Effects of dietary gallnut tannic acid supplementation on intestinal enzyme activity, morphology， microbial composition of common carp (*Cyprinus carpio*)

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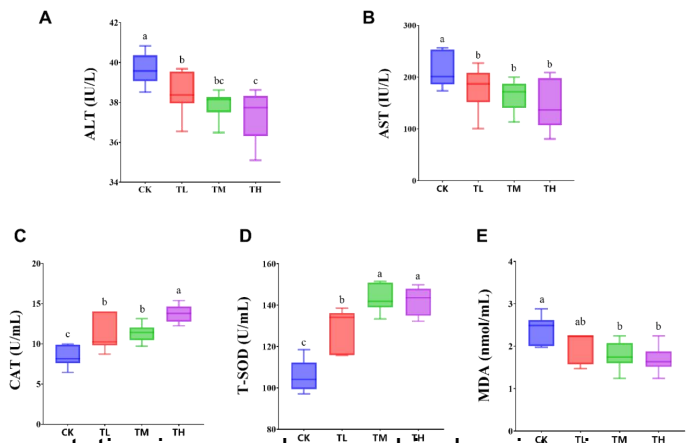
Introduction

- Antibiotics are often prioritized to address fish diseases associated with intensive aquaculture and to enhance growth performance and appetite in the short term. However, the prolonged use of antibiotics can lead to the development of resistance in fish, adversely affecting the sustainable development of aquaculture ecosystems.
- Current studies suggest that gallic acid benefits aquatic health. Yet, its effects on common carp remain underexplored. Our research explores this by adding varying levels of gallic acid to carp feed over six weeks, examining growth, digestive enzymes, body shape, and gut microbes.

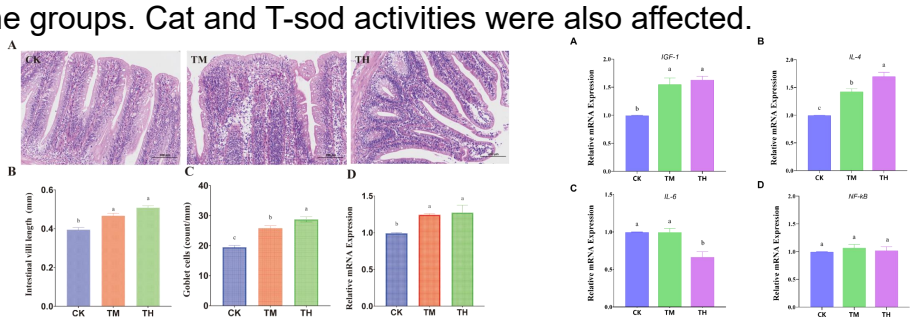
Methods

- In this study, we investigated the effects of gallic tannic acid (GTA) supplementation on the intestinal digestive enzymes, morphology and microbial composition of common carp (*Cyprinus carpio*).
- Fish experiments;
- Digestive enzyme activity analyses;
- Serum immune parameter analyses;
- Analysis of gut histology;
- Gene expression analysis;
- Analysis of the intestinal microbiota;

Results



- TA supplementation improved serum biochemistry in common carp. The Alt and Ast in the TL, TM, and TH groups were notably lower compared to controls ($p < 0.05$), with no marked differences among the groups. Cat and T-sod activities were also affected.



- The structure of each layer of intestinal tissue in each treatment group was clear, the morphology and struct-ure of epithelial cells were normal, and no obvious inflammatory reaction was observed.
- In the TH group, there was a significant increase in intestinal villus length and goblet cell count compared to the control group. Furthermore, *occludin* gene expression in the intestine was substantially upregulated in the TH group.
- Relative to the CK, *NF-κB* expression was significantly higher in the TL group. Growth factor *IGF-1* levels were notably upregulated in both TM and TH groups, without significant variance between them. Expression of the anti-inflammatory cytokine *IL-4* surged in these groups, and the TH group showed a substantial decrease in the pro-inflammatory cytokine *IL-6*. Given these findings, we suggest 10 g/kg TA as the optimal dietary supplementation for the best outcomes.

- The TM group showed a significant rise in *Proteobacteria* and *Actinobacteriota populations* ($p < 0.05$). Notably, the TM group had higher levels of *Gemmobacter*, *Shinella*, and *unclassified Actinobacteriota* ($p < 0.05$). These results indicate that GTA significantly modifies the metabolic pathways in the intestinal microbiota of common carp.

References

[1]Bao L, Chen Y, Li H, et al. Dietary Ginkgo biloba leaf extract alters immune-related gene expression and disease resistance to Aeromonas hydrophila in common carp, Cyprinus carpio [J]. Fish shellfish immunology, 2019, 94: 810-818.