The Effect of Temperature on the Respiratory Function of Coelacanth Blood

Little is known of the respiratory function of coelacanth blood with the exception of a brief comment by RIGGS[1]. This report is part of a study which was possible using samples of blood obtained by the recent British/French/American expedition from specimens of *Latimeria chalumnae* caught at Anjouan in January, and Iconi, Grande Comore, in March 1972.

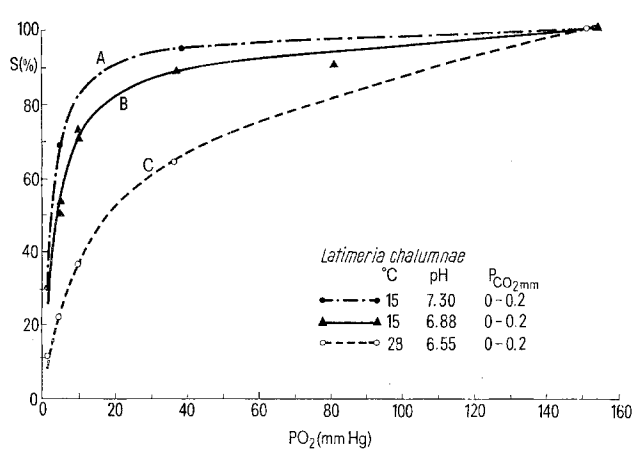
The oxygen content of blood equilibrated with various gas mixtures at two different temperatures was determined using a Lex O_2 Con analyzer. Blood from the second specimen had a very low haematocrit value (10%) and is considered to have been much diluted by the addition of citrate as anticoagulant and possibly because of weakening of the fish. Estimates suggest that the normal haematocrit for *Latimeria* is about 20%. From the raw data estimates were therefore made of the normal oxygen content of the blood by multiplying the amount combined with the haemoglobin by 2 and adding to it the volume of oxygen dissolved in the plasma. The latter was estimated from the oxygen content of sea water at the same concentration, Po_2 and temperature. The temperatures of 28 °C and 15 °C were chosen because they reflect the normal temperature of the surface waters about Grande Comore and the probable temperature at depths of 100 m at which the fish were caught, but no actual measurements are available for the latter.

The results are summarized in the Table and in the Figure. The blood showed a lower affinity for oxygen at 28 °C (Curve C) than at 15 °C (Curve B). This result coincides with those obtained for many other species of fish[2–9].

The blood samples had a low pH (6.88 at 15 °C). We examined the blood after adjusting its pH to 7.30 which is more likely to be closer to the normal range at 15 °C. The effect of dilution by bicarbonate solution was eliminated by a correction based on the changed haematocrit. This blood (Curve A) showed a higher affinity for oxygen than that originally found (B) at the same temperature. Curve A, having a very low P_{50}, is considered to show the natural properties of the blood. The coefficient '*n*' in Hill's equation decreased with decreasing pH. This is contrary to the result noted by RIGGS[1] but is similar to that known to occur for *Neoceratodus*[6] and *Protopterus*[8]. The effect of carbon dioxide on the blood is similar to that due to pH, i.e. there is a well marked Bohr shift, but no Root effect was observed in our experiments. The very high affinity for oxygen of *Latimeria* blood under normal conditions has probably contributed to its survival in regions and during periods when it might encounter waters of low oxygen tension. The lowering of pH and oxygen affinity of the blood by raising temperature may partly explain why the specimens only survived for about 6 h when kept in the surface water. The small O_2-carrying capacity (5.15 vols % at 15 °C) of the blood, which lies between the capacities of sluggish teleosts such as *Lophius* (angler fish)[10] and *Opsanus* (toadfish)[10], would also add to the respiratory problems in such circumstances.

P_{50} and coefficient '*n*' at different temperatures and pH

Curve in Figure	Temperature (°C)	P_{CO_2} (mm Hg)	pH of aerated blood	P_{50} (mm Hg)	Coefficient *n*
A	15	0–0.2	7.30	2.06	1.012
B	15	0–0.2	6.88	3.50	0.884
C	28	0–0.2	6.55	18.0	0.876



O_2 dissociation curves of *Latimeria* blood. A and B at 15 °C, C at 28 °C. The P_{CO_2} was 0–0.2 mm in all cases, and pH was 7.30 (A), 6.88 (B) and 6.55 (C).

Zusammenfassung. Die Sauerstoffdissoziationskurve vom *Latimeria*-Blut zeigt eine grössere Affinität zu Sauerstoff bei 15 °C (P_{50} = 2–3 mm) als bei 28 °C (P_{50} = 18.0 mm). Diese Unterschiede und die geringe Sauerstoffkapazität sind für eine Diskussion über das Überleben des Fisches beim Aufsteigen aus grosser Tiefe an die Gewässeroberfläche massgebend.

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