JOURNAL OF LIFE SCIENCE AND ENVIRONMENTAL PROTECTION
https://www.worldlinkpub.com/journals/journal-of-life-science-and-environmental-protecti/
ISSN: 3141-5989

THE APPLICATION OF PROBIOTICS *Lactobacillus acidophilus* AND *Saccharomyces cerevisae* TO IMPROVE GROWTH PERFORMANCE AND BODY COMPOSITION OF *Clarias gariepinus*

***Tahir Lauratu Hussaini, Abubakar Kotos Abdurrahman and Ja'afaru Ali**
Department of Zoology, Modibbo Adama University, Yola.
*Correspondence: laurattahir@mau.edu.ng

Received: 01 June 2026
Accepted for publication: 19 June 2026
Published: 01 July 2026

ABSTRACT

The African catfish *Clarias gariepinus* is one of the fresh water species that is popularly cultured in Adamawa state, Nigeria. In a bid to improve productivity and profitability in this sector, the present study was conducted. The study was aimed at assessing the effect of the probiotics, bacteria (*Lactobacillus acidophilus)* and yeast (*Saccharomyces cerevisae*) on the growth performance and body composition of *Clarias gariepinus*. Probiotics species were isolated, identified and cultured in the laboratory. A basal diet of 42% crude protein was formulated and supplemented with probiotics. Three hundred and sixty *Clarias gariepinus* fingerlings (3.30±0.36 g and 2.30±0.12 cm) were randomly assigned to four treatments of 30 fingerlings replicated three times in a completely randomized design in 300 L (0.9 m x 0.6 m x 0.5 m) concrete tanks through a semi-flow through system for five months period. The treatment groups include, T1, supplemented with *Lactobacillus acidophilus* (1 x 10^{10} cfu/g), T2 supplemented with *Saccharomyces cerevisae* (1 x 10^{10} cfu/g), T3 supplemented with *Lactobacillus acidophilus* (0.5 x 10^{10} cu/g) + *Saccharomyces cerevisae* (0.5 x 10^{10} cu/g), and T4, consisting of only the basal diet (the control group). The results of the experiment showed that the diet supplemented with *Lactobacillus acidophilus* significantly ($P<0.05$) enhanced growth by increasing the Specific growth rate (0.09±0.01%), so also it significantly ($P<0.05$) improved relative growth rate (367.17±22.49 %) while the lowest mean final weight (25.10±0.86g), relative growth rate (201.53±9.27g) and specific growth rate (0.05±0.003g) were recorded in the control. The survival rate was significantly ($p< 0.05$) higher in T3 (81.10±2.20%) and the least was recorded in T4 (53.33±1.93%). There were no significant ($p> 0.05$) differences in, ash content, and nitrogen-free extract among all treatment groups. The results showed that the addition of lactic acid bacteria and yeasts, introduced as probiotics in the diets of *Clarias gariepinus*, reared in a semi flowthrough system, improved the growth indicators and survival, but failed to improve its body composition. Farmers are therefore advised to incorcoporate *Lactobacillus acidophilus* in the diet of *Clarias gariepinus* for growth improvement and survival.

Key words: Probiotics, Bacteria, Yeast, Crude protein, Crude lipid, Crude fibre, Growth performance.

1.0 INTRODUCTION

Aquaculture is widely practiced around the world and is continually expanding due to advances in contemporary equipment and technology. Contrary to Asia, Africa has a relatively short history of aquaculture, and despite investment, a number of external issues have hindered its appropriate management and development. According to WHO (2002), probiotics are live bacteria that, when given in sufficient quantities, boost the host's health. Additionally, it can be described as a live, dead, or part of a microbial cell that, when added to the feed or rearing water, improves the host's resistance to disease, health, growth, feed utilization, stress response, or general vigor (Merrifield *et al.,*2010). Probiotics work by supplying nutrients, supplying digestive enzymes, adjusting the immune system, and boosting the body's defenses against harmful microorganisms. (Opiyo *et al*., 2018). The most often utilized probiotics in aquaculture are yeasts like *Saccharomyces cerevisiae* and lactic acid bacteria like *Lactobacillus* and *Enterococcus*. (Doroteo, 2018). *Clarias gariepinus*, the most widely farmed fish in Adamawa State, Nigeria, faces numerous difficulties, including high feed costs, managing fish health, competition from imported fish, a lack of technical skills, and inadequate information. This study was carried out in an effort to reduce these difficulties by implementing an environmentally friendly strategy. The purpose of the study is to ascertain how the probiotics *Saccharomyces cerevisae* and *Lactobacillus acidophilus* affect *Clarias gariepinus's* body composition and growth performance.

