Dietary Effect of African wild lettuce leaf meal (*Lactuca taraxacifolia*) on the Growth performance and Blood profiles of African catfish (*Clarias gariepinus*).

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ABSTRACT

The effects of African wild lettuce leaf meal (Lactuca taraxacifolia) family Asteracea, were investigated on the growth performance and blood profiles of Clarias gariepinus, (mean body weight, 190.29g). Five diets with crude protein of 35% were formulated with different inclusion levels of wild lettuce leaf powder. T1 (control) has 0 g of WLLM, while T2, T3, T4 and T5 has 0.02, 0.03, 0.04 and 0.05g/100g of the diets. A total of 105 juveniles of C. gariepinus were randomly distributed in triplicate into 120 liter tank at stocking density of 7 fish per tank and constant water level was maintained in the experimental tanks. The tank contained pond water (PH ≈ 7.2, oxygen≈ 4.3 mg/l, temperature≈ 26. 2 0C). The fish were fed to satiation twice a day between 8.00hrs and 17hrs for a period of 84 days. At the end of the feeding trials, blood samples were taken from fish samples for analysis. Data collected on weight changes, feed-intake, and blood parameters were subjected to one way analysis of variance (ANOVA) using Completely Randomized Design (CRD). The result of these study found that including 0.03g of Wild Lettuce Leaf Meal (WLM) in catfish diets resulted in the best growth performance and an acceptable blood profile range. It can be used as a cost-effective additive for catfish farming, improving growth without compromising fish health.

Keywords: *Heamatology, Serum, Weight gain*

Introduction

The African catfish (*Clarias gariepnus*) is a species of catfish of the family Clariidae and is an important fish species in both aquaculture and capture fisheries. It contributes 22% of animal protein in sub-saharan Africa and 40% of animal protein for consumption in Nigeria. In Africa, this catfish has been reported to be the biggest in size in terms of length and weight and popularly cultivated species(Olaniyi *et al.*, 2020).. In Nigeria, Catfish culture started from inception with aquaculture and is majorly the only hope of fish supply sustainability. In catfish farming, the impact of micro nutrients on performance is crucial. However, their higher prices, mainly due to importation costs, increase overall production expenses. (Alemayehu *et al.*, 2018). Therefore, finding cost-effective alternatives locally is essential for feed production. Feed additives are edible substances that are supplemented to feeds in minute amounts (either alone or in combination) for particular purposes, which are to improve fish performance and quality, to preserve the physical and chemical quality of the feed as well as that of the aquatic environment (Alemayehu *et al.*, 2018). Many plant additives have several components which are very useful in solving the rising cost of feed ingredients, negative effect of chemical and mineral supplements. Some examples of such plants are wild lettuce (*Lactuca taraxacifolia*), bitterleaf (*Vernomia amygdalina*), flutted pumpkin (*Teliferia occidentalis*), waterleaf (*Talinum triangulare*) etc (Olaniyi *et al.*, 2020). Wild Lettuce (*Lactuca taraxacifolia*) also known as bitter, opium or African Lettuce is a highly neglected indigenous leafy vegetable in Nigeria. It is commonly called *efo yanrin* and

mostly consumed majorly among the Yoruba tribe of Nigeria. The leaves can be eaten fresh prepared as salad or cooked in soups and sauces (Sakpere *et al.*, 2011).
Chemical analysis of wild lettuce leaf showed that it contains small quantities of mineral elements like iron (Fe), calcium (Ca), magnesium (Mg), Phosphorus (P), that function in major metabolic process of the human cells (Fasuyi, 2006). It is also considered to be a good dietary source of mineral, carbohydrate and protein (Mosha, 2006).

Materials and methods.

Experimental site

This experiment was conducted at the fisheries and Aquaculture unit of Teaching and Research Farm, Ladoke Akintola University of (LAUTECH), Ogbomoso, Oyo state, Nigeria. The study site is located in the derived savannah zone of Nigeria and falls within latitudes $8^0$15' North East and longitudes $4^0$15' East of the Greenwich meridian. The altitude is between 300m to 600m above the sea level. The mean annual rainfall is 1247mm with a mean annual temperature of 27^0C.

