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RESEARCH ARTICLE

Effect of Different Artificial Diets on the Culture Potential of *Labeo victorianus* (Boulenger, 1909) Reared in Aquaria.

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Abstract

Culture potential of *Labeo victorianus* was investigated using three different diet treatments for 8 weeks in $0.24m^3$ capacity aquaria. Aquaria tanks was filled with 50 liters of water and stocked with *Labeo victorianus* fry of mean weight 0.54 ± 0.02 g and mean length 4.42 ± 0.1cm at a stocking density of $2L^{-1}$. Three different dietary treatments were performed in replicates: Treatment 1: *Rastrenobola argentia*, maize bran, sunflower seedcake. Treatment 2: *Caradina niloticus*, rice bran, sunflower seedcake. Treatment 3: *Rastrenobola argentia*, wheat bran, cotton seedcake. The fish were fed powdered diets at 3% body weight twice daily with the different diets, which contained 30% crude protein. Physico-chemical parameters of the aquaria water were recorded weekly while mortality records were done daily. There was significant difference in specific growth rate (SGR) between diet 1 and 2 ($P < 0.05$) and diet 1 and 3 ($P < 0.05$), with diet 1 recording 0.53% compared to 0.42% and 0.45% for diet 2 and 3 respectively. There was no significant difference between diet 2 and 3, ($P = 0.605$).The mean weight gain of individual fish were 0.45 ± 0.02, 0.31 ± 0.03 and 0.41 ± 0.01 for diets 1, 2 and 3 respectively. There was positive correlation between length and weight ($r^2 = 0.8352$). The survival rates and water quality parameters were similar in all the treatments ($P < 0.05$). The low growth rate in Diet 2 could be attributed to high fiber content of rice bran, which makes it difficult to digest and thus less palatable. Poor growth rate in Diet 3 was attributed to gossypol, which is a toxic chemical contained in cotton seed meals. *Labeo victorianus* fry can adapt to culture conditions when fed appropriate supplementary diet.

Introduction

Labeo victorianus is a fast-growing, bottom-feeding omnivorous freshwater cyprinid endemic to Lake Victoria basin (Cadwalladr 1965; Greenwood 1966) *Labeo victorianus* (Pisces: Cyprinid), (Boulenger, 1901) also known as Ningu by the local community in Kenya is a migratory species that spends most of its life in the lake and ascends the rivers

to breed during the two rainy seasons, where it spawns in lateral flood pools and flooded marshland (Cadwalladr 1965). *Labeo victorianus* is one of the species that is commercially important yet ecologically endangered (Rutaisire & Booth 2005). In the past, it was widely distributed in the shallow shoreline waters of Lake Victoria and its tributary rivers (Greenwood 1966), but during the course of forty years, it has gone from being the basis for the world's most important fishery of a potamodromous species (Cadwalladr 1965) to being limited to small catches at river inlets (Rutaisire & Booth 2005). This is illustrated in 204 metric tonnes of *L. victorianus* being caught between 1966 and 1967 (after the onset of the collapse), 20 tonnes between 1976 and 1977, and the species being nearly absent from catches by 1986 (Ochumba & Manyala 1992; Balirwa *et al*., 2003). Recognizing the declining stocks of this species, which is still in high market demand, the current study investigates the culture potential of this species. Currently, few protocols for the aquaculture of this species are available (Rutaisire & Booth 2005; Oyoo-Okoth *et al*., (2011).

For successful and sustainable fish culture, it is important to consider the factors that influence its production such as feed type, ration size and how they may influence on growth (Ogello *et al*., 2014; Zannatul *et al*,. 2014**).** A species that adapts to artificial diet and supplementary feeding is a good candidate for aquaculture; therefore the nutritional needs must be understood. Today, little information exists on the dietary requirements and culture potential of *Labeo victorianus* (Owori-Wadunde 2012), yet feeding and breeding are pre-requisite factors in culture of any animal.