It is unclear whether probiotics genuinely increase hunger or if they only make meals easier to digest, despite the fact that

they have been used in aquaculture to increase the growth of cultured animals. Since some people are tempted to believe that both of these factors could be at play, it would be important to find out if probiotics genuinely improve the flavor of the food that aquaculture animals eat (Kumar *et al*., 2016; Umaru *et al*., 2019; Husain *et al.,* 2020). According to Luo *et al.* (2021), probiotic bacteria can colonize the gastrointestinal system when administered over an extended length of time since their rate of multiplication is higher than their rate of evacuation. Because of this property, probiotics can adhere to the intestinal mucosa and provide a variety of benefits to fish cultures. It has been claimed that probiotics can enhance the growth of edible fish. When *Streptococcus* probiotic is added to the diet of Nile tilapia (*Oreochromis niloticus*), the amount of crude protein and crude fat is greatly increased. After nine weeks of culture, the fish's weight increased as well, rising from 0.154 g to 6.164 g (Sahraoui *et al.,* 2021). When given dietary doses of probiotics *Lactobacillus acidophilus, Staphilococcus lentus,* and a combination of *L. acidophilus* and *S. lentus, C. gariepinus* has been shown to improve growth performance. Probiotics have also been investigated for their favorable growth patterns in shellfish production. A diet comprising each of the three potential probiotics was created, with a final concentration of about 107 cells per gram of dry feed. Small (20 mm) and giant (67 mm) abalones grew by 8% and 34%, respectively, over the course of an eight-month culture. Additionally, probiotic-supplemented abalones showed a survival rate of 62% against the harmful bacteria *Vibrio anguillarum* and outlived their untreated pairs by 25%. *Weight gain (WG)*:

Several research have explored the effect of probiotics on SGR in different fish species, including common aquaculture species such as tilapia, carp, and salmonids. Overall, the findings imply that probiotic supplementation can significantly influence SGR in fish. For instance, in Nile tilapia (*O. niloticus*), nutritional administration of probiotics dramatically improved SGR compared to the control group (Fath El-Bab *et al.,* 2022). Other species, including rainbow trout (*Oncorhynchus mykiss)* in Giri *et al*. (2016) and European sea bass (*Dicentrarchus labrax*) in Lobo *et al.* (2014), showed comparable beneficial benefits. Additionally, a 2009 study by Al-Dohail *et al.* shown that *L. acidophilus* enhanced *C. gariepinus's* growth rate and nutrient consumption. Probiotics have an impact on SGR through a variety of methods. Probiotics can improve the digestion and absorption of nutrients, which will increase growth and feed conversion efficiency. They create a variety of enzymes that help break down complicated food items so the fish may more easily use them (Ringo *et al.,* 2022). Additionally, probiotics alter the composition of the gut microbiota, encouraging the development of advantageous bacteria that support the metabolism and absorption of nutrients (Reyes-Becerril, 2019). Additionally, probiotics increase fish immune and general health, which tangentially supports better growth and SGR. A number of factors affect how well probiotics work to affect SGR. Because different probiotic strains have differing capacities to stimulate development, strain selection is essential. For example, certain strains of Lactobacillus and Bacillus have shown superior effects on growth performance compared to others (Ringo *et al.,* 2022). The probiotic's dosage and duration of use are other factors. Since too high or too low dosages would not have the desired growth-promoting effects, it is essential to determine the optimal dosage levels (Dawood *et al*., 2019). The effect of probiotics on SGR in fish has also been the subject of conflicting findings in some studies; these findings may be influenced by the interaction between probiotics and the fish's diet, the presence of other stressors, and the experimental conditions, probiotic strains, and fish species and size (Nayak, 2021 and Gule and Geremew, 2022).

There has been a lot of interest in aquaculture studies regarding the effectiveness of probiotics in raising fish's Feed Conversion Ratio (FCR). A key measure of feed efficiency is the feed conversion ratio (FCR), which shows how much feed is needed for each unit of fish weight gain. A lower FCR denotes better growth performance and more effective feed usage. Research has examined how probiotics affect FCR in *C. gariepinus*, offering valuable information on their possible advantages. FCR in this species has been demonstrated to improve with probiotic administration. In contrast to the control group, a study by Umaru *et al*. (2019) showed that adding multispecies probiotics to the diet of *C. gariepinus* significantly improved FCR. Among the processes that contribute to these favorable effects on FCR are improved nutrient utilization and feed conversion ratio. Probiotics have an impact on the composition and load of the gut microbiota, which encourages the growth of helpful bacteria that enhance nutrition absorption and metabolism.

In aquaculture, probiotic supplementation has drawn interest as a possible tactic to enhance fish health and growth performance. Probiotics' impact on *C. gariepinus* carcass composition has been the subject of current research (Umaru *et al*., 2019; Putra *et al.,* 2020 and Umaru *et al*., 2021). Since crude protein is a representation of the structural and functional proteins necessary for growth and development, it is an essential part of the composition of fish carcasses. Probiotic supplementation in *C. gariepinus* has been shown to significantly improve crude protein content in a number of investigations (Umaru *et al.,* 2019; Putra *et al.,* 2020; and Umaru *et al*., 2021). According to Umaru et al. (2019), when *C. gariepinus* was fed a Multispecies Commercial Probiotic, the carcass's crude protein content at T1 (1g) and T2 (2g) was noticeably greater than in the Control group.

