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Impact of *Chromolaena odorata* Leaf on Growth and Reproductive Performance of *Clarias gariepinus* Broodstock

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Abstract

This study was conducted to assess the effects of *Chromolaena odorata* leaf (COL) on the growth and reproductive performance of *Clarias gariepinus* broodstock. The feeding trial was carried out in an earthen pond unit with 24 net-hapas (0.6 m x 1.1 m x 1.2 m (LBH) suspended within the pond. Forty-eight table-sized *Clarias gariepinus* (Age = 7 months; Sex = 24 males, 24 females) were randomly stocked and allotted to four dietary treatments [0%-Control 1, 0.5%-COL 2, 1%-COL 3, and 1.5%- COL 4], at two fish (both sexes) per net-hapa in six replicates. *Chromolaena odorata* leaf paste was prepared using standard procedures, mixed into each diet, and pelletized to 6 mm. The feeding trial lasted 16 weeks. The growth performance and reproductive parameters (relative fecundity-RF, gonadosomatic indices-GSI, hepatosomatic index of liver-HSI) of the fish and hatchability of eggs were evaluated. The results showed that broodstock fish fed diets containing *Chromolaena odorata* leaf had better growth compared to those fed the control diet. Weight gain, relative fecundity, and weight of the ovaries and testes of the fish increased as the inclusion levels of *Chromolaena odorata* leaf in the diets increased. Broodstock fish fed diets containing *Chromolaena odorata* leaf had a higher gonadosomatic index than those on the control diet. Inclusion of *Chromolaena odorata* leaf up to 1.5% in diets reduced the fish gonadosomatic and hepatosomatic index. Hatchability rate was highest (49.66%) in fish fed diets containing *Chromolaena odorata* leaf. In conclusion, inclusion of *Chromolaena odorata* leaf in the fish diet improved the growth and reproductive performance of *Clarias gariepinus* broodstock.

Introduction

Aquaculture is one of the fastest-growing food production sectors globally and plays a crucial role in food security, nutrition, and livelihood development, particularly in sub-Saharan Africa. According to FAO (2022), aquaculture supplies more than half of the fish consumed worldwide, highlighting its strategic importance in meeting the high demand for animal protein. In Nigeria, aquaculture production is largely owing to its rapid growth rate, high feed conversion efficiency, tolerance to poor water quality, disease resistance, and strong consumer acceptance. However, the sustainable production of this species depends significantly on the availability of high-quality broodstock capable of optimal growth and reproductive performance.

Conventional broodstock feeds often depend on expensive protein sources and synthetic additives, which increase the production costs and may raise environmental concerns. Consequently, attention has

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shifted towards the use of natural plant-based additives (phytobiotics) as sustainable alternatives in aquaculture nutrition (Reverter *et al*., 2014). Dada and Sonibare (2015) reported that one of the best methods to reduce feed cost and improve the growth of fish is through the use of plant-based additives or phytobiotics. This enhances the performance of fish through improvement of health, weight gain, reproduction, and feed efficiency. It is noteworthy that high feed costs have forced fish farmers to seek alternative ways of reducing production costs. One of the ways to reduce production costs is the use of dietary supplements that include plant-based additives (Dada, 2017). Phytobiotics, when included in animal diets, significantly improved the growth, health, and well-being of animals (Adegbesan and Yusuf, 2024).

Chromolaena odorata (L), with a common name, Siam weed, is an invasive, exotic plant whose parts have been used for various purposes in medicine as an antimicrobial and anti-septic, and in animal nutrition as growth promoters and egg improvers in laying hens and broilers (Nurul Huda *et al*., 2004; Ekenyem *et al*., 2010; Dada, 2017). *Chromolaena odorata* (Siam weed) is a perennial shrub widely distributed across tropical Africa and recognised for its rich phytochemical composition. The leaves contain bioactive compounds such as flavonoids, tannins, saponins, alkaloids, and phenolic compounds, which exhibit antimicrobial, antioxidant, and anti-inflammatory properties (Akinmoladun *et al*., 2007). Antioxidants are important in broodstock management because oxidative stress can negatively affect oocyte maturation, sperm quality, and embryonic development. The antioxidant potential of *C. odorata* suggests that its inclusion in broodstock diets may enhance reproductive performance by protecting gametes from oxidative damage.

