Interplay between daily rhythmic serum-mediated bacterial killing activity and immune defence factors in rainbow trout (Oncorhynchus mykiss)

Circadian rhythm is emerging as an important regulator of immune functions. However, there is a paucity of information on the influence of this biological phenomenon in the antimicrobial factors in teleost fish. This study investigated the dynamics and interplay of serum-mediated bacterial killing activity and immune defence factors throughout the light:dark (LD) cycle in rainbow trout (Oncorhynchus mykiss). The juvenile fish came from two different emergence time fractions (i.e., late and early) that were believed to exhibit behavioural and physiological differences. Serum collected during the day from fish (mean ± SD: 39.8 ± 6.3 g) reared under 14L:10D photoperiod demonstrated bactericidal activity against Flavobacterium psychrophilum, Yersinia ruckeri and Aeromonas salmonicida subsp. salmonica of varying magnitude, but no significant differences between the emergence fractions were observed. A day-night comparison in the same batch of fish revealed time-of-day dependence in the bactericidal activity against F. psychrophilum and Y. ruckeri amongst emergence fractions. A group of fish (63.3 ± 4.7 g) from each fraction was entrained to 12L:12D photoperiod for 21 days to investigate whether serum bactericidal activity exhibit daily rhythm. Serum-mediated bacterial killing activity against F. psychrophilum and Y. ruckeri displayed significant daily rhythm in both emergence fractions, where the peak of activity was identified during the light phase. Moreover, several serum defence factors manifested variations during the LD cycle, where anti-protease (ANTI) and myeloperoxidase (MPO) activities exhibited significant daily oscillation. However, there were no remarkable differences in the daily changes of serum factors amongst emergence fractions. Acrophase analysis revealed that the peaks of activity of alkaline phosphatase (only in late fraction), ANTI, lysozyme (only in early fraction) and MPO were identified during the light phase and corresponded with the period when serum-mediated bacterial killing activity was also at its highest. The daily dynamics of bactericidal activity and immune defence factors displayed positive correlation, particularly between MPO and, the two pathogens (i.e., F. psychrophilum and Y. ruckeri). Taken together, the study revealed that serum-mediated bacterial killing activity and immune defence factors remarkably varied during the LD cycle in rainbow trout. In addition, the two emergence fractions displayed nearly comparable immunological profiles.
Short-term exposure to repeated chasing stress does not induce habituation in Senegalese sole, Solea senegalensis

Animals can habituate to certain repeated stressors and reduce the physiological response that such stressor evoked initially. Studies related to stress habituation in fish are scarce and the available data differ depending on the species and on the type, duration and severity of the stressor. The main objective of this study was to investigate the stress response of juvenile Senegalese sole (Solea senegalensis) submitted to repeated chasing stress for 3 days previous to the experiment in order to evaluate the occurrence of habituation to those stress conditions in this fish species. Thus, five different experimental groups were evaluated: not stressed fish (control, C), fish stressed only on the experimental day
(ST/naïve), and fish stressed on the experimental day and on the 3 previous days: during the day (ST/Dt), at night (ST/Nt) or both (ST/Dt + Nt). Parameters related to primary and secondary responses to chasing were evaluated in plasma, liver and brain. Chasing in ST/naïve group induced incremented values of plasma cortisol, glucose and lactate but no changes in catecholamine levels compared to controls. In trained fish, higher cortisol but decreased glucose, lactate and catecholamine levels were observed after stress compared to controls and to ST/naïve groups. In the liver, stress did not induce any changes with respect to controls whereas ST/Dt and ST/Dt + Nt showed lower values of glucose and glycogen than stressed naïve fish. In the brain, ST/naïve group presented no significant changes in serotonergic activity. However, incremented serotonergic activity was detected in fish previously trained. Furthermore, dopaminergic activity decreased in diurnal trained and nocturnal trained groups with respect to ST/naïve fish. Crh expression in hypothalamus was higher in ST/naïve fish but not in fish submitted to repeated stress compared to controls. In summary, it seems that there was no habituation to the repeated acute stress protocol in Solea senegalensis in terms of serotonergic activity and cortisol release during the physiological stress response. However, the decreased levels of plasma catecholamines and energy metabolites, and of the hypothalamic crh mRNA abundance and dopaminergic activity, indicate a modulation of the stress response in trained fish. Altogether, the results suggest that either the chasing stressor was too strong or the training period too short for the animals to habituate, indicating that repeated chasing within short periods should be avoided when manipulating fish in order to keep proper welfare conditions in this species.

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Crosstalk between innate immunity and circadian rhythm: Do fish immune defences have a sense of time?

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Authors: Lazado, C. C. (Intern), Lund, I. (Intern), Skov, P. V. (Intern), Jokumsen, A. (Intern), Gesto, M. (Intern), Huy, N. Q. (Ekstern), Pedersen, P. B. (Intern)
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Effects of repeated acute stress in Senegalese sole Solea senegalensis. Can this species habituate to reiterated handling stress?

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Authors: Conde-Sieira, M. (Ekstern), Gesto, M. (Intern), Comesaña, S. (Ekstern), Velasco, C. (Ekstern), Hernandez-Perez, J. (Ekstern), Valente, L. M. P. (Ekstern), Soengas, J. (Ekstern)
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Emergence time and skin melanin spot patterns do not correlate with growth performance, social competitive ability or stress response in farmed rainbow trout

In wild salmonid fish, specific individual behavioral traits have been correlated with the timing of fry emergence from their gravel spawning nests; Early emerging fish display more aggressive behavior and have a higher probability of becoming socially dominant, compared to fish that emerge at a later stage. Apart from aggression and dominance, other behavioral and metabolic traits, such as boldness, metabolic rate, or growth, have also been linked to emergence time. Altogether, the traits of early- and late-emerging fish resemble those of the proactive and reactive stress-coping style, respectively. As proactive fish are considered more resilient to stress, it may be desirable to select these for aquaculture production. However, it is currently unclear to what extent the link between emergence time and stress-coping styles is maintained in the selective breeding of farmed fish. In the present study, eyed eggs from a commercial supplier were hatched, and larvae fractionated according to their emergence time. Later on, juvenile fish from different emergence fractions were subjected to a stress challenge and also tested to evaluate their competitive ability for food. Beyond some slight dissimilarities in the acute stress responses, emergence fraction displayed no correlation with growth rates, or the ability to compete for feed. Within the whole group of fish utilized in the experiments, no relationship between skin melanin spot pattern and growth performance, stress response intensity, or competitive ability was found. Altogether, the differences in physiological traits related to emergence time were not as strong as those found in earlier studies. It is hypothesized, that the origin and degree of domestication of the fish might be partly responsible for this. The predictive value of skin spots or emergence time to infer the fish stress coping style in farmed fish is also discussed.
Neuroendocrine and immune responses undertake different fates following tryptophan or methionine dietary treatment: tales from a teleost model

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Neuroendocrine and immune responses undertake different fates following tryptophan or methionine dietary treatment: tales from a teleost model

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Neuroendocrine and immune responses undertake different fates following tryptophan or methionine dietary treatment: tales from a teleost model

Methionine and tryptophan appear to be fundamental in specific cellular pathways involved in the immune response mechanisms, including stimulation of T-regulatory cells by tryptophan metabolites or pro-inflammatory effects upon methionine supplementation. Thus, the aim of this study was to evaluate the immunomodulatory effect of these amino acids on the inflammatory and neuroendocrine responses in juveniles of European seabass, Dicentrarchus labrax. To achieve this, goal fish were fed for 14 days methionine and tryptophan-supplemented diets (MET and TRP, respectively, 2x dietary requirement level) or a control diet meeting the amino acids requirement levels (CTRL). Fish were sampled for immune status assessment and the remaining fish were challenged with intraperitoneally injected inactivated Photobacterium damselae subsp. piscicida and sampled either 4 or 24 h post-injection. Respiratory burst activity, brain monoamines, plasma cortisol, and immune-related gene expression showed distinct and sometimes opposite patterns regarding the effects of dietary amino acids. While neuroendocrine intermediates were not affected by any dietary treatment at the end of the feeding trial, both supplemented diets led to increased levels of plasma cortisol after the inflammatory insult, while brain monoamine content was higher in TRP-fed fish. Peripheral blood respiratory burst was higher in TRP-fed fish injected with the bacteria inoculum but only compared to those fed MET. However, no changes were detected in total antioxidant capacity. Complement factor 3 was upregulated in MET-fed fish but methionine seemed to poorly affect other genes expression patterns. In contrast, fish fed MET showed increased immune cells numbers both before and after immune challenge, suggesting a strong enhancing effect of methionine on immune cells proliferation. Differently, tryptophan effects on inflammatory transcripts suggested an inhibitory mode of action. This, together with a high production of brain monoamine and cortisol levels, suggests that tryptophan might mediate regulatory mechanisms of neuroendocrine and immune systems cooperation. Overall, more studies are needed to ascertain the role of methionine and tryptophan in modulating (stimulate or regulate) fish immune and neuroendocrine responses.

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Physiological roles of tryptophan in teleosts: current knowledge and perspectives for future studies

Tryptophan is an essential amino acid with a huge functional versatility, in addition to its participation in protein synthesis. Because of the complexity of its metabolism, and the functional relevance of several of its metabolites, it directly or indirectly participates in a wide array of physiological pathways. This amino acid is a precursor for the synthesis of the neurotransmitter/neuromodulator serotonin (5HT), the hormone melatonin and kynurenine and related compounds such as kynurenic acid, quinolinic acid or niacin. Because of this, it has a key role in the regulation of processes ranging from the neuroendocrine to the immune system in vertebrates. In aquaculture, extensive research has been performed to optimize the levels of tryptophan in the commercial diets for many fish species. Providing adequate levels of this amino acid is critically important for fish growth but also for fish welfare, as tryptophan has been shown to modulate fish behaviour, stress responses, and antioxidant and immune systems. Currently, available data suggest a wide variation in tryptophan requirements of different species ranging 0.3–1.3% of dietary protein level, but recent evidence also shows that fish tryptophan requirements can greatly vary depending on the rearing conditions of the fish. We also review here the participation of tryptophan and related metabolites in different physiological functions that are crucial for fish welfare. The review covers the involvement of tryptophan in 5HT- and melatonin-mediated functions, along with its participation in the regulation of the immune system and its role as an antioxidant and antitoxic agent in fish.