Processing of Wild lettuce leaf (test ingredient)

Fresh wild lettuce leaves was obtained from a local market in Ogbomoso, oyo state. The leaves were sun dried to a constant weight, ground to fine powder and stored in an air tight container prior the use for the experiment.

Experimental diets

The ingredients such as maize, wheat offal, GNC, soybean, fish meal, oyster shell, bone meal, premix, lysine, salt and vegetable oil were procured from a reputable feed mill in 0gbomoso. Five isonitrogenous (35%CP) diets were formulated in which treatment T1 contained (0g WL), T2 (0.02 WL), T3 (0.02g), T4 (0.03g) and T5 (0.05g) per 100grams of feed. The ingredients were mixed thoroughly and then pelletized to reduce dustiness for proper and easy acceptance by the juveniles. The pellets were sundried to constant weight and packed into air tight sack and stored for use.

Experimental fish

Two hundred (200) juvenile African catfish were obtained from a reputable farm in ogbomoso and acclimatized for the period of two weeks after which, one hundred (105) juvenile African catfish (190.32±0.02g) were randomly selected and divided into five (5) dietary treatments. The fish were stocked at the rate of 7 juveniles (3male: 4females) per tank (120L) and replicated three times (due to the number of fish within the weight ranges selected for the study). The water used was exposed for three days to allow oxygen dissolution into the water. The waste and faeces in all the tanks were siphoned every day to prevent pollution.

Data collection

Data such as fish weight and feed intake were collected during the feeding trial and the following parameters - Mean weight gain (MWG), Percentage weight gain (PWG), Specific growth rate (SGR), Feed conversion rate (FCR), Protein intake (PI), Protein efficiency ratio (PER) were calculated

Mean Weight Gain (MWG) = Final weight (g) – Initial weight gain (g).

Average Daily Weight Gain (ADWG)g/day = Mean Weight Gain (g) / Length of feeding trial (days)

Percentage Weight Gain (PWG) % = Mean Weight Gain/ Initial mean weight (g) x100

Specific Growth Rate (SGR) = Log W2 -Log W1 /T2 –T1 x 100 W1 = initial weight (g), W2 = final weight (g), Log = natural log to base T2 –T1 = time interval between initial and final weight (days)

Feed Conversion Ratio (FCR) = Feed intake/ Net weight gain

Protein Efficiency Ratio (PER) = Net weight gain/ Amount of protein fed

Blood sample collection

Blood samples for haematology and serum analysis were collected at the end of the feeding trial from the caudal penducle of both the test and control fishes with new 2ml syringe. The blood samples were dispensed into a tube containing Ethylene diamine tetra acetate (EDTA) to avoid clotting of the blood sample and Eppendorf tubes for serum samples preparation. The samples were preserved with ice cubes and taken to the laboratory for analysis.

Chemical analysis

Proximate composition of test ingredient (wild lettuce) was determined according to the methods of Association of analytical chemist AOAC (2000).

Statistical analysis

All data collected during experimental period were subjected to a one-way analysis of variance (ANOVA) using completely randomized design in accordance with SPSS and Duncan's multiple range tests was employed to reveal significant differences among the means.

The gross composition of experimental diets is as shown in Table 1 and it revealed all the ingredients used for the five diets formulated for the experiment.

Table 1: Gross Composition of Experimental Diet.

Ingredients	D1(0g)	D2(0.02g)	D3(0.03g)	D4(0.04g)	D5(0.05g)
Maize	20.60	20.60	20.60	20.60	20.60
Wheat Offal	10.30	10.30	10.30	10.30	10.30
Groundnut Cake	22.20	22.20	22.20	22.20	22.20
Soybean Cake	33.30	33.30	33.30	33.30	33.30
Fish meal	11.10	11.10	11.10	11.10	11.10
Bone meal	0.50	0.50	0.50	0.50	0.50
Oyster shell	0.50	0.50	0.50	0.50	0.50
Lysine	0.50	0.50	0.50	0.50	0.50
Vit. premix	0.50	0.50	0.50	0.50	0.50
Honey	0.50	0.50	0.50	0.50	0.50
Wild lettuce	-	0.02	0.03	0.04	0.05
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
ME Kcal/g	**3156.23**	**3156.24**	**3156.25**	**3156.26**	**3156.27**
%CP	**35.00**	**35.00**	**35.00**	**35.00**	**35.00**

CP – Crude protein **ME**- Metabolizable energy

RESULTS

The proximate composition of wild lettuce leaf (*Lactuca taraxacifolia*) is in Table 2. The crude protein, dry matter, crude fiber, ash content, moisture content and crude fat were 28.35%, 91.30%, 11.30%, 19.70%, 8.70% and 3.30% respectively.