Broodstock nutrition is one of the most important research areas in aquaculture (Varghese *et al*., 2009). Broodstock diet has a considerable influence on the success of hatchery operations directly as it affects fecundity, fertilisation rate, egg quality, embryo development, and larval quality (Bromage, 1998; Furuita, 2000; Izquierdo *et al*., 2001). The production of catfish seeds is not left out, as it represents a valuable fish species, most especially in Africa. This fish exhibits a seasonal gonadal maturation, which is frequently triggered by the rainy season. Given the nutritional responsiveness of *C. gariepinus* to dietary manipulation, exploring the potential of *C. odorata* leaf in fish diets could promote the growth and reproductive performance of broodstock fish. Hence, this study aims to determine the effects of dietary inclusion of *Chromolaena odorata* on the growth and reproductive performance of *Clarias gairiepinus* raised to broodstock.

Materials and Methods

Experimental site and systems

The experiment was conducted in the earthen pond unit (30 m x 5 m x 1.2 m) of the Teaching and Research Farm of the College. African mud catfish (*Clarias gariepinus*) broodstock and fingerlings were used for the study. A total of sixty (60) adult fish were purchased at a reputable private farm in South-South, Nigeria, and raised to broodstock. Twenty-four (24) net-hapa of dimensions 0.6 m x 1.1 m x 1.2 m (LBH) were suspended within the pond and supplied with fresh water. Fish were randomly stocked and allotted to four (4) dietary treatments in the net-happa at a stocking rate of two table-sized fish (one male, one female) per net-happa in six replicates. Best management practices, including water quality parameters and monitoring of fish response to feed, were adhered to.

Processing of *Chromolaena odorata* leaf and preparation of experimental diets

Fresh and young leaves of *Chromolaena odorata* were harvested in the premises of the College, and authenticated in the Department of Agricultural Technology, where a voucher specimen was maintained for the plant: *Chromolaena odorata* ID No: UAHA/08.180002. Harvesting of *Chromolaena odorata* leaf was as described by Kalu *et al*. (1986). The leaves were thoroughly rinsed with distilled water to remove dirt, weighed on an electronic scale, cut into smaller pieces using a knife, and blended with water at a ratio of 1:1 (1g of the leaves is equivalent to 1mL of water) to form a paste in a household electric blender (Century, CB-8231-M, China). The leaf paste was poured into a glass container and stored in the refrigerator for a day before it was incorporated into the basal diets as described by Adegbesan *et al*. (2018). The *Chromolaena odorata* leaf paste was added to the basal

diets at varying levels (0.5%, 1.0%, and 1.5%), thoroughly mixed using a mixer, and pelletized to a 6 mm size, using the pelletizing machine. Pelletized feed samples were dried to 10% moisture content using a dryer, allowed to cool in the open-air environment for a day before packaging. The experimental diets (Table 1) were packed and stored in an opaque nylon bag and stored until needed for the feeding trial. Four iso-nitrogenous diets were formulated at 40% crude protein, containing 0.5, 1, and 1.5% of *Chromolaena odorata* leaf paste and a control diet.

Table 1: Gross composition of the experimental diets

	Inclusion of *Chromoleana odorata* leaf (%)			
Ingredients	**Control- 1-(0%)**	**COL- 2- 0.5%**	**COL- 3- 1.0%**	**COL- 4 -1.5%**
Fishmeal	19.3	19.3	19.3	18.3
Soybean Meal	26.3	26.3	26.3	26.3
Groundnut Cake	26.3	26.3	26.3	26.3
Yellow Maize	21.0	20.5	20.0	20.5
Vitamin Premix	1.00	1.00	1.00	1.00
Lysine	0.50	0.50	0.50	0.50
Salt	0.50	0.50	0.50	0.50
Vegetable Oil	4.00	4.00	4.00	4.00
Methionine	0.50	0.50	0.50	0.50
Dicalcium phosphate	0.50	0.50	0.50	0.50
Chromolaena odorata leaf	0.00	1.00	2.00	3.00
Total	100	100	100	100

Feeding trial, assessment of growth and reproductive indicators

Fish were acclimatised for 7 days to the new environment and were fed two times daily with a commercial diet at 40% crude protein). Fish were starved for 24 hours before the feeding trial commenced. Fish were fed twice daily with the diets for 16 weeks (4 months), *ad libitum* both in the morning (08:00 - 09:00) and in the evening (17:00 – 18:00). Weekly weight of broodstock fish was determined using a sensitive electronic weighing scale (Mettler Toledo FB602).

