

Contrasting baseline expression of stress axis genes in rainbow trout selected for divergent stress responsiveness

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INTRODUCTION

- Rainbow trout selected for low (LR) and high (HR) cortisol excretion during stress have distinct physiological responses and behavioural phenotypes (Figs. 1&2).
- To understand how genes implicated in the hypothalamic-pituitary-interrenal response (Fig. 3) differ between HR and LR fish we assessed candidate gene expression in the brains of these fish.
- Eight candidate genes (AANAT, calcineurin, CRF, urotensin I, glucocorticoid receptor II, mineralocorticoid receptor, melatonin receptor 1a, and melanocortin 2 receptor) were investigated.

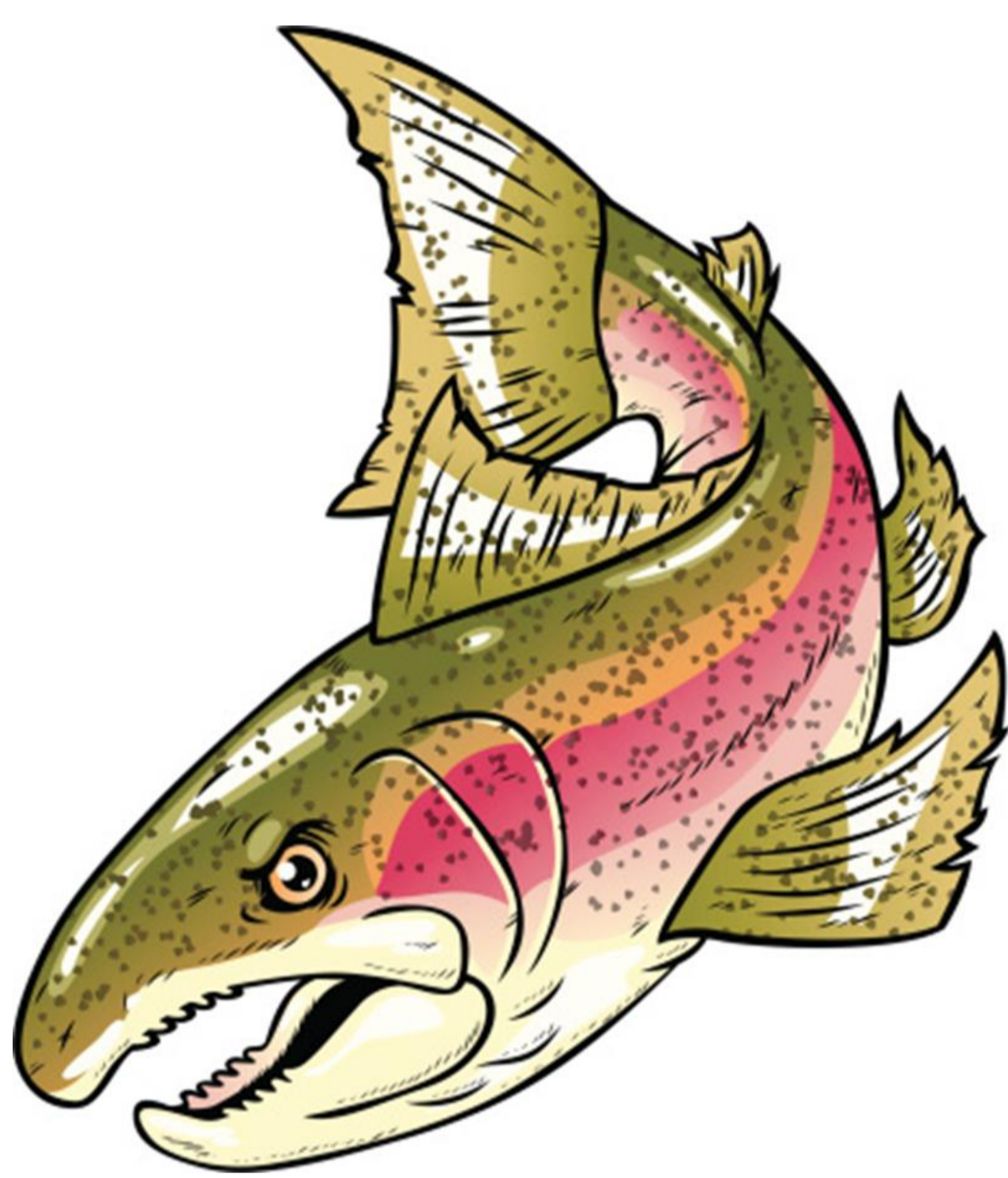


Fig. 1. The high stress responding rainbow trout (HR) normally associated with higher cortisol excretion during stress and exhibiting a more cautious shy behavioural phenotype.