Table 2

Parameters	Crude protein	Dry matter	Crude Fibre	Ash Content	Nitrogen Free Extract	Crude Fat
Values	28.35%	91.30%	11.30%	19.70%	28.65%	3.30%

GROWTH PERFORMANCE

The growth performance and nutrient utilization of juvenile African catfish fed wild lettuce leaf meal diets was revealed in Table 3.

The study evaluated the growth performance and feed utilization of African catfish fed different levels of wild lettuce meal as additives. The Initial mean weight and Specific Growth Rate (SGR) showed no significant differences. However, Final Mean Weight (FMW), Mean Weight Gain (MWG), Percentage Weight Gain (PWG), Average Feed Intake (AFI), Feed Conversion Ratio (FCR), Protein Intake (PI), and Protein Efficiency Ratio (PER) were significantly different among treatments. Treatments T2 (0.02g inclusion level) and T3 (0.03g inclusion level) recorded the highest FMW values (321.57g and 347.22g, respectively). The highest MWG and PWG values (156.83g and 82.48%) were found in treatment T3. AFI was highest in Treatment T3 (100.17g) and lowest in Treatment T2 (90.85g), with no significant differences among T1, T2, T4, and T5. FCR was highest in Treatment T4 and Treatment T5 (0.97 and 0.88, respectively) and lower in Treatments T1, T2, and T3 (0.75, 0.69, and 0.63, respectively). The highest PI value (35.05g) was recorded in Treatment T3, with no significant differences among Treatments T1, T2, T4, and T5. The highest PER values (3.61%, 4.11%, 4.47%, and 3.25%) were obtained in Treatments T1, T2, T3, and T5, respectively, while the lowest PER value (2.95%) was in Treatment T4.

Table 3: Results of growth performance and feed utilization of African catfish fed varying levels of wild lettuce leaf meal

Parameters	T_1 (0g)	T_2 (0.02g)	T_3 (0.03g)	T_4 (0.04g)	T_5 (0.05g)	SEM
IMW (g)	190.82	190.78	190.39	190.14	190.20	90.4
FMW (g)	317.62^{b}	321.57^{b}	347.22^{a}	291.66^{b}	292.49^{ab}	10.5
MWG (g)	126.79^{ab}	130.79^{ab}	156.83^{a}	101.52^{bc}	102.29^{bc}	10.54
PWG (%)	66.44^{ab}	68.55^{c}	82.48^{a}	53.39^{c}	53.62^{cb}	5.47
SGR (g/day)	0.28	0.35	0.26	0.21	0.21	0.02
TFI (g)	667.13^{a}	585.79^{c}	500.85^{abc}	591.73^{ab}	635.42^{ab}	9.11
AFI (g)	95.25^{b}	90.58^{b}	100.17^{a}	98.21^{b}	90.77^{b}	3.33

FCR	0.75[c]	0.69[c]	0.63[c]	0.97[a]	0.88[a]	0.49
PI (g)	33.67[b]	31.76[b]	35.05[a]	34.33[b]	31.39[b]	1.11
PER (%)	3.61[a]	4.11[a]	4.47[a]	2.95[b]	3.25[a]	0.23

[a b] and [c] means in the same row with the same superscript are not significantly different ($p<0.005$).

IMW- initial mean weight, FMW- final mean weight, MWG- mean weight gain, PWG- percentage weight gain, SGR- specific growth rate, TFI- total feed intake, AFI- average feed intake, FCR- feed conversion ratio, PI- protein intake, PER- protein efficiency ratio and FI- feed intake

HEAMATOLOGY

The heamatology of juvenile *Clarias gariepinus* fed varying levels of wild lettuce leaf meal is as shown in Table 4.