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Scopus rating (2012): SJR 1.001 SNIP 1.83 CiteScore 2.46
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A simple melatonin treatment protocol attenuates the response to acute stress in the sole Solea senegalensis

Several compounds have been tested in fish in order to attenuate the effects of different stressors, most often following previous observations in mammals. The hormone melatonin (MEL) and the amino acid L-tryptophan have been tested for this purpose with different degree of success. In Senegalese sole (Solea senegalensis) we have previously observed that during prolonged exposure to relatively mild stressors, the presence of MEL in the water helped to reduce the stress response. Here, we aimed to investigate the potential anti-stress effects of a short melatonin exposure that could be easily performed in fish farms before an intended manipulative event with the animals. Our results demonstrate that adding MEL to the tanks 30. min before an acute chasing stress is effective in reducing the intensity of the stress response in fish from
its beginning, as evidenced by the attenuated and delayed cortisol response in MEL-exposed animals. The hypothalamic levels of serotonergic activity and the mRNA levels of corticotropin-releasing factor were also attenuated in MEL-treated fish, suggesting that MEL effects occur through its inhibitory actions on the CNS pathways controlling the stress response in Senegalese sole. In view of the observed anti-stress effects of MEL, further research is warranted in order to optimize doses and timing of application to improve the effectiveness of the MEL treatment for aquaculture purposes.
Characterization of melatonin synthesis in the gastrointestinal tract of rainbow trout (Oncorhynchus mykiss): distribution, relation with serotonin, daily rhythms and photoperiod regulation

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Authors: Muñoz-Pérez, J. L. (Ekstern), López-Patiño, M. A. (Ekstern), Álvarez-Otero, R. (Ekstern), Gesto, M. (Intern), Soengas, J. L. (Ekstern), Míguez, J. M. (Ekstern)
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First feeding behavior: A potential tool to select robust trout for organic aquaculture

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Stress-resilience differences related to emergence time in farmed rainbow trout

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Stress-resilience differences related to emergence time in rainbow trout

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Welfare, Health and Individuality in Farmed FISH: The WINFISH project

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Chronic effects of clofibric acid in zebrafish (Danio rerio): A multigenerational study
Clofibric acid (CA) is an active metabolite of the blood lipid lowering agent clofibrate, a pharmaceutical designed to work as agonist of peroxisome proliferator-activated receptor alpha (PPARα). It is the most commonly reported fibrate in aquatic environments with low degradation rate and potential environmental persistence. Previous fish exposures showed that CA may impact spermatogenesis, growth and the expression of fat binding protein genes. However, there are limited data on the effects of chronic multigenerational CA exposures. Here, we assessed chronic multigenerational effects of CA exposure using zebrafish (Danio rerio) as a teleost model. Zebrafish were exposed through the diet to CA (1 and 10 mg/g) during their whole lifetime. Growth, reproduction-related parameters and embryonic development were assessed in the exposed fish (F1 generation) and their offspring (F2 generation), together with muscle triglyceride content and gonad histology. In order to study the potential underlying mechanisms, the transcription levels of genes coding for enzymes involved in lipid metabolism pathways were determined. The results show that chronic life-cycle exposure to CA induced a significant reduction in growth of F1 generation and lowered triglyceride muscle content (10 mg/g group). Also, an impact in male gonad development was observed together with a decrease in the fecundity (10 mg/g group) and higher frequency of embryo abnormalities in the offspring of fish exposed to the lowest CA dose. The profile of the target genes was sex- and tissue-dependent. In F1 an up-regulation of male hepatic pparα, pparb and acox transcript levels was observed, suggesting an activation of the fatty acid metabolism (provided that transcript level change indicates also a protein level change). Interestingly, the F2 generation, raised with control diet, displayed a response pattern different from that observed in F1, showing an increase in weight in the descendants of CA exposed fish, in comparison with control animals, which points to a multigenerational effect. (C) 2015 Elsevier B.V. All rights reserved.

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Authors: Coimbra, A. M. (Ekstern), Peixoto, M. J. (Ekstern), Coelho, I. (Ekstern), Lacerda, R. (Ekstern), Carvalho, A. P. (Ekstern), Gesto, M. (Intern), Lyssimachou, A. (Ekstern), Lima, D. (Ekstern), Soares, J. (Ekstern), Andre, A. (Ekstern), Capitao, A. (Ekstern), Castro, L. F. C. (Ekstern), Santos, M. M. (Ekstern)
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Scopus rating (2015): SJR 1.666 SNIP 1.175 CiteScore 3.79
Web of Science (2015): Indexed yes
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Scopus rating (2014): SJR 1.597 SNIP 1.337 CiteScore 3.75
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Scopus rating (2010): SJR 1.79 SNIP 1.381
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Scopus rating (2009): SJR 2.008 SNIP 1.379
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Scopus rating (2008): SJR 1.644 SNIP 1.346
Web of Science (2008): Indexed yes
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Web of Science (2006): Indexed yes
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Scopus rating (2003): SJR 1.531 SNIP 1.376
Web of Science (2003): Indexed yes
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Pisces Vertebrata Chordata Animalia (Animals, Chordates, Fish, Nonhuman Vertebrates, Vertebrates) - Osteichthyes [85206] Danio rerio species zebrafish common mature, embryo female, male, Danio rerio acox gene [Osteichthyes],
Effects of tributyltin and other retinoid receptor agonists in reproductive-related endpoints in the Zebrafish (Danio rerio)

Both field and experimental data examined the influence of exposure to environmental contaminant tributyltin (TBT) on marine organisms. Although most attention focused on the imposex phenomenon in gastropods, adverse effects were also observed in other taxonomic groups. It has been shown that imposex induction involves modulation of retinoid signaling in gastropods. Whether TBT influences similar pathways in fish is yet to be addressed. In this study, larvae of the model teleost Danio rerio were exposed to natural retinoids, all-trans-retinoic acid, 9-cis-retinoic acid, and all-trans-retinol, as well as to the RXR synthetic pan-agonist methoprene acid (MA) and to TBT. Larvae were exposed to TBT from 5 days post fertilization (dpf) to adulthood, and reproductive capacity was assessed and correlated with mode of action. TBT significantly decreased fecundity at environmentally relevant levels at 1 g TBT Sn/g in diet. Interestingly, in contrast to previous reports, TBT altered zebrafish sex ratio toward females, whereas MA exposure biased sex toward males. Since fecundity was significantly altered in the TBT-exposed group with up to 62% decrease, the potentially affected pathways were investigated. Significant downregulation was observed in brain mRNA levels of aromatase b (CYP19a1b) in females and peroxisome proliferator activated receptor gamma (PPARγ) in both males and females, suggesting an involvement of these pathways in reproductive impairment associated with TBT.

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Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Gradation of the Stress Response in Rainbow Trout Exposed to Stressors of Different Severity: The Role of Brain Serotonergic and Dopaminergic Systems

After an intense acute stressor, fish develop a metabolic and behavioural response that usually lasts for several hours. Brain monoaminergic systems, particularly the serotonergic system, appear to play a key role in the central regulation of the stress response. However, the influence of stressor severity on brain monoaminergic systems and on the induced stress responses is yet poorly understood. We hypothesise that serotonergic system could have a direct role in the integration of sensory information during stressor exposure and in the organisation of the subsequent integrated stress response. According to our hypothesis, a low stressor intensity would induce a low response of brain serotonergic system and therefore stress responses of low magnitude and duration. To test this hypothesis, we exposed fish to handling disturbance for 5s, 15s or 3min. We sampled fish at 0 (controls), 3, 15, 45 and 240min after the start of the stress protocol. Brain levels of serotonin, dopamine and their respective main oxidative metabolites were quantified, along with plasma levels of stress markers (catecholamines, cortisol, glucose and lactate). Regarding stress markers, the 5-s and 15-s stress protocols induced similar and relatively low elevations in all parameters assessed. As expected, the 3-min protocol induced responses of a higher intensity and duration in all plasma parameters. Interestingly, the alterations of brain monoaminergic systems did not follow the same trend. The three stress protocols induced increases in the serotonergic activity in all brain regions analysed (hypothalamus, telencephalon and medulla oblongata), independently of the duration of the handling disturbance, whereas the effects on the dopaminergic system were minor and brain region-dependent. These data suggest that the brain serotonergic system, although likely involved in the recognition of the stressor stimuli, is not the only actor determining the magnitude and duration of the acute stress response in trout.

General information
State: Published
Organisations: University of Vigo
Authors: Gesto, M. (Intern), Lopez-Patino, M. A. (Ekstern), Hernandez, J. (Ekstern), Soengas, J. L. (Ekstern), Miguez, J. M. (Ekstern)
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Scopus rating (2016): SJR 1.495 SNIP 0.97 CiteScore 3.21
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 1.541 SNIP 1.036 CiteScore 3.56
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 1.551 SNIP 0.986 CiteScore 3.24
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 1.414 SNIP 1.019 CiteScore 3.62
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 1.257 SNIP 0.898 CiteScore 3.5
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 1.61 SNIP 1.067 CiteScore 3.85
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 1.689 SNIP 1.164
Is gill cortisol concentration a good acute stress indicator in fish? A study in rainbow trout and zebrafish

Cortisol is the main biomarker of physiological stress in fish. It is usually measured in plasma, which requires blood collection. Though cortisol is produced in the anterior kidney, it can diffuse easily through cell membranes due to its lipophilic nature. Taking advantage of that, some non-invasive techniques have been developed to measure cortisol directly in the water from fish-holding tanks, in skin mucus or in scales. In this study, we explored the possibility to analyze fish cortisol from gill filaments as a reliable acute stress marker. Our results show that gill cortisol levels correlate well with plasma cortisol levels in both rainbow trout and zebrafish exposed or not to an acute stress protocol. Measuring cortisol in gill filaments increases the available possibilities for stress assessment in fish. Although this approach should yet be tested for its use with other stressors, it has several advantages: In relatively large fish (i.e. above 30 g) gill cortisol levels could be measured in vivo. Sampling of gill biopsies is very fast and easy, and the procedure does not induce stress if properly performed, making it an ideal option for in vivo stress assessment. In small fish, the use of gill tissue to measure cortisol has important technical advantages with respect to the current methods using whole-body homogenates. Gill homogenates could be used directly for ELISA cortisol analysis, avoiding the need of tedious and expensive cortisol extraction protocols, and, since no organic solvent is required, contributing for a more environmentally friendly analysis.

