GROWTH, FISH PRODUCTIVITY INDEX AND MORPHOMETRIC CHARACTERISTICS OF *Clarias gariepinus* JUVENILES FED LIQUID-BASED GROWTH STIMULANT SUPPLEMENTED DIETS

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ABSTRACT
Studies have shown that plants product can be used in place of synthetic therapeutic chemical agents to improve growth, health and meat quality of cultured fish. These effects of plant supplements are specific on different fish species. Therefore, this study investigated the potential of liquid-based growth stimulants (rice water, emulsified milk and molasses) (RWEMM) as feed supplements for the culture of C. gariepinus juveniles. The experimental diet composed of control (0 ml), $RWEMM_2$ (77.5 ml), $RWEMM_3$ (155 ml), $RWEMM_4$ (310 ml) and $RWEMM_5$ (620 ml). The fish (7.72 ± 0.01g) were replicated twice with 20 fish per replicate and were fed twice daily at 3 % body biomass for eight (8) weeks. The mean weight gain, feed conversion ratio, production performance index, total length, standard length, head length, dorsal width and height were measured. Data were analysed using descriptive statistics and ANOVA at P = 0.05. Clarias gariepinus fed treated groups had better (p > 0.05) weight gain, feed conversion ratio and production performance index compared to the control. Also. C. gariepinus fed treated groups had higher values of total length, dorsal width and head length were higher in treated compared to control. There were significant differences (p < 0.05) among the dietary groups. The result suggests that combination of rice water, emulsified milk and molasses improve the growth and physiological functions of C. gariepinus juveniles.
Keywords: ***Clarias gariepinus*; Rice water; Emulsified milk; Molasses; Physiological functions; Growth**

INTRODUCTION
The African catfish, *Clarias gariepinus* is one of the most widely consumed freshwater fish in Nigeria due to its large acceptability. It inhabits such varied habitats as natural and man-made lakes, impoundments, small ponds, streams and rivers, and thrives well in deep as well as shallow waters (Nyamweya *et al.,* 2010). Success of the fish could be attributed to its indiscriminate and opportunistic feeding habits, rapid growth arte and its ability to tolerate adverse environmental conditions (Elias, 2000). *Clarias gariepinus* is an indiscriminate and opportunistic feeder ingesting a wide variety of items including algae, macrophyte tissues, insects, other fish, detritus and sand grains (Clay, 1979). African catfish are elongate with fairly long dorsal and anal fins. The dorsal fin has 61-80 soft rays and the anal fin has 45-65 soft rays. They have strong pectoral fins with spines that are serrated on the outer side. Plants have been reported to produce various effects such as antistress, growth promotion, appetite stimulation, immunostimulant, aphrodisiac and antimicrobial properties in fish (Olusola and Akinola, 2019). These advantages make natural plants a preferable alternative to synthetic additives in fish feed, there is a little or no information on utilization of rice water, emulsified milk and molasses in aquaculture for raising *C. gariepinus* which command high economic value in Nigeria. Hence, the need to use natural plants that are eco-friendly such as rice water, emulsified milk and molasses as feed supplement which could has great improvement on growth, health status and physiology functions of *C. gariepinus*. This study was aimed at investigating the effect of rice water, emulsified milk and molasses as feed supplement on growth performances of *C. gariepinus*.

MATERIALS AND METHODS
Preparation of Growth Promoter
Ten (10) cups of local rice (1900g) were soaked in a bowl of (3 Litres) water and kept at room temperature for thirty minutes, after which the water was strained into an empty jar and covered with a mesh. The starchy liquid obtained was thereafter kept at room temperature, away from sunlight. After 7 days, the starchy liquid was again filtered into a clean, empty bowl. Thereafter, a tin of milk was added to 1 litre of the whitish liquid and stirred vigorously to obtain a homogenous mixture. The mixture was stored for another 5 days, and 1 litre of molasses was added to the mixture. The combination of rice water, emulsified milk and molasses was then stored in the refrigerator until required.