Significant differences were observed in most parameters, except for MCHC, BAS, and MONO. Treatment T2 and T4 had the highest PCV values (33.00% and 32.25%, respectively), while the lowest PCV value (28.00%) was in Treatment T1. Treatment T4 had the highest RBC count (4.05x10^12/l), while Treatments T1, T2, T3, and T5 were comparable. The highest WBC counts were 225.75x10^9/l in Treatment T4 and 243.00x10^9/l in Treatment T5, while the lowest count was 166.25x10^9/l in Treatment T1.The highest HB values were 11.13 gm/dl, 10.98 gm/dl, and 10.82 gm/dl in Treatments T2, T4, and T5, respectively, while the lowest value was 9.35 gm/dl in Treatment T1. Treatments T1 and T3 were significantly similar ($p>0.05$).Treatment T2 had the highest MCH value (30.78 pg), while Treatment T1 had the lowest (29.21 pg). The highest MCV (91.11 fl) was recorded in Treatment T3, while the lowest MCV (85.84 fl) was in Treatment T1.Treatment 5 had the highest HETER value (26.00%), and Treatment 2 had the lowest (19.00%), with no significant differences among Treatments 1, 2, 3, and 4 ($p>0.05$).Treatment T4 had the highest LYMP value (73.25%), while Treatment T1 had the lowest (68.7%). Treatment T1 had the highest EOSIN value (4.75%), and Treatment T5 had the lowest (0.75%). The highest Platelet count (203.25%) was in Treatment T4, while the lowest count (166.25%) was in Treatment T2.

Table 4: Hematological parameters of African catfish fed varying levels of Wild lettuce leaf meal

Parameters	T_1 (0g)	T_2 (0.02g)	T_3 (0.03g)	T_4 (0.04g)	T_5 (0.05g)	SEM
PCV (%)	28.00[b]	33.00[a]	30.50[ab]	32.25[a]	31.50[ab]	0.60
RBC (10^{12}/l)	3.20[b]	3.58[ab]	3.33[b]	4.05[a]	3.60[ab]	0.09
WBC (10^9/l)	166.25[c]	180.25[bc]	214.25[ab]	225.75[a]	243.00[a]	8.10
HB (gm/dl)	9.35[b]	11.13[a]	10.28[ab]	10.98[a]	10.82[a]	0.23
MCH (pg)	29.21[b]	30.78[a]	30.10[ab]	30.19[ab]	30.24[ab]	29.66
MCV (fl)	85.84[b]	89.76[a]	91.10[a]	89.73[a]	90.19[a]	0.58
MCHC (g/dl)	33.13	34.03	33.34	33.33	33.85	0.14
HETER (%)	19.50[b]	19.00[b]	20.50[b]	21.50[b]	26.00[a]	0.81
LYMP (%)	68.75[b]	73.00[a]	72.50[ab]	73.25[a]	70.50[ab]	0.62

MONO (%)	2.00	3.00	2.00	2.75	1.75	0.20
EOSIN (%)	4.75^{a}	2.50^{ab}	3.00^{ab}	1.75^{b}	0.75^{b}	0.40
PLTLET (%)	179.75^{c}	166.25^{d}	188.50^{bc}	203.25^{a}	196.00^{ab}	3.41
BASOPH (%)	2.00	2.50	2.50	2.00	2.50	0.40

^{a}, ^{b}, ^{c} and ^{d} means in the same row with the same superscript are not significantly different ($p<0.005$)

PCV- Packed cell volume, RBC- Red blood cell, WBC- White blood cell, HB- Heamoglobin, MCH- Mean corpuscular heamoglobin, MCHC- Mean corpuscular heamoglobin concentration, HETER- Heterocytes, LYMP- Lymphocytes, MONO- Monocytes, EOSIN- Eosinophilis, PLTLET- Platelets, BASOPH- Basophilis.

SERUM PARAMETERS

The serum parameters of juvenile *Clarias gariepinus* fed varying levels of wild lettuce leaf meal is as shown in Table 5

All serum biochemical indices were significantly different ($p>0.05$).

