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PRELIMINARY INSIGHT INTO THE INCORPORATION OF COMMON HOP *Humulus lupulus* L. INTO THE FISH FEED: EFFECT ON GROWTH PERFORMANCE, BLOOD BIOCHEMICAL AND ANTIOXDANT PROPERTIES OF CARP *Cyprinus carpio* L.

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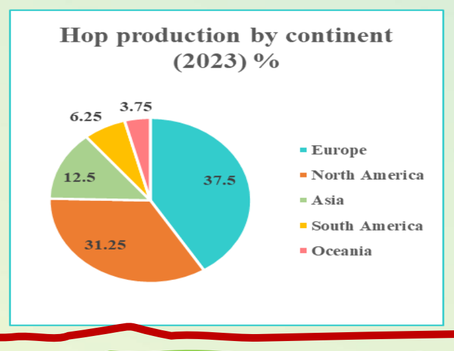
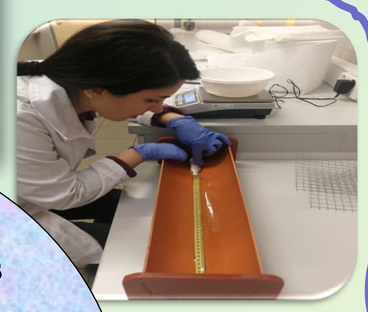
Introduction

Plant supplements have gained interest as an eco-friendly and beneficial alternative for chemotherapeutic agents in aquaculture to enhance growth performance, nutritional factors, and the health status of fish (Zhou et al., 2018). Common hop (*Humulus lupulus* L.) has significant health-promoting properties due to phenolic compounds (flavonoids and tannins), bitter acids, and essential oils (Blanco et al., 2018).

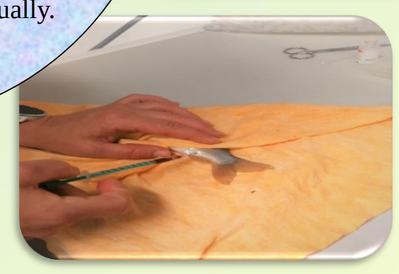
The common carp (*Cyprinus carpio* L.) is a critical aquaculture species, contributing over 4.1 million tonnes annually (FAO, 2020), and is susceptible to stressors in intensive facilities (Adineh et al., 2022). Therefore, due to its prominence in aquaculture, the aim of the study is to investigate how hop extract affects growth, nutritional factors, plasma biochemical and anti-oxidant factors.





Materials and Methods

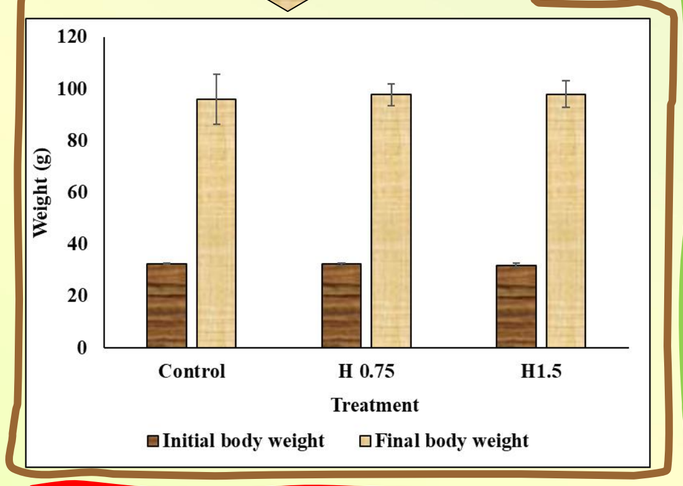
Common carp juveniles were fed with experimental feeds, including basal diet as a control (Control) without supplements, and with feeds containing hop extract at 0.75 g/kg ($H_{0.75}$) and 1.5 g/kg ($H_{1.5}$), for eight weeks twice a day manually.



