

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.

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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*), mullet (*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 $\sim 80 \text{ mg.L}^{-1}$). In the first experiment snapper, mullet and yellowtail kingfish were cultured in saline groundwater (salinity = $19 \pm 1 \text{ g.L}^{-1}$), half-strength coastal seawater (iso-osmotic; $19 \pm 1 \text{ g.L}^{-1}$) and oceanic seawater (except snapper; $37 \pm 1 \text{ g.L}^{-1}$) 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 ($\text{Mo}_{2\text{rout}}$), maximum metabolic rate ($\text{Mo}_{2\text{max}}$) and metabolic scope ($\text{Mo}_{2\text{scope}}$). 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. $\text{Mo}_{2\text{rout}}$ and $\text{Mo}_{2\text{max}}$ of snapper in saline groundwater was 41 % and 29 % greater respectively, than in iso-osmotic seawater. However, there was no significant difference for $\text{Mo}_{2\text{scope}}$ ($p > 0.05$) between water types, implying snapper grown in reduced potassium saline groundwater incur a greater metabolic cost compared to fish in iso-osmotic seawater. Mullet 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 mullet 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. Mullet 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 mullet (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 mullet. One hour post-exhaustion there was an increase in [Na⁺], [K⁺] and [Cl⁻] for mullet and yellowtail kingfish. However, insignificant decreases ($p > 0.05$) in [K⁺] in iso-osmotic water were recorded for mullet and [Na⁺] for yellowtail kingfish. Blood plasma lactate 1 hour post-exhaustion, was two to three-fold greater in mullet and snapper in contrast to yellowtail kingfish.

The results from this study suggest that the water from the SPDB is suitable for mullet 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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Table of Contents

Declaration	i
Abstract	ii
Acknowledgement	iv
List of Figures	2
List of Tables	5
Chapter 1: Introduction	6
Chapter 2: Growth and metabolic response of snapper (<i>Pagrus auratus</i>), mulloway (<i>Argyrosomus japonicus</i>) and yellowtail kingfish (<i>Seriola lalandi</i>) in saline groundwater	19
Introduction	19
Materials and Methods.....	24
Results	35
Discussion.....	41
Conclusion	49
Chapter 3: Osmoregulatory responses 1 hour post-exhaustion for snapper, mulloway and yellowtail kingfish in saline groundwater.....	50
Introduction	50
Materials and Methods.....	53
Results	55
Discussion.....	65
Conclusion	70
Chapter 4: General Discussion.....	71
References	77

List of Figures

Figure 1: Perched watertables (groundwater mounds) development beneath irrigation areas in the Murray-Darling Basin which enhances the volume of saline groundwater entering the rivers within the Murray-Darling Basin, Australia (Source: Yan et al, 2005).....	9
Figure 2: Current and future salt interception schemes in the Murray-Darling Basin, Australia (Source: P. Forward, SA Water). * indicates SIS is not currently operating.	11
Figure 3: 30 ML of intercepted saline groundwater enters the Stockyard Plains Disposal Basin each day at Waikerie, South Australia.....	13
Figure 4: Intercepted saline groundwater from the Qualco, Waikerie and Woolpunda salt interception schemes is diverted for evaporation and infiltration at the Stockyard Plains Disposal Basin in South Australia.....	17
Figure 5: 800 L tank with a recirculating biofiltration system used to grow fish prior to metabolic experiments.	26
Figure 6: 2 x 1000 L conical bottom, fibreglass reservoir tanks were used to hold water which was pumped using a submersible pump to the black, acrylic respirometer chambers (6 respirometer chambers per 1000 L reservoir tank).....	29
Figure 7: Mean wet weights (g, \pm SE) for snapper cultured in iso-osmotic water (Iso) and saline groundwater (SGW; t = 61 days).....	35
Figure 8: Mean food conversion ratio (\pm SE) for snapper cultured in iso-osmotic (Iso) and saline groundwater (SGW; t = 61 days).....	36
Figure 9: Mean specific growth rate (% bw.d ⁻¹ , \pm SE) for snapper cultured in iso-osmotic (Iso) and saline groundwater (SGW; t = 61 days).....	36
Figure 10: Mean routine metabolic rate, maximum metabolic rate and metabolic scope ($\mu\text{mol.g}^{-1}.\text{h}^{-1}$, + SE) for snapper cultured in iso-osmotic water and saline groundwater.	37