Formulation and Preparation of Experimental Diet

Five experimental diets were devised and produced utilizing Pearson's square method. The liquid-based growth promoter was incorporated at varying inclusion levels of 77.5 ml, 155 ml, 310 ml, and 620 ml with feed ingredients including fish meal, soybean, groundnut cake, rice bran, maize, blood meal, di-calcium phosphate, salt, vitamin premix, vegetable oil, and starch sourced from Peace of God Feed Mill in Okitipupa, Ondo State, The liquid-based growth promoter (rice water, emulsified milk and molasses) was weighed on v/v basis (volume of growth promoter required based on inclusion levels plus volume of water required) to form a paste, to create a diet containing 40% crude protein diet, 16% ash, 10% crude fibre, 8% ether extract, 6% moisture, and 20% nitrogen-free extract. Each diet formulation was individually extruded through a 1/4-mm die mincer of the Hobart A-200T pelleting machine to produce noodle-like strands, which were subsequently mechanically fragmented into appropriate sizes for the juveniles of *Clarias gariepinus*. The pelleted diets were sun-dried, packaged in labelled polyethylene bags, and stored in a cool, dry location until needed.

Experimental System and Feeding of Experimental Fish

Two hundred and forty (240) of *C. gariepinus* juveniles *(*mean weight, 7.72 ± 0.1g) were obtained from Lokoabata Farm in Okitipupa. They were transported to the Fisheries and Aquaculture Technology Laboratory, Olusegun Agagu University of Science and Technology, Okitipupa, in a modified plastic jerry can containing sufficient water from the farm and a drop of palm oil to prevent the water from dissolved oxygen depletion and reduce stress. The fish were acclimated for one week in outdoor holding tanks at the Fisheries and Aquaculture Technology Laboratory, Olusegun Agagu University of Science and Technology, Okitipupa. During the period, the fish were fed with commercial diets (blue crown, 0.02 mm) of 40% crude protein twice daily at 3% body weight. The experiment was carried out in ten (10) experimental tanks for 8 weeks in the Fisheries and Aquaculture Technology Teaching and Research Farm. The water volume in each tank was maintained at 40 litters throughout the experimental period. Water in each tank was replaced every two (2) weeks throughout the period of the experiment to maintain relatively uniform physiochemical parameters and also to prevent fouling that may result from feed residues. Water was sourced from the institution's water station. The quantity of feed administered was adjusted every two weeks based on the new weight gain of the fish throughout the 8 weeks of the outdoor feeding trial.

Biological Evaluation

The growth performance indices such as weight gain, feed conversion ratio, production performance index and fish productivity index and survival rate were calculated as described by Olusola et al., (2022).

Morphometric Characteristics

Morphometric characteristics was carried out every two weeks of the feeding trial by using three fish samples from each treatment. Prior to the measurements of the morphometric characters, the samples were taken from each experimental bowl and allowed to drain off water after which measurements were taken using measuring tape, with the samples placed on a wooden board. The morphometric measurements were taken as described by Agbebi *et al*. (2023). The data obtained include the standard length (SL), height (H), total length (TL), head length (HL), and dorsal width (DW).

RESULTS AND DISCUSSION

Growth Performance of *Clarias gariepinus* fed Diets containing Combination of Rice Water, Emulsified Milk and Molasses for 56 days

The treated groups had the highest numerical values for final body weight, weight gain and better feed conversion ratio and production performance index compared to the control. There was no significant difference ($P > 0.05$) among the dietary groups (Table 1).