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Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 0.983 SNIP 0.94 CiteScore 2.18
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 0.956 SNIP 1.058 CiteScore 2.36
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 0.773 SNIP 1.032 CiteScore 2.18
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 0.858 SNIP 1.048 CiteScore 2.2
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Scopus rating (2010): SJR 0.836 SNIP 1.041
BFI (2009): BFI-level 1
Scopus rating (2009): SJR 0.794 SNIP 0.944
Web of Science (2009): Indexed yes
BFI (2008): BFI-level 1
Scopus rating (2008): SJR 0.725 SNIP 0.806
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 0.639 SNIP 0.893
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 0.62 SNIP 0.892
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 0.653 SNIP 0.907
Scopus rating (2004): SJR 0.756 SNIP 1.02
Scopus rating (2003): SJR 0.594 SNIP 0.972
Scopus rating (2002): SJR 0.535 SNIP 0.723
Scopus rating (2001): SJR 0.433 SNIP 0.695
Scopus rating (2000): SJR 0.397 SNIP 0.664
Scopus rating (1999): SJR 0.48 SNIP 0.635

Original language: English
acute stress, Pisces Vertebrata Chordata Animalia (Animals, Chordates, Fish, Nonhuman Vertebrates, Vertebrates) - Osteichthyes [85206] Danio rerio species zebrafish common Oncorhynchus mykiss species rainbow trout common, cortisol 50-23-7, 10060, Biochemistry studies - General, 10067, Biochemistry studies - Sterols and steroids, 15002, Blood - Blood and lymph studies, 15004, Blood - Blood cell studies, 16004, Respiratory system - Physiology and biochemistry, gill respiratory system, plasma blood and lymphatics, ELISA laboratory techniques, immunologic techniques, gill filament biopsy laboratory techniques, Biochemistry and Molecular Biophysics

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Retinoid level dynamics during gonad recycling in the limpet Patella vulgata

General information
State: Accepted/in press
Arginine vasotocin treatment induces a stress response and exerts a potent anorexigenic effect in rainbow trout, oncorhynchus mykiss
The peptide arginine vasotocin (AVT), homologous to mammalian arginine vasopressin, is involved in many aspects of fish physiology, such as osmoregulation, regulation of biological rhythms, reproduction, metabolism or responses to stress, and the modulation of social behaviours. Because a decrease in appetite is a general response to stress in fish and other vertebrates, we investigated the role of AVT as a possible food intake regulator in fish. We used i.c.v. injections for central administration of AVT to rainbow trout (Oncorhynchus mykiss). In a first experiment, we evaluated the temporal response of food intake after AVT treatment. In a second experiment, we investigated the effects of central AVT administration on the response of typical stress markers (plasma cortisol, glucose and lactate), as well as brain serotonergic, noradrenergic and dopaminergic activity. In addition, the mRNA levels of genes involved in food intake regulation [neuropeptide Y, pro-opiomelanocortin (POMC), cocaine- and ampheta-mine-regulated transcript (CART) and corticotrophin-releasing factor (CRF)] and in CRF- (CRF-binding protein) and AVT-signalling (pro-VT and AVT receptor), were also assessed after AVT treatment. Our results showed that AVT is a potent anorexigenic factor in fish. Increases of plasma cortisol and glucose after AVT treatment strongly suggest that AVT administration induced a stress response and that AVT action was mediated by hypothalamic-pituitary-interrenal axis activation, which was also supported by the increase of the serotonergic activity in trout telencephalon and hypothalamus. The increased hypothalamic levels of POMC and CART suggest that these peptides might have a role in the anorexigenic action of AVT, whereas the involvement of CRF signalling is unclear. © 2014 British Society for Neuroendocrinology.
Environmental levels of the antidepressant venlafaxine impact the metabolic capacity of rainbow trout

The antidepressant venlafaxine is detected at parts per billion levels in tertiary-treated municipal wastewater effluent. However, the impact of this serotonin-norepinephrine reuptake inhibitor (SNRI) on non-target aquatic animals is poorly understood. We tested the hypothesis that environmentally relevant levels of venlafaxine disrupt the highly conserved cortisol and glucose response to stress in rainbow trout (Oncorhynchus mykiss). Juvenile trout were exposed to venlafaxine (0, 0.2 and 1.0 μg/L) in a static system with daily renewal for seven days. The fish were then subjected to an acute handling disturbance and sampled either prior to (0 h) or 1, 4 and 24 h after stressor exposure. Venlafaxine exposure did not affect the handling disturbance-mediated transient elevation in plasma cortisol levels or target tissue glucocorticoid receptor expression. The drug exposure disrupted the interrenal steroidogenic capacity, including altered handling stressor-mediated changes in mRNA abundances of steroidogenic acute regulatory protein and cytochrome P450 side chain cleavage. The handling stressor-induced transient elevations in plasma glucose levels were significantly reduced in the venlafaxine-exposed fish. This was not accompanied by changes in liver glycogen content, glucose transporter 2 mRNA abundance or the glycolytic capacity, whereas the capacity for gluconeogenesis and amino acid catabolism were enhanced. Venlafaxine also brought about changes in the gill of trout, including enhanced lactate dehydrogenase activity and Na⁺/K⁺ ATPase protein expression, while the Na⁺/K⁺ ATPase enzyme activity was reduced. Collectively, our results demonstrate that venlafaxine at levels detected in the aquatic environment impacts tissue metabolic capacities and may compromise the adaptive responses to an acute stressor in rainbow trout. (C) 2014 Elsevier B.V. All rights reserved.

General information
State: Published
Organisations: University of Waterloo
Authors: Best, C. (Ekstern), Melnyk-Lamont, N. (Ekstern), Gesto, M. (Intern), Vijayan, M. M. (Ekstern)
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Web of Science (2016): Indexed yes
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Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 1.597 SNIP 1.337 CiteScore 3.75
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 1.88 SNIP 1.503 CiteScore 4.06
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Scopus rating (2012): SJR 1.904 SNIP 1.487 CiteScore 3.83
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): SJR 1.995 SNIP 1.393 CiteScore 3.99
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Scopus rating (2010): SJR 1.79 SNIP 1.381
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Scopus rating (2009): SJR 2.008 SNIP 1.379
Web of Science (2009): Indexed yes
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Scopus rating (2008): SJR 1.644 SNIP 1.346
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 1.663 SNIP 1.42
Scopus rating (2006): SJR 1.675 SNIP 1.408
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 1.445 SNIP 1.336
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 1.495 SNIP 1.378
Scopus rating (2003): SJR 1.531 SNIP 1.376
Web of Science (2003): Indexed yes
Scopus rating (2002): SJR 1.43 SNIP 1.328
Web of Science (2002): Indexed yes
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MARINE, TOXICOLOGY, ACUTE REGULATORY PROTEIN, SIDE-CHAIN CLEAVAGE, ONCORHYNCHUS-MYKISS, STRESS-RESPONSE, STAR PROTEIN, FISH, CORTISOL, LIVER, PHARMACEUTICALS, WATER, Fish, Salmonid, Environmental pharmaceuticals, Serotonin-norepinephrine reuptake inhibitor, Stress response, Intermediary metabolism, Aquatic Science, Health, Toxicology and Mutagenesis, adenosine triphosphatase (potassium sodium), cytochrome P450, glucocorticoid receptor, glucose, glucose transporter 2, hydrocortisone, lactate dehydrogenase, venlafaxine, aquatic environment, drug, effluent, environmental impact, enzyme activity, metabolism, pollution exposure, salmonid, wastewater , amino acid metabolism, amino acid sequence, animal experiment, animal tissue, article, controlled study, down regulation, environmental exposure, environmental stress, glucocereogenesis, glucose transporter 2 gene, glycogen analysis, glycolysis, hydrocortisone blood level, metabolic capacity, nonhuman, nucleotide sequence, priority journal, protein expression, rainbow trout, steroidogenesis, Animals, Antidepressive Agents, Blood Glucose, Cyclohexanols,
Gluconeogenesis, Glucose, Glycolysis, Handling (Psychology), Hydrocortisone, Liver, Liver Glycogen, Oncorhynchus mykiss, Receptors, Glucocorticoid, Stress, Physiological, Water Pollutants, Chemical, Serotonin–norepinephrine reuptake inhibitor, Pisces Vertebrata Chordata Animalia (Animals, Chordates, Fish, Nonhuman Vertebrates, Vertebrates) - Osteichthyes [85206] Oncorhynchus mykiss species rainbow trout common immature, cortisol 50-23-7, cytochrome P450 9035-51-2 EC 1.14.14.1, glucocorticoid receptor expression, glycogen 9005-79-2, lactate dehydrogenase 9001-60-9 EC 1.1.1.27, messenger RNA, serotonin-norepinephrine reuptake inhibitor SNRI, sodium ion-potassium ion ATPase expression EC 3.6.3.9, venlafaxine 93413-69-5 antidepressant-drug toxin, 10060, Biochemistry studies - General, 10062, Biochemistry studies - Nucleic acids, purines and pyrimidines, 10064, Biochemistry studies - Proteins, peptides and amino acids, 10067, Biochemistry studies - Sterols and steroids, 10068, Biochemistry studies - Carbohydrates, 10802, Enzymes - General and comparative studies: coenzymes, 12512, Pathology - Therapy, 14004, Digestive system - Physiology and biochemistry, 15002, Blood - Blood and lymph studies, 15004, Blood - Blood cell studies, 16004, Respiratory system - Physiology and biochemistry, 22026, Pharmacology - Psychopharmacology, 22501, Toxicology - General and methods, Biochemistry and Molecular Biophysics, gill respiratory system, liver digestive system, plasma blood and lymphatics, municipal wastewater applied and field techniques, Enzymology, Toxicology

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Gradation of the acute stress response in rainbow trout exposed to stressors of different intensity

General information
State: Published
Organisations: Universidade de Vigo, University of Vigo
Authors: Gesto, M. (Intern), Otero-Rodino, C. (Ekstern), Hernández, J. (Ekstern), Naderi, F. (Ekstern), Velasco, C. (Ekstern), Libran-Perez, M. (Ekstern), López-Patiño, M. A. (Ekstern), Soengas, J. (Ekstern), Míguez, J. (Ekstern)
Publication date: 2014
Event: Abstract from 27th Conference of European Comparative Endocrinologists, Rennes, France.
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Insulin treatment modulates the response of hypothalamic fatty acid sensors in rainbow trout

General information
State: Published
Organisations: Universidade de Vigo, Universidad de Vigo
Authors: Libran-Perez, M. (Ekstern), Otero-Rodino, C. (Ekstern), Velasco, C. (Ekstern), Gesto, M. (Intern), Álvarez, R. (Ekstern), López-Patiño, M. A. (Ekstern), Míguez, J. (Ekstern), Soengas, J. (Ekstern)
Publication date: 2014
Event: Abstract from Aquaculture Europe 14, Donostia-San Sebastian, Spain.
Main Research Area: Technical/natural sciences
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Is plasma cortisol response to stress in rainbow trout regulated by catecholamine-induced hyperglycemia?
Based on previous studies we hypothesize that under stress conditions catecholamine-induced hyperglycemia contributes to enhance cortisol production in head kidney of rainbow trout. Therefore, treatment with propranolol (beta-adrenoceptor blocker) should reduce the hyperglycemia elicited by stress and, therefore, we expected reduced glucosensing response and cortisol production in head kidney. Propranolol treatment was effective in blocking most of the effects of catecholamines in liver energy metabolism resulting in a lower glycemia in stressed fish. The decreased glycemia of stressed fish treated with propranolol was observed along with reduced transcription of genes involved in the cortisol synthetic pathway, which supports our hypothesis. However, changes in putative glucosensing parameters assessed in head kidney were scarce and in general did not follow changes noted in glucose levels in plasma. Furthermore, circulating cortisol levels did not change in parallel with changes in glycemia. As a whole, the present results suggest that glycemia could participate in the regulation of cortisol synthetic pathways but other factors are also likely involved. Propranolol effects on trout stress response were different depending on time passed after stress onset; the direct or indirect
involvement of catecholaminergic response in the regulation of cortisol production and release deserves further investigation. (C) 2014 Elsevier Inc. All rights reserved.
Metabolic response of rainbow trout Brockmann bodies to decreased circulating fatty acid levels

