INVESTIGATION OF THE EFFECTS OF *Dictyota ciliolata* EXTRACT ON GROWTH PERFORMANCE, FEED UTILISATION, HAEMATO-BIOCHEMICAL INDICES, HEPATIC ANTIOXIDANT ACTIVITIES AND IMMUNE RESPONSES OF AFRICAN CATFISH *Clarias gariepinus*

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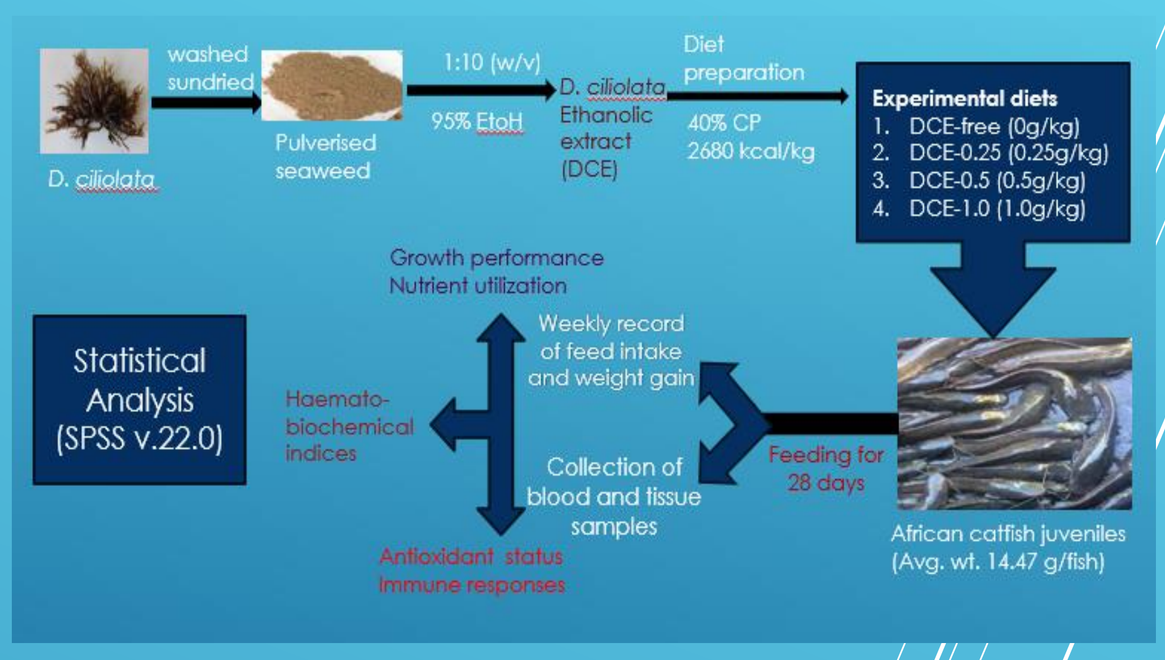
THE BACKGROUND TO THE STUDY

The increasing evidence suggesting the deleterious accumulation of antibiotic residues in the environment and fish muscle has propelled the urgent need for alternative disease control measures that are safe, efficient and biodegradable.

THE AIM

This study evaluated the dietary effects of *D. ciliolata* extract on the growth performance and health status of *C. gariepinus*

THE METHODOLOGY



RESULTS

At the end of the feeding trial, significantly reduced feed conversion ratio and increased protein efficiency ratio were recorded in fish fed DCE-based diets when compared to the control ($p < 0.05$). Erythrocytes and leukocytes counts were significantly higher ($p < 0.05$) in *C. gariepinus* fed DCE-0.25 and DCE-0.5 diets compared to the control. The liver function enzyme, alkaline phosphatase (ALP), was significantly higher ($p < 0.05$) in fish fed DCE-0.5 and DCE-1.0 diets than fish fed control diet. Dietary DCE improved enzymatic and non-enzymatic antioxidant activities and decreased malondialdehyde (MDA) levels in *C. gariepinus*. Cytokines such as Tumour Necrosis Factor – alpha (TNF-a), Interleukin-1 Beta (IL-1β), and Interleukin-6 (IL-6) were elevated in fish fed DCE-based diets when compared to the control.

