GROWTH HORMONE-INDUCED INCREASE IN AGGRESSION IN JUVENILE RAINBOW TROUT

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EXTENDED ABSTRACT ONLY – DO NOT CITE

Introduction

Growth hormone promotes mammalian growth (Steele and Evock-Clover, 1993) as well as growth of teleosts (McLean and Donaldsson, 1993). By stimulating growth, GH increases the metabolic demands, which should elevate the hunger level experienced by an animal. Consequently, studies have shown that GH increases dominant feeding-behaviour and reduces anti-predator behaviour of salmonids (see Björnsson 1997).

In freshwater streams, juvenile rainbow trout (*Oncorhynchus mykiss*) either defend territories or form dominance-based hierarchies. In these structures, agonistic behaviour is an important component since dominance is established in pairwise encounters, and the outcome of these mainly depend on the relative fighting ability of the opponents (Huntingford and Turner, 1987).

The aim of the present study was to clarify the role of growth hormone in social interactions in juvenile salmonids. The hypotheses that GH increases aggression levels and/or the fighting ability were tested.

Material and methods

Agonistic behaviour in pairs of juvenile rainbow trout consisting of two control fish (C/C pairs), two growth hormone treated fish (GH/GH pairs), or one growth hormone treated and one control fish (C/GH pairs) was observed. After implantation with either a cholesterol pellet containing 25 μg GH/g fish, or a placebo, each pair was placed in an aquarium. Each individual was separated by a removable longitudinal wall, and fed for four days to allow acclimation to the new environment and to allow the GH treatment to take effect. The following four days the experimental observations were carried out.

Each morning, the PVC longitudinal dividers were removed, allowing the fish to interact. Each pair of fish was then observed during three sessions each. The agonistic behaviour observed were: 1) frontal/lateral display, 2) circling, 3) replace, 4) attack, 5) chasing, and 6) bite. The initiator and the winner of each aggressive act were registered. After the last observation on each day, the dividers were inserted, separating the two fish of each pair. The fish were fed, and kept isolated until the next morning when the fish were observed again. For each pair, the individual that won most of the interactions was considered to be dominant.

Statistics

The behavioural data were not normally distributed and were therefore $\log_e$ transformed, whereupon they conformed to normal distribution and could be analyzed using ANOVA. Multiple comparisons were made with a Tukey test.

Results and discussion

Aggression was lowest in the C/C pairs, intermediate in the C/GH pairs, and highest in the GH/GH pairs, the difference between the C/C pairs and the GH/GH pairs being significant (Figure 1). This supports the hypothesis that GH increases aggression levels. However, in the C/GH pairs, the number of conflicts won by GH-treated and control fish did not differ significantly. In nine of these pairs, the control fish became dominant and in the remaining seven fish the GH-treated fish became dominant. Thus, because social status was not increased, GH did not appear to affect fighting ability. A possible explanation for these results is that GH increases swimming activity, thereby elevating the encounter rate between the two individuals. It may also be speculated that the GH-treated fish increased their foraging activity, to due a GH-induced increase in appetite.

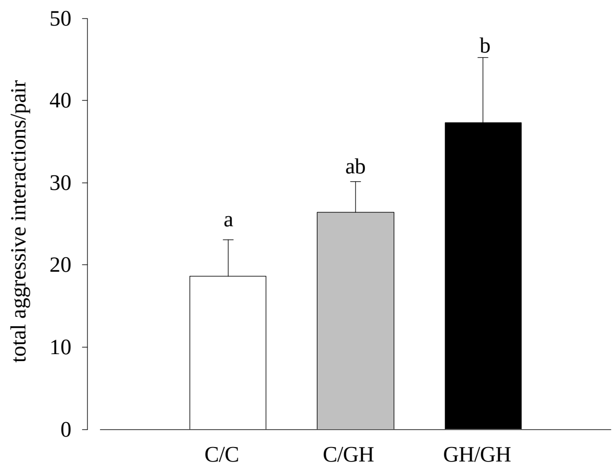

Figure 1. Total number of aggressive interactions in the three treatment groups of juvenile trout, see text for further description. Data are presented as means±se. Bars with the same letter are not significantly different ($p<0.05$).

In wild mice, GH increased aggression without affecting non-aggressive motor activity when two identically treated individuals were confronted (Matte, 1981). Thus, GH may affect agonistic behaviour of mammals and teleosts differently. In juvenile Atlantic salmon, elevated aggression in food-deprived fish was only partly an effect of increased locomotion (Symons, 1968), indicating that hunger also has a direct effect on aggression. Thus, hunger and GH may influence agonistic behaviour by partly different routes.

It has previously been shown that GH injected salmonids have an improved ability to compete for food (Björnsson, 1997). In the present study, by feeding the competing fish separately, the stimulatory effect of GH per se was removed. Hence, it appears that GH increases feeding motivation rather than social status.

In conclusion, the results of the present study indicate that GH elevates aggression indirectly, without affecting fighting ability, in juvenile rainbow trout. This further strengthens the view that GH may induce numerous behavioural changes in salmonids. Since these behavioural changes may incur energetic and mortality costs, this may limit selection for high GH levels in natural populations.

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