General information
State: Published
Organisations: Universidade de Vigo, Universidad de Vigo
Authors: Velasco, C. (Ekstern), Libran-Perez, M. (Ekstern), Otero-Rodino, C. (Ekstern), López-Patiño, M. A. (Ekstern), Naderi, F. (Ekstern), Gesto, M. (Intern), Hernandez-Perez, J. (Ekstern), Soengas, J. (Ekstern)
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Methionine and tryptophan differentially regulate the European seabass *Dicentrarchus labrax* inflammatory response

**General information**
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Organisations: Universidade de Vigo, Universidade do Porto, Universidad Autonoma de Barcelona
Number of pages: 3
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Source: PublicationPreSubmission
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Publication: Research › Conference abstract for conference – Annual report year: 2014

Oral administration of melatonin counteracts several of the effects of chronic stress in rainbow trout

To assess a possible antistress role of melatonin in fish, we orally administered melatonin to rainbow trout for 10 d and then kept the fish under normal or high stocking density conditions during the last 4 d. Food intake; biochemical parameters in plasma (cortisol, glucose, and lactate concentrations); liver (glucose and glycogen concentrations, and glycogen synthase activity); enzyme activities of amylase, lipase, and protease in foregut and midgut; and content of the hypothalamic neurotransmitters dopamine and serotonin, as well as their oxidized metabolites, 3,4-dihydroxyphenylacetic acid and 5-hydroxy-3-indoleacetic acid, were evaluated under those conditions. High stocking density conditions alone induced changes indicative of stress conditions in plasma cortisol concentrations, liver glycogenolytic potential, the activities of some digestive enzymes, and the 3,4-dihydroxyphenylacetic acid-to-dopamine and 5-hydroxy-3-indoleacetic acid-to-serotonin ratios in the hypothalamus. Melatonin treatment in nonstressed fish induced an increase in liver glycogenolytic potential, increased the activity of some digestive enzymes, and enhanced serotoninergic and dopaminergic metabolism in hypothalamus. The presence of melatonin in stressed fish resulted in a significant interaction with cortisol concentrations in plasma, glycogen content, and glycogen synthase activity in liver and dopaminergic and serotoninergic metabolism in the hypothalamus. In general, the presence of melatonin mitigated several of the effects induced by stress, supporting an antistress role for melatonin in rainbow trout. (C) 2014 Elsevier Inc. All rights reserved.

**General information**
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Organisations: University of Vigo
Authors: Conde-Sieira, M. (Ekstern), Munoz, J. L. P. (Ekstern), Lopez-Patino, M. A. (Ekstern), Gesto, M. (Intern), Soengas, J. L. (Ekstern), Miguez, J. M. (Ekstern)
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Web of Science (2017): Indexed Yes
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Scopus rating (2016): SJR 0.75 SNIP 0.861 CiteScore 1.85
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 0.804 SNIP 0.928 CiteScore 1.74
Preliminary evidence on the presence and functioning of alternative glucosensor systems in rainbow trout hypothalamus

General information
Retinoid metabolism in invertebrates: When evolution meets endocrine disruption

Recent genomic and biochemical evidence in invertebrate species pushes back the origin of the retinoid metabolic and signaling modules to the last common ancestor of all bilaterians. However, the evolution of retinoid pathways are far from fully understood. In the majority of non-chordate invertebrate lineages, the ongoing functional characterization of retinoid-related genes (metabolism and signaling pathways), as well as the characterization of the endogenous retinoid content (precursors and active retinoids), is still incomplete. Despite limited, the available data supports the presence of biologically active retinoid pathways in invertebrates. Yet, the mechanisms controlling the spatial and temporal distribution of retinoids as well as their physiological significance share similarities and differences with vertebrates. For instance, retinol storage in the form of retinyl esters, a key feature for the maintenance of retinoid homeostatic balance in vertebrates, was only recently demonstrated in some mollusk species, suggesting that such ability is older than previously anticipated. In contrast, the enzymatic repertoire involved in this process is probably unlike that of vertebrates. The suggested ancestry of active retinoid pathways implies that many more metazoan species might be potential targets for endocrine disrupting chemicals. Here, we review the current knowledge about the occurrence and functionality of retinoid metabolic and signaling pathways in invertebrate lineages, paying special attention to the evolutionary origin of retinoid storage mechanisms. Additionally, we summarize existing information on the endocrine disruption of invertebrate retinoid modules by environmental chemicals. Research priorities in the field are highlighted. (C) 2014 Elsevier Inc. All rights reserved.
Short-term time course of liver metabolic response to acute handling stress in rainbow trout, Oncorhynchus mykiss

To elucidate the short-term time-course of liver metabolic response to acute handling stress we subjected rainbow trout to 5 mm chasing and obtained samples 0 to 480 mm post-stress. Levels of cortisol, glucose and lactate were measured in plasma, whereas metabolite levels, enzyme activities, mRNA abundance of parameters related to energy metabolism, and glucocorticoid receptors were assessed in liver. Acute stress affected many parameters related to energy metabolism, with most of them turning back to normal levels after 480 mm. In general, the present results support the existence of two stages in the short-term time-course of metabolic response to handling stress. A first stage occurring few minutes post-stress (15-45 min), was characterized by increased mobilization of liver glycogen resulting in increased production of endogenous glucose, reduced use of exogenous glucose and reduced lipogenic potential. A second stage, occurring 60-120 mm post-stress onwards was characterized by the recovery of liver glycogen levels, the increased capacity of liver for releasing glucose, and the recovery of lipogenic capacity whereas no changes were noted in gluconeogenic potential, which probably needs longer time periods to become enhanced. (C) 2013 Elsevier Inc. All rights reserved.
Stress affects the daily pattern of central neuropeptides involved in food intake regulation of rainbow trout

General information
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Organisations: Universidade de Vigo, Universidad de Vigo
Authors: Naderi, F. (Ekstern), Míguez, J. (Ekstern), Hernandez-Perez, J. (Ekstern), Velasco, C. (Ekstern), Álvarez-Otero, R. (Ekstern), Libran-Perez, M. (Ekstern), Gesto, M. (Intern), López-Patiño, M. A. (Ekstern)
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Stress inhibition of melatonin synthesis in the pineal organ of rainbow trout (Oncorhynchus mykiss) is mediated by cortisol

Cortisol has been suggested to mediate the effect of stress on pineal melatonin synthesis in fish. Therefore, we aimed to determine how pineal melatonin synthesis is affected by exposing rainbow trout to different stressors, such as hypoxia, chasing and high stocking density. In addition, to test the hypothesis that cortisol is a mediator of such stress-induced effects, a set of animals were intraperitoneally implanted with coconut oil alone or containing cortisol (50 mg kg⁻¹ body mass) and sampled 5 or 48 h post-injection at midday and midnight. The specificity of such effect was also assessed in cultured pineal organs exposed to cortisol alone or with the general glucocorticoid receptor antagonist, mifepristone (RU486). Stress (in particular chasing and high stocking density) affected the patterns of plasma and pineal organ melatonin content during both day and night, with the greatest reduction occurring at night. The decrease in nocturnal melatonin levels in the pineal organ of stressed fish was accompanied by increased serotonin content and decreased AANAT2 enzymatic activity and mRNA abundance. Similar effects on pineal melatonin synthesis to those elicited by stress were observed in trout implanted with cortisol for either 5 or 48 h. These data indicate that stress negatively influences the synthesis of melatonin in the pineal organ, thus attenuating the day-night variations of circulating melatonin. The effect might be mediated by increased cortisol, which binds to trout pineal organ-specific glucocorticoid receptors to modulate melatonin rhythms. Our results in cultured pineal organs support this. Considering the role of melatonin in the synchronization of daily and annual rhythms, the results suggest that stress-induced alterations in melatonin synthesis could affect the availability of fish to integrate rhythmic environmental information.

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Stress response and changes of liver metabolism in rainbow trout depend on the stress duration

**General information**

State: Published

Organisations: Universidade de Vigo

Authors: Hernandez-Perez, J. (Ekstern), López-Patiño, M. A. (Ekstern), Naderi, F. (Ekstern), Conde-Sieira, M. (Ekstern), Gesto, M. (Intern), Otero-Rodino, C. (Ekstern), Soengas, J. (Ekstern), Míguez, J. (Ekstern)

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The antidepressant venlafaxine disrupts brain monoamine levels and neuroendocrine responses to stress in rainbow trout

Venlafaxine, a serotonin-norepinephrine reuptake inhibitor, is a widely prescribed antidepressant drug routinely detected in the aquatic environment. However, little is known about its impact on the physiology of nontarget organisms. We tested the hypothesis that venlafaxine perturbs brain monoamine levels and disrupts molecular responses essential for stress coping and feeding activity in fish. Rainbow trout (Oncorhynchus mykiss) were exposed to waterborne venlafaxine (0.2 and 1.0 μg/L) for 7 days. This treatment elevated norepinephrine, serotonin, and dopamine levels in the brain in a region-specific manner. Venlafaxine also increased the transcript levels of genes involved in stress and appetite regulation, including corticotropin releasing factor, pro-opiomelanocortin B, and glucose transporter type 2 in distinct brain regions of trout. The drug treatment reduced the total feed consumed per day, but did not affect the feeding behavior of the dominant and subordinate fish. However, the subordinate fish from the venlafaxine-exposed group had significantly higher plasma cortisol levels compared to the subordinate fish in the control group. Collectively, our results demonstrate that venlafaxine, at environmentally realistic levels, is a neuroendocrine disruptor, impacting the stress and feeding responses in rainbow trout. We propose the midbrain region as a key target for venlafaxine impact and the mode of action involves abnormal monoamine content in trout.

**General information**
Differences in retinoid levels and metabolism among gastropod lineages: Imposex-susceptible gastropods lack the ability to store retinoids in the form of retinyl esters.