Table 1: Growth performance and feed utilisation of *C. gariepinus* fed with *D. ciliolata* extract at various inclusion levels

Parameters	Control	DCE-0.25	DCE-0.5	DCE-1.0
IBW (g/fish)	14.47 ± 0.06^{a}	14.43 ± 0.06^{a}	14.47 ± 0.05^{a}	14.47 ± 0.03^{a}
FBW (g/fish)	44.10 ± 0.64^{a}	41.52 ± 6.03^{a}	42.19 ± 2.25^{a}	41.01 ± 3.61^{a}
MWG (g/fish)	29.67 ± 0.58^{a}	27.05 ± 5.94^{a}	27.73 ± 2.32^{a}	26.57 ± 3.62^{a}
RWG (g/day)	0.85 ± 0.02^{a}	0.77 ± 0.17^{a}	0.79 ± 0.07^{a}	0.76 ± 0.11^{a}
FCR	1.36 ± 0.01^{b}	1.16 ± 0.06^{a}	1.26 ± 0.08^{ab}	1.26 ± 0.15^{ab}
PER	1.84 ± 0.01^{a}	2.13 ± 0.35^{b}	1.99 ± 0.12^{ab}	1.96 ± 0.04^{a}
Feed Intake (g)	40.79 ± 1.16^{a}	31.82 ± 6.61^{a}	34.87 ± 1.75^{a}	33.86 ± 4.55^{a}
Protein Intake (g)	16.31 ± 0.47^{b}	12.73 ± 2.64^{a}	13.95 ± 0.70^{ab}	13.54 ± 1.82^{ab}

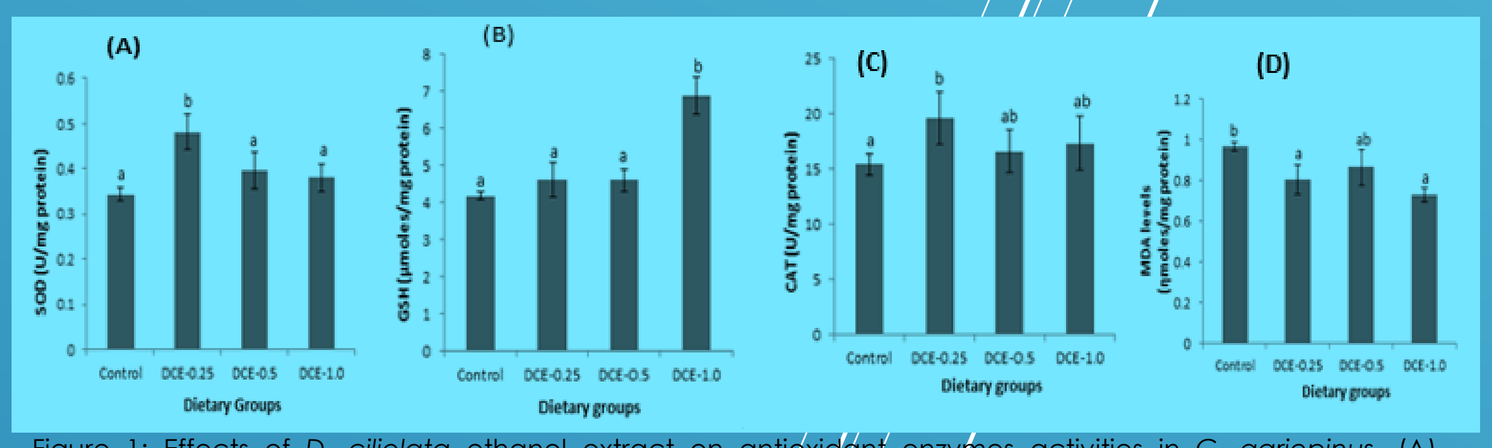


Figure 1: Effects of *D. ciliolata* ethanol extract on antioxidant enzymes activities in *C. gariepinus*. (A) superoxide dismutase (SOD); (B) Reduced glutathione (GSH); (C) Catalase (CAT); (D) malondialdehyde (MDA) levels. Data are presented as mean ± S.D (n=3) and different superscript on top bars indicate the significant differences between experimental groups ($p < 0.05$).

Table 2: Effects of *D. ciliolata* extracts on haemato-biochemical indices of *C. gariepinus*

Parameters	Control	DCE-0.25	DCE-0.5	DCE-1.0
WBC (10^3/ µl)	137.07 ± 15.96^{a}	164.53 ± 12.27^{b}	145.27 ± 4.37^{ab}	142.63 ± 12.69^{a}
RBC (10^6/µl)	2.53 ± 0.25^{a}	3.23 ± 0.21^{b}	2.90 ± 0.1^{ab}	2.60 ± 0.30^{a}
Protein (g/l)	41.43 ± 3.01^{a}	43.27 ± 5.32^{a}	37.77 ± 1.10^{a}	41.03 ± 4.12^{a}
LDL-C (mmol/l)	0.37 ± 0.12^{a}	0.23 ± 0.06^{a}	0.33 ± 0.06^{a}	0.40 ± 0.10^{a}
HDL-C (mmol/l)	1.63 ± 0.12^{a}	1.80 ± 0.30^{a}	1.60 ± 0.20^{a}	1.57 ± 0.31^{a}
ALP (U/l)	16.30 ± 1.61^{a}	17.67 ± 1.20^{a}	26.03 ± 1.68^{b}	26.43 ± 3.04^{b}
ALT (U/l)	38.90 ± 7.30^{a}	43.00 ± 11.96^{a}	41.33 ± 4.71^{a}	38.30 ± 0.95^{a}

