Innate immune defenses exhibit circadian rhythmicity and differential temporal sensitivity to a bacterial endotoxin in Nile tilapia (Oreochromis niloticus) - DTU Orbit (09/11/2017)

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The present study investigated the daily dynamics of humoral immune defenses and the temporal influence in the sensitivity of these responses to a bacterial endotoxin in Nile tilapia (Oreochromis niloticus). The first experiment subjected the fish to two photoperiod conditions, 12L:12D (LD) and 0L:24D (DD), for
20 days to characterize the rhythms of humoral immunity. Serum alkaline phosphatase (ALP), lysozyme (LYZ), peroxidase (PER) and protease (PRO) exhibited significant rhythmicity under LD but not in DD. No
significant rhythms were observed in esterase (ESA) and anti-protease (ANTI) in both photoperiod conditions. Fish reared under LD were subsequently subjected to DD while the group previously under DD was exposed to LD, and this carried on for 3 days before another set of samples was collected. Results
revealed that the rhythms of LYZ, PER and PRO but not ALP persisted when photoperiod was changed from LD to DD. Nonetheless, immune parameters remained arrhythmic in the group subjected from DD to LD. Cluster analysis of the humoral immune responses under various light conditions revealed that
each photic environment had distinct daily immunological profile. In the second experiment, fish were injected with bacterial endotoxin lipopolysaccharide (LPS) either at ZT3 (day) or at ZT15 (night) to evaluate the temporal sensitivity of humoral immunity to a pathogen-associated molecular pattern. The results demonstrated that responses to LPS were gated by the time of day. LPS significantly modulated serum ALP and ANTI activities but only when the endotoxin was administered at ZT3. Serum LYZ and PER were stimulated at both injection times but with differing response profiles. Modulated LYZ activity was
persistent when injected at ZT3 but transient when LPS was applied at ZT15. The magnitude of LPSinduced PER activity was higher when the endotoxin was delivered at ZT3 versus ZT15. It was further shown that plasma cortisol was significantly elevated but only when LPS was administered at ZT3. On the
other hand, plasma melatonin was significantly affected by LPS injection but only when exposed at ZT15. Taken together, this study shows that several key components of humoral immunity in tilapia exhibit circadian rhythms and adapt to photoperiodic changes. Further, results of the bacterial endotoxin
challenge suggest that responsiveness of serum humoral factors to a biological insult is likely mediated by the time of day, highlighting the importance of circadian rhythm in the immunological functions of fish

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