Figure 11: Mean routine metabolic rate, metabolic scope and maximum metabolic rate ($\mu\text{mol.g}^{-1}.\text{h}^{-1}$, + SE) for mulloway one hour post-chasing cultured in iso-osmotic water, saline groundwater and oceanic seawater..... 38

Figure 12: Mean routine metabolic rate, maximum metabolic rate and metabolic scope (+ SE, $\mu\text{mol.g}^{-1}.\text{h}^{-1}$) for yellowtail kingfish grown in iso-osmotic (Iso), saline groundwater (SGW) and coastal seawater..... 40

Figure 13: Mean (+ SE) blood plasma sodium for snapper cultured in iso-osmotic (Iso; n = 12) and saline groundwater (SGW; n = 11) 1h post-exhaustion ($p > 0.05$). 55

Figure 14: Mean (+ SE) blood plasma chloride for snapper cultured in iso-osmotic (Iso; n = 12) and saline groundwater (SGW; n = 11) 1h post-exhaustion ($p > 0.05$). 56

Figure 15: Mean (+ SE) blood plasma lactate for snapper cultured in iso-osmotic (Iso; n = 12) and saline groundwater (SGW; n = 11) 1h post-exhaustion ($p > 0.05$). 56

Figure 16: Mean (+ SE) blood plasma osmolality for snapper cultured in iso-osmotic (Iso; n = 12) and saline groundwater (SGW; n = 12) 1h post-exhaustion ($p > 0.05$). 57

Figure 17: Mean (+ SE) blood plasma potassium for snapper cultured in iso-osmotic (Iso 1, n = 6; Iso 2, n = 6); and saline groundwater (SGW 1, n = 5; SGW 2, n = 6) 1h post-exhaustion. Means with the same letter are not significantly different ($p > 0.05$). Snapper in water types with the same number were sampled on the same day..... 57

Figure 18: Mean (+ SE) blood plasma sodium for mulloway cultured in iso-osmotic (Iso; n = 6; n = 12), saline groundwater (SGW; n = 5; n = 12) and seawater (SW; n = 6; n = 12) 1h post-exhaustion. Means with the same letter are not significantly different ($p > 0.05$). 58

Figure 19: Mean (+ SE) blood plasma chloride for mulloway cultured in iso-osmotic (Iso; n = 6; n = 12), saline groundwater (SGW; n = 5; n = 12) and seawater (SW; n = 6; n = 12) 1h post-exhaustion. Means with the same letter are not significantly different ($p > 0.05$). 59

Figure 20: Mean (+ SE) blood plasma osmolality for mulloway cultured in iso-osmotic (Iso; n = 6; n = 12), saline groundwater (SGW; n = 5; n = 12) and seawater (SW; n = 6; n = 12) 1h post-exhaustion. Means with the same letter are not significantly different ($p > 0.05$). 59

Figure 21: Mean (+ SE) blood plasma lactate for mulloway cultured in iso-osmotic (Iso; n = 6; n = 12), saline groundwater (SGW; n = 5; n = 12) and seawater (SW; n = 6; n = 12) 1h post-exhaustion ($p > 0.05$). 60

Figure 22: Mean (+ SE) blood plasma potassium for mulloway cultured in iso-osmotic (Iso; n = 6; n = 12), saline groundwater (SGW; n = 5; n = 12) and seawater (SW; n = 6; n = 12) 1h post-exhaustion. Means with the same letter are not significantly different ($p > 0.05$). 60