Highlights: [•] Until recently, the presence of an elaborated retinoid system was believed to be a chordate/vertebrate novelty. [•] Patella depressa has the capacity to store retinoids in the form of inactive retinyl esters. [•] The imposex-susceptible species Nucella lapillus and Nassarius reticulatus lacked detectable amounts of retinol or retinyl esters. [•] An exposure test with N. lapillus confirmed that this species is not able to synthesize retinyl esters in vivo. [•] The incapacity to inactivate retinoid precursors might negatively affect retinoid signaling homeostasis.

General information
State: Published
Organisations: University of Porto
Authors: Gesto, M. (Intern), Castro, L. F. C. (Ekstern), Santos, M. M. (Ekstern)
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Scopus rating (2015): SJR 1.666 SNIP 1.175 CiteScore 3.79
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 1.597 SNIP 1.337 CiteScore 3.75
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Melatonin partially minimizes the adverse stress effects in Senegalese sole (Solea senegalensis).

Abstract: Senegalese sole is a highly valued marine teleost introduced in aquaculture since the early 1980s, but growth and survival from juvenile to market-size fish still reveal deficiencies, with stress being one of the possible explanations for this issue. High circulating levels of catecholamines and cortisol are involved in the integrated response to stress in fish and, thus triggering tissue alterations in order to counter the impact of the stressor and satisfy the increased energy demand. Chronic exposure to stressors can lead to an allostatic overload (or distress) affecting negatively food intake, reproduction, growth and immune functions, leading to increased incidence of diseases and reduced animal welfare. Melatonin is mainly synthesized in pineal organ and plays a critical role in the regulation of seasonal and circadian rhythms of physiology and behavior. However, a role as an anti-stress molecule at both central and peripheral levels has been also proposed for the hormone. Based on that, the aim of the present study was to evaluate the putative role of melatonin in reducing stress-related neuroendocrine and metabolic effects in Senegalese sole exposed to different and representative chronic stress conditions such as high stocking density (HSD) and low water replacement (LWR). Our results show that stressing Senegalese sole by high stocking density or low water replacement induce typical changes in parameters related to stress response in teleosts (increased plasma cortisol levels, enhanced liver glycogenolytic potential, and increased dopaminergic and serotonergic activities in the hypothalamus). Whereas melatonin treatment in non-stressed fish increases the dopaminergic activity in the hypothalamus, the opposite effect is observed after the addition of the hormone to tank water before and during stress exposure, thus attenuating the effect of stress on plasma cortisol and liver glycogen levels. The dopaminergic and serotonergic metabolism was also affected by melatonin
treatment only in the hypothalamus on stressed fish. Thus, the presence of melatonin at night in tank water was able to counteract several of the effects induced by stress especially those related to cortisol synthesis and release, which is in support of an anti-stress role for melatonin in Senegalese sole.

**General information**

State: Published
Organisations: University of Vigo
Authors: López-Patiño, M. A. (Ekstern), Conde-Sieira, M. (Ekstern), Gesto, M. (Intern)
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- BFI (2016): BFI-level 2
- Scopus rating (2016): CiteScore 2.75 SJR 1.101 SNIP 1.524
- Web of Science (2016): Indexed yes
- BFI (2015): BFI-level 2
- Scopus rating (2015): SJR 1.103 SNIP 1.254 CiteScore 2.12
- Web of Science (2015): Indexed yes
- BFI (2014): BFI-level 2
- Scopus rating (2014): SJR 1.002 SNIP 1.34 CiteScore 2.16
- Web of Science (2014): Indexed yes
- BFI (2013): BFI-level 1
- Scopus rating (2013): SJR 1.136 SNIP 1.3 CiteScore 2.18
- ISI indexed (2013): ISI indexed yes
- Web of Science (2013): Indexed yes
- BFI (2012): BFI-level 1
- Scopus rating (2012): SJR 1.212 SNIP 1.487 CiteScore 2.32
- ISI indexed (2012): ISI indexed yes
- Web of Science (2012): Indexed yes
- BFI (2011): BFI-level 1
- Scopus rating (2011): SJR 1.294 SNIP 1.542 CiteScore 2.39
- ISI indexed (2011): ISI indexed yes
- Web of Science (2011): Indexed yes
- BFI (2010): BFI-level 1
- Scopus rating (2010): SJR 1.151 SNIP 1.394
- Web of Science (2010): Indexed yes
- BFI (2009): BFI-level 1
- Scopus rating (2009): SJR 0.941 SNIP 1.263
- Web of Science (2009): Indexed yes
- BFI (2008): BFI-level 2
- Scopus rating (2008): SJR 0.909 SNIP 1.173
- Web of Science (2008): Indexed yes
- Scopus rating (2007): SJR 1.019 SNIP 1.318
- Web of Science (2007): Indexed yes
- Scopus rating (2006): SJR 1.008 SNIP 1.689
- Web of Science (2006): Indexed yes
- Scopus rating (2005): SJR 0.915 SNIP 1.236
Physiological responses during thermal shock in pre-slaughter procedures in turbot

General information
State: Published
Organisations: Universidade de Vigo, University of Vigo, Universidad de Vigo
Authors: Hernández, J. (Ekstern), Gesto, M. (Intern), Conde-Sieira, M. (Ekstern), López-Patiño, M. A. (Ekstern), Libran-Perez, M. (Ekstern), Cabaleiro, S. (Ekstern), Míguez, J. (Ekstern)
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The dynamics of the response of brain serotonergic and dopaminergic systems to an acute stressor in rainbow trout

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Organisations: Universidade de Vigo, Universidad de Vigo
Authors: Gesto, M. (Intern), Libran-Perez, M. (Ekstern), López-Patiño, M. A. (Ekstern), Hernández, J. (Ekstern), Míguez, J. (Ekstern)
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The response of brain serotonergic and dopaminergic systems to an acute stressor in rainbow trout: a time course study

The brain monoaminergic neurotransmitter systems are known to be involved in the integrated response to stress in vertebrates. However, present knowledge about the timing of their actions as well as their specific roles in the regulation of the endocrine axes that drive the stress response is incomplete. This is partly because of the complexity of the reciprocal interactions among the monoaminergic systems and other biochemical effectors of the stress response such as corticotropin-releasing factor (CRF), arginine vasotocin (AVT), adrenocorticotropic hormone (ACTH) and corticosteroids. In this study, we show for the first time in teleost fish (rainbow trout) the short-and mid-term time course of the response of the forebrain serotonergic and dopaminergic activities after exposure to an acute stressor. Other stress markers like the plasma levels of cortisol, glucose and lactate were also monitored, providing a context in which to precisely locate the monoaminergic activation within the fish acute stress response. Our results show that acute stress induced a rapid increase in forebrain serotonergic activity, which became elevated after only 15 s of chasing. Several hours after stress, serotonergic activity recovered its basal levels, in parallel with the recovery of other stress markers such as plasma catecholamines and cortisol. Dopaminergic activity was also increased after stress, but only in the telencephalon and only after 20 min. The increase in serotonergic activity happened before the elevation of plasma catecholamines, suggesting
that this monoamine system could have a key role in triggering the initial steps of the activation of not only the hypothalamus-pituitary-inter-renal axis but also the brain-sympathetic-chromaffin axis in fish.

**General information**

State: Published  
Organisations: University of Vigo  
Authors: Gesto, M. (Intern), Lopez-Patino, M. A. (Ekstern), Hernandez, J. (Ekstern), Soengas, J. L. (Ekstern), Miguez, J. M. (Ekstern)  
Pages: 4435-4442  
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BFI (2016): BFI-level 2  
Scopus rating (2016): CiteScore 2.62 SJR 1.722 SNIP 1.279  
Web of Science (2016): Indexed yes  
BFI (2015): BFI-level 2  
Scopus rating (2015): SJR 1.812 SNIP 1.222 CiteScore 2.4  
Web of Science (2015): Indexed yes  
BFI (2014): BFI-level 2  
Scopus rating (2014): SJR 1.722 SNIP 1.331 CiteScore 2.51  
Web of Science (2014): Indexed yes  
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Scopus rating (2013): SJR 1.719 SNIP 1.323 CiteScore 2.75  
ISI indexed (2013): ISI indexed yes  
Web of Science (2013): Indexed yes  
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Scopus rating (2012): SJR 1.612 SNIP 1.395 CiteScore 2.91  
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BFI (2011): BFI-level 2  
Scopus rating (2011): SJR 1.534 SNIP 1.315 CiteScore 2.77  
ISI indexed (2011): ISI indexed yes  
Web of Science (2011): Indexed yes  
BFI (2010): BFI-level 2  
Scopus rating (2010): SJR 1.474 SNIP 1.341  
Web of Science (2010): Indexed yes  
BFI (2009): BFI-level 2  
Scopus rating (2009): SJR 1.764 SNIP 1.365  
BFI (2008): BFI-level 2  
Scopus rating (2008): SJR 1.91 SNIP 1.363  
Web of Science (2008): Indexed yes  
Scopus rating (2007): SJR 1.583 SNIP 1.404  
Web of Science (2007): Indexed yes  
Scopus rating (2006): SJR 1.432 SNIP 1.36  
Web of Science (2006): Indexed yes  
Scopus rating (2005): SJR 1.591 SNIP 1.309  
Web of Science (2005): Indexed yes  
Scopus rating (2004): SJR 1.504 SNIP 1.314
Arginine vasotocin is a potent anorexigenic factor in the trout

General information
State: Published
Organisations: Universidade de Vigo, University of Vigo, Universidad de Vigo
Authors: Gesto, M. (Intern), Conde-Sieira, M. (Ekstern), Libran-Perez, M. (Ekstern), López-Patiño, M. A. (Ekstern), Míguez, J. (Ekstern)
Pages: 148
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Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 2.99 SJR 1.547 SNIP 1.063
Glucose concentration influences ACTH-stimulated cortisol release by head kidney of rainbow trout

General information
State: Published
Organisations: Universidade de Vigo, University of Vigo
Authors: Conde-Sieira, M. (Ekstern), Libran-Perez, M. (Ekstern), Gesto, M. (Intern), Míguez, J. (Ekstern), Soengas, J. (Ekstern)
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Mechanistic insight into the effect of Venlafaxine on cortisol stress axis activity in rainbow trout

General information
State: Published
Organisations: University of Waterloo
Authors: Vijayan, M. (Ekstern), Melnyk-Lamont, N. (Ekstern), Best, C. (Ekstern), Gesto, M. (Intern)
Publication date: 2012
Main Research Area: Technical/natural sciences
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Melatonin synthesis in trout pineal organ is influenced by stress

