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HEMOGLOBIN CONTENT OF THE BLOOD OF FIFTEEN SPECIES OF MARINE FISHES

The ability of the blood to carry oxygen depends on the concentration of the respiratory pigment present, and its nature. A knowledge of the amount of hemoglobin in the blood of fishes can be of considerable significance in understanding their ecological and physiological relationships.

Many of the analytical techniques commonly used for determining blood hemoglobin levels are not suitable for fish bloods (Anthony, 1961). Colloidal suspensions, unstable solutions, or inadequate standardizations are hazards frequently encountered in many of the analyses. As a consequence, some of the data available in the literature respecting hemoglobin levels in fish bloods may not be completely reliable.

The pyridine hemochromogen technique of Roets (1940) and Collier (1944) has been demonstrated to be a satisfactory analytical technique for determining hemoglobin concentrations in fish blood (Anthony, 1961; Klawe, Barrett, and Klawe, 1963). Recently, in the course of other studies on tunas, the blood of 15 species of marine fishes (mostly scombroids and billfishes) has been collected and analyzed for hemoglobin content by this technique (Table 1).

TABLE 1

Range, Mean, and Standard Error of the Mean of Blood Hemoglobin Levels in 15 Species of Marine Fishes

Species	*Common name*	*Number*	*gm Hb/100 ml*		
			Range	*Mean*	*S.E.*
Mackerel and Tunas					
Thunnus thynnus	bluefin tuna	10	18.7–21.0	19.8	0.28
Auxis rochei	frigate mackerel	10	16.5–22.8	19.2	0.57
Thunnus alalunga	albacore	11	15.3–19.3	17.2	0.36
Thunnus albacares	yellowfin tuna	8	12.5–19.8	16.8	0.86
Thunnus obesus	bigeye tuna	25	10.3–20.8	15.6	0.53
Sarda chiliensis	Pacific bonito	9	11.2–15.3	12.9	0.74
Acanthocybium solanderi	wahoo	9	5.9–16.5	10.4	1.2
Billfish and Swordfish					
Makaira nigricans	blue marlin	8	7.4–16.2	13.0	2.0
Tetrapturus angustirostris	shortbill spearfish	13	8.2–15.6	12.9	0.50
Tetrapturus audax	striped marlin	16	5.8–16.8	11.3	0.75
Xiphias gladius	swordfish	5	5.3–12.5	10.2	--
Other					
Engraulis mordax	northern anchovy	9	11.7–16.8	14.4	0.54
Coryphaena hippurus	dolphinfish	18	8.1–14.4	11.6	0.46
Seriola dorsalis	California yellowtail	5	4.0–14.7	8.3	--
Paralabrax clathratus	kelp bass	8	4.0–10.2	7.6	0.90

The fish sampled were collected from many parts of the Pacific Ocean in 1963 and 1964 by jig, troll, live-bait, purse-seine, or long-line techniques aboard commercial tuna clippers, tuna purse seiners, a Japanese exploratory long-line fishing vessel, and a sportfishing boat. Blood samples were taken by direct heart puncture, except for those from the

northern anchovy (*Engraulis mordax*) which were taken from the cut caudal artery. Heparin solution, used routinely as the anticoagulant, was introduced into the syringe and the excess ejected. Blood samples from kelp bass (*Paralabrax clathratus*), yellowtail (*Seriola dorsalis*), Pacific bonito (*Sarda chiliensis*) and northern anchovy were held on ice and analyzed within a few hours after being taken. The rest of the blood samples were frozen. Prior to analysis, the frozen samples were thawed overnight in a refrigerator.

A pyridine hemochromogen method adapted from Roets (1940) and Collier (1944) was used for determining the amount of hemoglobin in the blood. To 6 ml of 0.1N NaOH in a colorimeter tube we added 0.02 ml of blood, measured with a Sahli pipet. The solution, in the tube, was boiled for 4 minutes in a water bath and then cooled. Two ml of pyridine (C_5H_5N) were added and the solution, after thorough mixing, was left to stand for 30 minutes in the dark. (This latter was a precautionary measure, but it is not a strictly essential part of the procedure. Analyses of solutions left standing for 8 minutes in direct sunlight showed no significant differences in colorimeter readings from those held in subdued light.) Five to 10 mg of sodium hydrosulfite were added and the solution, after mixing, was read in a Bausch and Lomb Spectronic 20 Colorimeter at 545μu.

Hemoglobin concentrations (g/100 ml blood) of the various bloods were determined from a Beer's law plot of a series of dilutions of Hyland Whole Blood Hemoglobin Standard (Hyland Laboratories, Los Angeles 39, California) treated by the method described above. A new determination of the Beer's curve was made for each day's analyses.

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—*Izadore Barrett and Alice A. Williams, Inter-American Tropical Tuna Commission, c/o Scripps Institution of Oceanography, La Jolla, California, March 1965.*

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