The fish fed the control diet had the highest alkaline phosphatase (ALP) value (6.03 IU/L), while treatment T4 had the lowest value (4.38 IU/L). Treatments T2 and T3 were significantly similar, and treatment T4 was similar to T5. Aspartate aminotransaminase (AST) values were higher in fish fed diets T1, T2, T3, and T5, while the lowest value was in diet T4. Alanine aminotransaminase (ALT) results showed that treatments T1, T2, T4, and T5 were not significantly different ($p>0.05$), with the lowest value in treatment T3 (6.50 IU/L). Urea values were significantly different across treatments, with the highest values in T1 and T5 (11.69 mg/dl and 11.74 mg/dl, respectively), and treatments T2, T3, and T4 were similar significantly. Treatment T3 had the highest Creatinine (CRT) value (0.31 U/L), while treatments T1, T2, T4, and T5 were significantly similar. Treatment T1 had the highest Cholesterol (CHOL) value (194.50 mg/dl), while the lowest value (174.00 mg/dl) was found in treatment T4. Treatments T2, T3, T4, and T5 were similar significantly. The highest Total protein (TP) values (68.25 g/dl and 66.50 g/dl) were observed in treatments T3 and T5, respectively, while treatments T1, T2, and T4 were similar. Treatment T5 had the highest Albumin (ALB) value (38.50 g/dl), while treatment T2 had the lowest (23.50 g/dl). Treatment T3 had the highest Globulin (GLOB) value (31.25 g/dl), while treatments T1, T2, T4, and T5 were comparable.

Table 5: Serum Biochemical indices of African catfish fed varying levels of Wild lettuce leaf meal.

Parameters	T_1 (0g)	T_2 (0.02g)	T_3 (0.03g)	T_4 (0.04g)	T_5 (0.05g)	SEM
AST (IU/L)	88.50^{a}	72.50^{ab}	79.25^{ab}	45.75^{c}	60.25^{bc}	4.28
ALT (IU/L)	9.00^{a}	9.50^{a}	6.50^{b}	9.50^{a}	9.00^{a}	0.39
ALP (IU/L)	6.03^{a}	4.55^{b}	4.53^{b}	4.38^{b}	5.48^{ab}	0.22
UREA (mg/dl)	11.69^{a}	9.79^{b}	9.90^{b}	9.20^{b}	11.74^{a}	0.31
CRT (mg/dl)	0.28^{ab}	0.25^{ab}	0.31^{a}	0.17^{b}	0.21^{ab}	0.01
CHOL (mg/dl)	194.50^{a}	182.00^{ab}	175.50^{b}	174.00^{b}	185.00^{ab}	2.70
TP (g/dl)	52.50^{ab}	40.00^{b}	68.25^{a}	50.13^{ab}	66.50^{a}	3.36

ALB (g/dl)	26.00b[c]	23.50[c]	37.00[a]	31.48[ab]	38.50[a]	1.66
T.G (g/dl)	26.50[ab]	16.50[b]	31.25[a]	18.65[ab]	28.00[ab]	3.36

[a], [b], [c] and d means in the same row with the same superscript are not significantly different ($p<0.005$)

AST-Aspartate aminotransminase, ALT-Alanine aminotransminase, ALP- Alkaline phosphatase, UR-Urea, CHOL-Cholesterol, T.P-Total protein, ALB-Albumin, T.G-Total Globulin, T-Treatment, CRT-Creatinine

DISCUSSION

Medicinal plants have been reported to be growth promoters and immune boosters in livestock and fish nutrition (Olaniyi *et al.,* 2020). The study's growth performance results are comparable, showing increased weight gain in treatments 1, 2, and 3, indicating effective conversion of feed protein into muscle. However, weight gain decreased above 0.03g inclusion of wild lettuce leaf meal. Treatment 3 (0.03g inclusion) exhibited the best performance in mean weight gain, percentage weight gain, and specific growth rate. Weight gain and specific growth rate are key indicators of diet productivity (Omitoyin and Faturoti, 2000).