Formulated feeds are an important source for supporting fish production considering that confined fish has no access to a variety of natural food which is a source of all required nutrients. The feeds enhance survival, growth and production performance. Several studies have been carried out to evaluate the effect of feeding frequency on growth, survival, feed intake, body composition among other aspects of fish development in different species of *Labeo* (Webster *et al*., Dada *et al*., 2002). However, there is limited information on *Labeo victorianus* performance under formulated feeds. This study focuses on the effects of three different diets on the growth and survival of *Labeo victorianus* fry with the aim of obtaining the right feeds for *L. victorianus* under culture system.

Materials and methods

Experimental design:

The study was conducted in Kenya Marine & Fisheries Research Institute (KMFRI), Sangoro Aquaculture Research station (034^0N 58.1^0E and latitude 0^042^0N 50.44^0S) at the laboratory from 4th, February to 4th, April 2014. The aquaria used in this study were $0.24m^3$. Each of the 9 aquaria tanks was filled with 50 liters of water and randomly stocked with *Labeo victorianus* fry of mean weight 0.54 ± 0.02 g and mean length 4.42 ± 0.1cm at a stocking density of 2 fry L^{-1}. Three different dietary treatments were executed in replicates, where Treatment 1 was composed of *Rastrenobola argentia*, maize bran, and sunflower seedcake. Treatment 2: *Caradina niloticus*, rice bran, and sunflower seedcake. Treatment 3: *Rastrenobola argentia* wheat bran and cotton seedcake. The fish were fed powdered diet *ad labium* twice daily with the different diets, which contained 30% crude protein. The aquariums were kept aerated using air stones connected to electric air pump. Physico-chemical parameters of the aquaria water were monitored weekly while mortality records were taken daily

Broodstock collection

Labeo victorianus brooders were collected by use of an electrofisher from River Mara situated south of the Kenyan Rift Valley in October, 2013; this is the time of the year when most of the brooders are gravid (Owori-Wadunde 2012;Oyoo-Okoth *et al*.,2011). Gravid males and females were collected upon identification through a gentle squeeze on the belly. Gravid males released milt and females released golden green eggs upon the gentle squeeze. The brooders were then transported in oxygen bags to Sangoro Aquaculture Research Station for semi artificial propagation.

Propagation procedure

The female brooders were injected intramuscularly with 2ml fresh pituitary hormone extracted from catfish (C.g.PE) and dissolved in saline solution. The brooders were put in breeding tanks at a ratio of 2 females: 1 male. The breeding tanks were then exposed to continuous running fresh water over a period of 12 hours for maximum aeration. The prevailing temperature of the tank was fixed at 23^0C ± 2 using thermo heaters (Orina *et al*., 2013).The eggs enclosed in jelly like shells that created a water proof environment for the eggs hence protecting the delicate eggs. The eggs hatched after 39 hours of spawning and broodstock were removed immediately after spawning to limit egg damage. Hatchlings were separated from egg shells to limit fungal infection and water pollution which could lead to infections and eventual mortality.

The hatchlings were nursed for one month within these tanks while feeding them on live rotifer and egg yolk the rotifers were harvested from ponds within the station using zooplankton net. They were then transferred to outdoor nursery tanks where further nursing continued. This process continued for four months before the fingerlings were transferred to the indoor glass aquaria for commencement of the feed trial experiment. The aquaria tanks were aerated throughout the experiment.

Growth evaluation of *Labeo victorianus* fry

Random sample of 30 fry per tank was subjected to initial Length-Weight measurements before stocking them at 2 fry L^{-1} in the nine 50L aquaria. Feeding using the three formulated diets 30% CP was performed twice a day (at 10.00 am and 4 pm *ad labium*. The water in the aquaria was exchanged once every week. This was done by siphoning out 50% of the water and filling the aquarium with equal volume of fresh water. Length data (Total length) of a sample population of 30 fish was taken using 30cm ruler while weight measurements were taken using 0.01g sensitive weighing balance on bi-weekly basis. Physico-chemical parameters of the aquaria water were taken weekly while mortality records were taken daily. Dissolved oxygen and pH were measured directly using a digital electronic oxygen meter (NSI, Model 58, USA). Growth parameters were calculated as follows:

Mean weight gain (g) = mean final weight – mean initial weight

$$\text{Specific growth rate (SGR); \%/day} = \frac{\ln(\text{final weight}) - \ln(\text{initial weight})}{\text{Number of experimental days (240)}} \times 100 \text{ (Brown, 1957)}$$

Survival = (Number of fish harvested /Number of fish stocked) ×100

Statistical analysis:

Before statistical analysis, normality of the data was determined using Shapiro-Wilk test, while homogeneity of variance was ascertained using Levene's test. The data obtained was subjected to one way analysis of variance (ANOVA) using S.P.S.S. version 16.0 (2007) computer packages. Comparisons for significantly different means was performed using Tukey test. Differences were considered significant at $P < 0.05$.

Results

Growth performance parameters for *L. victorianus* in aquaria under varying treatments during the 60-day experimental period are presented in Table 1.

Table 1: Proximate composition of the ingredients of the experimental diets **(**Munguti *et al*., 2012**).**

Product	**n**	***DM**	**CP**	**EE**	**CF**	**NfE**	**Ash**
		g/kg	**g/kg DM**				
Fishmeal(*Rastrineobola argentea)*		879±0.6	551±1.7	187±1.5	13±0.6	68±1.0	182±1.5
Fresh water Shrimp(*Caridina nilotica*)		877±1.7	635±3.3	13±1.3	50±1.8	67±2.1	228±2.5
Maize (*Zea mays*) bran	8	894±3.0	118±4.6	107±2.7	55±0.7	349±3.5	29±1.3
Wheat(*Triticum aestivum*) bran	8	882±1.6	171±6.2	58±2.3	127±2.3	582±6.9	60±2.6
Rice(*Oriza sativa*)	5	923±4.2	70±3.8	41±1.6	309±2.4	349±3.5	229±2.2
Cotton(*Gossypiumspp*)seed cake	5	892±2.0	388±7.2	107±1.0	249±4.5	192±2.6	63±4.6
Sunflower (*Helianthus annus*) seedcake	5	929±0.4	259±0.1	54±0.8	368±0.2	266±0.8	51±0.1

Table 2: Growth performance of *L. victorianus* under different dietary treatments (Means±SEM).

Parameter	Diet 1	Diet 2	Diet 3
Number of fish stocked	100	100	100
Initial length (cm fish^{-1})	4.42 ± 0.07	4.21±0.08	4.14±0.06
Final length (cm fish^{-1})	5.14±0.07	4.71 ±0.04	4.84 ±0.06
Initial weight (g fish^{-1})	0.54±0.02	0.48±0.03	0.44±0.03
Final weight (g fish^{-1})	0.99±0.04	0.79±0.03	0.85±0.04
Mean wt. gain (g fish^{-1})	0.45±0.02	0.31±0.03	0.41±0.01
SGR (%)	0.53±0.03	0.42±0.01	0.45±0.01
Survival (%)	87±2.13	85±1.84	85±1.45

The results indicated no significant difference in percentage survival of *L. victorianus* fingerlings amongst all the treatments during the entire experimental period. The results obtained from the feeding trial further indicated a varied growth rate under different diets. Diet 1 differed significantly with diet 2 and 3 ($P<0.05$) but there was no significant difference between diet 2 and 3.The results have also indicated a positive correlation between length and weight ($r^2 = 0.8352$) figure 2.

The mean weight gain of individual fish in Diet 1 was higher (0.45±0.02) than those of Diet 2 (0.31±0.03) and Diet 3: (0.41±0.01) table 1 and figure 1. The results further showed a slight decline in mean weight of fish in all the diets between stocking and first week (figure 1). However, this trend changed from week two to the final week with a steady but slow mean weight gain in all the treatments figure 1.