Another crucial factor in carcass composition is the amount of crude lipid, which is used as an energy source and supports a number of metabolic processes. The impact of probiotic supplementation *on C. gariepinus*'s crude lipid content has been inconsistent. Probiotic addition has been linked to higher lipid content in certain trials (Umaru *et al*., 2021). For instance, *C. gariepinus* fed a diet supplemented with a multi-species probiotic blend showed increased levels of crude lipids, according to Umaru *et al.* (2019). Crude fiber content affects the fish's gastrointestinal health and is the portion of

the meal that cannot be digested. Few research have explicitly examined how probiotics affect the amount of crude fiber in *C. gariepinus*. Probiotic inclusion has been shown to improve fiber digestibility in other fish species, though, which may have a beneficial effect on *C. gariepinus's* crude fiber level.

2. MATERIALS AND METHODS

2.1 Experimental Design

The study was conducted in a private fish farm (Shehu Fish farm) in Jimeta/Yola. Three Hundred and Sixty (360) *Clarias gariepinus* of (3.35±0.47) weight (g) and (2.30±0.12) length (cm) were obtained from the same fish farm. After acclimatization period of two weeks to the rearing conditions, experimental fish were randomly divided into four groups of triplicate tanks with 30 fishes in each 300L(0.9mx0.6mx0.5m) tank in a semi flow through system. Water was changed daily. Physicochemical parameters such as temperature, dissolved oxygen, ammonia and pH were monitored and maintained at optimal level. Experimental diets were given to fish at 5% of their body weights and feeding was conducted three times a day at 06.00, 12:00 and 18:00 for a period of five months.

2.2 Collection and Processing of Fish Samples

Ten samples of matured *Clarias gariepinus* were collected from Shehu Fish farm in Jimeta/Yola and taken to the microbiology lab of Modibbo Adama University Yola for processing. The fishes were washed in sterile distilled water and then the samples were dissected to remove the digestive tracts in the sterilization condition. The digestive tracts were homogenized in the same sterile distilled water for centrifugation. After which the supernatants were taken and serially diluted in sterile distilled water in the test tubes to 10^{-2},10^{-3},10^{-4},10^{-5},10^{-6}, and10^{-7} dilution and they were poured on nutrient agar plates. The plates were incubated for 24hrs at room temperature.

2.3 Isolation and Confirmation of *Lactobacillus* and *Saccharomyces* spp

Individual colonies from incubated plates were taken with typical characteristics. Namely pure white, off white, yellow, small (2 mm diameter) with entire margin was picked and sub-cultured into selective media, MRS agar (De Man, Rogosa and Sharpe agar) is selective for *Lactobacillus* while PDA (Potato dextrose agar) is selective for Saccharomyces sp. Selective colonies were characterized and identified following Bergey's Manual of Systematic Bacteriology (Whitman *et al.,* 2009) for their colony and cell morphology, gram staining, biochemical and physiological tests (Li *et al.,* 2020). The need for gram staining was to identify the isolates as specific *Lactobacillus acidophilus* and *Saccharomyces cerevisiae*. Biochemical test was done to confirm each isolates organisms to species level. After confirmatory testing, the stock organism was placed in slant culture bottles as reference sample for the multiplication which were later mixed with the fish feed as experimental treatments.

2.4 Formulation of Experimental Diet

The basal ingredient for formulating the diet was yellow maize (*Zea mays,* crude protein = 10%) locally sourced from the local market in Jimeta Yola, Adamawa State. Source of protein include Clupeid fish meal with a crude protein content of 75% obtained from Jimeta market Yola. Also, soya bean cake (crude protein of 40%) was used as one of the supplementary protein sources. The fixed ingredient used in the diet formulation comprised of cassava starch flour sourced locally from the market and used as the binder for the ingredients for easy pelleting. Other ingredients included vitamins/ mineral pre-mix, and table salt obtained from the local market in Jimeta Yola, Adamawa State.

All the feed ingredients were weighed using a sensitive electronic weighing balance (Sertorius CP8201). The feed ingredients were processed and milled into fine particle sizes following standard procedures (Ademulegun and Koleosho, 2012). The dried and fine, ingredients were weighed and divided into four parts. The isonitrogenous and isocaloric diets were formulated to contain varying different probiotic content in equal proportions (T1, T2, and T3). The ingredients were thoroughly mixed and warm water was added and stirred until dough was formed. The dough was properly mixed and extruded through 2mm dice. The pellets were dried to constant weight and stored in plastic bags at room temperature. Diet formulation was done according to "Pearson's Square" method to determine the percentage replacement level of individual ingredients at 42% crude protein. Feed ingredients was processed and milled to fine particle size. The dried ingredients were weighed using a sensitive electronic weighing balance (Sertorius CP8201) and divided for supplementation of probiotic for the trail exercise. The test diets for each treatment were prepared as follows:

i. T1 = LA = *L. acidophilus* at 100%
ii. T2 = SC = *S. cerevisiae* at 100%
iii. T3 = LASC50 = *L. acidophilus* and *S. cerevisiae* at 50%
iv. T4 = LASC0 = *L. acidophilus* at 0% (Control)