Table 1: Growth Performance of *Clarias gariepinus* fed Diets containing Combination of Rice Water, Emulsified Milk and Molasses for 56 days

	CONTROL (0)	$RWEMM_2$ (77.5 ml)	$RWEMM_3$ (155 ml)	$RWEMM_4$ (310 ml)	$RWEMM_5$ (620 ml)
IBW (g)	7.70±0.02^a	7.70±0.02^a	7.70±0.01^a	7.70±0.02^a	7.70±0.01^a
FBW (g)	22.38±3.00^a	22.24±0.38^a	24.26±0.41^a	24.07±0.01^a	22.61±0.04^a
WG (%)	14.68±2.09^a	14.54±6.38^a	16.56±0.41^a	16.37±0.01^a	14.91±0.04^a
SR (%)	85.00±5.00^{ab}	82.50±7.50^{ab}	70.00±5.00^a	77.50±2.50^{ab}	90.00±5.00^b
FCR	2.37±0.48^a	2.21±0.06^a	2.24±0.06^a	2.27±0.00^a	2.82±0.01^a
PPI (%)	22.05±3.29^a	21.45±2.50^a	20.73±1.99^a	22.65±0.73^a	23.95±1.28^a
FPI	56.70±19.30^a	54.70±7.71^a	52.11±6.27^a	55.87±1.79^a	47.55±2.36^a

IBW = Initial Body Weight, FBW = Final Body Weight, WG = Weight gain, SR = Survival Rate, FCR = Feed Conversion Ratio, PPI = Production Performance Index, FPI = Fish Productivity Index. Mean (n-2) in each row with similar superscripts are not significantly different ($p>0.05$).

Morphometric characteristics of *C. gariepinus* juveniles fed diets containing combination of rice water, emulsified milk and molasses for 56 days

The result shows that all the treated groups had better values in total length, standard length, head length, dorsal width, and height compared to the control and were significantly different ($P < 0.05$) among the dietary groups (Table 2).

Table 2: Morphometric Characteristics of *C. gariepinus* Juveniles fed Diets containing Combination of Rice Water, Emulsified Milk and Molasses for 56 days

	CONTROL (0)	$RWEMM_2$ (77.5 ml)	$RWEMM_3$ (155 ml)	$RWEMM_4$ (310 ml)	$RWEMM_5$ (620 ml)
			Total length (cm)		
Week 0	11.33±0.01[a]	11.33±0.02[a]	11.33±0.01[a]	11.33±0.01[a]	11.33±0.02[a]
Week 2	12.23±1.70[ab]	13.28±0.28[ab]	11.86±0.90[a]	11.85±0.55[a]	13.91±0.25[b]
Week 4	13.98±0.42[a]	14.28±0.52[a]	14.17±1.07[a]	13.22±0.16[a]	14.33±0.24[a]
Week 6	14.52±0.42[a]	14.66±0.50[a]	14.18±1.32[a]	14.40±0.07[a]	15.17±0.17[a]
Week 8	15.83±0.50[a]	14.95±0.79[a]	15.62±1.39[a]	14.78±0.28[a]	16.91±0.15[a]
			Standard length (cm)		
Week 0	9.90±0.02[a]	9.90±0.01[a]	9.90±0.00[a]	9.90±0.00[a]	9.90±0.01[a]
Week 2	10.80±0.30[a]	11.30±0.07[a]	9.52±1.39[a]	10.18±0.92[a]	12.27±0.07[a]
Week 4	12.27±0.24[a]	12.38±0.12[a]	12.35±0.98[a]	11.57±0.07[a]	12.53±0.13[a]
Week 6	13.16±0.00[a]	12.68±0.15[a]	12.42±0.92[a]	12.60±0.07[a]	13.16±0.00[a]
Week 8	14.07±0.07[a]	13.23±0.52[a]	13.75±1.15[a]	12.42±0.70[a]	14.27±0.44[a]
			Head length (cm)		
Week 0	3.16±0.02[a]	3.16±0.02[a]	3.16±0.02[a]	3.16±0.02[a]	3.16±0.02[a]
Week 2	3.35±1.05[a]	4.14±1.91[a]	3.42±0.82[a]	2.35±0.05[a]	2.93±0.47[a]
Week 4	4.32±0.02[a]	4.37±0.02[a]	4.18±0.05[a]	4.20±0.04[a]	4.43±0.06[a]
Week 6	4.17±0.07[a]	4.38±0.22[a]	4.30±0.70[a]	4.45±0.12[a]	4.67±0.17[a]
Week 8	4.82±0.19[a]	4.45±0.25[a]	4.80±0.37[a]	4.63±0.20[a]	5.81±0.12[a]
			Dorsal width (cm)		
Week 0	6.40±0.00[a]	6.40±0.00[a]	6.40±0.00[a]	6.40±0.00[a]	6.40±0.00[a]
Week 2	6.67±0.37[a]	6.85±0.39[a]	6.93±0.97[a]	6.73±0.07[a]	6.53±0.40[a]
Week 4	7.22±0.02[a]	7.80±0.40[a]	7.88±0.72[a]	7.45±0.00[a]	7.81±0.27[a]
Week 6	8.22±0.22[a]	7.78±0.38[a]	7.97±1.37[a]	7.98±0.02[a]	8.23±0.10[a]
Week 8	8.16±0.00[a]	8.31±0.35[a]	8.05±1.49[a]	8.28±0.18[a]	9.03±0.10[a]
			Height (cm)		
Week 0	1.83±0.00[a]	1.83±0.00[a]	1.83±0.00[a]	1.83±0.00[a]	1.83±0.00[a]
Week 2	1.90±0.10[a]	1.62±0.12[a]	1.78±0.05[a]	1.90±0.04[a]	2.05±0.15[a]
Week 4	2.48±0.08[a]	2.55±0.05[a]	2.50±0.10[a]	2.47±0.14[a]	2.52±0.09[a]
Week 6	2.61±0.05[a]	2.88±0.12[a]	2.82±0.19[a]	2.82±0.09[a]	3.00±0.17[a]
Week 8	2.64±0.04[a]	2.67±0.17[a]	2.82±0.12[a]	3.23±0.06[a]	3.48±0.32[a]