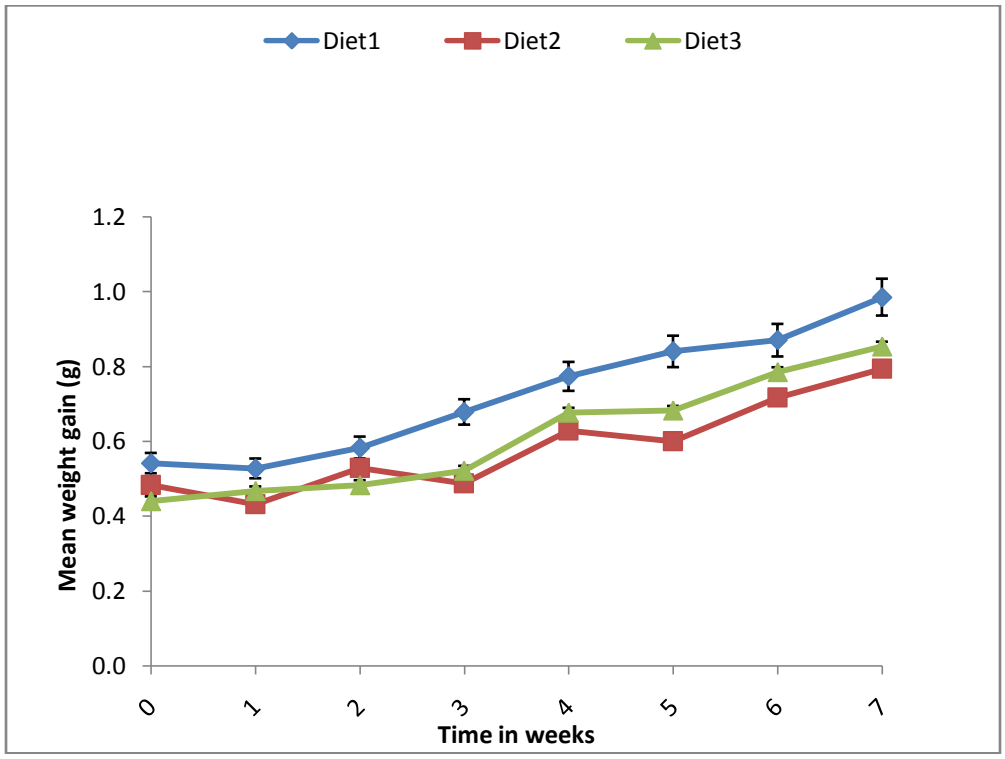

Figure 1: Growth trends in mean weight of different dietary over growth period

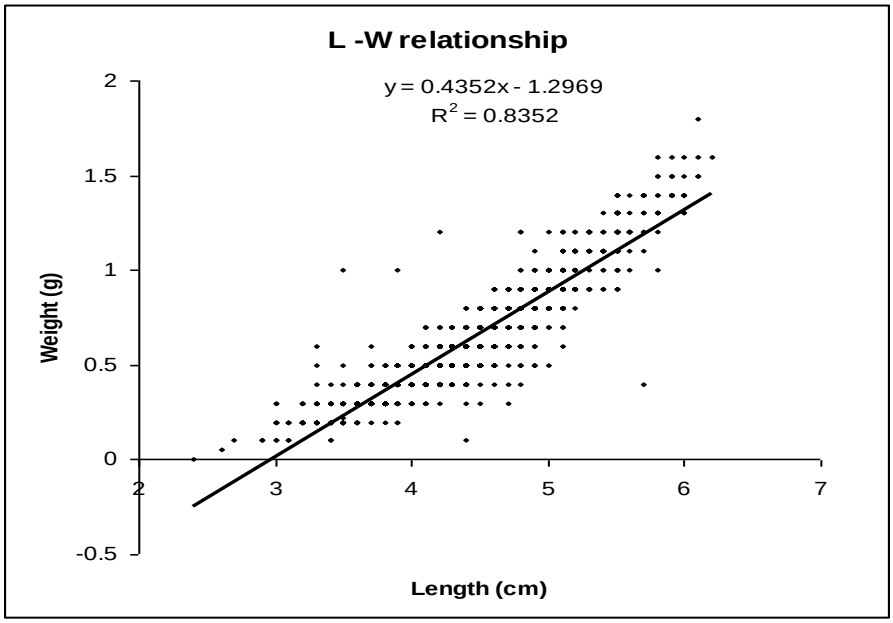

Figure 1: Length - weight relationship of the experimental Labeo victorianus fry

Physico-chemical parameters

The results posted optimum levels of water quality parameters in all the treatments (table 2). There was no significant different between the parameters in all the treatments ($p > 0.05$).

