria filled with untreated seawater and fed sufficiently with *Chlorella/Brachionus*. After 10 days, samples were taken for histological sections to check gill condition.

Physico-chemical condition did not vary markedly among the treatments. From the averages calculated for each test concentration, the following values were obtained.

	Ranges	Averages (n=7)
Temperature	28.00–29.64°C	28.84±0.7472
Salinity	33.73–35.63°/oo	34.75±0.8826
Dissolved oxygen	4.04–4.88 ppm	4.58±0.3099
pH	7.60–7.93	7.76
Total alkalinity	136.00–145.66 ppm	140.36±3.4361

The 96h median lethal concentration, determined by the Reed-Muench method (Woolf, 1968), was calculated at 28.09 ppm NH_3 29.69 ppm. Table 1 gives the results obtained. Even at high concentrations of unionized ammonia, most of the fry mortality occurred after 48 to 96 hours exposure.

Examination of the gill condition of fry exposed to different NH_3 concentrations shows that severe gill damage occurs only at concentrations above 20 ppm, especially above the LC 50. Gills of fish exposed to 11.25 ppm are comparable to those of control fish, though slight changes may take place. Figures 1 to 4 show some of the gill sections made.

The high LC 50 value obtained shows that milkfish fry has a great tolerance to ammonia. In fact, fry with severely-damaged gills can still recover days after it is returned to favorable culture condition, as indicated by Figures 1-4. Considering that ammonia concentration is usually below 1 ppm even in a pond where there is accumulation of "lab-lab" (Jumalon, 1978) or in feeding trials (Mangalik, 1979), it can be deduced that observed mortalities of milkfish fry under culture conditions are not due to ammonia toxicity.

Table 1. Analysis by the Reed-Muench Method

NH_3 Concentration (ppm)	Dose (ppm NH_3) Log scale	N	Number dead	Number alive	Accumulated No. dead	Accumulated No. alive	Total	Cumulative % mortality
0.69 (control)	−0.1612	100	0	100	0	494	494	0.00
11.25	1.0512	100	3	97	3	394	397	0.76
20.81	1.3183	100	10	90	13	297	310	4.19
26.08	1.4163	100	28	72	41	207	248	16.53
26.91	1.4299	100	44	56	85	135	220	38.64
29.66	1.4722	100	58	42	143	79	222	64.81
31.28	1.4953	100	63	37	206	37	243	84.77

Fig. 1. Gill section from control fish. 0.69 ppm NH_3 x 67.

Fig. 2. Gill section from fry exposed to 26.08 ppm NH_3. Hyperplasia of gill epithelium has resulted to fusion of some lamellae. x67.

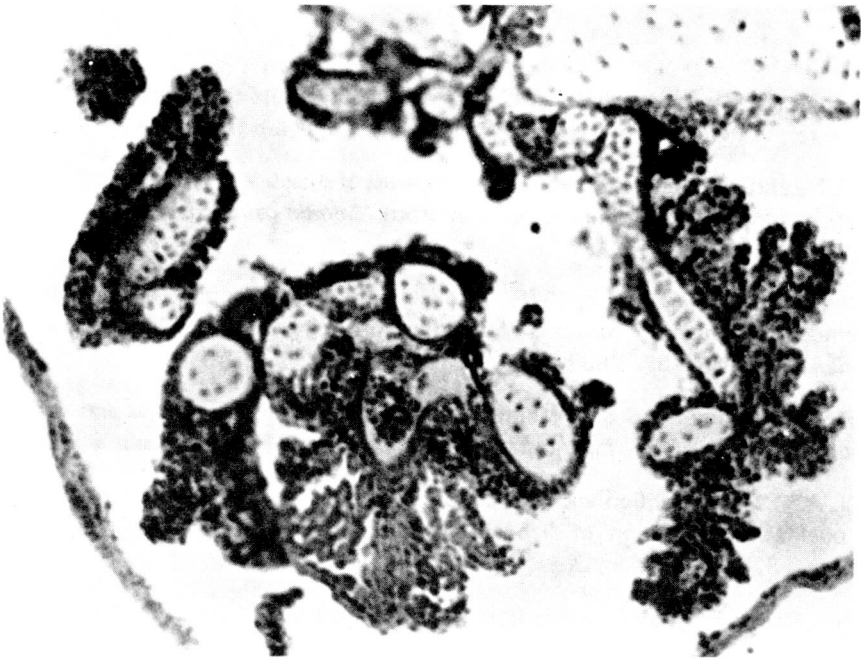

Fig. 3 Gill section from fry exposed to 29.66 ppm NH_3 Severe hyperplasia of gill epithelium has resulted to fusion of lamellae. x67.

