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Phytochemical profiles of garlic, ginger and black cumin as phyto – additives in catfish feed

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ABSTRACT

The phytochemical profiles of garlic, ginger, and black cumin as phyto – additives in catfish feed were evaluated. One hundred grams (100g) each of garlic bulbs, ginger rhizomes, and lack cumin seeds were screened in the laboratory for alkaloids, flavonoids, glycosides, oxalates, phenolics, phytates, saponins, and tannins using ethanol and water. Data collected from the quantitative analysis were subjected to one- way analysis of variance (ANOVA) at a 95% probability level, and where significant differences were detected, mean values were separated using least significant difference (LSD). Higher phytochemicals were obtained qualitatively using ethanol than water. Quantitative phytochemical analysis shows that alkaloid values ranged from 0.08 – 9.00, flavonoids 0.16 – 3.30, glycosides 0.04 – 1.24, oxalates 0.13 – 1.65, phenolics 0.25 – 2.06, phytates 0.04 – 0.95, saponins 0.29–4.23, and tannins 0.19 – 1.47. There was a significant ($p<0.05$) difference in the values of quantitative phytochemical analysis of the garlic bulbs, ginger rhizomes and black cumin seeds using both ethanol and water. The garlic bulbs, ginger rhizomes, and lack cumin seeds are rich in some active bioactive compounds which can serve as both immunenonutrients and immunostimulants in catfish feed.

Key words: *Allium sativum*, *Nigelia sativum*, *Zingiber officinale,* Oxalates, Tannins.

INTRODUCTION

The advancement in fish farming is always accompanied by the high cost of feed, which accounts for approximately 70 to 80% of the total costs of production, thereby causing a decline in profits (Ishaku *et al.,* 2023). An attempt to increase the economic benefits is to reduce the feed cost as much as possible; one way to do this is to explore the use of phyto additives (Sogbesan *et al.,* 2017). Phyto additives are plant substances that are added in trace amounts to diets or feed ingredients to preserve their nutritional characteristics prior to feeding, facilitate ingredient dispersion or feed pelleting, facilitate feed ingestion and consumer acceptability of the product, or supply essential nutrients in purified form (Ali *et al.,* 2024). There are many available feed additives that can be included in fish diets to improve fish performance, such as growth, survival, digestibility, and other important parameters (Ali, 2022). Many of these additives that are used in the formulation of feeds are synthetic products such as antibiotics and hormones, which are not successful or sustainable due to unfavorable side effects (Ali *et al.,* 2024).

Attention has now shifted away from the use of synthetic feed additives; the use of phyto additives such as garlic(*Allium sativum*) bulbs, ginger(*Zingiber officinale*) rhizomes, and black cumin (*Nigelia sativum*) seeds as an alternative to synthetic growth promoters in fish feed is becoming popular (Sogbesan *et al.,* 2019). These phyto additives comprises of various classes of bioactive compounds, including alkaloids, flavonoids, glycosides, oxalates, phenolics, phytates, saponins, and tannins. This study evaluates the

phytochemical profiles of garlic, ginger and black cumin as phyto – additives in catfish feed.

MATERIALS AND METHODS

Collection and Processing of Garlic, Ginger and Black Cumin

One hundred grams (100g) each of garlic (*A. sativum*) bulbs, ginger (*Z. officinale*) rhizomes, and black cumin (*N. sativum*) seeds were purchased from the market in Jalingo, Taraba State, and they were prepared for the experiment by rinsing in distilled water and dried to constant weight as described by Sogbesan *et al.* (2019).

The garlic bulbs were washed with distilled water and air-dried at room temperature for some hours. The dried outer covering of the bulbs was peeled off with the help of a knife, washed with distilled water, sliced, sun-dried, and ground with hammer mill into fine powder, kept in a polythene bag labelled and stored at room temperature until needed.

Ginger rhizomes were washed with distilled water, sun-dried, and cleaned of dirt through hand picking. The rhizomes were chopped into smaller sizes with a pestle and mortar, sun-dried, labelled, and kept in a polythene bag until needed.

The black cumin seeds were winnowed to remove dirt, ground with a hammer mill into powder, kept in a labelled polythene bag, and stored at room temperature until needed.

Phytochemical Profile of Active Ingredients

The garlic bulbs, ginger rhizomes and black cumin seeds were evaluated in the laboratory for alkaloids. Flavonoids, glycosides, oxalates, phenolics, phytates, saponins, and tannins were determined using ethanol and water as described by the Association of Official Analytical Chemists (AOAC, 2005).

Statistical Analysis

Data collected from the quantitative analysis were subjected to one - way analysis of variance (ANOVA) at a 95% probability level, and where significant differences were detected, mean values were separated using least significant difference (LSD).

RESULTS

The results of the qualitative phytochemical analysis of the garlic bulbs, ginger rhizomes, and black cumin seeds are shown in Table 1. Qualitative phytochemical analysis shows that alkaloids extracted using ethanol was excess in ginger, moderate using water, while it was trace using ethanol and water in both garlic and black cumin. Flavonoids extracted using ethanol was excess in ginger and moderate in black cumin, while it was moderate in ginger using water, it was trace using ethanol and water in garlic and trace in black cumin using water. Glycosides extracted were trace using ethanol and water in both garlic and black cumin, while it was rare using ethanol and water in ginger. Oxalates extracted were moderate in garlic using water, ginger using ethanol, and also in black cumin using both ethanol and water, while it was trace in garlic using ethanol and ginger using water.