Table 1: Percentage Composition of ingredients (g/100g diets)

Inclusion levels of probiotic (%)	LASC0	LA100	LASC50	SC100
Fishmeal (68%)	32.00	32.00	32.00	32.00
Yellow maize (10%)	30.00	30.00	30.00	30.00
Vitamin/mineral premixes	1.0	1.0	1.0	1.0
Lysine	0.5	0.5	0.5	0.5
Methionine	0.5	0.5	0.5	0.5
Palm oil	1.0	1.0	1.0	1.0
Cassava starch	1.0	1.0	1.0	1.0
Dicalcium phosphate	0.5	0.5	0.5	0.5
Common salt	0.5	0.5	0.5	0.5
Total	100.0	100.0	100.0	100.0

LA = *Lactobacillus acidophilus*; SC = *Saccharomyces cerevisiae*

2.5 Determination of Proximate Composition

The proximate composition of whole fish (*C. gariepinus*) carcass was carried out to determine the following factors.

Moisture content of Clarias gariepinus

Moisture content was determined using the method of AOAC (2005). A clean glass petri dish was dried to a constant weight and weighed (w_1). Two grams of the sample was weighed into the glass Petri dish (w_2) and then placed inside a hot air oven for 5 hours at $130^0 \pm 3^0$c. It was allowed to cool for ten (10) minutes in a desiccator each time before weighing. The procedure was continued until a constant weight was obtained (w_3). The moisture content was calculated thus:

$$\%\ Moisture\ Content = \frac{w_2 - w_3}{w_2 - w_1} \times 100$$

2.5.1 Ash content of *Clarias gariepinus*

Ash content was determined using the method of AOAC (2005). Two grams of the finely ground sample was weighed (w_2) into a previously weighed, clean and empty porcelain crucible (w_1). The sample was placed in a muffle furnace and preheated to 600^0C, held at this temperature for two (2) hours. The crucible and its residual ash were removed from the furnace and then allowed to cool in a desiccator before being weighed (w_3).

The ash content was calculated thus:

$$\%\ Ash\ = \frac{w_2 - w_3}{w_2 - w_1} \times 100$$

2.5.2 Crude fibre content of *Clarias gariepinus*

The crude fibre was determined using the method of AOAC (2005). A defatted finely ground sample from fat determination was transferred into a quick fit flask. Then 150ml of 1.25% sulphuric acid was added and the mixture boiled for 30 minutes, the solution was allowed to cool and filtered using Buchner funnel fitted with Whatman filter paper.The soluble matter was rinsed three (3) times with hot distilled water, once with sulphuric acid and lastly with 95% ethanol. The filter paper containing residue was removed from the porcelain crucible and dry in the oven for 2hours at 130^0C, cooled in a desiccator and weighed (C2). This residue was then incinerated in a muffle furnace at $550^0 \pm 10^0$c for two hours cooled in a desiccator and reweighed (C3).

$$\%\ \text{Crude fibre} = \frac{c_2 - c_3}{w} \times 100$$

The loss in weight on ashing (incineration) = $C_2 = C_3$, Weight of original sample = w

2.5.3 Crude protein (Kjeldahl method) content of *Clarias gariepinus*

Nitrogen was determined by the micro Kjeldahl method (crude protein) according to AOAC (2005). The nitrogen of protein and other compounds was converted to ammonium sulphate by acid digestion with boiling sulphuric acid. Two grams (2g) of the sample was weighed into a 100 ml Kjeldahl flask and about 200 mm of catalyst mixture (potassium sulphate, copper sulphate and selenium powder) was added. Exactly 10.0cm^2 of concentrated sulphuric acid was also added to the content in the flask. The content in the kjeldahl digestion flask was then heated gently for few minutes at first in a kjeldahl digestion heating unity until frothing ceases and then more vigorously for one (1) hour (with occasional rotation of the flask to ensure even digestion and to prevent overheating of the content). The solution was allowed to cool and diluted with 100cm^{3}of distilled water. Afterward, 10.0cm^3 aliquot of the distilled water - dilute solution was pipetted into a distillation chamber of micro Kjeldhal distillation apparatus. 10.0cm^3 of 40% sodium hydroxide solution was added. The solution was steam distilled into 10.0cm^3 of 4% boric acid and a drop of mixed indicator (methyl red and methyl blue ratio 2:1). The content was titrated with standard 0.01N or 0.02N hydrochloric acid until a grey colour end point was obtained.

$$\%N = \frac{\left((a-b) \times 0.01\ \times 14.0057\ \times c\ \times 100\right)}{d\ \times e}$$

a = titre value for the sample
b = titre value for the blank
c = Volume to which digest is made up with distilled water
d = Aliquot taken for distillation
e = Weight of dried sample (mg)
To convert to % crude protein, multiply by the necessary conversion factor (6.25).
The protein was calculated as: Crude protein= 6.25×%N

2.5.6 Growth performance and feed utilization computation

Weight gain (biweekly gain in weight, average weight gain per fish and tank), Mean Length Gained (MLG), specific growth rate (SGR), and feed conversion ratio (FCR) were determined using the formulae indicated below:

Weight gain (MG): This was calculated using the formula;
Weight gain of fish = Final weight (W_f) - Initial weight (W_i)
Mean weight gain (MWG): The mean weight gain was calculated using the formula;
Mean weight gain (g) = $W_f - W_i$ (Putra *et al.*, 2017)
Where: W_f = Final average weight (g); W_i = Initial average weight (g)

Specific growth rate: This is the percentage rate of change in the logarithm body weight. It was computed according to Muchlisin *et al*. (2016). The SGR was calculated using the formula below:

$$SGR(\%\ day^{-1}) = \frac{L_n W_t - L_n W_o}{\text{t}} \times 100$$

Where, SGR = Specific growth rate ($\%\ day^{-1}$), t = experimental period (days), W_o= initial weight (g), W_t = final weight (g).

Feed conversion ratio (g): This is the amount of unit weight of food that specimens were able to be converted into unit flesh. It was determined according to (Eyo and Ekanem, 2011)

$$FCR = \frac{\text{Feed intake (g)}}{\text{Total weight gain (g)}}$$

Feed intake (g): This was calculated as 5 % of fish bulk body weight X No.of days (Eyo and Ekanem, 2011)
Feed conversion efficiency: This was calculated using the formula (Eyo and Ekanem, 2011)

$$\text{Feed conversion efficiency} = \frac{\text{Weight gain (g)}}{\text{Feed consumed (g)}} \times 100$$

Relative growth rate (RGR): This is the percentage ratio of the weight gained to the initial body weight and will be determined as follows:

$$\text{Relative growth rate} = \frac{\text{Weight gain (g)}}{\textit{Initial Weight (g)}} \times 100$$

$$\textbf{Condition factor (CF)} = \frac{(\text{Weight of fish (g)} \times 100}{(\text{Length of fish, L})^3 (\text{cm})}$$

The weight and length measurement were used to determine the growth performance of the fishes. The feed supplied were also used to determine the nutrient utilization following the methods of Aderolu and Sogbesan,(2010).

Percentage survival rate: The survival rate was calculated by the following formula based on Muchlisin *et al*. (2016):

$$Survival(\%) = \frac{N_O - N_t}{N_O} \times 100\%$$

Where, N_O= total fish at the start of the experiment, N_t= total fish dead during of experiment.

3. RESULTS AND DISCUSSION

The highest total final weight (608.30±9.34g) was recorded in T1(Lactobacillus supplemented group and the lowest was recorded in T4, the control (463.70±3.07) g so also the highest value for mean weight gain (30.35±0.47) g, relative growth rate (367.17±22.49) % and specific growth rate (0.09±0.01) were recorded in the *Lactobacillus* fed group and lowest of these parameters, (23.07±0.15) g, (201.53±9.27) g and(0.05±0.003) g respectively were recorded in the control group as seen in table 2. Numerous studies showcased positive probiotic results revealing improved growth performance (Kuebutornye *et al,* 2020, Silva *et al*, 2021, Yi *et al,* 2019, Guidoli *et al.,*2018). Probiotics stimulate growth axis, increasing the transcription of insulin-like growth factor 1(1GF-1) and growth hormone receptor (Yi *et'al.*, 2019). In contrast, Smith (2024) revealed that while long-term probiotic supplementation decreased mortality by approximately 10% compared to the control group, there were no positive effects on fish growth. The study concluded that despite improved survival rates, the probiotic supplementation did not enhance growth performance in Chinook salmon This difference may be due to the type of bacteria used. The yields for SGR in this investigation (0.09±0.01) were lower compared to those of other studies. (Mocanu, *et al.*, 2022) reported that diet pellets supplemented with *Saccharomyces boulardii* resulted in SGR of about 2.7%. This can be accrued to the fact that SGR depends on so many factors like weight, age, rearing condition and diet.

Table 2: Growth Indices and Survival Rate of *Clarias gariepinus* fed *Lactobacillus acidophilus* and *Saccharomyces cerevisiae* Diet

Parameters	T1	T2	T3	T4	p-value
TIW(g)	1.67±0.12a	2.17±0.23a	1.97±0.23a	2.30±0.12a	0.161
TFW(g)	608.30±9.34a	511.00±5.92c	542.20±1.61b	463.70±3.07d	0.000
MWG(g)	30.35±0.47a	25.44±0.28c	27.01±0.08b	23.07±0.15d	0.000
MIW(g)	3.30±0.36a	2.90±0.12a	2.70±0.25a	2.77±0.20a	0.381
MFL (cm)	28.10±2.88a	26.87±2.78c	27.13±1.64b	25.10±0.86d	0.81
RGR (%)	367.17±22.49a	239.87±23.72bc	281.67±32.02b	201.53±9.27c	0.006
SGR(%/day)	0.09±0.01a	0.06±0.01ab	0.07±0.012ab	0.05±0.003b	0.05
CF	3.17±1.17a	3.06±1.12a	2.83±0.47a	2.97±0.29a	0.993
SR (%)	65.57±1.13b	66.67±1.937b	81.10±2.20a	53.33±1.93c	0.000

Values (means +SE) in the same row with different superscripts differ significantly (p<0.05). Key: Total initial weight=TIW, Total final weight=TFW, Mean weight gain=MWG, Mean initial length=MIW, Mean final length=MFL, Relative growth rate=RGR, Specific growth rate=SGR, Condition factor (k) = CF, Survival rate = SR, T1-*Lactobacillus* supplemented diet, T2-*Saccharomyces* supplemented diet, T3-*Lactobacillus*+*Saccharomyces* supplemented diet, T4-Basal diet.

