

Abstract

Flavonoids in lemon peel have a wide range of biological activities, including antibacterial, antifungal, anti-diabetic, anti-cancer and antiviral activities. Probiotics are also viable microorganisms that, if administered in sufficient quantities, can increase fish health. The aim of this study was to investigate the effect of diets containing lemon peel and probiotic *Bacillus licheniformis* on the growth performance, nonspecific immunity, and activity of antioxidant enzymes in common carp (*Cyprinus carpio*). Common Carp fish with mean weight (45.67 ± 3.32 g) for 56 days, were randomly divided into four groups including T₀(control) with basic food (0 % lemon peel and 0 CFU/g *B. licheniformis*), T₁ (10⁸ CFU/g *B. licheniformis*), T₂ (1.5 % lemon peel and 10⁸ CFU/g *B. licheniformis*), T₃ (3 % lemon peel and 10⁸ CFU/g *B. licheniformis*). (three replicates per group) At the end of the experiment, growth, blood, nonspecific immunity and antioxidant enzymes (superoxide dismutase, glutathione peroxidase, catalase and malondialdehyde) were measured. Based on the results, fish fed the lemon peel and *Bacillus licheniformis* (T₂, T₃) had significantly higher final body weight, weight gain, specific growth rate and lowest feed conversion ratio (P <0.05). The activity of nonspecific immune factors including lysozyme and immunoglobulin was significantly different in all groups compared to the control group. Also, the highest activity of CAT, SOD and GPX enzymes was observed in the group fed 1.5% lemon peel and *Bacillus licheniformis* which had a significant difference with the control. On the other hand, the level of MDA in all groups was lower than control (P <0.05). In terms of blood factors, these dietary supplements increased the immune response in common carp by increasing the number of white and red blood cells. The results showed that lemon peel and probiotic *Bacillus licheniformis* can be used as additives to improve growth performance, immune responses and oxidative status of common carp.

Key words: Lemon peel, Probiotic *Bacillus licheniformis*, Specific Growth Rate, Oxidative status, *Cyprinus carpio*



University of Zabol
Graduate school
Faculty of Natural Resources
Department of Fisheries

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Bacillus licheniformis on the growth parameters, non-
Specific immune and antioxidant enzyme activity in
Common carp (*Cyprinus carpio*).**

Supervisor:
Dr. Ehsan Ahmadi Far

Advisor:
Dr. Mohsen Shriary Moghadam
Dr. Maryam Ghyasi

By:
Faezeh Sadeghi

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