Growth performance and nutrient utilization of fish were determined following the methods as illustrated by Agbebi *et al.,* (2012) in term of Final Individual Weight, Survival (%), Specific Growth Rate (SGR%/day). The following growth parameters were calculated at the end of the experiment:

Percentage weight gain PWG (%) =

$$\frac{\text{Final mean body weight}}{\text{Initial mean body weight}} \times 100$$

Specific growth rate, SGR =

$$\frac{L_n W_2 - L_n W_1}{\text{Time (days of experiment)}} \; x \; 100$$

Where,

W_1 = Initial weight gained

W_2 = Final weight gained

L_n = Natural logarithm

Survival rate =

$$\frac{\text{No of fish remaining at the end of the experiment}}{\text{No of fish at the beginning of the experiment}} \times 100$$

Feed Conversion Ratio (FCR), Protein Efficiency Ratio (PER) and Net Protein Utilization (NPU) responses were calculated and data were obtained from them.

Protein efficiency ratio (PER) =

$$\frac{\text{Mean weight gain}}{\text{Average crude protein fed}}$$

Where,

Mean weight gain (MWG) =

Final weight (g) of fish – Initial weight (g) of fish

Feed conversion ratio (FCR) =

$$\frac{\text{Dry Weight of feed fed (g)}}{\text{Fish Weight gained}}$$

$$\text{ANPU} = \frac{\text{Net Protein in Carcass}}{\text{Protein fed}} \text{x } 100$$

Determination of relative fecundity, gonadosomatic index, hepatosomatic index, and hatchability rate

Egg counting was done using sodium sulfite and saline solution. Female broodstocks were selected from each dietary treatment, dissected to remove the gonads (ovaries), and detached from the other viscera. Fifteen grams (15 g) of sodium sulfite was weighed and dissolved in 100 mL of distilled water, making up the concentrated stock solution that was needed. The stock solution was later diluted with 900 mL of hatchery water (Larry, 1977). A certain volume of the sodium sulfite solution was used to separate the cluster of spawned eggs. Eggs were transferred into a jar. The separated eggs were then counted by the gravimetric sub-sampling wet method described by Bagenal (1978). Eggs from each jar containing the clean eggs of an ovary were weighed after removing excess water on filter paper. A small portion of the eggs was weighed and counted. From this, the number of eggs in a whole ovary was extrapolated as described by Shinkafi and Ipinjolu (2012).

After weighing the fish, it was dissected to remove the gonads (testis and ovaries) and the liver in males and females for the determination of Gonadosomatic Index (GSI) and Hepatosomatic Index (HSI). Moisture of the gonads and liver was removed using blotting paper, and the weight of the gonads and liver was recorded in grams (Parmeswaran, 1974). Hatchability is a measure of the number of eggs hatched in relation to the total number of eggs incubated, expressed as a percentage. Total number of eggs incubated = Hatched eggs + unhatched eggs (Onada and Ogunsola, 2017). Highlighted below are the formulae for the determination of the relative fecundity, gonadosomatic index, hepatosomatic index, and hatchability.

$$Relative\ Fecundity = \frac{\text{Total number of eggs}}{\text{Body weight of fish}} \qquad (1)$$

$$\text{Gonadosomatic Index } (GSI) = \frac{\text{Weight of Gonad}}{\text{Body Weight of Fish}} \text{ x } 100 \qquad (2)$$

$$\text{Hepatosomatic Index (HSI)} = \frac{\text{Weight of Liver}}{\text{Body Weight of Fish}} \text{ x } 100 \qquad (3)$$

$$\text{Hatchability} = \frac{\text{Number of Hatched Eggs}}{\text{Total number of eggs incubated}} \text{ x } 100\% \qquad (4)$$

Statistical analysis

GraphPad Prism was used as the software for all computations. Data were subjected to Analysis of Variance (ANOVA), and Duncan Multiple Range Tests were used to establish significant differences at $p<0.05$.

Results

Growth Performance and Feed Intake

The growth performance and feed intake of *Clarias gariepinus* broodstock fed *C. odorata* leaf paste at three varying levels of dietary supplementation are shown in Table 2. There was no significant difference ($p > 0.05$) in the initial mean weight among the dietary treatments. There were significant differences ($p < 0.05$) in the final mean weights of the fish at the end of the experiment. The feed intake, final, and mean weight gain of fish increased as the inclusion levels of *C. odorata* leaf increased in the diets. The final weight (5.17 ± 0.19 kg) and mean weight gain (3.87 ± 0.18kg) were highest in fish fed 1.5% *C. odorata* and lowest in fish fed the control diet (1.27 ± 0.03). Feed conversion ratio (1.17 ± 0.01) was lowest in fish fed dietary inclusion of 1.5% *C. odorata* and highest in fish fed the control diet (1.72 ± 0.03).

