熱帯魚の寒冷麻酔

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Short Paper

Cold Anaesthesia of Tropical Fish*1

Tricaine methanesulphonate (MS-222), hypothermia, and electroanaesthesia are all commonly employed as anaesthesia for fishes[1-4]. The temperature at which cold anaesthesia is induced, like temperature tolerance[5], has been shown to be dependent upon acclimation temperature[3]. Reported temperatures of cold anaesthesia of freshwater and marine temperate fishes ranged 0 to 10°C according to acclimation temperature and species[3]. However, this phenomenon in marine tropical fishes has not been reported.

Tropical fishes, *Tilapia mossambica* and *Cyprinodon dearborni*, were collected from Laguna Los Patos in Cumana City, Venezuela, and were acclimated for 24 days prior to experiments at four temperatures (24, 27, 30, and 33°C), which are representative temperatures in area throughout the year. Average standard length was 39 mm (SD±0.8) for *T. mossambica* and 27 mm (SD±0.5) for *C. dearborni*. Capture and experimental salinity was 2‰.

Cold-shock bioassays were performed by the critical thermal minimum method[6]. Two fish were placed in an aquarium with 2-liter of water at the acclimation temperature and the temperature was lowered by an immersible refrigerated laboratory chiller. Rate of decrease in temperature was 5°C/h. Ten fish were tested at each acclimation temperature.

Temperatures at which fish (1) became sluggish, (2) completely lost movement, and (3) became stiff and immobile and completely lost respiratory movement (CRM) were recorded in each bioassay. After fish ceased respiratory movement completely, they were returned to acclimation temperatures to determine revival probability (RP) and times required to revive (TRR).

Temperatures of CRM, RP, and TRR at acclimation temperatures are given in Table 1.

T. mossambica started to be sluggish from 10.8–11.2°C (acclimated at 24°C), 11.4–11.9°C (27°C), 11.9–12.1°C (30°C), and 13.3–14.7°C (33°C); completely stopped movement and stayed on the bottom of aquarium from 10.1–10.7°C (24°C), 10.3–11.3°C (27°C), 11.2–11.5°C (30°C), and 12.6–13.1°C (33°C); and became stiff and immobile from 7.9–9.1°C (24°C), 9.4–10.7°C (27°C), 10.3–11.4°C (30°C), and 10.3–12.5°C (33°C). *C. dearborni* began to lose equilibrium from 8.5–9.1°C, 9.4–11.2°C, 10.3–11.8°C, and 11.5–15.6°C; completely stopped movement from 4.5–5.1°C, 5.6–6.1°C, 6.5–7.4°C, and 8.7–9.1°C; and became stiff and immobile from 3.3–3.6°C, 4.1–4.9°C, 4.6–5.3°C and 6.2–7.4°C at acclimation temperatures of 24, 27, 30, and 33°C, respectively.

Table 1. Temperatures at which cold anaesthesia occurred in *Tilapia mossambica* and *Cyprinodon dearborni* acclimated at 24–33°C and percent revival and times required to revive after returned to acclimation temperatures

Acclimation temperature (°C)	Cold anaesthesia (°C)	Percent revival (%)	Times required to revive (min)
Tilapia mossambica			
24	8.5±SD 0.38	100	0.8–2
27	9.8±SD 0.45	100	0.2–1.5
30	10.7±SD 0.35	100	0.3–1
33	11.5±SD 0.67	100	0.2–1.5
Cyprinodon dearborni			
24	3.4±SD 0.09	100	0.01–0.3
27	4.4±SD 0.31	100	0.01–1
30	5.1±SD 0.69	100	0.01–1
33	6.8±SD 0.48	100	0.2–1.5

When fishes anaesthetised were returned to acclimation temperatures, 100% revived within a few minutes (Table 1).

Previous study[3] indicated that cold anaesthesia of freshwater Indian fish, *Monopterus cuchia* and *Heteropneustes fossilis*, and freshwater temperate fish, *Carassius auratus*, acclimated 23–25°C occurred at 10, 6–7, and 0°C, respectively; that of marine temperate fish, *Spinachia spinachia* and *Blennius pholis*, acclimated at 10°C was 0°C.

The above indicate that cold-adapted fish experience cold anaesthesia at lower temperatures than warm-adapted fish and also marine fish tend to reach cold anaesthesia at much lower temperatures than freshwater fish; thus, tropical marine fishes appeared to be completely anaesthetised at temperatures well above 0°C.

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