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Comparative analysis of the sanitation labour costs and benefits associated with the use of different first feeds in *Clarias gariepinus* nursery

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Abstract: **Understanding the costs associated with the use of different first feeds is very essential in making choice of the appropriate larval feed to use post-endogenous feeding. A study was conducted to determine and compare the cost of sanitation labour for different larval first feeds: yeast-fed rotifer, algae-fed rotifer, whole-chicken egg and shell-free *Artemia*. The daily sanitation time was recorded in each case and the cost of sanitation labour was determined. A cost-benefit analysis was also carried out based on the collected data. The results indicated that the first feed chosen affected the time spent in sanitation and allied cost of labour. Mean daily sanitation time recorded was 1043±34.37, 1204.8±24.20, 1022±31.95 and 2348±49.65 seconds for yeast-fed rotifer, algae-fed rotifer, whole-chicken egg and *Artemia* respectively. One-way analysis of variance on these showed there was a significant difference (P<0.05). The sanitation labour cost for the control treatment (shell-free *Artemia*) was slightly more than twice (₦2607.20, $6.34) the cost of Yeast-fed rotifer (₦1158.08, $2.81) and whole-chicken egg (₦1134.88, $2.76) and almost twice that of algae-fed rotifer (₦1336.96, $3.25). Whole-chicken egg was 56.47% less than the control while yeast-fed and algae-fed rotifer treatments were 55.59% and 48.72% less respectively, showing that the control treatment recorded higher costs than all the treatments. Cost-Benefit analysis indicated that there was loss in all the treatments: ₦ 673.08 ($1.64), ₦361.96 ($0.88), ₦ 1054.88 ($2.56) and ₦1737.2 ($4.22) for yeast-fed rotifer, algae-fed rotifer, whole-chicken egg and shell-free *Artemia* respectively. The study shows that sanitation labour for the control (shell-free *Artemia*) treatment costs more than yeast-fed rotifer, algae-fed rotifer, whole-chicken egg. It is recommended that more studies be conducted for field trial and optimization of algae-fed rotifer on *Clarias gariepinus* hatchlings.**

Keywords: **Sanitation, Labour cost, *Clarias gariepinus*, First feed, nursery.**

1. INTRODUCTION

The production of fish per annum in Nigeria stands at about 1.0 million metric tonnes with capture fisheries accounting for 71% of the production while aquaculture takes the remaining 29%. The aquaculture sector in Nigeria employs more than 13,000 persons (Bradley *et al.*, 2020). There has been an increase in the demand for catfish fingerlings due to recent government policies in favour of agriculture and allied areas. But hatcheries generally grapple with the challenge of low survival rates of their hatchlings either due to nutritional challenges and (or) poor management practices. It is in record that inadequate feeding and poor acceptance of feed is the source of mortality within the first month of the fry's post-endogenous feeding life (Ekelemu & Nwabueze, 2011). Foreign starter feeds for larvae, such as decapsulated *Artemia* eggs, are usually very exorbitant and the shelf-life are usually easily lowered when handled by unskilled hatchery staff or where there is lack of adequate facilities. In any case, shell-free *Artemia* has almost attained the position of serving as a reference first feed. It is imperative that cheaper and easily managed alternative sources like culture of live zooplankton

(*Brachionus spp*) and whole-chicken egg may ameliorate these challenges and provide cheaper fingerlings which will enhance fish production.