Figure 23: Mean (+ SE) blood plasma potassium for yellowtail kingfish cultured in iso-osmotic (Iso; n = 6; n = 4), saline groundwater (SGW; n = 6; n = 9) and seawater (SW; n = 6; n = 5) 1h post-exhaustion. Means with the same letter are not significantly different ($p > 0.05$). 62

Figure 24: Mean (+ SE) blood plasma sodium for yellowtail kingfish cultured in iso-osmotic (Iso; n = 6; n = 4), saline groundwater (SGW; n = 6; n = 9) and seawater (SW; n = 6; n = 5) 1h post-exhaustion ($p > 0.05$). 62

Figure 25: Mean (+ SE) blood plasma chloride for yellowtail kingfish cultured in iso-osmotic (Iso; n = 6; n = 4), saline groundwater (SGW; n = 6; n = 9) and seawater (SW; n = 6; n = 5) 1h post-exhaustion ($p > 0.05$). 63

Figure 26: Mean (+ SE) blood plasma lactate for kingfish cultured in iso-osmotic (Iso; n = 6; n = 4), saline groundwater (SGW; n = 6; n = 9) and seawater (SW; n = 6; n = 5) 1h post-exhaustion ($p > 0.05$). 63

Figure 27: Mean (+ SE) blood plasma osmolality for yellowtail kingfish cultured in iso-osmotic (Iso; n = 6; n = 4), saline groundwater (SGW; n = 6; n = 9) and seawater (SW; n = 6; n = 5) 1h post-exhaustion. Means with the same letter are not significantly different ($p > 0.05$). 64

List of Tables

Table 1: Mean calcium, magnesium, potassium, sodium and chloride for seawater, iso-osmotic and saline groundwater used in all experiments ($\text{mg.L}^{-1} \pm \text{SE}$). Analysis carried out by AWQC, SA Water.	24
Table 2: Composition of seawater, iso-osmotic and saline groundwater sources used in this study (mg.L^{-1} unless stated). Analysis carried out by AWQC, SA Water.....	25
Table 3: Mean ($\pm \text{SE}$) water temperature ($^{\circ}\text{C}$), dissolved oxygen (% sat), pH, salinity (g.L^{-1}) and total ammonia nitrogen (mg.L^{-1}) for snapper cultured in iso-osmotic water and saline groundwater ($t = 61$ days).....	28
Table 4: Mean ($\pm \text{SE}$) water temperature ($^{\circ}\text{C}$), dissolved oxygen (% sat), pH, salinity (g.L^{-1}) and total ammonia nitrogen (mg.L^{-1}) for mullet cultured in iso-osmotic water, saline groundwater and oceanic seawater ($t = 45$ days).....	31
Table 5: Mean ($\pm \text{SE}$) dissolved oxygen (% saturation), pH, salinity (g.L^{-1}), water temperature ($^{\circ}\text{C}$) and total ammonia nitrogen (mg.L^{-1}) for yellowtail kingfish in iso-osmotic, saline groundwater and coastal seawater ($t = 21$ days).....	33
Table 6: Mean initial weight ($\text{g} \pm \text{SE}$), final weight ($\text{g} \pm \text{SE}$), food conversion ratio ($\pm \text{SE}$) and specific growth rate ($\% \text{bw.d}^{-1} \pm \text{SE}$) for mullet cultured in iso-osmotic water, saline groundwater and oceanic water ($t = 45$ days). Means in each column with the same letter are not significantly different ($p > 0.05$).....	38
Table 7: Mean ($\pm \text{SE}$) initial weight (g), final weight (g), food conversion ratio (FCR) and specific growth rate (SGR; $\% \text{bw.d}^{-1}$) for yellowtail kingfish in iso-osmotic, saline groundwater and coastal seawater ($t = 21$ days). Means in each column with the same letter are not significantly different ($p > 0.05$).	39