Results

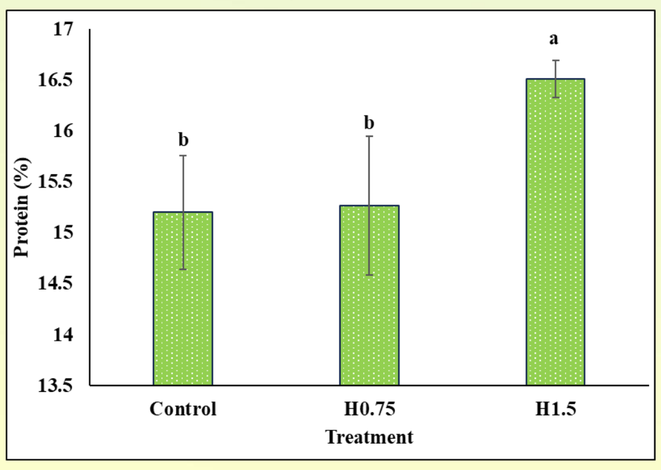
Growth performance

No significant differences in growth performance were observed among groups ($p>0.05$).



whole-body proximate composition

No significant changes in lipid, moisture, and ash contents in the whole-body proximate composition among all groups were found, but the $H_{1.5}$ group showed higher crude protein content compared to the control group ($p<0.05$).



Fillet fatty acid

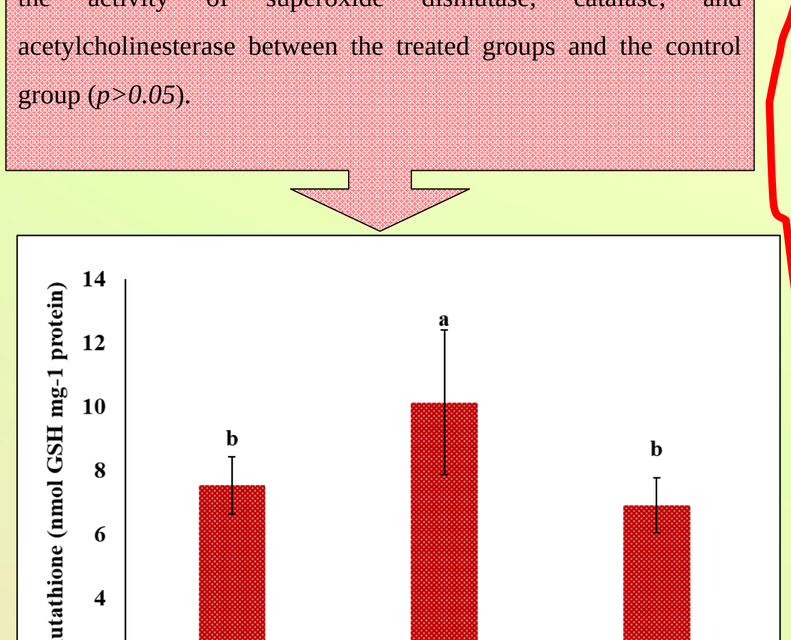
$H_{0.75}$ significantly increased the proportion of heptadecenoic acid (C17:1), α-linolenic acid (C18:3 n-3), heneicosanoic acid (C21:0), docosapentaenoic acid (DPA, C22:5 n-6), and docosahexaenoic acid (DHA, C22:6 n-3) compared with the control treatment ($p<0.05$), however, the mentioned fatty acids did not change significantly by $H_{1.5}$ ($p>0.05$). In addition, both $H_{0.75}$ and $H_{1.5}$ raised considerably the value of oleic acid (C18:1 n-9) and eicosatrienoic acid (C20:3 n-3) ($p<0.05$); in contrast, octadecenoic acid (C18:1 n-7) and eicosapentaenoic acid (EPA, C20:5 n-3) were changed significantly by $H_{1.5}$ compared to the control ($p<0.05$). At the same time, no notable difference was observed between treatments $H_{0.75}$ and the control ($p>0.05$).