Table 2: Body Composition of *Clarias gariepinus* Fed *Lactobaccilus acidophilus* and *Saccharomyces cerevisiae* Diet

Nutrients (%)	T1	T2	T3	T4	p-value
CP	18.95±0.37ab	17.69±0.51b	19.00±0.27a	18.05±0.29ab	0.094
CL	1.75±0.03a	1.93±0.09a	1.75±0.01a	1.86±0.03ab	0.089
CF	1.21±0.06a	1.22±0.02a	1.26±0.06a	1.29±0.03a	0.617
AS	2.58±0.08a	2.92±0.06a	3.10±0.35a	2.95±0.04a	0.301
NFE	10.20±0.59a	10.78±0.27a	11.16±0.18a	10.88±0.16a	0.318

Values (means +SE) in the same row with different superscripts differ significantly (p<0.05). Key: CP = Crude Protein, CL= Crude Lipid, CF = Crude Fiber, AS = Ash, NFE = Nitrogen free extract, T1-Lactobacillus supplemented diet, T2-Saccharomyces supplemented diet, T3-Lactobacillus+Saccharomyces supplemented diet, T4-Basal diet.

Table 3 Physico-chemical Parameters Recorded during the Experimental Period

Parameters	T1	T2	T3	T4	p-value
Temp (°C)	27.56±2.17	27.23±3.07	27.43±3.12	27.10±2.06	0.052
Dissolved Oxygen (mg/L)	6.13± 0.36	6.27± 0.29	6.17± 0.47	6.33± 0.12	0.975
pH	6.73± 0.12	7.03± 0.12	7.27± 0.19	7.30± 0.15	0.073
Ammonia (mg/L)	0.05± 0.01	0.03± 0.02	0.04± 0.01	0.04± 0.01	0.772
Conductivity (µs/cm)	401.00± 13.58	441.67±20.50	411.67±11.02	407.33± 8.57	0.146

Values (means +SE) in the row with the same superscripts do not differ significantly (p>0.05). Key: DO = Dissolved oxygen, pH = Hydrogen ion concentration, EC = Electrical conductivity, Temperature=Temp, T1-Lactobacillus supplemented diet, T2-Saccharomyces supplemented diet, T3-Lactobacillus+Saccharomyces supplemented diet, T4-Basal diet.

Body Composition

The carcass crude protein was insignificantly (p< 0.05) highest (19.00±0.27%) in the group fed the combination of both probiotics and the lowest (17.69±0.51%) was observed in the group fed with only *Saccharomyces* supplemented feed. There were no significant (p> 0.05) differences in crude lipid, crude fibre, ash content, and nitrogen-free extract in all the treatments and the control. The neutral effect of both probiotics here may be attributed to so many factors such as robustness of the species which could have masked any potential effects of the treatment on body composition (Milián-Sorribes *et al*, 2021), insufficient treatment duration to induce any significant changes (Ahmed *et al*., 2018 and da Parata *et al*.,2021), genetic variability within the population might have overshadowed any potential effects or even methodology limitations. This outcome aligns with the studies of Adeyemo and Olaniyi, (2019) who found no significant differences in the body composition of *Clarias* ssp fed different probiotic groups. So also, Akinwande and Dada, (2016). Ahmed *et al*., (2018), etc. however it disagrees with the work of Shehata *et al., (*2024) who discovered a significant difference in crude protein and lipids of *Mugil capito* when fed with *Saccharomyces cerevisae* and *Lactobacillus bugaricus.*

The incorporation of probiotics in the diet of *Clarias gariepinus* (African catfish) here showed improvements in growth performance but with little to no effect on body composition (carcass composition). Even though Probiotics enhanced the efficiency of nutrient absorption by producing digestive enzymes (e.g., amylases, proteases, lipases) that improve digestion and absorption, modulating gut microbiota to increase beneficial bacteria, which aids in better feed conversion, and enhancing intestinal morphology (longer villi, improved surface area) for better nutrient uptake. However, while improved digestion and absorption promote growth (length and weight gain), they may not necessarily alter the proportions of protein, fat, and ash in the carcass. Also,responses of *Clarias gariepinus* to probiotics may be influenced by factors such as culture conditions (water quality, stocking density, culture system) and feed formulation.