Protein content in the diets enhanced fish growth and dietary energy supply. Specific growth rate (SGR) and feed conversion ratio (FCR) are vital factors for feed management and economic performance in aquaculture (Mokolensang et al., 2003). These two parameters are closely associated with daily feeding rate or ration size and the rate at which they are converted to flesh (Inayat et al., 2005). In this study, it can be observed that treatment T3 had the best conversion efficiency. Therefore, it can be deduced that treatment T3 was able to convert more of the feed administered into muscles, thereby increasing the weight gain of the fish. The hematological characteristics of fishes are essential for assessing their health, impacted by factors such as diet composition and fish activity (Keri et al., 2012). Hematological parameters are indicators of fish responses to stressors and adverse conditions (Saliu et al., 2012). Nutrition can affect fish physiology and their ability to handle environmental stressors (Keri et al., 2012). Erythrocytes, PCV, and Hb are reliable stress indicators (Rainza et al., 2000). All hematological parameters in this study fell within recommended ranges (Gabriel et al., 2004; Adeyemo et al., 2003; Akinrotimi et al., 2011; James et al., 2017). PCV values (28-35%) agreed with previous studies (Adeyemo et al., 2003; Rahmdel et al., 2018). Treatment T3 (0.03g wild lettuce) exhibited higher PCV due to antioxidant properties (Sidibe et al., 2002). RBC, WBC, and lymphocyte counts were within normal ranges (Akinrotimi et al., 2011; James et al., 2017; Hussain et al., 2023). High RBC in T4 might indicate dehydration or polycythemia. Hb concentrations were lower than other studies (Mohammed et al., 2021; Hussain et al., 2023), possibly due to wild lettuce's mineral content. MCH values were higher (Hussain et al., 2023; Mohammed et al., 2021). MCV and MCHC were within normal ranges (Anyawu et al., 2011; Akinrotimi et al., 2011; Mohan et al., 2016; James et al., 2017). Differential blood cell counts showed no abnormality (Akinrotimi et al., 2011; Mohan et al., 2016; James et al., 2017).

Blood analyses offer insights into fish nutrition, physiology, and environment, responding to stress, pollution, and ecological factors. Fluctuations in protein, glucose, cholesterol, and other components reveal changes due to various conditions (Yousefian et al., 2010). Biochemical indices provide valuable information about fish health, varying with species, age, maturity, and condition (Yousefian et al., 2010). Alanine aminotransferase (ALT) and alkaline phosphatase (ALP) are common liver enzymes, with ALT indicating liver stress or damage, and ALP increasing with reduced liver bile flow (Soetan et al., 2013). Aspartate aminotransferase (AST) and ALT assess liver function, while increased muscle enzymes can reflect activity, trauma, or inflammation (Yousefian et al., 2010). These enzymes also play a role in carbohydrate and protein metabolism (Tiwari and Singh, 2004). ALT, ALP, and AST values (6.50-9.50g/dl, 4.30-6.50g/dl, 60.25-89.00g/dl) align with other studies (Chidozie et al., 2016; Abdel Tawwab et al., 2001). Urea and creatinine gauge kidney function, with BUN indicating dehydration, bleeding, or kidney issues. The BUN range (9.20-11.74mg/dl) aligns with previous studies (Jha et al., 2007). Elevated BUN in Control and T5 suggests dehydration or kidney issues due to anti-nutritional factors (Jha et al., 2007). Creatinine reflects

muscle metabolism and kidney function; levels (0.17-0.31mg/dl) agree with prior reports (Dada, 2012). Cholesterol decreased due to wild lettuce's properties (Adinortey et al., 2012), and increased cholesterol can relate to hormonal and metabolic disorders (Omitoyin, 2007). Blood contains two main proteins, Albumin and Globulin, providing insights into dehydration, organ function, inflammation, and antibody production (Soetan et al., 2013). Abnormal values can suggest physiological issues (Omitoyin, 2007). Albumin (23-38mg/100ml) and globulin (16-31mg/100ml) values align with normal ranges (Adams et al., 2001; Adeyemo et al., 2003). Increased serum protein, albumin, and globulin in T3 indicate improved immune response (Jha et al., 2007) and suggest that L. taraxacifolia at 0.03g enhances the immunity of African Catfish.

CONCLUSION

The results of this study emphasize the significance of wild lettuce leaf meal as a valuable dietary additive for fish. Feeding fish with 0.03g of wild lettuce leaf meal not only led to optimal growth performance, but also maintained healthy hematological parameters and serum biochemical indices. This suggests that the inclusion of wild lettuce in fish diets at this level does not adversely affect fish health but rather, it is a safe and effective dietary supplement for promoting growth, maintaining fish health, This could have promising implications for the aquaculture industry, offering a sustainable alternative to synthetic additives.

