

COBIA EXHIBITS A PERMANENT GASTRIC ACIDITY AS DIGESTION STRATEGY

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Introduction

Cobia (Rachycentron canadum) is a species with large commercial interest in tropical waters and a promising candidate for aquaculture. This species has a high voracity and growth rate. A better knowledge of its digestive functionality after feeding will help to implement appropriate feeding protocols and formulate optimal feeds. Also, with the perspectives of an increasing water temperature due to climate changes, it is important to know its physiology at elevated temperatures. Considering its carnivorous habits, a key part of the digestion occurs in the stomach. This includes mechanical degradation and the proteolytic action of pepsin together with the denaturing effect on proteins of the low pH. Pepsinogen activation depends of luminal gastric pH and it is necessary to know the pH conditions during feeding to have reliable estimation of the pepsin activity (Yúfera et al. 2012). With this aim, we have measured the postprandial pH changes in the different sections of the digestive tract in juveniles reared at 30° and 34° C.

Materials and methods

Cobia juveniles were obtained from a local hatchery in Nha Trang, Vietnam. Fish were reared in 200 L tanks connected to a recirculation seawater system and fed twice a day (at 08:00 and 17:00 local time) with an experimental feed with optimized nutrient composition based on current knowledge. Juveniles were cultured under a light/dark cycle and two temperatures (30 and 34°C) using 3 tanks for each temperature. After 10 days under these conditions (body weight: ca. 6-8 g range) the gastrointestinal pH was measured by sampling 3 fish per tank every 4 hours during 24 hours. The pH was measured in the stomach, anterior intestine, medium intestine and posterior intestine using a pH microelectrode as described in Yúfera et al. (2012).

Results

The luminal pH in the stomach was permanently acidic with mean values ranging from 2.76 to 4.74 (Fig. 1A) although an increase was observed after each of the two meals. The intestinal pH ranged from 6.05 to 7.69 (Fig. 1B and C). An increase was observed after the first meal and this slight alkalinity was maintained during several hours before declining to neutral or slightly acidic values at the end of the day. Furthermore, the maximum measured pH values were progressively higher when moving from proximal to distal part of the intestine. No significant differences in gastric pH were found between fish reared at the two temperatures. On the contrary, a slightly higher alkalinity seems to be reached in the intestine at 30°C.

Discussion and conclusions

Two different gastric digestion strategies have been described in vertebrates, characterized either by a permanent secretion of hydrochloric acid or not, which maintains respectively an acidic or neutral environment at the stomach during fasting. In

teleostean fish, most of the analyzed species exhibit the second strategy (neutral pH); only *Oncorhynchus mykiss* has been described to have a permanently acidic stomach (Bucking & Wood, 2009), while *Solea senegalensis* does not have the capacity to significantly reduce the gastric pH from neutral values (Yúfera & Darias, 2007). Our results demonstrate that cobia juveniles follow the first strategy and maintain a gastric luminal pH close to 4 throughout the day. To our knowledge, this is the second teleostean species that has been found to exhibit such a strategy. The increase in pH after feeding is due to the buffering and dilution effect of the ingested food and drunk sea water. In the intestine, an increased pH after the first meal was also observed, but the effect of the second meal on pH was only observed in the anterior intestine.

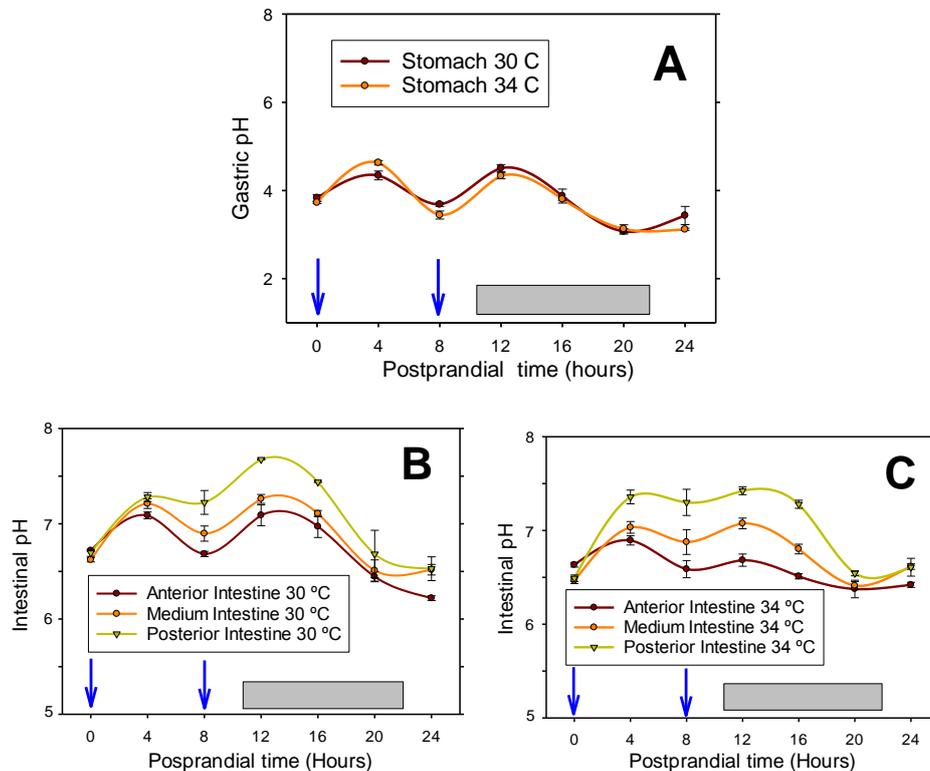


Fig. 1. Intestinal pH (mean \pm SEM) in juvenile Cobia reared at 30 and 34°C during a 24 hours cycle. Arrows indicates the meal time. Grey bar indicates the dark period.

References

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