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The gaseous gastrointestinal tract of a seawater teleost, the English sole (*Parophrys vetulus*)

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Abstract:

There has been considerable recent progress in understanding the respiratory physiology of the gastrointestinal tract (GIT) in teleosts, but the respiratory conditions inside the GIT remain largely unknown, particularly the luminal PCO_2 and PO_2 levels. The GIT of seawater teleosts is of special interest due to its additional function of water absorption linked to HCO_3^- secretion, a process that may raise luminal PCO_2 levels. Direct measurements of GIT PCO_2 and PO_2 using micro-optodes in the English sole (*Parophrys vetulus*; anaesthetized, artificially ventilated, 10–12 °C) revealed extreme luminal gas levels. Luminal PCO_2 was 14–17 mmHg in the stomach and intestinal segments of fasted sole, considerably higher than arterial blood levels of 5 mmHg. Moreover, feeding, which raised intestinal HCO_3^- concentration, also raised luminal PCO_2 to 34–50 mmHg. All these values were higher than comparable measurements in freshwater teleosts, and also greater than environmental CO_2 levels of concern in aquaculture or global change scenarios. The PCO_2 values in subintestinal vein blood draining the GIT of fed fish (28 mmHg) suggested some degree of equilibration with high luminal PCO_2, whereas subintestinal vein PO_2 levels were relatively low (9 mmHg). All luminal sections of the GIT were virtually anoxic ($PO_2 \leq 0.3$ mmHg), in both fasted and fed animals, a novel finding in teleosts.

Keywords: lemon sole, feeding, CO_2, O_2, pH, HCO_3^-, stomach, intestine