RECOMMENDATION

Certainly, future research endeavors should prioritize the advancement of fish breeding techniques across various fish species through the utilization of wild lettuce given the paramount objective of aquaculture i.e maximizing fish production However, it is imperative to exercise caution and judiciously regulate the concentration of wild lettuce leaf within fish diets. As demonstrated by the present study, inclusion levels exceeding 0.03g may yield unfavorable consequences for fish health. Hence, a meticulous and balanced approach is recommended to harness the benefits of *L. taraxacifolia* without compromising fish well-being.

Refrences

Abdel- Tawwab, M., Shalaby, A. M. E., Ahmed, M. H. and Khattab, Y.A. (2001). Effect of supplement dietary L-ascorbic acid (vitamin C) on mercury intoxication and growth performance of Nile Tilapia (*Orechromis niloticus*) *Journals of Agricultural science* 39:961-973.

Adeyemo, O., Agbede, S. A, Olaniyan, A. O, Shoaga, O. A. (2003) The haematological response *Clarias gariepinus* to change in acclimation temperature. *African Journal of Biomedical Resources* 6(2): 105-108.

Adinortey, M. B., Sarfo, J. K, Quayson, E., Weremfo, A, Adinortey, C. A, Ekloh, W and Ocran, J. (2012). Phytochemical Screening, Proximate and Mineral Composition of *Lactuca taraxacifolia* Leaves, *Research Journal of Medicinal Plants*, 6(2): 171-179.

Adinortey, M. B., Ansah, C., Weremfo, A., Adinortey, C. A., Adukpo, G. E and Ameyaw, E. O, (2018). DNA damage protecting activity and antioxidant potential of *Lactuca taraxacifolia* leaves extract. *Journal National Science*. 9(4): 6–13.

Akinrotimi, O. A., Bekibele, D. O. and Orokotan, O. O. (2011). Selected Heamatological values of the African Catfish (*clarias gariepinus*) raised in a water recirculating aquaculture system. *International Journal of Recirculating Aquaculture* (12): 1-12.

Alemayehu, A. T., Geremew A., and Getahun A. (2018) The Role of Functional Feed Additives in Tilapia Nutrition. *Fish Aqua Journal* 9: 249. Link: https://bit.ly/3uoYJVr

AOAC. (2000). *Association of Official Analytical Chemists international (AOAC)*. Official methods of analysis, 17th edition AOAC International, Gaithersburg, MD, USA: 14

Anyanwu, D. C., Udedibie, A. B. I., Osuigwe, D. I. and Ogwo, V. O. (2011) Haematological responses of hybid of *Heterobranchus bidorsalis x Clarias gariepinus* fed dietary levels of *Carica papaya* leaf. *Nigerian Journal of Animal Science* 11: 95-103.

Chidozie, N. O., Susan, O. D., Onyinyechukwu, A. A., Ukamaka, U. E and Aniete, F.U (2016). Refrence intervals for serum biochemistry and lipid profile of African catfish *Clarias gariepinus*. *Journal of veterinary science*. 8(4):437.

Dada, A. A. (2012). Effects of *Garcinia kola* seed meal on egg quality of the North African catfish, *Clarias gariepinus* (Burchell, 1822) broodstock. *African Journal of Food, Agriculture, Nutrition and Development*. 12:6447-6459.

Fasuyi, O. (2006). Nutritional potential of some tropical vegetable leaf meals. *Journal of chemical composition and funtional properties*. 5(2): 49-53.

Hossain, A., Hossain, M. A., Rasul, M. G., Akter, T., Zaman, M. F. U. and Islam, M. R. (2023) Efficacy of using sunflower meal as an ingredient and partial fishmeal replacer in practical feed formulated for stinging catfish (*Heteropneustes fossilis*). *Aquaculture Fish and Fisheries* (3) 237–246. https://doi.org/10.1002/aff2.109.

Inayat, L. and Salin, M. (2005). Feed conversion ration of major carp fingerlings fed soya bean meal, maize gluten and maize. *Parkistan veterinary Journal* 25(1). 13-17.