General information
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Organisations: Universidade de Vigo, Universidad de Vigo
Authors: López‑Pathó, M. A. (Ekstern), Munoz, J. (Ekstern), Gesto, M. (Intern), Soengas, J. (Ekstern), Míguez, J. (Ekstern)
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Publication date: 2012
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Scopus rating (2016): CiteScore 2.99 SJR 1.547 SNIP 1.063
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 1.611 SNIP 1.049 CiteScore 2.78
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 1.793 SNIP 1.241 CiteScore 3.5
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 1.613 SNIP 1.066 CiteScore 3.66
ISI indexed (2013): ISI indexed yes
BFI (2012): BFI-level 1
Scopus rating (2012): SJR 1.507 SNIP 1.19 CiteScore 4.05
ISI indexed (2012): ISI indexed yes
Web of Science (2012): Indexed yes
BFI (2011): BFI-level 1
Scopus rating (2011): SJR 1.427 SNIP 1.055 CiteScore 2.64
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 1
Retinol metabolism in the mollusk Osilinus lineatus indicates an ancient origin for retinyl ester storage capacity

Although retinoids have been reported to be present and active in vertebrates and invertebrates, the presence of mechanisms for retinoid storage in the form of retinyl esters, a key feature to maintain whole-organism retinoid homeostasis, have been considered to date a vertebrate innovation. Here we demonstrate for the first time the presence of retinol and retinyl esters in an invertebrate lophotrochozoan species, the gastropod mollusk Osilinus lineatus. Furthermore, through a pharmacological approach consisting of intramuscular injections of different retinoid precursors, we also demonstrate that the retinol esterification pathway is active in vivo in this species. Interestingly, retinol and retinyl esters were only detected in males, suggesting a gender-specific role for these compounds in the testis. Females, although lacking detectable levels of retinol or retinyl esters, also have the biochemical capacity to esterify retinol, but at a lower rate than males. The occurrence of retinyl ester storage capacity, together with the presence in males and females of active retinoids, i.e., retinoic acid isomers, indicates that O. lineatus has a well developed retinoid system. Hence, the present data strongly suggest that the capacity to maintain retinoid homeostasis has arisen earlier in Bilateria evolution than previously thought.
Tissue-specific distribution patterns of retinoids and didehydroretinoids in rainbow trout Oncorhynchus mykiss

Retinoids (vitamin A) are known to be involved in many key biological functions in mammals, such as embryonic development, reproduction or vision. Besides standard vitamin A forms, freshwater fish tissues contain high levels of didehydroretinoids or vitamin A(2) forms. However, the tissue distribution, metabolism and function of both standard and particularly the didehydroretinoids are still poorly known in fish. In this study, we have quantified the levels of retinoids, including retinol, retinaldehyde, retinyl palmitate and their corresponding didehydro forms, as well as the levels of the active polar retinoids all-trans-, 9-cis- and 13-cis-retinoic acid in distinct tissues of juvenile rainbow trout. Our results indicate that the liver is clearly the main retinoid storage tissue in juvenile rainbow trout. Didehydroretinoids were dominant over retinoids in all analyzed tissues with the exception of plasma. Additionally, significant differences among tissues were observed between retinoids and didehydroretinoids, such as differences in the ester profiles and the proportions between free and esterified forms, suggesting that mechanisms that favor the utilization or storage of one of the other groups of compounds might exist in fish. Our data also show the presence of polar retinoids in different tissues of fish at the fmol/g scale. Overall, this study clearly demonstrates the presence of tissue-specific patterns of accumulation of both polar and nonpolar retinoids in fish tissues. The biological relevance of these findings should be the focus of future studies. (C) 2011 Elsevier Inc. All rights reserved.
Changes in plasma melatonin levels and pineal organ melatonin synthesis following acclimation of rainbow trout (Oncorhynchus mykiss) to different water salinities

Melatonin has been suggested to play a role in fish osmoregulation, and in salmonids has been related to the timing of adaptive mechanisms during smolting. It has been described that acclimation to different environmental salinities alters levels of circulating melatonin in a number of fish species, including rainbow trout. However, nothing is known regarding salinity effects on melatonin synthesis in the pineal organ, which is the main source of rhythmically produced and secreted melatonin in blood. In the present study we have evaluated, in rainbow trout, the effects of acclimation to different salinities on day and night plasma melatonin values and pineal organ melatonin synthesis. Groups of freshwater (FW)-adapted rainbow trout were placed in tanks with four different levels of water salinity (FW, 6, 12, 18 p.p.t.; parts per thousand) and maintained for 6 h or 5 days. Melatonin content in plasma and pineal organs, as well as the pineal content of serotonin (5-HT) and its main oxidative metabolite (5-hydroxyindole-3-acetic acid; 5-HIAA) were measured by high performance liquid chromatography. In addition, day-night changes in pineal organ arylalkylamine N-acetyltransferase (AANAT2) activity and aanat2 gene expression were studied. Plasma osmolalities were found to be higher in rainbow trout exposed to all salinity levels compared with the control FW groups. A salinity-dependent increase in melatonin content was found in both plasma and pineal organs. This effect was observed during the night, and was related to an increase in aanat2 mRNA abundance and AANAT2 enzyme activity, both of which also occurred during the day. Also, the levels of indoles (5-HT, 5-HIAA) in the pineal organ were negatively affected by increasing water salinity, which seems to be related to the higher recruitment of 5-HT as a substrate for the increased melatonin synthesis. A stimulatory effect of salinity on pineal aanat2 mRNA expression was also identified. These results indicate that increased external salinity promotes melatonin synthesis in the pineal organ of rainbow trout by enhancing synthesis of AANAT protein independently of its regulation by light. The possibility that pineal melatonin is a target for hormones involved in the response of fish to osmotic challenge is discussed, as well as the potential role of melatonin in the timing of osmoregulatory processes.

General information
State: Published
Organisations: Universidad de Vigo
Authors: Lopez-Patino, M. A. (Ekstern), Rodriguez-Illamola, A. (Ekstern), Gesto, M. (Intern), Soengas, J. L. (Ekstern), Miguez, J. M. (Ekstern)
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Scopus rating (2014): SJR 1.722 SNIP 1.331 CiteScore 2.51
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BFI (2013): BFI-level 2
Scopus rating (2013): SJR 1.719 SNIP 1.323 CiteScore 2.75
ISI indexed (2013): ISI indexed yes
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BFI (2012): BFI-level 2
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BFI (2011): BFI-level 2
Scopus rating (2011): SJR 1.534 SNIP 1.315 CiteScore 2.77
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Web of Science (2011): Indexed yes
BFI (2010): BFI-level 2
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Web of Science (2010): Indexed yes
BFI (2009): BFI-level 2
Scopus rating (2009): SJR 1.764 SNIP 1.365
BFI (2008): BFI-level 2
Scopus rating (2008): SJR 1.91 SNIP 1.363
Web of Science (2008): Indexed yes
Scopus rating (2007): SJR 1.583 SNIP 1.404
Web of Science (2007): Indexed yes
Scopus rating (2006): SJR 1.432 SNIP 1.36
Web of Science (2006): Indexed yes
Scopus rating (2005): SJR 1.591 SNIP 1.309
Web of Science (2005): Indexed yes
Scopus rating (2004): SJR 1.504 SNIP 1.314
Web of Science (2004): Indexed yes
Scopus rating (2003): SJR 1.256 SNIP 1.197
Web of Science (2003): Indexed yes
Web of Science (2002): Indexed yes
Scopus rating (2001): SJR 1.48 SNIP 1.32
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Alterations in the brain monoaminergic neurotransmitters of rainbow trout related to naphthalene exposure at the beginning of vitellogenesis

The contents of dopamine (DA), noradrenaline (NA), serotonin (5HT), and some related metabolites were studied in different brain regions of rainbow trout at two different stages of sexual maturation (at the beginning of vitellogenesis), after naphthalene (NAP) administration. The effects of NAP varied according to duration of exposure, brain region and vitellogenesis stage of the trout, and were more significant during previtellogenesis. The changes observed in DA metabolism were generally stimulatory after exposure for 3 h, and either stimulatory or inhibitory (depending on the brain regions) after exposure for 3 days to NAP. NA levels were altered by NAP in various brain regions, but only during previtellogenesis. With respect to 5HT, treatment with NAP reduced levels of the amine and/or its main metabolite in most of the brain regions studied, particularly 3 h after treatment. The results suggest that NAP might interfere with the processes regulating brain monoamine metabolism, either locally or indirectly by altering steroid feedback to brain centres, and thus disrupt endocrine control of reproductive development through the brain-pituitary axis.

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State: Published
Organisations: Universidad de Vigo
Authors: Gesto, M. (Intern), Tintos, A. (Ekstern), Alvarez, R. (Ekstern), Soengas, J. L. (Ekstern), Miguez, J. M. (Ekstern)
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Scopus rating (2016): CiteScore 1.7 SJR 0.562 SNIP 0.821
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Scopus rating (2015): SJR 0.736 SNIP 0.918 CiteScore 1.59
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 0.652 SNIP 0.891 CiteScore 1.77
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 0.708 SNIP 0.952 CiteScore 1.72
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beta-Naphthoflavone and benzo(a)pyrene alter dopaminergic, noradrenergic, and serotonergic systems in brain and pituitary of rainbow trout (Oncorhynchus mykiss)

In the present study we evaluate for the first time the potential of the flavonoid compound beta-naphthoflavone (BNF) and the high molecular weight- Polycyclic aromatic hydrocarbon (PAH) benzo(a)pyrene (BaP) to alter brain neurotransmitter metabolism in fish. Fish of three different groups were intraperitoneally (i.p.) injected (2 µl g(-1)) with vegetable oil alone (control) or containing BNF or BaP (10mg kg(-1)) and sacrificed 3, 24, and 72h after treatment. Contents of dopamine (DA), noradrenaline (NA) and serotonin (5HT), as well as the amine oxidative metabolites, 3,4-dihydroxyphenylacetic acid (DOPAC) and 5-hydroxyindole-3-acetic acid (5HIAA) were assayed in telencephalon, hypothalamus, preoptic region, optic tectum, and brain stem, as well as the pituitary. Fish treated with PAHs showed after 3 h decreases in 5HT content in telencephalon, hypothalamus, preoptic region (with both BNF and BaP), and pituitary (with BaP), resulting in increased 5HIAA/5HT ratio. An increased ratio was also observed in hypothalamus 24 h after BaP, and in preoptic region 72 h after BNF, in both cases due to an increased 5HIAA content. In other brain regions PAHs effects on 5-HT metabolism were less consistent. With respect to the dopaminergic system, changes induced by PAHs mainly occurred after 24 and 72 h of treatment, with increased DOPAC/DA ratio in preoptic region and brain stem. In hypothalamus, tectum, and pituitary, changes in DA metabolism showed strong variability. Finally, a decreased content of NA was evident in preoptic region (3
h) and in telencephalon (24 h) after both BNF and BaP treatments. Therefore, both BNF and BaP seem to act in rainbow trout brain by impairing 5HT availability at short term (3 h) and increasing neuronal metabolic utilization of both 5HT and DA after 24 and 72 h. Data collected in the present study suggest that brain monoamine neurotransmitters are potential targets of BNF and BaP, and their alteration could have a role in known effects of PAHs on several neuroendocrine processes that are centrally regulated or modulated by brain monoamines. (C) 2008 Elsevier Inc. All rights reserved.
Effects of naphthalene, beta-naphthoflavone and benzo(a)pyrene on the diurnal and nocturnal indoleamine metabolism and melatonin content in the pineal organ of rainbow trout, Oncorhynchus mykiss