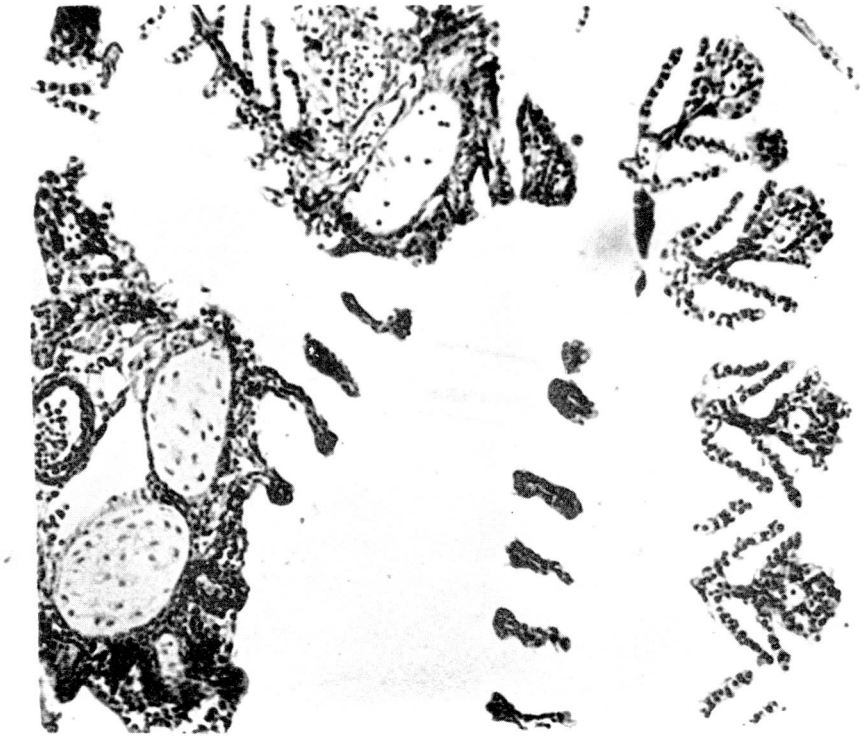

Fig. 4. Gill section from surviving fry after 96 hours exposure to 29.66 ppm NH_3 followed by a 10-day recovery period. Note that gills are starting to become normal again. x67.

Literature Cited

American Public Health Association, 1971. Standard methods for the examination of water and wastewater. American Public Health Association, Washington D. C. 13th ed. 874 pp.

Downing. K. M. and J. C. Merkens, 1955. The influence of dissolved oxygen concentration on the toxicity of unionized ammonia to rainbow trout *(Salmon gairderi).* Ann Appl. Biol. 43 (2): 243-246.

Food and Agriculture Organization, 1975. Manual of methods in aquatic environment research. I. Methods for detection, measurement and monitoring of water pollution. FAO Fisheries Technical Paper No. 137. 283 pp.

Hazel, C. R., W. Thomsen and S. J. Meith, 1971. Sensitivity of striped bass and stickleback to ammonia in relation to temperature and salinity. Calif. Fish and Game 57 (3): 154-161.

Jumalon, N. A., 1978. Selection and application of a suitable sampling method for quantitative and qualitative evaluation of 'lab-lab'. Unpublished M. S. Thesis. University of the Philippines System, Diliman, Quezon City, Philippines. 122 pp.

Mangalik, A., 1979. Effects of various lipid sources on the growth and survival rates of *Penaeus monodon* Fabricius from postlarvae to juveniles in a controlled environment. Unpublished M. S. Thesis. University of the Philippines System, Diliman, Quezon City, Philippines. 65 pp.

Robinette, H. R., 1976. Effect of selected sublethal levels of ammonia on the growth of channel catfish (*Ictalurus punctatus*). Prog. Fish. Cult. 38 (1): 26-29.

Smith, C. E. and R. G. Piper, 1975. Lesions associated with chronic exposure to ammonia. The Pathology of Fishes. The University of Wisconsin Press, Wisconsin. 1004 pp.

Woolf, C. M., 1968. Principles of biometry. Van Nostrand Co. Inc. 359 pp.