Some of the studies that have been carried out in this area prove the likelihood of success. Abubakar *et al.* (2013) reported higher percentage survival of *Clarias gariepinus* larvae on dried zooplankton in a comparative feeding trial with dried-zooplankton and *Artemia*; the zooplankton for their trial study composed of about 53 % *Brachionus spp*. In another study, best survival and growth was reported for *C. gariepinus* fry feed on decapsulated *Artemia* as compared to copepods and formulated feed (Olurin *et al.*, 2012). Okunsebor *et al.* (2015) reported a relatively higher survival rate and condition factor for *C. gariepinus* fry fed decapsulated *Artemia* in aerated condition as compared to the non-aerated condition. Okunsebor and Sotolu (2011) showed that live feed (Rotifers) compete favourably with *Artemia* as first feed. Abdulraheem *et al*. (2012) reported a low survival of *C. gariepinus* fry in a test feeding carried out with chicken egg-yolk. Legion *et al.* (2008) compared the cost of hybrid catfish and pure strain. Salehi (2011) reported on the contribution of different factors of production in fingerling production. Kumar and Engle (2017) reported on the economics of different aeration intensities for catfish ponds. Adeyemo *et al*. (2011) compared the productivity and cost-effectiveness of fingerling production in Earthen ponds and Recirculatory system. Ali *et al*. (2018) studied the production economics of striped catfish in a polyculture system. Premono *et al*. (2017) reported on the factors influencing catfish seed production.

Many fish farms in Nigeria, however, usually feed fish hatchlings with imported *shell-free Artemia* eggs in spite of the cost since it is the most readily available choice. Other challenges associated with the use of *Artemia* generally is that it does not survive more than two hours in freshwater, being a marine water inhabitant; owing to osmo-regulatory problems (Porticelli, 1987; Ovie, Adeniyi and Olowo, 1993 cited in Ekelemu & Nwabueze, 2011); coupled with the fact that one must simulate the right environment for it to hatch effectively. When these *Artemia* die without being consumed by the fry, they will eventually act as substrates for the growth of pathogenic organisms; thus enhancing the susceptibility of the fry to diseases.

Peteri *et al*. (1992) in an FAO manual recommends regular siphoning and other sanitation protocols to ensure successful hatchery and nursery production of catfish seeds. This directive will certainly impinge on the amount of time spent daily in cleaning the hatchery and (or) nursery tanks. The implication may be of some effect in the cost of hatchery and (or) nursery labour.

Given the mixed reports from various authors on comparative success of decapsulated *Artemia* and other first feeds and lack of report on comparative economics on use of different first feeds, we decided to consider in this study the aspect of labour costs in maintenance of proper sanitary condition in nursery ponds treated with *Artemia* and those treated with freshwater rotifer and whole chicken egg.

2. MATERIALS AND METHODS

One thousand six hundred individuals of the experimental fish (*Clarias gariepinus* frys) were distributed equally into sixteen 15 L ponds containing 10 L of dechlorinated city-supplied water each on the 5th day post-hatch. The ponds were randomly labelled according to the following four trial feeding schemes: Yeast-fed rotifer (Yr), Algal-fed rotifer (Ar), Whole chicken egg (EG) and decapsulated-*Artemia* cysts (AT) in four replicates. Trial feeding commenced on the 6th day post hatch. The experimental fish were fed at 1,900 rotifer /larvae/day in the respective rotifer treatments, while whole egg diet was fed at the rate of 1 table spoonful per pond (Chow, 1980) for the first-three days; then, 1ml/tank/day and the decapsulated-*Artemia* was administered at 8 % body weight accordingly. Decapsulated *Artemia* was used as control. The feeding schedule was doubled after the eighth day in the case of the rotifer-fed groups and whole egg-fed groups while that of the decapsulated *Artemia*-fed groups were adjusted based on the average body weight of the group on the eighth day. The daily rations were shared into two and were fed to the experimental fish in two rations in the mornings and evenings. Aeration was usually stopped for an hour during feeding and (or) sanitation. The time spent in sanitation of nursery tanks were recorded daily using a digital stopwatch. The culture media was replaced every third day. The trial feeding lasted for sixteen days. The percentage survival was obtained using the formula below:

$$\text{Percentage Survival} = \frac{N_2}{N_1} \times 100 \text{ (NACA, 1989)}$$

Where N_1= initial number of fry or number of fry at time t_1; N_2 = number of fry at time t_2 or final number of fry.

