Immunostimulatory Effects of Black Soldier Fly Meal on Phagocytic Activity of Peripheral Leukocytes and Gene Expression Profiling in Ornamental Koi Carp (Cyprinus carpio)

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Résumé

Insect meal, particularly from black soldier fly (*Hermetia illucens* : BSF) larvae, has emerged as a promising substitute for fishmeal. In northeastern Japan, BSF larvae can be reared using local food waste, such as sake lees, rice bran, and okara. Notably, insect-derived polysaccharides have been shown to boost immune responses in fish, further highlighting the functional potential of insect meal, although its practical application remains limited. This study evaluated the effects of BSF meal on koi carp immunity by analyzing leukocyte phagocytic activity and conducting RNA sequencing. Microscopic analysis of head kidney leukocytes showed that koi fed a diet with 50% BSF exhibited a significant increase in leukocytes phagocytosing of zymosan particles, in terms of frequency and number of particles ingested per cell. Importantly, this increase in immune function was observed without any impact on survival, growth, or skin color when compared to fishmeal-fed controls. Additionally, a rapid, non-lethal method using peripheral blood leukocytes and flow cytometry was developed, producing results comparable to those obtained through microscopic analysis. This alternative method may offer a more efficient approach to evaluating immune responses in aquaculture settings. RNA sequencing analysis further revealed alterations in the expression of genes associated with immune responses in the 50% BSF-fed group. These findings suggest that BSF meal not only enhances immune function in koi carp but also has the potential to modulate gene expression, which may contribute to improved overall health and resilience in aquaculture species in koi carp.

Mots-Clés: Sustainable fish feed, Insect meal, Flow cytometry, Phagocytosis, Leukocytes

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