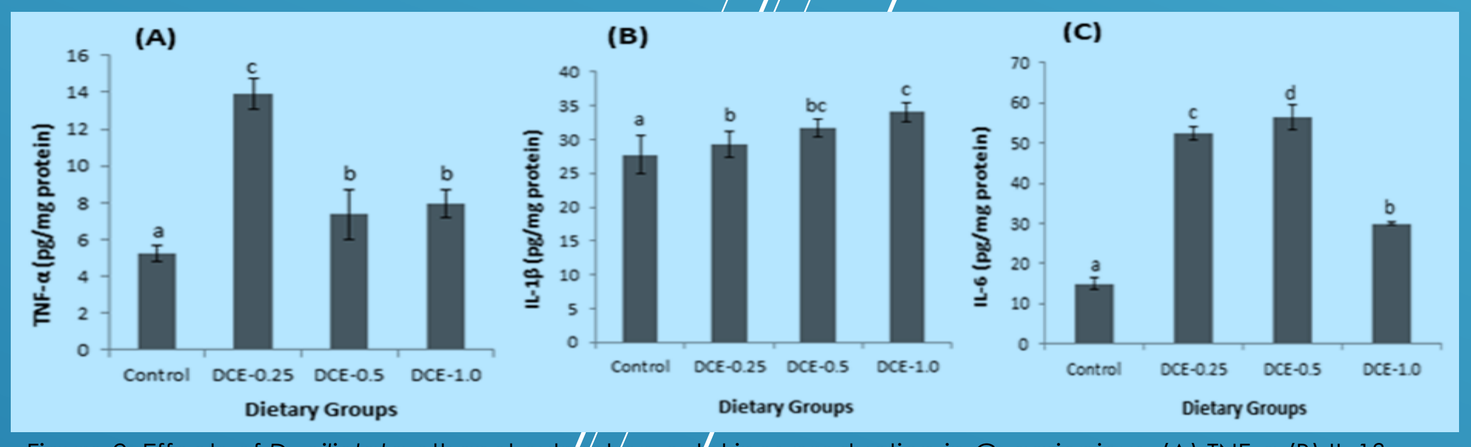


Figure 2: Effects of *D. ciliolata* ethanol extract on cytokines production in *C. gariepinus*. (A) TNF-α (B) IL-1β (C) IL-6. Data are presented as mean ± S.D of three replicates; different superscripts on top bars indicate the significant differences between experimental groups ($p < 0.05$).

DISCUSSION

- The inclusion of DCE in *C. gariepinus* diet decreased the quantity of feed needed for synthesizing body protein. This might be due to the presence of saponins in DCE, since saponins have been found to promote digestive enzymes activities (Francis et al. 2005).
- The improved antioxidant activities in *C. gariepinus* fed DCE might be due to the presence of phenolic compounds such as tannin. The brown seaweeds are found to be rich in phlorotannins, a unique type of tannin, which could act as electrons donor (O'sullivan et al. 2011; Abdelhamid et al. 2018).
- The ability of DCE to stimulate immune responses may be due to the presence of alkaloids and glycosides, which have been reported as the main active metabolites responsible for the immunostimulatory properties of plant extracts (Galina et al. 2009).

CONCLUSION

These findings indicated that the inclusion of ethanol extract of the brown seaweed *D. ciliolata* improved nutrient utilisation, antioxidants activities and impeded oxidative stress in *C. gariepinus*. Furthermore, DCE enhanced the immunity of *C. gariepinus* by inducing the production of immunoregulatory cytokines.

REFERENCES

- Abdelhamid A, Jouini M, Bel Haj Amor H, Mzoughi Z, Dridi M, Ben Said R, Bouraoui A (2018). Phytochemical analysis and evaluation of the antioxidant, anti-inflammatory, and antinociceptive potential of phlorotannin-rich fractions from three Mediterranean brown seaweeds. Marine biotech 20:60-74.
- Francis G, Makkar HP, Becker K (2005). Quillaja saponins — a natural growth promoter for fish. Anim Feed Sci Tech 121(1-2):147-57.
- Galina J, Yin G, Ardo L, Jeney Z (2009). The use of immunostimulating herbs in fish. An overview of research. Fish Physiol Biochem 35:669-76.
- O'sullivan AM, O'callaghan YC, O'grady MN, Queguineur B, Hanniffy D, Troy DJ, Kerry JP, O'brien NM (2011) In vitro and cellular antioxidant activities of seaweed extracts prepared from five brown seaweeds harvested in spring from the west coast of Ireland. Food Chem 126(3):1064-70.