

**EFFECTS OF DIETARY SUPPLEMENTAL TRYPTOPHAN
ON INTRASPECIFIC AGGRESSIVE BEHAVIOUR
IN RAINBOW TROUT:
IMPLICATION FOR THE REARING OF FISH IN AQUACULTURE**

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Introduction

In a recent series of experiments we have found that the addition of the amino acid L-tryptophan (TRP) to fish feed leads to a significant reduction of intraspecific aggressive behaviour in rainbow trout (*Oncorhynchus mykiss*). The amino acid L-tryptophan (TRP) is the precursor of the monoaminergic neurotransmitter, serotonin (5-HT). In fact the conversion of TRP to 5-hydroxytryptamin (5-HTP) by tryptophan hydroxylase is the rate limiting step in the 5-HT synthesis. Behavioural effects of 5-HT are well documented in both

teleost fish and mammals, and the consensus is that 5-HT is believed to be involved in the regulation of agnostic behaviour and mediates a general behavioural inhibition, including the reduction of aggressive behaviour. Intraspecific aggressive behaviour, and the formation of social dominance hierarchies, may constitute a substantial problem for the rearing of fish at high densities in aquaculture systems, and raise a number of problems concerning both production and animal welfare. The effect of hierarchy formation include injuries, unequal distribution of food and appetite reduction in subordinates, causing growth depensation in subordinates and stress induced, elevation of cortisol in subordinates, which negatively influence the immune system possibly related in immune suppression.

Methods

Experiments were performed on fish isolated in individual 62,5 litres compartments in 250 litres glass aquaria. During the first week after transfer to social isolation fish were hand fed commercial feed (EWOS ST40) to satiation daily and individual feed intake was quantified. Following one week of acclimation the fish were tested for aggressive behaviour, using a resident-intruder test. A small rainbow trout (body wt ca 50 % of the resident fish) was introduced. The formation resident-intruder pairs pair of fish always led to unilateral aggression from the resident against the smaller intruder. The frequency of attacks during 30 min following the first aggressive act was quantified from video recording. After one hour the intruder was removed, and during the following week fish were fed an experimental wet feed prepared from herring and shrimps. For one group of fish (n=12), the experimental feed was supplemented with 1,5 % TRP (by weight), an other group (n=12) received 0,15 % TRP, while a similar number of controls received the same feed without TRP supplementation. The fish were fed to satiation daily, and the individual feed intake was recorded. Aggressive behaviour was quantified again after 3 and 7 days of TRP feeding, using the resident-intruder test. Following the last test of aggressive behaviour the fish were sacrificed, weighed, and sampled for blood and brain tissue (telencephalon, hypothalamus, brain stem). Some untested fish (n=8 in each group) were kept in isolation during the all experiment period to serve as no-stress controls for the effect of the intruder on blood and brain parameters. Blood plasma was analysed for TRP and cortisol concentrations, brain tissue for levels of TRP, serotonin, and 5-hydroxyindoleacetic acid (5-HIAA, the major 5-HT metabolite).

Results and Discussion

The results show that dietary supplementation of TRP suppress aggressive behaviour in rainbow trout. Fish fed with 1,5 % and 0,15 % TRP supplemented feed for 7 days displayed a significant reduction in the number of aggressive acts performed against the intruder (Figure 1). However, there was no difference in aggressive behaviour between control and TRP supplemented fish after 3 days.

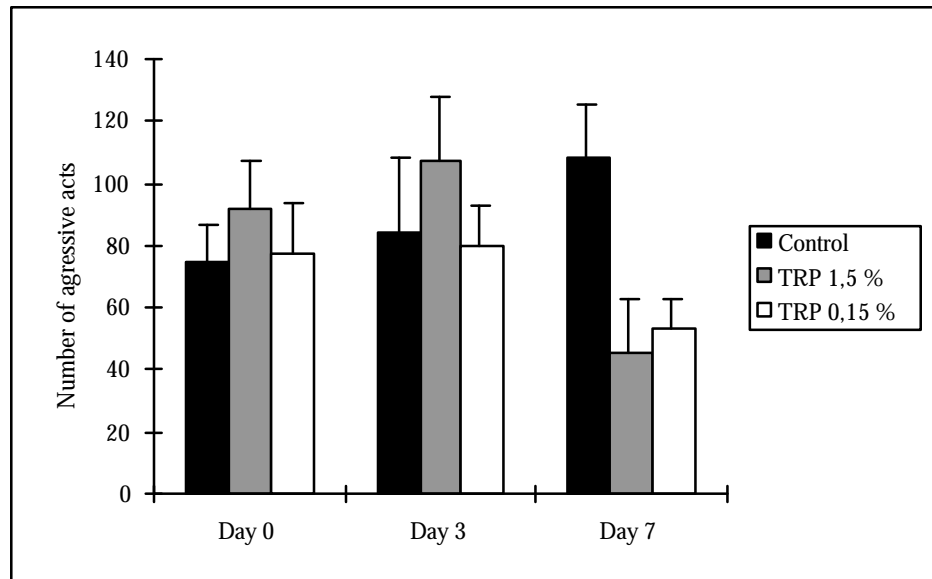


Figure 1. Number of aggressive acts performed by resident fish against an intruder during 30 minutes following the first aggressive acts, before TRP feeding (day 0), after three days (day 3), and seven days (day 7) of TRP feeding.

Plasma and brain levels of TRP were increased in fish given TRP supplemented feed as compare to controls. Brain levels of 5-HIAA, as well as

5-HIAA/5-HT ratio (an index of 5-HT activity), were increased in fish fed TRP supplemented feed. Fish subjected to resident-intruder test showed slightly higher plasma cortisol levels than undisturbed controls. There was no difference in plasma cortisol concentration between TRP supplemented fish and controls, neither in fish subjected to resident-intruder tests, or in fish that had been kept isolated.

The observed inhibition of aggression appear to be related to a TRP-induced increase in brain serotonergic activity. The result suggest that supplementation with dietary TRP increases brain 5-HT activity, and thereby decreases aggressive behaviour in juvenile rainbow trout. The effect of TRP enhanced feed on aggressive behaviour suggest a number of experiments to precede the possible utilisation of dietary supplementation of TRP in large-scale aquaculture operations. Experiments include effects of supplemental TRP on physiological stress responses, on the immune system, and effects on social behaviour of fish during periodic feeding restrictions.