Polycyclic aromatic hydrocarbons (PAHs) have deleterious effects on neuroendocrine systems in teleost fish affecting, among other processes, reproductive function or stress responses. The hormone melatonin, mainly produced in the pineal organ of vertebrates, is involved in the regulation of biological rhythms as well as other important functions, and may also act as an antioxidant molecule. The effects of environmental pollutants on the endocrine and metabolic activity of the pineal organ have been studied only in mammals. We here evaluate the effects of the PAHs naphthalene (NAP) and benzo(a)pyrene (BaP) and the flavonoid beta-naphthoflavone (BNF) on the pineal organ of rainbow trout by quantifying the diurnal and nocturnal pineal content of some indoles and methoxyindoles, including melatonin. NAP mainly induced diurnal increases in the pineal content of melatonin and other methoxyindoles like 5-methoxytryptamine (5-MT) and 5-methoxyindole-3-acetic acid (5-MIAA), whereas BNF induced strong increases in diurnal levels of melatonin. Those increases did not occur at night, when even occasional decreases were observed compared with controls. NAP also induced some diurnal and nocturnal decreases in the levels of indolic compounds like serotonin (5-HT) and 5-hydroxytryptophol (5-HTOL), while pineal content of 5-hydroxytryptophan (5-HTP) was first decreased (few hours after injection) and then increased (few days after injection) during the day. BaP and BNF induced strong increases in diurnal levels of melatonin, whereas other pineal compounds were unaffected. It seems that an increase of the methylation capacity of the pineal organ takes place during the day, and a decrease occurs at night. Those effects could be mediated by changes in the activity of key enzymes involved in pineal melatonin biosynthesis, maybe as a result of the alteration of the cellular phototransduction mechanisms involved in the light-induced inhibition of melatonin synthesis in the pineal photoreceptor cells. These results demonstrate for the first time that environmental pollutants can disrupt the activity of the pineal organ of teleost fish. This disruption could be a threat for the survival of the animals in their natural environment, although the increases observed in melatonin levels could play a relevant role as a toxicity-protection factor. (c) 2008 Elsevier B.V. All rights reserved.

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Acute and prolonged stress responses of brain monoaminergic activity and plasma cortisol levels in rainbow trout are modified by PAHs (naphthalene, beta-naphthoflavone and benzo(a)pyrene) treatment

We have investigated if treatment with two different PAHs such as naphthalene (NAP) and benzo(a)pyrene (BaP), and the PAH-like Compound beta-naphthoflavone (BNF), may modify the stress responses elicited in rainbow trout by acute or prolonged stress stimuli, and the possible involvement of brain monoamines in those responses. Two experiments (acute and prolonged stress) were performed. In the acute stress experiment, fish were i.p. injected with vegetable oil alone (control) or oil containing NAP, BNF or BaP (10 mg kg(-1)); and 72 It after injection fish were acutely stressed by chasing. In the prolonged stress experiment, a similar group-design and injection protocol were followed, but fish were submitted to severe confinement stress by maintaining fish under high stock density (70 kg fish mass m(-3)) for 72 It. The levels of cortisol, glucose and lactate were assayed in plasma. In addition, the contents of dopamine (DA), noradrenaline (NA) and serotonin (5HT), as well as their oxidized amine metabolites, 3,4-dihydroxyphenyl acetic acid (DOPAC) and 5-hydroxy-3-indoleacetic acid (5HIAA) were assayed in telencephalon, hypothalamus, preoptic region, optic tectum and brain stem, as well as the pituitary. Both acute and prolonged stress stimuli increased plasma levels of cortisol, which further increase with NAP and BNF treatments after acute stress. In contrast, cortisol levels of fish exposed to prolonged stress showed a clear tendency to decrease after the treatment with BNF and BaP. Stress stimuli also increased plasma glucose levels, which were not affected by PAHs in acute stressed fish but decreased in fish exposed to prolonged stress. Increased plasma levels of lactate in fish exposed to stress decreased after PAHs treatment in acute stress but not in prolonged stress. With respect to monoaminergic systems, major changes induced by both acute and prolonged stress were increases of the metabolites DOPAC and 5HIAA and DOPAC/DA or 5HIAA/5HT ratios in several brain regions. PAHs induced alterations in the normal responses of monoaminergic systems to stress, with dopaminergic system being the most affected after acute stress, and serotonergic system after prolonged stress. Those alterations, especially after prolonged stress, showed certain parallelism with alterations of plasma cortisol levels. Thus, results suggest that in stressed fish PAH effects on plasma cortisol levels (and its derived metabolic actions) could be in part mediated by alterations on the monoaminergic systems at the CNS of rainbow trout. (c) 2007 Elsevier B.V. All rights reserved.
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BFI (2018): BFI-level 2
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beta-naphthoflavone and benzo(a)pyrene treatment affect liver intermediary metabolism and plasma cortisol levels in rainbow trout Oncorhynchus mykiss

To assess the effects of the polycyclic aromatic hydrocarbons (PAHs) beta-naphthoflavone (beta-NF) and benzo(a)pyrene (BaP) on liver intermediary metabolism and plasma steroid hormones, immature female rainbow trout (Oncorhynchus mykiss) were intraperitoneally injected (2 μl g⁻¹) with vegetable oil alone (control) or containing beta-NF or BaP (10 mg kg⁻¹) and returned to their tanks; 3, 24, and 72 h after injection, 11 fish were sampled from each group. On each sampling time, plasma hormone levels (cortisol and 17 beta-estradiol) and metabolic parameters in plasma (glucose, lactate, and alpha-amino acid levels) and liver (glycogen, glucose, lactate, and alpha-amino acid levels, and HK, GK, PK, LDH, G6Pase, G6PDH, FPase, GH, Asp-AT, and HOAD activities) were assessed. Changes described for hormonal systems resulted in an increase in plasma levels of cortisol after 24 and 72 h of treatment with both PAHs whereas no changes were noticed for 17 beta-estradiol levels. Changes in intermediary metabolism described effects in several pathways due to treatment with both PAHs. These changes can be summarized as increased glucose and lactate levels in plasma, and increased glycogenolysis and gluconeogenesis in liver after 24 and 72 h of treatment with both PAHs. Furthermore, beta-NF treatment stimulated amino acid catabolism in liver. These metabolic changes can be associated with increased levels of plasma cortisol, and suggest a different metabolic behavior depending on PAHs. (c) 2007 Elsevier Inc. All rights reserved.

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Immunolocalization of glucokinase in glucosensing tissues of rainbow trout

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Naphthalene treatment alters liver intermediary metabolism and levels of steroid hormones in plasma of rainbow trout (Oncorhynchus mykiss)

To assess the effects of naphthalene on liver intermediary metabolism and plasma steroid hormones, immature female rainbow trout (Oncorhynchus mykiss), in a first experiment, were intraperitoneally injected (2 μL g(-1)) with vegetable oil alone (control) or containing naphthalene (10 and 50 mg kg(-1)) and returned to their tanks. At 1, 3, and 6 h after injection, eight fish were sampled from each group. A second experiment was similarly designed but used fish intraperitoneally implanted (10 μL g(-1)) with slow-release coconut oil implants alone (control) or containing naphthalene at doses of 10 and 50mg kg(-1) body weight that were sampled 1, 3, and 5 days after injection. At each sampling time, plasma hormone levels (cortisol and 17 beta-estradiol) and metabolic parameters in plasma (glucose and lactate) and liver (glucose, lactate, and glycogen levels and HK, GK, GPase, GDH, FBPase, and PK activities) were assessed. Changes described for both hormonal systems resulted in a decrease in plasma levels of cortisol and 17 beta-estradiol. Changes observed in intermediary metabolism described effects in several pathways of liver energy metabolism due to naphthalene. These changes can be summarized as increased glycogenolysis, use of exogenous glucose, and glycolysis and decreased gluconeogenesis. The increased energy production in liver suggested by these changes can be related to the increased detoxification activity known to occur in liver after PAH exposure, and can be also related directly or indirectly to the changes observed in the levels of plasma steroids. (c) 2006 Elsevier Inc. All rights reserved.
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Effects of acute and prolonged naphthalene exposure on brain monoaminergic neurotransmitters in rainbow trout (Oncorhynchus mykiss)

We have shown previously that acute (1 to 6 h) and prolonged (1 to 5 days) exposure of rainbow trout to naphthalene resulted in decreased plasmatic cortisol and 17-beta-estradiol levels. In order to elucidate the mechanisms through which naphthalene might disrupt endocrine regulation, the present study investigated whether brain monoaminergic neurotransmitters are altered by the action of this polycyclic aromatic hydrocarbon. In a first experiment, immature rainbow trout were injected with vegetable oil alone or containing naphthalene (10 and 50 mg/kg, i.p.), and sacrificed 1, 3 and 6 h after treatment. In a second experiment, slow-coconut oil implants alone or containing naphthalene (doses of 10 and 50 mg/kg) were i.p. located and fish sacrificed 1, 3 and 5 days after treatment. Levels of dopamine (DA), 3,4-dihydroxyphenylacetic acid (DOPAC), serotonin (5-HT), 5-hydroxyindoleacetic acid (5-HIAA) and noradrenaline (NA) were measured in several brain regions by HPLC. The results show that short-term naphthalene increases DA and 5-HT contents in hypothalamus and telencephalon, but differentially alter contents of the acid metabolites. Implants with naphthalene reduced DA content in hypothalamus and preoptic region but increased in telencephalon. 5-HT metabolism was decreased in hypothalamus, preoptic region, pituitary and brain stem after 3 to 6 days of treatment. In addition, the levels of NA were increased in hypothalamus and telencephalon after acute treatment and in hypothalamus and preoptic area after several days of exposure to naphthalene. These data suggest that brain neurotransmitter systems are sensitive to polycyclic aromatic hydrocarbons and could represent a target of the naphthalene-induced neuroendocrine disruption.