Body weight and Relative Fecundity of Female *2* Broodstock

The weight of female broodstock and the relative fecundity of fish fed the varying levels of *C. odorata leaf paste* are presented in Table 3. As the weight of female broodstock increases, fecundity increases, with the relative fecundity being highest in the female broodstock fed a diet of 1.5% *C. odorata*, and the lowest in broodstock offered a diet without *C. odorata*.

Table 2: Growth performance and feed intake of *Clarias gariepinus* broodstock fed a diet containing *Chromolaena odorata* leaf (Mean ± SEM)

Percentage Inclusion of *Chromoleana odorata* leaf				
Parameters	Control- 1- 0%	C0L- 2- 0.5%	COL- 3- 1%	COL- 4 - 1.5%
IW (kg)	1.37 ± 0.05^{a}	1.30 ± 0.10^{a}	1.47 ± 0.18^{a}	1.30 ± 0.10^{a}
FW (kg)	2.63 ± 0.33^{d}	3.57 ± 0.12^{c}	4.23 ± 0.15^{b}	5.17 ± 0.19^{a}
MWG (kg)	1.27 ± 0.03^{c}	2.27 ± 0.13^{b}	2.77 ± 0.20^{b}	3.87 ± 0.18^{a}
FI (kg)	2.18 ± 0.02^{c}	3.52 ± 0.21^{b}	3.62 ± 0.22^{b}	4.52 ± 0.19^{a}
FCR	1.72 ± 0.03^{a}	1.55 ± 0.02^{b}	1.31 ± 0.02^{c}	1.17 ± 0.01^{c}
SGR	0.58 ± 0.03^{c}	0.78 ± 0.01^{b}	0.91 ± 0.06^{a}	1.01 ± 0.11^{a}
PER	1.47 ± 0.03^{b}	1.59 ± 0.02^{a}	1.88 ± 0.05^{a}	2.11 ± 0.02^{a}
ANPU (%)	45.44 ± 5.60^{c}	52.49 ± 1.83^{c}	58.03 ± 5.00^{b}	72.33 ± 3.28^{a}

$^{a,b,c\ d}$= Means along the same row with the same letter are not significantly different (p >0.05), IW = Initial Weight, FW = Final Weight, MWG = Mean Weight Gain, FI = Feed Intake, FCR = Feed Conversion Ratio, PER = Protein Efficiency Ratio, SGR = Specific Growth Rate, ANPU = Apparent Net Protein Utilization

Table 3: Body weight and relative fecundity of female *Clarias gariepinus* broodstock fed diets containing *Chromolaena odorata* leaf (Mean ± SEM)

Percentage Inclusion of *Chromoleana odorata* leaf				
Paramete	CONTROL-1 -(0%)	C0L- 2 - (0.5%)	C0L- 3 - (1%)	C0L- 4 - (1.5%)
BW (kg)	1.43 ± 0.03^{c}	1.80 ± 0.0^{a}	2.20 ± 0.16^{a}	2.70 ± 0.06^{a}
RF	17877.97 ± 464.34^{d}	20063.67 ± 337.21^{c}	20006.80 ± 247.35^{c}	21774.05 ± 441.74^{b}

^{a,b,c,d} = Means in the same row with the same letter are not significantly different (p > 0.05)
BD = Body Weight; RF = Relative Fecundity

Gonadosomatic and Hepatosomatic Indices of *C. gariepinus* Male and Female Broodstocks

The gonadosomatic and hepatosomatic indices of *C. gariepinus* male and female broodstocks fed dietary inclusions of varying levels of *C. odorata* leaf paste are presented in Table 4. Gonadosomatic index value of female broodstock was highest (8.11 ± 0.39) in fish fed a feed with a 1% *C. odorata* leaf paste. The hepatosomatic index of the female broodstock offered the control diet (0.51 ± 0.04) was higher than that of the other female broodstocks on diets with *C. odorata* leaf paste inclusion. The gonadosomatic index value tends to increase as the weight of the ovary of the female broodstock increases. Similarly, in the male broodstock, the gonadosomatic index increased as the weight of the testis increased with increasing levels of *C. odorata* leaf paste in the diets. However, the gonadosomatic index values (0.60-0.73) among the male broodstocks fed diets with *C. odorata* leaf paste inclusion were not different (p>0.05) but higher than the broodstock fed the control diet (0.28). In contrast, the hepatosomatic index among male broodstock decreased as the inclusion levels of *C. odorata* leaf paste in their diets increased. Fish fed the control diet had the highest hepatosomatic index of 0.44, while those fed the diet with a higher percentage (1.5%) inclusion of *C. odorata* leaf paste) had the lowest hepatosomatic index (0.30).

