GROWTH, METABOLISM AND N-RETENTION IN COBIA AT ELEVATED WATER TEMPERATURES- THE ROLE OF DIETARY METHIONINE LEVELS


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Introduction
Increased sea temperature due to global warming will affect the physiology, behavior, and geographical distribution of marine fish (Botkin et al., 2007). Temperature is one of the vital factors affecting metabolism, growth and energy budget of fish, as for other ectothermic organisms (Hunter et al., 2016). Until now, there is no information available on the impact of temperature on amino acids metabolism on cobia (Rachycentron canadum), a candidate species in aquaculture. The present study aimed to determine the interactions of elevated temperature and dietary methionine on growth, metabolism and N-retention in cobia.

Materials and Methods
Juvenile cobia (BW 2-3g), collected from a hatchery in Nha Trang were transferred and acclimatized in 2 indoor cylindrical fiberglass tanks (6 m$^3$) with a density of 200 fish per m$^3$ in a wet lab of Nha Trang University (Vietnam) for 1 week. Seawater temperature in one holding tank was raised 1°C day$^{-1}$, and held at 34°C using thermal controllers (Chuan Kuan Ltd., Taiwan), while, temperature in the other tank was kept at 30°C. The fish were fed by hand to apparent satiety at 8:00 and 17:00 with a commercial diet (NRD, Inve Ltd.).

After acclimatization, juveniles with 3.7±0.4g BW and 9.7±0.9 cm TL were randomly distributed to 18 experimental tanks (200 l rectangular fiberglass tanks; 60 fish tank$^{-1}$) and reared at two temperatures (30 and 34°C) in recirculation systems (Nguyen et al., 2014). Each of the experimental diets, produced by SPAROS Lda. (Portugal) was randomly assigned to three tanks. Formulations of the experimental diets were modified from Nguyen et al. (2014), and contained 47% protein and 10% lipid. Crystalline methionine was added into the diets, in order to make diets with low methionine (9.1g kg$^{-1}$; M9), fulfilled requirement (12.8g kg$^{-1}$; M12) and surplus methionine (16.8g kg$^{-1}$; M16) according to Zhou et al. (2006). The feeding trial lasted for 6 weeks. After one week, 44 cobia from each tank were removed for peri-prandial gene expression study (data not shown). Uneaten feed was siphoned for the calculation of feed intake, food conversion ratio (FCR) and protein productive value (PPV). Salinity was 32±2.1g l$^{-1}$, pH 8.0-8.3, oxygen 4.8±0.5mg l$^{-1}$, NH3≤0.03 mg l$^{-1}$. At the end of the experiment, the length and weight were determined and fish were collected for proximate analysis (NIFES, Norway), as described by Espe et al. (2006).

Results and Discussions
Dietary methionine and temperature significantly affected growth (Fig.1A) and FCR (Fig.1B). The interaction between dietary methionine and rearing temperature on growth was significant (P<0.01). Cobia reared at 30°C grew faster and showed better FCR than those reared at elevated temperature (34°C). At both temperatures, dietary low methionine (M9) retarded growth. Cobia fed M12 showed better growth and FCR than those fed either M9 or M16. Results from the present study support the findings reported in cobia by Zhou et al. (2006) and Nguyen et al. (2014). However, no differences in growth was present requirement of methionine in this species may change at elevated temperatures. Similarly, th highest PPV wasrecorded in cobia fed M12 at 30°C, following by cobia fed M16 at 30°C (Fig.2A). Lower PPV was observed amongst cobia reared at elevated temperature.

Fig. 1. Body weight (A) and FCR (B) in cobia at the end of the feeding trial. Values are Mean±S.E.M; different letters indicate significant difference (P<0.05; Two-way ANOVA); asterisk (*) indicates interaction between Met. and Temp.

The interaction between dietary methionine and rearing temperature on PPV in cobia was significant (P<0.05). This suggests that elevated temperatures affect energy allocation in cobia, as reported by Sun and Chen (2014).

Fig. 2. Protein productive value (A) and retention of essential amino acids (ER; %) (B) in cobia. Values are Mean±S.E.M; different letters indicate significant difference (P<0.05; Two-way ANOVA); asterisk (*) indicates interaction between Met. and Temp.

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In addition, cobia fed M12 at 30°C showed the best ER, following by cobia fed M16 at this temperature. The lowest ER was found in cobia fed M9 at elevated temperature (Fig.2B). This probably is due to the poorer growth, FCR and PPV of cobia in this treatment. Results from our study support the hypothesis that water temperature increases beyond the upper thermal tolerance limit negatively affect growth and nutrient utilization.

Conclusions
Results from the present study indicate both dietary methionine levels and temperatures affect growth, FCR, PPV and amino acid retention in cobia. Elevated temperature causes negative impacts on growth and nutrient utilization in the species.

References

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