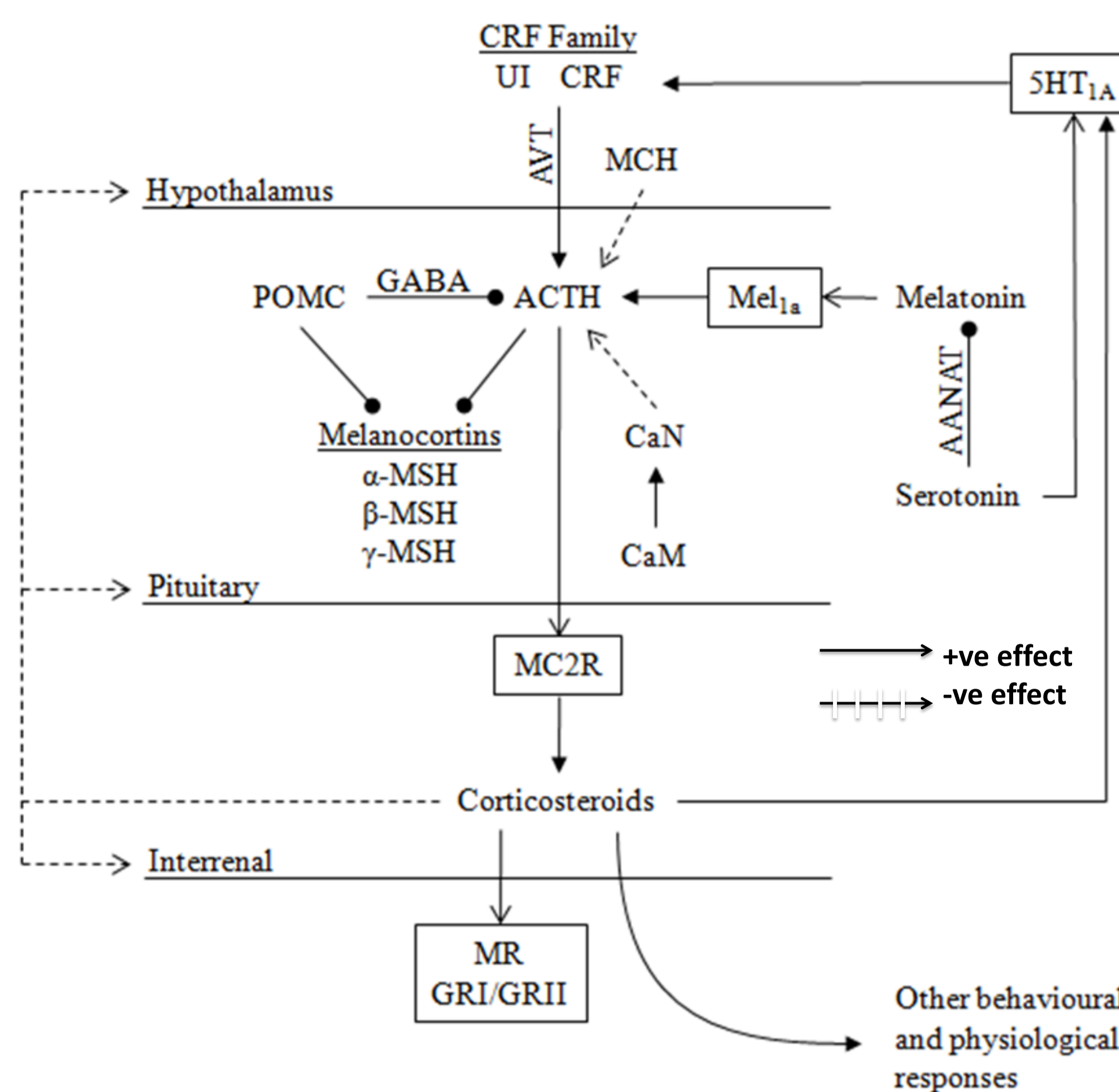


Fig. 2. The low stress responding rainbow trout (LR) normally associated with lower cortisol excretion during stress and exhibiting a bold, risk taking behavioural phenotype.

Fig. 3. Schematic representation of the teleostean hypothalamo-pituitary-interrenal stress axis. 5HT_{1A} = 5-hydroxytryptamine (serotonin) receptor 1A; AANAT = arylalkylamine-*n*-acetyltransferase; AVT = arginine vasotocin; ACTH = adrenocorticotrophic releasing hormone; CaM = calmodulin; CaN = calcineurin; CRF = corticotrophin releasing factor; GABA = γ -aminobutyric acid; GR = glucocorticoid receptor; Mel_{1A} = melatonin receptor 1A; MC2R = melanocortin 2 receptor; MCH = melanin concentrating hormone; MR = mineralocorticoid receptor; MSH = melanocyte-stimulating hormone; POMC = proopiomelanocortin; UI = urotensin I. Closed arrowheads indicate positive (stimulatory) control, open arrowheads and dashed lines indicate negative (inhibitory) control, open arrowheads with solid lines indicate binding of a ligand to a receptor, and round arrowheads indicate a derivative or product. Boxed elements represent receptors.