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Interactive effects of naphthalene treatment and the onset of vitellogenesis on energy metabolism in liver and gonad, and plasma steroid hormones of rainbow trout Oncorhynchus mykiss

The purpose of the study was to assess in female fish the possible interaction between treatment with a polycyclic aromatic hydrocarbon (PAH) like naphthalene and the onset of vitellogenesis. In a first experiment, female rainbow trout (Oncorhynchus mykiss) at stages 2-3 (previtellogenesis) or 4 (early vitellogenesis) were intraperitoneally injected (2 μl g(-1)) with vegetable oil alone (control) or containing naphthalene (50 mg kg(-1)) to be sampled 3 h later. A second experiment was similarly designed but using fish intraperitoneally implanted (10 μl g(-1)) with slow-release coconut oil implants alone (control) or containing 50 mg naphthalene kg(-1) body mass that were sampled 3 days after injection. On each sampling time, plasma levels of cortisol and 17 beta-estradiol, and several metabolic parameters in plasma, liver and gonad were assessed. In controls, early vitellogenic fish compared with previtellogenic fish displayed changes that in some cases are confirmatory of previous studies whereas in other cases provide new information in plasma (increased amino acid levels), liver (decreased capacity for exporting glucose and reduced amino acid levels) and gonad (decreased amino acid levels). Naphthalene treatment produced in previtellogenic fish decreased 17 beta-estradiol levels in plasma, increased plasma glucose or decreased liver gluconeogenic capacity whereas no major effects were noticed on parameters involved in lipid, amino acid and lactate metabolism. Differential effects of naphthalene treatment were noticed in early vitellogenic fish such as decreased 17 beta-estradiol and glucose levels in plasma, increased hexokinase and glucokinase and lack of changes in fructose 1,6-bisphosphatase activities in liver, and a lower decrease of amino acid levels in gonad. Those alterations produced by naphthalene treatment resulted in a decreased capacity for covering the energy demand of vitellogenesis in liver and gonad that could contribute to a delay and/or impairment of the onset of maturation. (c) 2006 Elsevier Inc. All rights reserved.

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Interactive effects of naphthalene treatment and vitellogenesis on energy metabolism and steroid hormones in rainbow trout

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Organisations: Universidad de Vigo, Universidade de Vigo
Authors: Tintos, A. (Ekstern), Gesto, M. (Intern), Fernandez-Duran, B. (Ekstern), Polakof, S. (Ekstern), Míguez, J. (Ekstern), Soengas, J. (Ekstern)
Publication date: 2006
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Arginine vasotocin stimulates melatonin release from trout pineal organs in culture: Possible action mediated by V1-type receptor

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Organisations: Universidad de Vigo, Universidade de Vigo
Authors: Rodríguez-Illamola, A. (Ekstern), Gesto, M. (Intern), Ceinos, R. (Ekstern), Soengas, J. (Ekstern), Míguez, J. (Ekstern)
Publication date: 2005
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Effect of season on daily rhythms of several indoles and 5-methoxyindoles in the pineal organ of trouts exposed to natural conditions

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Authors: Ceinos, R. (Ekstern), Rodríguez-Illamola, A. (Ekstern), Gesto, M. (Intern), Grádin, A. (Ekstern), Soengas, J. (Ekstern), Míguez, J. (Ekstern)
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Effects of naphthalene exposure on melatonin production and indole metabolism in trout pineal gland

**General information**
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Organisations: Universidad de Vigo, Universidade de Vigo
Authors: Míguez, J. (Ekstern), Gesto, M. (Intern), Tintos, A. (Ekstern), Ceinos, R. (Ekstern), Rodríguez-Illamola, A. (Ekstern), Soengas, J. (Ekstern)
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Event: Abstract from Congress of the European Pineal and Biological Rhythms Society, Frankfurt, Germany.
Main Research Area: Technical/natural sciences
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Arginine vasotocin modulates the secretion of melatonin and other 5-methoxyindoles in the pineal organ of the rainbow trout: an in vitro study

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Organisations: Universidad de Vigo, Universidade de Vigo
Authors: Rodríguez-Illamola, A. (Ekstern), Gesto, M. (Intern), Ceinos, R. (Ekstern), Soengas, J. (Ekstern), Míguez, J. (Ekstern)
Publication date: 2005
Event: Abstract from Congress of the European Pineal and Biological Rhythms Society, Frankfurt, Germany.
Main Research Area: Technical/natural sciences
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Effect of in vivo administration of arginine vasotocin on indoleamines and 5-methoxyindoles in the pineal organ of rainbow trout

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Organisations: Universidad de Vigo, Universidade de Vigo
Authors: Gesto, M. (Intern), Rodriguez-Illamola, A. (Ekstern), Ceinos, R. (Ekstern), Soengas, J. (Ekstern), Míguez, J. (Ekstern)
Publication date: 2004
Event: Abstract from 5th International Symposium on Fish Endocrinology, Castellon, Spain.
Main Research Area: Technical/natural sciences
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Publication: Research › Conference abstract for conference – Annual report year: 2004

Growth hormone actions on carbohydrate metabolism and osmoregulatory capacity of rainbow trout

General information
State: Published
Organisations: Universidad de Vigo, Universidade de Vigo
Authors: Alvarellos, S. (Ekstern), Tintos, A. (Ekstern), Gesto, M. (Intern), Rodriguez-Illamola, A. (Ekstern), Míguez, J. (Ekstern), Soengas, J. (Ekstern)
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Event: Abstract from 5th International Symposium on Fish Endocrinology, Castellon, Spain.
Main Research Area: Technical/natural sciences
Source: PublicationPreSubmission
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Publication: Research › Conference abstract for conference – Annual report year: 2004

Projects:

Welfare, health and individuality in farmed fish (WIN-FISH) (39236)
In modern aquaculture, production costs are the major driver. This has resulted in culture practices and rearing environments aimed at maximizing production capacity. Consequently, fish are exposed to unavoidable stressors, which can be detrimental to animal health and welfare. Moreover, it is increasingly clear that individuality in stress reactions have to be included in the concept of animal welfare. Such differences often take the form of suites of traits, or stress coping styles (SCS), where traits like sympathetic reactivity, aggression and the tendency follow and develop routines show positive relationships. In addition, these traits show a negative relationship with plasma cortisol levels and are also associated with differences in immune function. The project will validate behavioural and physiological welfare indicators for selected fish species at the individual and rearing unit level. This will generate new information about responses to environmental factors, knowledge that can be applied to improve husbandry and management practices. Recirculating aquaculture systems (RAS) have been developed as a sustainable alternative with low ecological consequences compared to traditional flow through systems. However, in RAS factors such as higher rearing densities and water quality parameters may challenge the welfare of fish. In WIN-FISH, health, welfare and production related effects of RAS rearing of species at different densities will be monitored. In order to account for individual variation, these studies will be performed on fish screened for SCS. Similarly, in flow through systems, health, welfare and production related effects of rearing densities will be further investigated in sea bream differing in SCS. Generally, environmental enrichment has positive effects on animal welfare. WIN-FISH will investigate effects of environmental enrichment on rainbow trout with contrasting SCS. In an attempt to generate genetic markers for selective breeding to optimize performance and welfare of farmed Atlantic salmon, a genome-wide association analysis will be performed on salmon with divergent SCS, focusing on proactive fish differing in aggressive behaviour. In addition, zebrafish will be used as a model to gain additional knowledge on mechanisms underlying SCS and aggressive behaviour.
This project is coordinated by DTU Aqua.
The project is funded by EU, Framework Programme 7.

National Institute of Aquatic Resources
Section for Aquaculture

IFREMER
Universidad Politécnica de Madrid
Instituto Zooprofilattico Sperimentale delle Venezie

Institute of Agri-food Research and Technology

New possibilities for growth and robustness in organic aquaculture (ROBUSTFISH) (39159)
Main aim:
To support the credibility, growth and robustness in the production of healthy and stress resilient Danish organic rainbow trout, considering environmental, ethical as well as economic aspects.

Sub goals:
1) Develop methods for selecting robust fry.
2) Investigating how sustainable non-fish based feed given early in the development affect the robustness of the fry.
3) Include welfare and environmental aspects in relation to water treatment procedures.
4) Improve economic competiveness of Danish organic aquaculture.

The project is coordinated by DTU Aqua.

This project is funded by Organic RDD 2 Programme, which is coordinated by the International Centre for Research in Organic Food Systems (ICROFS). It has received grants from the Danish Ministry of Food, Agriculture and Fisheries through the Green Growth and Development Programme (GUDP).

National Veterinary Institute
National Institute of Aquatic Resources
Section for Aquaculture

Danish Aquaculture Association
University of Copenhagen
Aalborg University

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National Veterinary Institute
National Institute of Aquatic Resources
Section for Aquaculture

Danish Aquaculture Association
University of Copenhagen
Aalborg University
Enhancing the European aquaculture production by removing production bottlenecks of emerging species, producing new products and accessing new markets (DIVERSIFY) (39132)

Following the objectives of this Call, DIVERSIFY identified a number of new/emerging, large and/or fast growing finfish species, which are believed to be excellent candidates for the expansion of the aquaculture industry of Europe. The emphasis is on the Mediterranean or warm-water cage culture industry, but also addressed is pond/extensive culture, fresh water recirculation systems and cold-water species. These new/emerging species are marketed at a large size and can be processed easily into a range of products to provide the consumer with both a greater diversity of fish species and new processed products. In collaboration with a number of SMEs, DIVERSIFY will build on recent/current national initiatives for species diversification in aquaculture, in order to overcome the documented bottlenecks in the aquaculture production of these selected species. DIVERSIFY will provide knowledge where needed to solve bottlenecks in juvenile production, grow-out, nutrition and feeding husbandry, new product development and marketing. The programme will also provide tools for genetic improvement and disease control. This will provide improved efficiency in production and reduced costs, and identify markets for the new products.

The expertise in the consortium and lessons learned, could provide in a 5 year period what took the Atlantic salmon industry 20 years of development. DIVERSIFY focuses on meagre (Argyrosomus regius) and greater amberjack (Seriola dumerili) for marine warm-water cage culture, wreckfish (Polyprion americanus) for warm- and cool-water marine cage culture, Atlantic halibut (Hippoglossus hippoglossus) for marine cold-water culture, grey mullet (Mugil cephalus) a euryhaline herbivore for warm-water pond, extensive and integrated culture, and pikeperch (Sanders lucioperca) for freshwater intensive culture using Recirculation Aquaculture Systems (RAS).

The project is coordinated by the Hellenic Center for Marine Research. 31 research institutions etc. are involved in the project.

The project is funded by EU, Framework Programme 7.

National Institute of Aquatic Resources

Section for Aquaculture

Period: 01/01/2014 → 01/01/2018

Number of participants: 3

Research area: Aquaculture

Project participant:

Lund, Ivar (Intern)

Skov, Peter Vilhelm (Intern)

Gesto, Manuel (Intern)

Project