The growth performance of fish fed diets containing combination of rice water, emulsified milk and molasses had the highest weight gain, food conversion ratio (FCR) and production performance index. Although all the dietary groups had better FCR values, the least value was recorded in $RWEMM_5$ (2.82 ± 0.01) and the best was recorded in $RWEMM_2$ (2.21 ± 0.06). This result was in accord with Eunice and Olamiposi (2019), who reported better performance in growth and feed utilization in *Clarias gariepinus* fed on *Acacia auriculiformis* leaf-supplemented diets. The possible reason for the improved growth performance of *C. gariepinus* after feeding with organic growth promoter might be due to improved gut functions and feed efficiency of diet (Olusola *et al*., 2021), which ultimately stimulated the appetite of fish (Omitoyin et al., 2019). The result obtained in this study showed that there was an increase in head length, total length, dorsal width, and height in the treated groups when compared to the control group. Generally, it was observed that the head length, standard length, total length, dorsal width, and height increased as the week of exposure increased. Also, the result in Table 2 revealed that as the inclusion level of the organic growth promoter increased, the morphometric characteristics increases, and there were significant differences ($P < 0.05$) among dietary groups at 6 and 8 weeks. This result was in agreement with Olusola *et al*. (2022), who reported an increase in the values of head length, standard length, total length, dorsal width, and

height in the treated groups when compared to the control of *C. gariepinus* fed with *Cinnamomum zeylanicum* Linn. Similarly, Fawole *et al.* (2021) reported improved body measurements and weight gain with emulsified milk, while Adedeji *et al.* (2023) found that molasses enhanced length and weight metrics in catfish.

CONCLUSION

Based om the results of this study, the liquid-based growth stimulant promotes better growth and physiological functions in *C. gariepinus* juveniles. Therefore, the liquid-based growth stimulant at 330 ml in the diets of *C. gariepinus* juveniles is recommended for profitable performance.

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