RESULTS

Seven genes were expressed at a significantly higher level in the low-responding line compared to the high-responding line (Fig. 4), and four genes, AANAT, CRF, UI and CaN, were positively correlated with baseline plasma cortisol concentrations. Only AANAT was not significantly differentially expressed between the two stress lines (due to high variation among individuals). Hence there is clear evidence of a tangible relationship between gene expression and stress physiology in these animals prior to stress with plasma cortisol concentrations double in HR fish (Fig. 5).

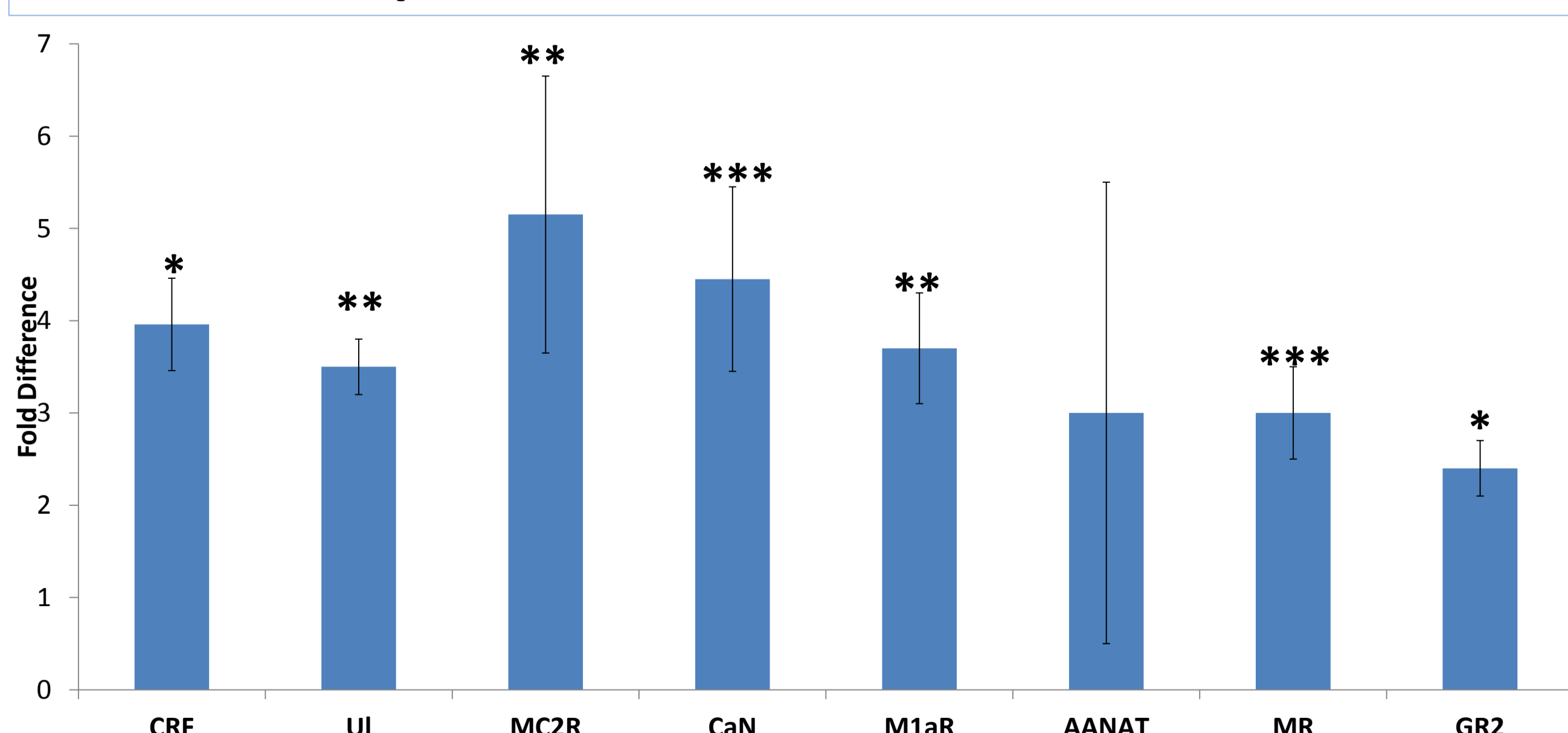


Fig. 4. Fold difference (\pm SD) in candidate gene expression between the brains of HR and LR fish. Fold difference was calculated using the $2^{-\Delta\Delta C_t}$ method, where $\Delta\Delta C_t$ was calculated as $(C_{t_{LR}} - C_{t_{HR}})$.