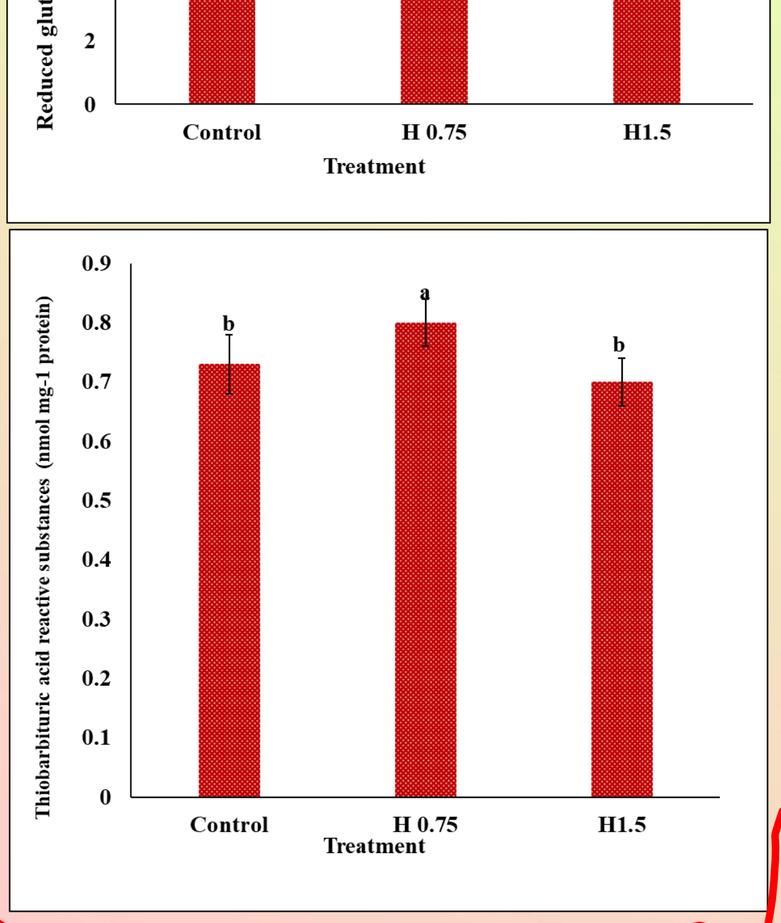
Fatty acid	Control	$H_{0.75}$	$H_{1.5}$
C17:1	0.21 ± 0.03^{b}	0.26 ± 0.03^{a}	0.23 ± 0.02^{b}
C18:1 n-9	28.77 ± 0.34^{b}	30.26 ± 0.91^{a}	30.83 ± 1.09^{a}
C18:1 n-7	3.09 ± 0.04^{b}	3.10 ± 0.07^{b}	3.18 ± 0.04^{a}
C18:3 n-3	2.34 ± 0.09^{b}	2.54 ± 0.06^{a}	2.34 ± 0.19^{b}
C21:0	0.44 ± 0.01^{b}	0.48 ± 0.02^{a}	0.44 ± 0.04^{b}
C20:3 n-3	0.17 ± 0.01^{b}	0.19 ± 0.01^{a}	0.19 ± 0.013^{a}
C20:5 n-3	2.75 ± 0.12^{a}	2.79 ± 0.08^{a}	2.49 ± 0.22^{b}
C22:5 n-6	0.85 ± 0.03^{b}	0.92 ± 0.05^{a}	0.81 ± 0.08^{b}
C22:6 n-3	7.06 ± 0.55^{b}	8.30 ± 0.73^{a}	6.64 ± 0.26^{b}

MUFA: C17:1, C18:1 n-9, C18:1 n-7
PUFA: ALA: C18:3 n-3
SFA: C21:0
PUFA: EPA: C20:5 n-3
PUFA: DPA: C22:5 n-6
PUFA: DHA: C22:6 n-3

Plasma antioxidant response

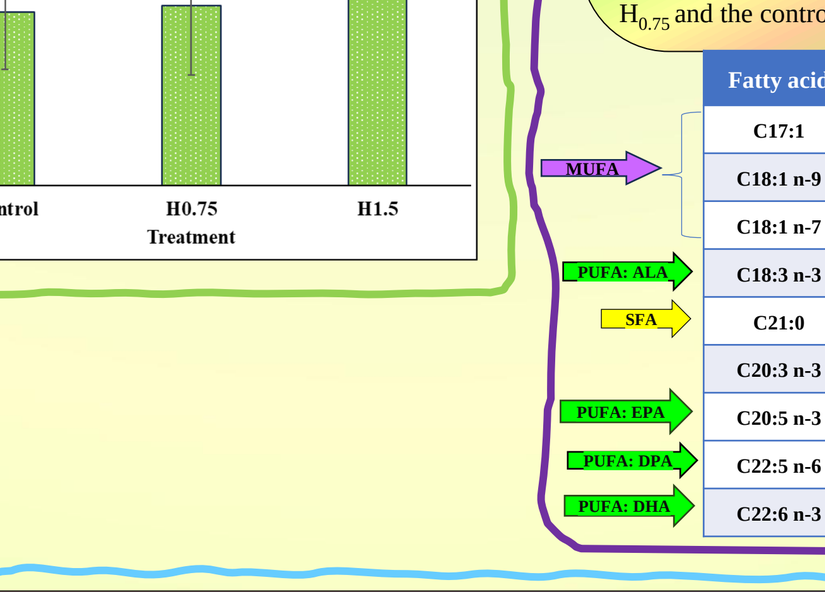
Reduced glutathione and thiobarbituric acid reactive substances were significantly higher in $H_{0.75}$ compared with the $H_{1.5}$ and control groups ($p<0.05$). No significant change was observed in the activity of superoxide dismutase, catalase, and acetylcholinesterase between the treated groups and the control group ($p>0.05$).