Table 2: Physico-chemical conditions of water in fingerlings rearing system under different treatments (arithmetic mean ± SE)

Parameters	Diet1	Diet2	Diet3
DO (mgL^{-1}	3.47±0.30	3.51±0.25	3.58±0.30
pH	7.16±0.04	7.17±0.40	7.17±0.05
Temperature (^0C)	22.38±0.20	22.47±0.13	22.4±0.16
NH_3	0.017±0.02	0.013±0.01	0.015±0.02
Conductivity	197.99±6.01	203.57±6.61	193.55±6.18

Discussion

Results of the present study indicate a significant growth performance of *Labeo victorianus* on varying diet formulations. This is also confirmed by a study by Owori-Wadunde (2012), where he discovered that three weeks old larvae of 'ningu' had reasonable survival and growth when fed a formulated diet containing Maize bran, "mukene" baby- soya food and mineral premixes, this is important since it reduces the cost of prolonged weaning on natural feeds which could be more expensive and complicated. In the current study, mean weight gain during the study period ranged from 0.54±0.02 to 0.99±0.04 for diet 1, 0.48±0.03 to 0.79±0.03 from diet 2 and 0.44±0.03 to 0.85±0.04 for diet 3. There was slow adaptability of the species to commercial diet perhaps due to lack of live feeds

as present in fertilized ponds hence this minimal weight gain. Sustainable aquaculture is possible when quality feed or ingredients of feed are readily available to fish farmers. In fish feed formulation, individual ingredients are chosen depending on the nutritive quality and applicability as per the age of fish. Culture potential of *Labeo victorianus* will heavily depend on the type of feed administered, the diet formulated should be palatable, digestible and has low Food conversion ratio (FCR). In this study all the diets used as treatments were made from locally available ingredients. However the variation was on the brans used in each diet. Diet 2 produced a significantly the least mean weight than 1 and 3. This can be attributed to high fiber content of rice bran which perhaps makes it less palatable or difficult to digest Jaravata *et al*., (2004) discovered significantly lower growth of *Oreochromis niloticus* on a diet containing rice bran. These findings are similar to those of Ashraf et al, (2008) who found out that rice bran limits growth ability of *Chrrhinus mrigala* fingerlings. Diet 3 contained cotton seedcake which is known to contain several anti-nutritional substances including gossypol which depresses growth of fish and may cause intestinal and internal organ abnormalities thus affecting growth, Perhaps, this explains the significantly low mean weight gain of diet 3 compared to diet 1. To support growth, (Francis et al., 2001) recommend solvent extraction of glandless cotton seed meal.

In the current study, there was low mortality of *Labeo victorianus* fry in this experiment because there was maximum aeration of the aquaria tanks which ensured that the recommended levels of physico- chemical parameters for aquaculture were maintained (Boyd, 1982; Beveridge 1996), This therefore indicated that growth of *Labeo victorianus* fry was not affected by water quality, but the variation in the quality of different diets.

Fish survival among the treatments was not significant perhaps due to constant aeration, water exchange and good fish handling. Water quality parameters were within the acceptable range as recommended for tropical aquaculture.

Conclusion and recommendations

Labeo victorianus fingerlings have the potentiality to adapt to culture conditions considering the positive growth over the experimental period when fed supplementary diet. In this study diet 1 containing; *Rastrenobola argentia*, maize bran, sunflower seedcake is recommended for supplementary feeding of *Labeo victorianus*. However, better performance could be realized in culture systems that incorporate live feeds such as a well fertilized earthen pond or periphyton based aquaculture systems where substrates are used to aid the generation of biofilms which can be part of the food of *L. victorianus.*

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