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Effects of feed restriction and re-feeding on body condition, plasma metabolites and intestinal brush border enzyme activity in rainbow trout

Original

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Publisher:

Published

DOI:

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1 **Effects of feed restriction and re-feeding on body condition, plasma**
2 **metabolites and intestinal brush border enzymes activity in rainbow**
3 **trout *O. mykiss***
4

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11 Recovery of body weight and condition as a consequence of liberal feeding after periods of fasting
12 or feed shortage, is a well-known phenomenon in salmonid fish species. To what extent the
13 adoption of culture protocols, alternating liberal feeding to severe feed restriction to exploit
14 compensatory growth, could be a challenge in terms of metabolic adaptation and welfare, still
15 remains questionable. In this context, the present study was aimed at evaluating some physiological
16 responses of rainbow trout subjected to 3 weeks fasting or restricted feed ration and re-feeding over
17 the following 2 weeks. Ninety-nine trout (body weight 109.1 ± 3.5 g) were randomly distributed
18 among 3 tanks (0.5 m^3) each supplied with 8 L min^{-1} of well water at a temperature of $12.7 \pm 0.1^\circ\text{C}$.
19 Fish groups were subjected to one of the following treatments: C, continuous feeding with a
20 commercial trout diet at 1% body weight over 5 weeks; R, restricted ration (30% of C ration) over 3
21 weeks followed by 2 weeks feeding to visual satiety; F, fasting over 3 weeks followed by 2 weeks
22 feeding to visual satiety. Three fish per group were euthanized at time 0 and after 1, 2, 4, 7, and 14
23 days during the re-feeding period and sampled for viscera, liver and mesenteric fat to calculate
24 carcass yield, visceral organ or tissue weight and somatic indices. Blood and gut samples were also
25 collected and analysed for plasma metabolites (glucose, lipid and protein levels) and the activity of
26 intestinal brush border membrane (BBM) enzymes (disaccharases, alkaline phosphatase, γ -glutamyl
27 transaminase) in different sections (pyloric caeca, foregut, hindgut).

28 In comparison to the control group, i.e. continuously fed fish, a feed restriction or fasting over 3
29 weeks resulted in significantly reduced body and visceral to body weight ratio and in diminished
30 activity of the intestinal BBM enzymes. Among plasma metabolites, only cholesterol was reduced.
31 During the re-feeding period, liver and viscera weight increased more rapidly in groups R and F
32 than in group C, resulting in significantly higher organ to body scores. The pattern of the activity of
33 the intestinal BBM enzymes varied among the different tracts in a specific manner, but no
34 differences were observed among treatments after 2 weeks of re-feeding.

35 In conclusion, a period of 14 days of liberal feeding seems to be able to restore the metabolic status
36 in rainbow trout previously subjected to fasting or restricted feed ration over 3 weeks.

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38 **Acknowledgements** The research was funded by Centro per la Ricerca Tecnologica in Agricoltura,
39 Udine, Regione FVG. “Acquacoltura” project.