



## Beneficial alterations in growth performance, blood biochemicals, immune responses, and antioxidant capacity of common carp (*Cyprinus carpio*) fed a blend of *Thymus vulgaris*, *Origanum majorana*, and *Satureja hortensis* extracts

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### ABSTRACT

A blend of medicinal herbs extracts (BHE) obtained from *Thymus vulgaris*, *Origanum majorana*, and *Satureja hortensis* fed to common carp (20.57 ± 0.66 g; mean ± S.D.) at five incremental levels of 0 (control), 0.5%, 1%, 2%, and 3% of diet for 60 days. At the end of the study, final body weight, body weight increment, specific growth rate, survival rate, and feed conversion ratio were significantly better in the groups fed 1 and 2% BHE relative to the control ( $P \leq 0.05$ ), and the best values were recorded for fish fed the diet containing 1% BHE. According to the results, serum total protein and albumin values showed significant enhancements by 1–3% BHE compared with the control ( $P \leq 0.05$ ). However, globulin concentrations were not affected by BHE inclusion ( $P \geq 0.05$ ). Interestingly, all experimental groups fed with BHE-supplemented diets presented profound declines in terms of serum cortisol, glucose, triglycerides, cholesterol, aspartate aminotransferase, and alkaline phosphatase concentrations as compared to the control ( $P \leq 0.05$ ). Further, incorporating BHE at levels higher than 1% reduced alanine aminotransferase activity ( $P \leq 0.05$ ). The superoxide dismutase, catalase, and glutathione peroxidase activities were significantly intensified in serum by diets supplemented with 1–3% BHE than the control ( $P \leq 0.05$ ). In comparison, malondialdehyde contents were dose-dependently diminished upon BHE additive ( $P \leq 0.05$ ). Significantly higher levels of serum lysozyme (LYZ) activity and mucosal total immunoglobulins (Ig) were found in the 2% BHE group relative to the control, 0.5, or 3% BHE treatments ( $P \leq 0.05$ ). The highest levels of serum total Ig and alternative complement activity (ACH<sub>50</sub>) activity as well as skin mucus LYZ activity were observed in 1% BHE treatment. However, no remarkable differences were detected among treatments for mucus ACH<sub>50</sub> activity ( $P \geq 0.05$ ). Alkaline phosphatase (ALP) activity showed significant improvements in BHE-supplemented groups as compared to the control ( $P \leq 0.05$ ), with the 2% BHE had notably higher ALP activity than 3% BHE ( $P \leq 0.05$ ). Meanwhile, 1 and 2% BHE resulted in significantly enhanced skin mucus protease activities than the control and 0.5% BHE ( $P \leq 0.05$ ). In conclusion, 1% BHE supplementation was the most optimum dosage favorably improved feed efficiency, growth performance, immunological responses, and antioxidant status of common carp.

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