

**GROWTH POTENTIAL AND PERFORMANCE OF
FARMED SOUTHERN BLUEFIN TUNA, *Thunnus maccoyii***

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EXTENDED ABSTRACT ONLY - DO NOT CITE

Introduction

Lack of information on the physiology of farmed southern bluefin tuna (SBT) requires the use of alternative methods to complement the direct assessment of growth. Relationships between growth rate and indirect measurements including biochemical growth correlates (RNA, DNA and protein concentration and ratios between them), organ weights and plasma IGF-I concentrations have been assessed over several years. Significant positive relationships between individual specific growth rates and indices of RNA content (RNA

concentration, RNA: protein, RNA: DNA) in the epaxial muscle have been observed (Carter et al. 1998). In the latter study SBT were fed at near maintenance but the muscle RNA: protein ratio (8.3 ± 1.4 g protein/mg RNA) was at least four times higher than would be predicted from other fishes based on their weight and temperature (Houlihan et al. 1995). RNA:protein was similar to that in unfed mammals (Millward et al. 1973) and suggested there may be differences in protein turnover of tuna compared with other teleosts. The current research aimed to gain a more detailed understanding of nutrient utilisation and growth of SBT through investigation of potential indicators of protein metabolism such as biochemical growth correlates over 24 hours following feeding.

Methods

SBT (13.9 ± 2.9 kg; mean \pm sd) held in a 30m cage on the Tuna Research Farm, South Australia were used (Carter et al. 1998). Five fish were removed prior to feeding in the morning and further groups of five removed at 2, 4, 8, 12 and 24 hours after the morning feed. The fish were killed quickly by pithing, weight and fork length measured and tissue samples taken (Carter et al. 1998). Measurements were made of tissue protein, RNA and DNA (Carter et al. 1998) and plasma IGF-I concentrations. There were no significant ($P > 0.2$) differences between plasma cortisol concentrations at 0h and the other times and suggested that repeated returns to the cage did not increase stress levels.

Results and Discussion

Muscle growth correlates were not different between times (Table 1). There was a suggestion that muscle temperature increased to peak at 8h following feeding.

The relationship between the RNA:protein ratio (capacity for protein synthesis) and protein synthesis (PS) has been described by $PS (\%/d) = 2.3 \text{RNA:Protein} - 6.4$ (Carter et al. 1993). The mean RNA:protein ratio predicted a muscle protein synthesis rate of 3.7 %/d. This is similar to those found in other fish and around 1.3 times the rate predicted when weight and muscle temperature are taken into account (Houlihan et al. 1995; McCarthy et al. 1999). Consequently, these data don't provide any strong evidence that RNA:protein ratio and protein turnover in tuna is significantly different from other teleosts. Furthermore, rates of protein synthesis in tuna muscle are likely to be explained by the relationship

between temperature and synthesis established for endotherms and ectotherms (McCarthy et al. 1999). However, it is important to note that rates of protein synthesis are also determined by RNA activity. The high RNA:protein ratio found in the earlier study (Carter et al. 1998) are not easily explained and may have related to a long period of poor nutrition.

Table 1. Change in muscle protein, RNA and DNA concentrations (mg/g muscle tissue) and ratios and temperature prior to (0h) and following feeding.

	0h	2h	4h	8h	12h	24h	P
Protein (mg/g)	145 ±14	141 ±11	137 ±19	153 ±12	154 ±11	150 ±21	ns
RNA (mg/g)	0.71 ±0.0 9	0.55 ±0.0 3	0.49 ±0.0 5	0.67 ±0.0 9	0.73 ±0.1 1	0.69 ±0.0 7	ns
DNA (mg/g)	0.46 ±0.1 1	0.36 ±0.1 0	0.55 ±0.1 3	0.48 ±0.1 0	0.40 ±0.1 2	0.42 ±0.1 3	ns
RNA:protein	4.9± 0.6	3.9± 0.2	3.6± 0.3	4.4± 0.7	4.7± 0.6	4.7± 0.6	ns
RNA:DNA	2.2± 0.7	2.1± 0.5	1.2± 0.3	2.2± 1.0	2.8± 0.9	2.4± 0.7	ns
Temp. (°C)	25.5 ±0.7	25.0 ±0.4	26.1 ±0.4	27.1 ±0.2	26.5 ±0.6	25.7 ±0.4	<0.07

The growth rates of the tuna in the current experiment were not known. However, IGF-I concentration (38.8 ± 16.1 ng / ml) varied between individual fish and was significantly correlated with muscle RNA ($r = 0.60$; $P < 0.01$) and protein ($r = 0.53$; $P < 0.01$) concentrations and more weakly with the RNA:protein ratio ($r = 0.35$; $P < 0.05$). These data are suggestive of the relationships between whole animal growth and mechanisms of protein accretion found previously (Millward et al. 1973; Carter et al. 1998; McCarthy et al. 1999) as well as with IGF-I concentrations. These measures have potential for understanding SBT growth performance particularly in relation to farming, feeding and feed development.

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