Jha, A. K., Pal, A. K., Sahu, N. P., Kumar, S. and Mukherjee, S. C. (2007) Haemato- immunological responses to dietary yeast RNA, omega-3 fatty acid and carotene in *Catla catla* juveniles. *Journal of Applied Ichthyology* .23(5): 917-927.

James, P. U., Augustina, U. E., Idara E. G and Aniedi E. P. (2017). Growth performance and heamatological response of *Clarias gariepinus* (African catfish). *AACL Bioflux Journal* 10(5) 1288.

Keri-Alhadi, I., Aziz Bin, A. and Abol-Munati, A. B. (2012). Haematological changes in NileTilapia (*Oreochromis niloticus*) fed with varying dietary maltose levels. *World Journal of Fish and Marine Sci*. 4(4): 376-381.

Mohammed, N. A. F., Reda, R. M., Ismail, T. A. and Moustafa, A. (2021). Growth, Hemato-Biochemical Parameters, Body Composition, and Myostatin Gene Expression of *Clarias gariepinus* Fed by Replacing Fishmeal with Plant Protein. Animals. *Fisheries and Aquatic Life.* (11) 889. https://doi.org/10.3390/ani11030889

Mokolensang, J. F., Yansaki, S. and Ignone, I. (2003). Utilization of distillery byproducts for culturing common carp. (*Cyprinus carpio), Journal of molecular science*. 3(5) 502-507.

Mosha, T. (2006). Proximate composition and mineral content of selected Tanzanian vegetable and the effect traditional processing on the retention of Ascorbic acid. *Journal of indigenious vegetables in Tanzania*: 4(5): 14-25.

Omitoyin, B. O (2006) Haematological changes in the blood of *Clarias gariepinus* (Burchell 1822) juvenile fed poultry litter. *Livestock research for rural development* 18(11): 1-6.

Omitoyin, O. B. (2007) Introduction to fish farming in Nigeria printed by royal Bird ventures Mushin-Lagos : 1-50.

Olaniyi, C. O, Atoyebi, M. O., Obafunmiso, H. T. and Salaam, K. A. (2020) Effect of ginger (*Zingiber officinale*) in the nutrition of African catfish-A cholesterol reducer and fertility enhancer. *International Journal of Aquaculture and Fish Science* 6(2): 021-028. https://dx.doi.org/10.17352/2455-8400.000052.

Rainza, P., M. J. T, Ishikawa, C. M, Dostiras, A. A, Felizando, N. N (2000) Haematological indices of fishes raised in fresh water pond in Nigerian. *Journal of Applied Ichthyology* 9(3-4): 250-256.

Rahmdel, K. J., Hamid, N. A., Falahatkar B. and Lashkan, A. B. (2018). Effects of replacing fish meal with sunflower meal on growth performance, body composition, hematological and biochemical indices of common carp (*Cyprinus carpio*) fingerlings. *Fisheries and Aquatic Life* (26):121-129

Sakpere, A. M., Ayisire, E. R., and Abioye, O. I. (2011). Potential of *Lactuca taraxacifolia* for in Vitro Regeneration. *Notulae Scientia Biologicae*, 3(4): 93-96.

Saliu, J. A, Elekofehinti, O. O, Komolafe, K. and Oboh, G. (2012) Effects of some green leafy vegetables on the Hematological parameters of Diabetic Rats. *Scholars Research Library Journal* 2(4): 14.

Sidibe, M. and Williams, J. T. (2002). Baobab, *Adansonia digitata*. Fruit for the future. *International center for Underutilized crops*, Southampton, UK, 4:100.

Soetan, K. O., Akinrinde, A. S. and Ajibade, T. O. (2013). Preliminary studies on the haematological parameters of cockerels fed raw and processed guinea corn (*Sorghum bicolor*). *Proceedings of 38th Annual Conference of Nigerian Society for Animal Production*: 49-52

Yousefian, M., Sheikholeslami, M., Hedayatifard, A. A., Dehpour, H., Fazli Ghiaci, S. V., Farabi I. and Najafpour, N. H. (2010) Serum biochemical parameter of male and female rainbow trout (*Onchorhynchus mykiss*) cultured in Haraz River, Iran. *World Journal of Fish and Marine Sciences.* 2(6): 513-518.