Hatchability of Eggs of *C. gariepinus* Broodstock

The hatchability of the eggs of female broodstock fed varying levels of *C. odorata* leaf paste is presented in Table 5. The eggs of fish fed *C. odorata* leaf had the highest number of eggs (14165) than the eggs of fish fed the control diet.

Table 4: Gonadosomatic and hepatosomatic indices of *Clarias gariepinus* Male and female broodstocks fed diets containing *Chromolaena odorata* leaf

Percentage Inclusion of *Chromoleana odorata* leaf					
Sex	Parameter	CONTROL-1-(0%)	C0L- 2 - (0.5%)	C0L- 3 - (1%)	C0L- 4 -(1.5%)
	Body weight (kg)	1.20 ± 0.00^{c}	2.20 ± 0.17^{a}	1.92 ± 0.06^{b}	2.47 ± 0.13^{a}
	Weight of testis (kg)	3.50 ± 0.02^{e}	10.30 ± 0.04^{b}	11.40 ± 0.05^{b}	14.90 ± 0.01^{a}
Male	Gonadosomatic index	0.28 ± 0.03^{d}	0.73 ± 0.02^{a}	0.71 ± 0.04^{a}	0.60 ± 0.04^{a}
	Weight of liver (g)	5.00 ± 0.40^{c}	7.00 ± 0.20^{b}	7.00 ± 0.20^{b}	7.00 ± 0.30^{b}
	Hepatosomatic index	0.44 ± 0.07^{a}	0.38 ± 0.02^{b}	0.36 ± 0.02^{b}	0.30 ± 0.00^{c}
	Body weight (kg)	1.43 ± 0.03^{c}	1.80 ± 0.06^{b}	2.20 ± 0.16^{a}	2.70 ± 0.06^{a}
	Weight of ovaries (kg)	0.09 ± 0.01^{c}	0.13 ± 0.02^{b}	0.18 ± 0.02^{b}	0.20 ± 0.02^{a}
Female	Gonadosomatic index	6.13 ± 0.29^{c}	7.29 ± 0.13^{b}	8.11 ± 0.39^{a}	7.34 ± 0.14^{b}
	Weight of liver (g)	7.00 ± 0.70^{c}	7.00 ± 0.40^{c}	8.00 ± 0.10^{a}	8.00 ± 0.10^{a}
	Hepatosomatic index	0.51 ± 0.04^{a}	0.40 ± 0.01^{a}	0.35 ± 0.02^{b}	0.30 ± 0.02^{c}

^{a,b,c,d} = Means in the same row with similar superscripts are not significantly different ($p>0.05$)

Table 5: Hatchability of Eggs of *Clarias gariepinus* Broodstock

Treatments	Number of hatched eggs	Number of unhatched eggs	Total number of eggs (incubated)	Hatchability rate (%)
1 (Control)	4175	5425	9600	43.48
3 (C. *odorata* fed group)	7034	7131	14165	49.66

Discussion

Feed Intake and Growth Performance

The observed improvements in growth indices (weight gain, specific growth rate, and feed conversion ratio) of *Clarias gariepinus* broodstock suggest that *Chromolaena odorata* leaf possesses functional properties capable of enhancing nutrient utilization and physiological performance in broodstock. Similar growth-promoting effects of phytogenic feed additives have been reported in aquaculture, where plant-derived bioactive compounds improved digestion, modulated gut microbiota, and stimulated appetite (Reverter *et al*., 2014). The growth enhancement may be attributed to the rich phytochemical composition of *Chromolaena odorata*, including flavonoids, tannins, saponins, alkaloids, and phenolic compounds (Akinmoladun *et al*., 2007). Improved feed efficiency among broodstock is particularly important, as broodstock require adequate nutrient reserves for gonadal maturation and spawning.

