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ORIGINAL ARTICLE

Probiotic effects of the fungi, *Aspergillus niger* on growth, immunity, haematology, intestine fungal load and digestive enzymes of the common carp, *Cyprinus carpio*

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Abstract

The present study was conducted to investigate the probiotic role of the unicellular fungi, *Aspergillus niger* on growth performance, immunity, haematology and digestive enzymes in common carp, *Cyprinus carpio*. One non-supplemented group (T_0) was considered as control and two groups fed the fungi including T_1 (fish supplemented with diet containing 1×10^3 *A. niger*) and T_2 (fish supplemented with diet containing 1×10^6 *A. niger*) considered as the experimental treatments in three replicates. Fish were fed experimental diets for 60 days. The survival rate and growth parameters (final length and weight, weight gain (%), thermal growth coefficient (TGC), protein efficiency ratio and lipid efficiency ratio) significantly increased in *A. niger* supplemented fish compared with control ($p < 0.05$). The values of FCR (feed conversion ratio) and CF (condition of factor) significantly decreased after feeding experiment in fish of T_2 and T_1 compared with control ($p < 0.05$). The plasma levels of lysozyme and total immunoglobulin significantly elevated in *A. niger* supplemented groups compared with control ($p < 0.05$). The RBC (red blood cell) counts, Hb (haemoglobin) concentrations, MCH (mean corpuscular haemoglobin) and MCV (mean corpuscular volume) values significantly increased in *A. niger* supplemented fish compared with control ($p < 0.05$). The WBC (white blood cell) and Hct (haematocrit) value were higher in fish of T_2 compared with control ($p < 0.05$). The number of neutrophils significantly increased in the treatment, T_2 compared with control ($p < 0.05$). Furthermore, the lymphocyte counts significantly increased in *A. niger* supplemented fish compared with control ($p < 0.05$). The body composition of fish showed increases in the fish dry matter and protein content and decreases in lipid content of T_1 and T_2 groups compared with control ($p < 0.05$). The digestive

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compared with control ($p < 0.05$). The supplementation of fish with *A. niger* also prompted the load of the fungi in intestine ($p < 0.05$). The results of the present study confirmed the probiotic role of *A. niger* in common carp, since it improved growth, immunity, digestion and the fish haematology.

CONFLICTS OF INTEREST

There is no conflict of interest to declare.

Open Research ^

DATA AVAILABILITY STATEMENT

The datasets generated during and/or analysed during the current study are available from the corresponding author on reasonable request.

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