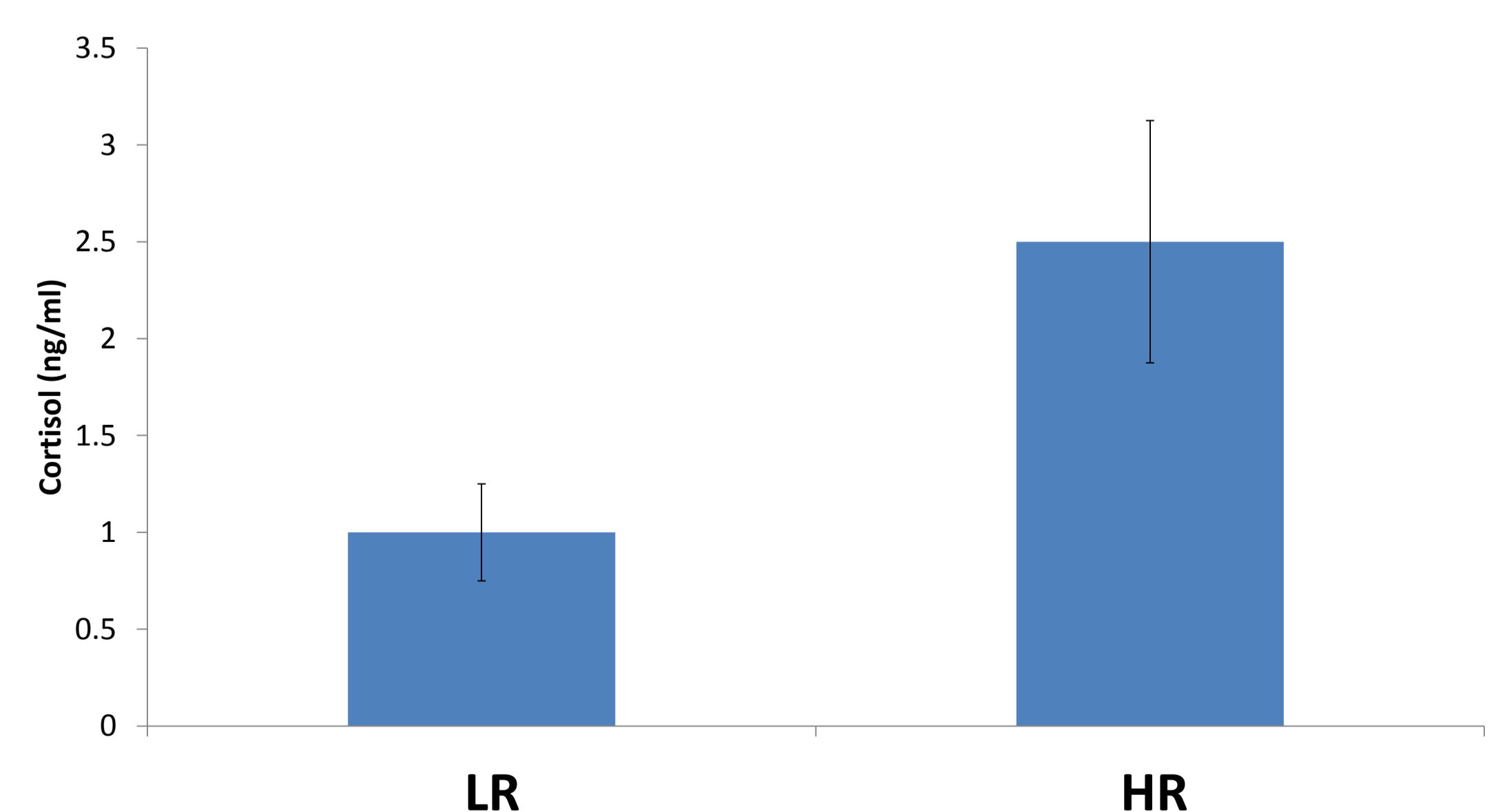


Fig. 4. Median (\pm IQR) plasma cortisol in LR and HR rainbow trout.

Acknowledgements

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The University of Liverpool Fish Indicators of Stress and Health (F.I.S.H.) website:
<http://www.liv.ac.uk/integrative-biology/research/projects/fish-indicators-stress-health/about/>
 OR: Simply scan the QR code!

