Metabolic and Osmoregulatory Responses of Snapper (*Pagrus auratus*), Mulloway (*Argyrosomus japonicus*) and Yellowtail Kingfish (*Seriola lalandi*) in Saline Groundwater

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Declaration

I hereby declare, that the following thesis contains no material, which has been accepted for a degree or diploma by the University or any other institution, except in the way of background information that has been duly acknowledged in the thesis; and to the best of my knowledge and belief, that there is no material published or written by authors except where acknowledged in the text.

Authority of Access

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Abstract

Australia has an abundance of saline groundwater due to land clearing and irrigation within the Murray-Darling river system. Generally saline groundwater contains similar ions to coastal seawater with concentrations varying due to the source of the water. In this study Australian snapper (*Pagrus auratus*), mulloway (*Argyrosomus japonicus*) and yellowtail kingfish (*Seriola lalandi*) were chosen to examine their suitability for culture in saline groundwater. The growth and metabolic response of the aforementioned species were investigated to determine their suitability for culture in saline groundwater from the 'outfall' of the Stockyard Plains Disposal Basin (SPDB) in Waikerie, South Australia (potassium ~ 80 $mg.L^{-1}$). In the first experiment snapper, mulloway and yellowtail kingfish were cultured in saline groundwater (salinity = 19 ± 1 $g.L^{-1}$), half-strength coastal seawater (iso-osmotic; 19 ± 1 $g.L^{-1}$) and oceanic seawater (except snapper; 37 ± 1 $g.L^{-1}$) for 61, 45 and 21 days respectively, to determine survival, growth rate and food conversion ratio. At the end of each growth experiment, fish were placed in static box respirometers to record changes in oxygen consumption in the different water types. Changes in oxygen consumption were used as an indirect method to determine routine metabolic rate (Mo_{2rout}), maximum metabolic rate (Mo_{2max}) and metabolic scope (Mo_{2scope}). In the second experiment, blood samples were taken from the fish 1 hour post-exhaustion and analysed for blood plasma sodium, potassium, chloride, lactate and osmolality to determine if fish were able to cope with osmoregulatory changes.

All three species showed high survival rates and positive growth in saline groundwater and iso-osmotic water. Mo_{2rout} and Mo_{2max} of snapper in saline groundwater was 41 % and 29 % greater respectively, than in iso-osmotic seawater. However, there was no significant difference for Mo_{2scope} ($p > 0.05$) between water types, implying snapper grown in reduced potassium saline groundwater incur a greater metabolic cost compared to fish in iso-osmotic seawater. Mulloway growth and metabolic rate were unaffected by salinity and saline groundwater ($p > 0.05$). The

combined results obtained in this study support the aquaculture potential for mulloway in saline groundwater when the salinity is 20 $g.L^{-1}$ and the potassium concentration is > 40 % of that found in diluted seawater. Yellowtail kingfish growth in iso-osmotic seawater was significantly greater ($p < 0.05$) than in seawater and saline groundwater. No correlation between fish growth and metabolic rate was observed, as some fish were restless in the respirometry boxes making metabolic rate difficult to measure accurately. Mulloway and snapper both proved to be suitable candidates for the static boxes, whereas yellowtail kingfish were restless in the static boxes which may have confounded the metabolic results.

The routine blood plasma sodium [Na+], potassium [K+] and chloride [Cl-] ion concentrations indicated that mulloway (45 days) and yellowtail kingfish (21 days) can survive in water with salinities ranging from 19-35 $g.L^{-1}$. The routine blood plasma lactate concentration for yellowtail kingfish was five-fold greater than for mulloway. One hour post-exhaustion there was an increase in [Na^+], [K^+] and [Cl^-] for mulloway and yellowtail kingfish. However, insignificant decreases ($p > 0.05$) in [K^+] in iso-osmotic water were recorded for mulloway and [Na^+] for yellowtail kingfish. Blood plasma lactate 1 hour post-exhaustion, was two to three-fold greater in mulloway and snapper in contrast to yellowtail kingfish.

The results from this study suggest that the water from the SPDB is suitable for mulloway aquaculture without any ionic adjustment. Snapper growth deficiency could be overcome by supplementing the saline groundwater from SPDB with potassium to > 40 %. Further experiments using yellowtail kingfish with longer exposure to iso-osmotic water are required to determine the aquaculture potential of this species.

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