This study showed that *Chromolaena odorata* leaf diets enhanced and promoted the growth and nutrient utilisation parameters of *C. gariepinus* broodstock, which resulted in improved weight gain, better FCR, and good specific growth rate. Specifically, the highest mean weight gain of *Clarias gariepinus* broodstock fed a diet containing 1.5% *Chromolaena odorata* leaf implied that the plant could promote the growth of *C. gariepinus* broodstock. The increased feed intake observed as the inclusion levels of *Chromolaena odorata* increased in the diet of broodstock fish corroborates the findings of Jiwuba *et al*. (2018), that up to 1.56% inclusion of Siam weed leaf meal in broiler diets increased their feed intake.

Reproductive Performance and Hatchability of Eggs.

Clarias gariepinus broodstock fed *C. odorata* leaf paste showed improvements in gonadosomatic index, fecundity, and hatchability. The relative fecundity of female *C. gariepinus* broodstock increases as the body weight increases, though with a slight variation. According to Bithy *et al*. (2012), fecundity is important in the reproductive biology of the fish. Fecundity

explains the variation in the level of fish production, particularly in efforts made to increase the amount of harvest. The weight of the fish's body and gonad gives the gonadosomatic index. It is the ratio of gonad weight to body weight of fish. Gonadosomatic index helps in identifying days and seasons of spawning, as the ovaries of gravid females swiftly increase in size just before spawning. The development and growth of the gonad occur simultaneously in the fish as it grows, indicating a high gonadosomatic index. At the maturity stage, fish have a maximum value of gonadosomatic index, and after spawning, the value declines. In addition, the gonadosomatic index value of fish is dependent on the amount of food available to the fish in the water and the temperature of the water. In the present study, an increased ovary weight and body weight were observed among the fish fed dietary inclusion of *C. odorata* leaf paste. Thus, the gonadosomatic index value tends to increase as the ovarian weight increases with higher inclusion of *C. odorata* leaf paste in the diet. This corroborates the report of Adedeji *et al*. (2015), who observed that inclusion of *A. africana* leaves in diets could enhance the reproductive potential of rabbits.

The hepatosomatic index provides information about the liver condition, metabolic activity in the body, and the impact of water pollution. The hepatosomatic index value increases when food is available in large amounts, and the seasonal variations and culture conditions are favourable (Adewolu *et al*. 2008; Olurin and Aderibigbe, 2006)

An increase in the daily weight of the body is related to an increase in the H.S.I. value, and it is also observed that H.S.I. also depends upon the seasonal cycle. Liver, being a vital organ in the body, performs various physiological functions such as converting excess sugar into glycogen, detoxifying toxic substances, acting as a haemopoietic organ, and destroying the old red blood cells, etc. Its healthy condition is essential for the growth of fish. As the body's weight increases, the weight of the liver also increases. H.S.I. also provides an indication of the status of the energy reserve in fish. In a poor environment, fish usually have a smaller liver with less energy stored in it. H.S.I. has been reported to decrease in fish exposed to environmental stressors such as water pollution (Adewolu *et al*. 2008; Olurin and Aderibigbe, 2006). The decreased HSI of female broodstock as the body weight increased as revealed in this study implied that the higher the body weight a female broodstock possesses, the lower the hepatosomatic index value. Also, in the male *C. gariepinus* broodstock, the HIS values decreased among fish as the inclusion level of *Chromolaena odorata* leaf in the diets increased. Hence, in this study, as the body weight of broodstock increased, the liver weight also increased. Broodstock nutrition is widely recognised as a critical determinant of reproductive output and larval quality (Adebayo *et al*. 2004). Adequate dietary nutrients, especially proteins, lipids, vitamins, and antioxidants, are essential for vitellogenesis, hormone synthesis, and gamete development. The higher hatchability rate (49.66%) in fish fed a dietary inclusion of *C. odorata* than the fish fed the control diet indicates the hatchability potential of *C. gariepinus* broodstock fed plant-based additives. The antioxidant components of *Chromolaena odorata* may have contributed to improved gamete quality by mitigating oxidative stress, which is known to impair oocyte maturation and sperm viability. Overall, the positive reproductive responses observed in this study are consistent with Reverter *et al*. (2014), who reported enhanced endocrine function and gonadal tissues with the inclusion of plant-based additives in broodstock nutrition.

Conclusion and Recommendation

Inclusion of *Chromolaena odorata* leaf in fish diets positively influenced the growth and reproductive performance and hatchability of *Clarias gariepinus* broodstock. Further research is recommended to evaluate long-term reproductive and progeny performance under commercial hatchery conditions. Dietary inclusion of 1.5% *Chromolaena odorata* leaf in the broodstock diet is recommended.

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