Water Quality

Water temperature is a major determinant of fish growth in pond-based fish farming. Unlike offshore aquaculture, temperature in ponds can be influenced to some extent by factors such as pond depth, shading, water exchange, and management practices. The current study revealed no significant difference in the temperature used to raise *C. gariepinus* among all treatments including the control. However, temperature values were within the optimum level for rearing of *Clarias gariepinus*, (27.56±2.17- 27.10±2.06). Oxygen and pH concentration were within the acceptable level throughout the experiment across all treatments. However, ammonia concentrations in water increased insignificantly in all treatments nevertheless it was within the permissible range of 0.01 to 1mg/l (Soler *et al.,* 2021).

4. CONCLUSION

The experiment demonstrated efficacy of probiotics in enhancing growth and survival of *Clarias gariepinus.* Among the probiotics tested*, Lactobacillus acidophilus* produced the best result as the most effective strain in improving the mean weight gain, relative growth rate, specific growth rate and condition factor of *Clarias gariepinus* while the best survival rate was obtained in the group fed diet supplemented with both *Lactobacillus acidophilus* and *Saccharomyces cerevisae* so also the best crude protein content was obtained in this treatment group. However generally there was little or no effect of probiotics on the body composition of *Clarias gariepinus* in this study. Therefore, it is recommended that farmers should incorporate probiotics such as *Lactobacillus acidophlus* into the diet of *Clarias gariepinus* to maximize weight gain and improve feed conversion ratio (FCR).

REFERENCES

Ademulegun, T. I and Koleosho, A. T. (2012). Effects of processing method on the nutrient composition of maize/soya complementary food. *Journal of Pharmacy and Biological Sciences*.4(1),39-43.

Aderolu, A.Z. and Sogbesan, O.A. (2010). Evaluation and potential of cocoyam as carbohydrate source in catfish *Clarias gariepinus* (Burchell, 1822) juvenile diets. *African journal of General Agriculture* 5(6),453-457.

Adeyemo, A. A., Adeniyi, A. A., and Orode, A.O. (2019). Effects of water temperature on growth performance and body composition of *Clarias gariepinus*. *Journal of thermal Biology*, 86,102-384.

Ahmed, N., Thompson, S and Glaser, M. (2019). Global aquaculture productivity, environmental sustainability, and climate change adaptability. *Environmental Management*, 63, 159-172.

Akinwande, A. A and Dada, A. A. (2016). Growth and nutrient utilization of hybrid catfish *Heteroclarias* fed maggot meal at varying inclusion levels. *African Journal of General Agriculture*, *2*(1),93-101

Dawood, M. A, Koshio, S, Abdel-Daim, M. M and Van Doan, H. (2019). Probiotic application for sustainable aquaculture. *Reviews in Aquaculture*, 11(3), 907-924.

Doroteo, A. M., Pedroso, F. L., Lopez, J. D. M and Apines-Amar, M. J. S. (2018). Evaluation of potential probiotics

isolated from saline tilapia in shrimp aquaculture. *Aquaculture International*, *26*, 1095-1107.

Eyo, V. O. and Ekanem, A. P. (2011). Effect of feeding frequency on the growth, food utilization and survival of African catfish (*Clarias gariepinus*) using locally formulated diet. *African journal of environmental pollution and health*, *9*(2), 11-17.

Fath El-Bab, A. F., Majrashi, K. A., Sheikh, H. M., Shafi, M. E., El-Ratel, I. T., Neamat-Allah, A. N., and Naiel, M. A. (2022). Dietary Supplementation of Nile Tilapia *(Oreochromis niloticus*) with β-Glucan and/or *Bacillus coagulans*: Synergistic Impacts on Performance, Immune Responses, Redox Status and Expression of Some Related Genes. *Frontiers in Veterinary Science*, 9, 101-115.

Guidoli M. G., Mendoza J.A, Falcon S.L, Boeringer S.I, Sanchez S., Macias, M. E. F. N. (2018). Autochthonus probiotic mixture improves biometrical larvae of *Piaractus mesopotamicus* (*Caracidae, characiforme teleostei*). *Aquaculture*,3(1),65-73.

Gule, T. T., and Geremew, A. (2022). Dietary Strategies for Better Utilization of Aquafeeds in Tilapia Farming. *Aquaculture Nutrition*, 8,201-210.

Husain, S., Allotey, J., Drymoussi, Z., Wilks, M., Fernandez-Felix, B. M., Whiley, A., and Millar, M. (2020). Effects of Oral Probiotic Supplements on Vaginal Microbiota During Pregnancy: A Randomised, Double-Blind, Placebo-Controlled Trial with Microbiome Analysis. BJOG: s*An International Journal of Obstetrics and Gynaecology*, 127(2), 275-284.

Kuebutornye, F. K. A., Abarike, E. D., Sakyi, M. E., Lu Y and Wang Z. (2020). Modulation of nutrient utilization, growth and immunity of Nile tilapia, *Oreochromis niloticus*. The role of probiotics. *Aquaculture International*, 28,277-291.

Kumar, V., Roy, S., Meena, D. K., and Sarkar, U. K. (2016). Application of Probiotics in Shrimp Aquaculture: Importance, Mechanisms of Action, And Methods of Administration. *Reviews in Fisheries Science and Aquaculture*, 24(4), 342-368.