The condition factor of the experimental fish was determined using the following formula:

Condition factor (K) = $\frac{w}{l^3} \times 100$

Where w= weight in grams and l=length in mm (Bagenal & Tesch, 1987).

The prevailing daily cost (₦2,000) of unskilled labour within Jos Metropolis (personal communication) was used to determine the average daily labour cost of sanitation for each of the treatments and the total sanitation labour cost was also determined for the duration of the experiment using the following formulae:

$$Average\ Daily\ cost\ of\ nursery\ tank\ sanition\ labour\ (ADC) = mean\ daily\ sanitation\ time, T \times cost\ of\ labour\ per\ unit\ time, \text{C (₦)}$$

$$Total\ Cost\ of\ nursery\ tank\ sanitation\ labour\ (TCL) = ADC \times No.of\ nursery\ days\ (ND);\ \ where\ ADC = average\ daily\ cost\ of\ nursery\ tank\ sanitation\ labour;, l\ \ ND = 16$$

The prevailing market price of two-week old fingerling (₦ 5.00) was also used to determine the total value of fingerlings thus:

$$Total\ value\ of\ fingerlings\ (TVF) = No.of\ survival\ \times \text{₦}5$$

$$Benefits\&Loss = Total\ value\ of\ fingerlings - Total\ cost\ of\ sanitation\ Labour$$

Results and Discussions

In table 1 and Fig 1 are the result of the time measurements taken during the study. It ranged from 2348±49.65 secs in the control treatment to 1 022±31.95 secs in the whole egg treatment with the others as intermediary values in the distribution. It indicates that the control treatment (shellfree *Artemia*) consumed more time in labour than all the remaining treatments. This was followed by algae-fed rotifer treatment and yeast-fed rotifer in that order while the least was the whole egg treatment. The time consumed by the control treatment was 195% of the next higher time-consuming treatment. It was also about 230% of the least time-consuming treatment. It can be observed that more time was spent in cleaning the control treatment than in any other diet. A One-way ANOVA on the time spent in sanitation shows that there was a significant difference (P<0.05). These variations show that some first feeds are associated with very labour-intensive sanitation regimes which by extension may impinge on the ultimate derivable benefits and costs of using them. The higher values recorded in the control treatment may be indicative of excess feeding of the frys and (or) unacceptability of the feed to the fry given that it produced more debris requiring the siphoning process. When the periods spent in sanitation are matched with prevailing daily cost of unskilled labour, the average daily cost of sanitation varied directly with the time and have similar trend as the average time spent daily in nursery tank sanitation; with the control treatment (shellfree *Artemia*) recording the highest value while whole chicken egg was the least (table 2). Within the duration of this study, the total cost of sanitation labour (table 3) was highest for the control treatment (shellfree *Artemia*) while the least was the whole chicken egg. The Algae-fed rotifer and yeast-fed rotifer had an intermediary position in the cost continuum with the former recording relatively higher value than the later. Total sanitation labour cost as a percentage of the control treatment (table 3) shows that the least was whole chicken egg followed by yeast-fed rotifer and algae-fed rotifer. It is clear that the control treatment was slightly more than twice the cost of Yeast-fed rotifer and whole-chicken egg and almost twice that of algae-fed rotifer. Whole-chicken egg was 56.47% less than the control while yeast-fed and algae-fed rotifer treatments were 55.59% and 48.72% less respectively, showing that the control treatment recorded higher costs than all the treatments. When sanitation labour costs was calculated per individual fingerling survived after sixteen days of the experiment (table 3), it was noted that algae-fed rotifer had the least cost of sanitation labour per fingerling. This was followed by the yeast-fed rotifer while the control treatment appears third in the ascending order. The whole-chicken egg which recorded the least survival had the highest sanitation labour cost per individual, a value above 1000% of the least recorded value. When the per individual fingerling sanitation labour cost for the control treatment is used as a baseline to compare the experimental treatments, it was evident that algae-fed rotifer treatment had the least cost (54.21% less than the control treatment) followed by the yeast-fed rotifer (20.29%) while the whole chicken egg was 373% higher than the control treatment. This variation resulted from low survival recorded in the whole-egg treatment. The values recorded in this study are higher than those reported by Legion *et* al. (2008) for hybrid channel catfish. So, it can be clearly seen that the least in sanitation labour costs were recorded in the algae-fed rotifer treatment.

