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脂肪和L-肉碱对大口黑鲈饲料中蛋白质的节约作用 (英文)

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Protein Sparing Effect of Lipid and L-carnitine in Diets for Largemouth Bass (*Micropterus salmoides*)

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摘要 本试验旨在探讨脂肪和L-肉碱对大口黑鲈饲料中蛋白质的节约作用。采用3×2 (蛋白质脂肪比×L-肉碱) 完全随机设计, 配制了不同蛋白质脂肪比 (39.9%/7.4%、30.3%/13.9%和21.5%/19.5%) 和L-肉碱水平 (0和1 g/kg饲料) 的6种等能饲料。选取平均初重为 (3.27±0.21) g的大口黑鲈幼鱼270尾, 随机分为6组 (每组3个重复, 每个重复15尾), 随机饲喂1种饲料, 试验期6周。结果表明: 随着饲料中脂肪水平从7.4%升高到19.5% (蛋白质水平从39.9%下降到21.5%), 鲈鱼的增重率从685%显著降低到176% (P<0.05), 饲料效率从1.15增加到2.33 (P<0.05), 且投喂蛋白质脂肪比为21.5%/19.5%饲料的鲈鱼的肥满度显著低于投喂蛋白质脂肪比为39.9%/7.4%和30.3%/13.9%饲料的鲈鱼 (P<0.05)。投喂蛋白质脂肪比为21.5%/19.5%饲料的鲈鱼体水分含量显著低于投喂蛋白质脂肪比为39.9%/7.4%的饲料 (P<0.05), 且随着饲料中脂肪水平从7.4%升高到19.5% (蛋白质水平从39.9%下降到21.5%), 全鱼脂肪含量从5.6%显著升高到11.5% (P<0.05), 全鱼粗蛋白质含量从15.6%显著下降到10.4% (P<0.05)。鱼体肝脏和肌肉中脂肪含量以及肝体指数在投喂蛋白质脂肪比为21.5%/19.5%饲料时达到最高值。此外, 随着饲料中脂肪水平从7.4%升高到19.5% (蛋白质水平从39.9%下降到21.5%), 淋巴细胞百分比由38.30%升高到48.41% (P<0.05), 粒细胞百分比由51.75%下降到42.14% (P<0.05)。由此得出, 以节约蛋白质为目的的过量添加脂肪会导致鱼体生长速度降低, 甚至引起脂肪肝的发生和机体免疫系统的应激反应。此外, 饲料中添加1 g/kg的L-肉碱并不能提高大口黑鲈的生长性能, 但蛋白质脂肪比和L-肉碱对淋巴细胞百分比和粒细胞百分比存在互作作用, 并在饲喂添加1 g/kg L-肉碱的蛋白质脂肪比为21.5%/19.5%的饲料时达到峰值。

关键词: 大口黑鲈; 蛋白质脂肪比; L-肉碱; 生长; 体成分

Abstract: A 3×2 (protein/lipid ratio×L-carnitine) factorial experiment was conducted to evaluate the protein sparing effect of lipid and L-carnitine in diets for largemouth bass, *Micropterus salmoides*. Two hundred and seventy fingerlings with average body weight of (3.27±0.21) g were randomly divided into six groups with 3 replicates each and fifteen fingerlings per replicate. Six isocaloric experimental diets were formulated with three protein/lipid ratios (39.9%/7.4%, 30.3%/13.9% and 21.5%/19.5%) crossing two L-carnitine levels (0 and 1 g/kg), and were fed to the fingerlings for six weeks. The results showed as follows: weight gain rate was 686% when fish were fed the 39.9%/7.4% (protein/lipid) diet but was reduced to 176% when fish were fed the 21.5%/19.5% diet (P<0.05). Condition factor of fish fed 21.5%/19.5% (protein/lipid) diet was significantly lower than that of fish fed 39.9%/7.4% (protein/lipid) and 30.3%/13.9% (protein/lipid) diets (P<0.05). FCR was increased significantly from 1.15 to 2.33 when the dietary lipid level was increased from 7.4% to 19.5% (protein level was decreased from 39.9% to 21.5%) (P<0.05). Body moisture content was lower in the fish fed 21.5%/19.5% than that in the fish fed 39.9%/7.4% diet (P<0.05). When the dietary lipid level increased from 7.4% to 19.5% (protein level decreased from 39.9% to 21.5%), the body crude lipid content increased from 5.6% to 11.5% while body crude protein content decreased from 15.6% to 10.4% (P<0.05). The liver lipid, muscle lipid and hepatosomatic index reached the highest values when fish were fed 21.5%/19.5% (protein/lipid) diet. The percentage of lymphocytes was significantly increased from 38.30% to 48.41% (P<0.05), and the percentage of granulocytes was significantly decreased from 51.75% to 42.14% (P<0.05) when dietary lipid level was increased from 7.4% to 19.5% (protein level was decreased from 39.9% to 21.5%). It was concluded that more dietary lipid addition with the aim to spare dietary protein slowed the growth of largemouth bass, and led to a fatty liver and immune suppression. Moreover, though the addition of 1 g/kg L-carnitine in diet had no effect on all the parameters tested relevant to fish growth performance, an interactive effect of dietary protein/lipid ratio with L-carnitine was observed in the percentages of granulocytes and lymphocytes with the peak values found in the fish fed 21.5%/19.5% (protein/lipid) and 0.1% L-carnitine diet.

Keywords: Largemouth bass; Protein/lipid ratio; L-carnitine; Growth; Body composition

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