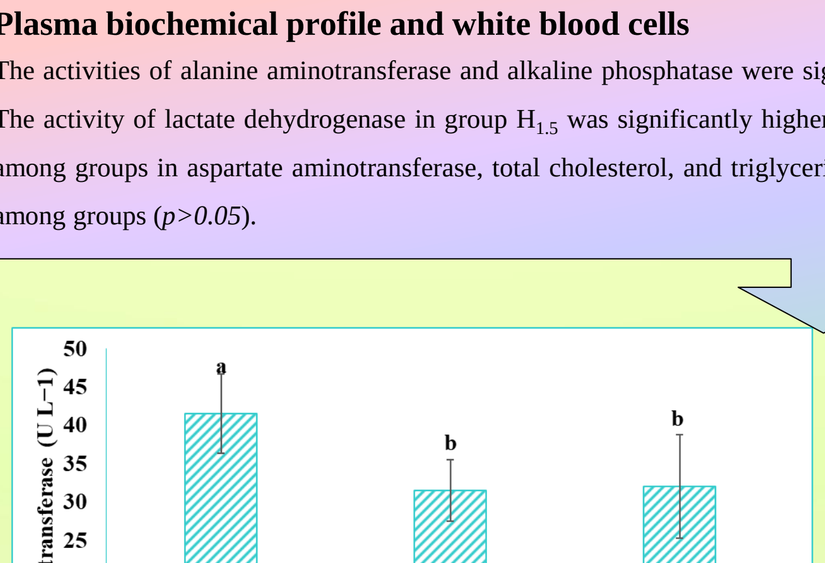


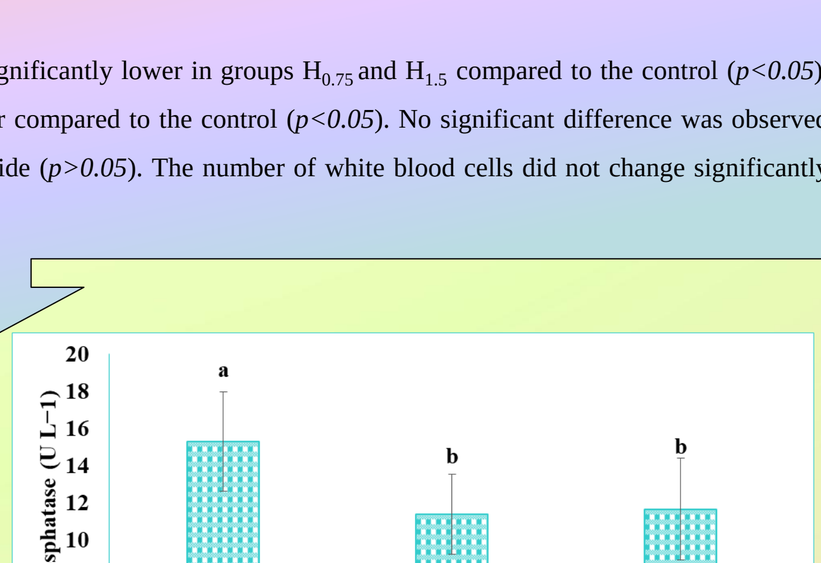


Plasma biochemical profile and white blood cells

The activities of alanine aminotransferase and alkaline phosphatase were significantly lower in groups $H_{0.75}$ and $H_{1.5}$ compared to the control ($p<0.05$). The activity of lactate dehydrogenase in group $H_{1.5}$ was significantly higher compared to the control ($p<0.05$). No significant difference was observed among groups in aspartate aminotransferase, total cholesterol, and triglyceride ($p>0.05$). The number of white blood cells did not change significantly among groups ($p>0.05$).







Acknowledgments

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