Phenolics extracted were excessive in black cumin using ethanol, moderate in ginger using ethanol and black cumin using water, and trace in ginger using water and also in garlic using both ethanol and water. Phytates extracted was moderates in garlic, ginger, and black cumin seeds using ethanol, while it was trace in garlic, ginger, and black cumin using water. Saponins extracted was excess in garlic using water, moderate in garlic using ethanol and also in both ginger and black cumin using water, while it was trace in both garlic and ginger using water. Tannins extracted were trace in both garlic, ginger, and black cumin using both water and ethanol.

The results of the quantitative phytochemical analysis of the garlic bulbs, ginger rhizomes, and black cumin seeds are shown in Table 2. Alkaloids values ranged from 0.08 – 9.00, flavonoids 0.16 – 3.30, glycosides 0.04 – 1.24, oxalates 0.13 – 1.65, phenolics 0.25 – 2.06, phytates 0.04 – 0.95, saponins 0.29-4.23, and tannins 0.19 – 1.47. There was a significant ($p<0.05$) difference in the values of quantitative phytochemical analysis of the garlic bulbs, ginger rhizomes, and black cumin seeds using both ethanol and water.

Table 1: Qualitative Phytochemical Profiles of Garlic, Ginger and Black Cumin as Phyto-Additives in Catfish Feed

Phytochemical	Garlic Ethanol	Garlic Water	Ginger Ethanol	Ginger Water	Black Cumin Ethanol	Black Cumin Water
Alkaloids	+	+	+++	++	+	+
Flavonoids	+	+	+++	++	++	+
Glycosides	+	+	-	-	+	+
Oxalates	+	++	++	+	++	++
Phenolics	+	+	++	+	+++	++
Phytates	++	+	++	+	++	+
Saponins	++	+++	+	++	+	++
Tannins	+	+	+	+	+	+

Key: - Rare, + Trace, ++ Moderate, +++ Excess

Table 2: Quantitative Phytochemical Profiles of Garlic, Ginger and Black Cumin, as Phyto-Additives in Catfish Feed

Phytochemical (mg/g)	Garlic Ethanol	Garlic Water	Ginger Ethanol	Ginger Water	Black Cumin Ethanol	Black Cumin Water
Alkaloids	0.60^{a}	0.40^{a}	9.00^{c}	6.49^{b}	0.11^{a}	0.08^{a}
Flavonoids	1.71^{b}	2.00^{b}	3.30^{c}	3.00^{c}	0.44^{a}	0.16^{a}
Glycosides	0.70^{a}	1.24^{b}	0.04^{a}	0.08^{a}	0.57^{a}	0.61^{a}
Oxalates	0.13^{a}	1.65^{b}	1.23^{b}	0.08^{a}	1.23^{b}	1.56^{b}
Phenolics	0.70^{a}	0.26^{a}	1.77^{b}	0.25^{a}	2.06^{b}	0.79^{a}
Phytates	0.80^{a}	0.30^{a}	0.78^{a}	0.04^{a}	0.95^{b}	0.18^{a}
Saponins	3.26^{c}	4.23^{d}	0.54^{a}	1.10^{b}	0.29^{a}	0.47^{a}
Tannins	0.92^{a}	0.19^{a}	1.08^{b}	1.47^{b}	0.81^{a}	0.92^{a}

Mean values in each row with similar superscripts are not significantly different ($p>0.05$).

DISCUSSION

The higher qualitative phytochemical profiles observed using ethanol than water in this study corroborated the findings of Idowu (2019) and Azimat *et al.* (2026), both of whom reported similar results for some selected plants screened using ethanol, methanol, and water extracts. The higher value of quantitative phytochemicals observed in this study using ethanol than water was consistent with the findings of Sogbesan *et al.* (2019) and Azimat *et al.* (2026), both of whom reported a reported higher value of phytochemicals quantitative values for some plants screened using ethanol than quantitative values recorded for the same plants screened using water. These results of the potency of ethanol extracts indicated the efficacy of ethanol (Idowu, 2019).

Garlic bulbs, ginger rhizomes and black cumin seeds all have the attribute to enhance digestion, energy, modulate the response against oxidative stress, and boost the immune system of fish (Anene *et al.,* 2019; Sogbesan *et al.,* 2019). These identified phytochemicals in garlic bulbs, ginger rhizomes, and black cumin seeds – alkaloids, flavonoids, glycosides, oxalates, phenolics, phytates, saponins, and tannins – are known to have very important potential that can be utilized as phyto-additives in fish feed with beneficial effects (Ramudu and Dash, 2013).

CONCLUSION

The garlic bulbs, ginger rhizomes, and cumin seeds are rich in some active bioactive compounds which can serve as both immunenonutrients and immunostimulants in catfish feed.

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