Lobo, C., Tapia-Paniagua, S., Moreno-Ventas, X., Alarcón, F. J., Rodríguez, C., Balebona, M. C., and de La Banda, I. G. (2014). Benefits of probiotic administration on growth and performance along metamorphosis and weaning of Senegalese sole (*Solea senegalensis*). *Aquaculture*, 433,183-195.

Luo, X., Kong, Q., Wang, Y., Duan, X., Wang, P., Li, C., and Huan, Y. (2021). Colonization of *Clostridium butyricum* in Rats and Its Effect on Intestinal Microbial Composition. *Microorganisms*, 9 (8), 15-23.

Milián-Sorribes M, C., Martínez-Llorens S, Cruz-Castellón C, Jover-Cerdá M and Tomás-Vidal A. (2021). Effect of fish oil replacement and probiotic addition on growth, body composition and histological parameters of yellow tail (*Seriola dumerili*). *Aquaculture Nutrition.* 27, 3– 16. https://doi.org/10.1111/anu.13171

Muchlisin, Z. A., Arisa, A. A., Muhammadar, A. A., Fadli, N., Arisa, I. I and Siti-Azizah, M. N. (2016). Growth performance and feed utilization of keureling fingerlings fed a formulated diet with different doses of vitamin E (alpha-tocopherol). *Fisheries and Aquatic Life*, *24*(1), 47-52.

Nayak, S. K. (2021). Multifaceted Applications of Probiotic *Bacillus* Species in Aquaculture with Special Reference to *Bacillus subtilis*. *Reviews in Aquaculture,* 13(2), 862-906.

Opiyo, M. A, Marijani E, Muendo P, Odede R, Leschen W and Charo-karisa H. (2018). A review of aquaculture production and health, management practices of farmed fish in Kenya. *International Journal of Veternary Science Medicine*, 6,141-148.

Putra A. N, Syamsunarno M. B and Ningrum W. Jumyanah, and Mustahal. (2020). Effect of the Administration of Probiotic, *Bacillus* NP5 in the Rearing Media on Water Quality, Growth, and Disease Resistance of African Catfish, (*Clarias gariepinus*). *Biodiversities,* 21(6), 2566-2575.

Ringø, E., Harikrishnan, R., Soltani, M., and Ghosh, K. (2022). The effect of gut microbiota and probiotics on metabolism in fish and shrimp. *Animals,* 12(21), 30-36.

Sahraoui, N., Dahmani, Y., Djemaa, H., Bouachaa, C., and Hornick, J. L. (2021). Effect of a Strain of *Lactobacillus* Used as Probiotic on the Biological Parameters of Tilapia (*Oreochromis niloticus). Journal of Negative Results,* 14,786-797.

Shehata, A. I., Soliman, A. A and Ahmed, H. A (2024). Evaluation of different probiotics on growth, body composition, antioxidant capacity, and histoarchitecture of *Mugil capito*. *Science Representation,* 14, 73-79.

Silva V. V., Salomão R. A. S., Mareco E. A., Dal Pai M. and Santos V. B (2021). Probiotic additive affects muscle growth of Nile tilapia (*Oreochromis niloticus*). *Aquaculture Research*, 52,2061–2069. doi: 10.1111/are.15057.

Soler P., Fara M. Barata C., Garcia-Galea E., Lorente, B., and Vinyoles, D (2021). Improving water quality does not guarantee fish health: effects of ammonia pollution on the behavior of wildcaught pre-exposed fish. *PLoS ONE* ,16(18),243-404

Umaru, J., Auta, J and Aluwong, T. (2019). Evaluation of a Multispecies Commercial Probiotic, Sanolife Pro–F on Growth Performance, Nutrient Utilizatiion and Body Composition of African Catfish Clarias gariepinus

Fingerlings. *Journal of Agriculture and Agricultural Technology*, 3(2), 6-13

Umaru, J., Ochokwu, I and Agbugui, M. (2021). Influence of Yeast-Based Commercial Probiotic on Growth Performance, Nutrient Utilizatiion and Body Composition of the African Catfish (*Clarias gariepinus*) Fingerlings. *Journal of Agriculture and Agricultural Technology*, 7(2), 155-160.

Whitman, W. B. De Vos, P. Garrity, G. M. Johes, D. Noel, R. Krieg, N. R. Ludwig, W. Rainey, F. A and Schleifer, K. H (2009): Bergeys manual of systematic bacteriology, 2nd edn. Vol. 3.

WHO, (2002). Guidelines for the Evaluation of Probiotics in Food. *Journal of London Cantorio*, April 30 – May 1.

Yi, C. C., Liu, C. H., Chuang, Y. T and Hu S. Y. (2019). A potential probiotic *Chromobacterium aquaticum* with bacterion-like activity enhances the expression of indicator genes associated with nutrients metabolism, growth performance and innate immunity against pathogen infections in zebra fish (*Danio rerio*). *Fish Shellfish Immunology*, 93, 124-134.