In table 4, it is observed that survival was highest in the algae-fed rotifer treatment followed by the control treatment and yeast-fed rotifer and whole chicken egg treatment in that order. The condition factor and total value of fingerlings from the operations also follow the same pattern. The Benefits/loss record clearly highlights a remarkable trend: showing losses across all the treatments when weighed against the cost sanitation labour alone. The least of the loss was recorded in the algae-fed rotifer treatment while the highest loss was recorded in the control treatment; while the intermediary position occupied by whole chicken egg and yeast-fed rotifer from high to lower order of loss. In line with the recommendation of Adeyemo et al (2011) that expected returns forms the primary goal of farming, Algae-fed rotifer which gave the least loss has a higher propensity for optimization. The implication of this outcome is that although the control treatment recorded the second position in survival and condition factor, its high time-demanding sanitation protocol impinges negatively on the cost of labour; thereby rendering the control treatment (shell-free *Artemia*) economically inefficient when compared with other first feeds used in this study. Legion *et al* (2008) reported about 15.22.5% decrease in cost of production of hybrid catfish when compared with pure strain. Salehi (2011) reported that labour costs account for over 40% being the highest cost factor in production of fingerling. Our report indicates that sanitation labour cost varies according to the type of first feed used in the nursery of catfish. Kumar and Engle (2017) reported that medium level aeration intensity gave the most revenue in intensive catfish culture. It is also noteworthy that the algae-fed treatment, even though it recorded the highest survival and best condition factor, accounted for the least loss. This implies that if a hatchery operator must break even and (or) make profit, he/she may need to optimize use of the algae-fed rotifer treatment. Generally, the results are in line with the reports of Ali *et al.* (2018) which said that feeding was one of the strong factors affecting fish production and profitability and also in accordance with the report of Premono *et al*. (2017) which suggested that feed, natural feed and labour were factors that influenced fish production. However, our study seems to negate their suggestion that the hatchery process does not influence productivity.

3. CONCLUSIONS AND RECOMMENDATIONS

Shell-free artemia can be rated as a reference first feed in many larviculture programs. This study has however brought to the fore a new narrative in the discussion on its use as first feed. It has shown that Shell-free *Artemia*, within the limits of this study, was associated with higher nursery sanitation labour costs when compared with yeast-fed rotifer, algae-fed rotifer and whole chicken egg. This may be prohibitive where labour is scarce. Hence, when labour is major factor in hatchery management, alternative feeds like whole chicken egg, algae-fed and yeast-fed rotifers can be used. It is recommended that more studies should be conducted to compare other feeding regimes of the control treatment and the rotifer and whole-egg-based first feeds. Full cost-benefit analysis should also be conducted to cover the entire duration of fingerlings nursery period from end of larval endogenous feeding accommodating all relevant factors. It is also very invaluable to conduct further studies to optimize use of algae-fed rotifer in *Clarias gariepinus* nursery operations.

REFERENCES

[1] Abdulraheem I, Otubusin SO, Agbebi OT, Olowofeso O, Alegbeleye WO, Abdul WO, Adeyemi K, Ashley-Dejo SS and Nathaniel B. 2012. The Growth Response of *Clarias gariepinus* Hatchlings to Different Dry Feeds. *Journal of Agricultural Science* 4(10): 75-80.

[2] Abubakar MY, Ipinjolu JK, Hassan WA and Alegbeleye WO. 2013. Survival and growth of *Clarias gariepinus* (burchel 1822) on freshwater zooplankton and decapsulated *Artemia*. *Scientific Journal of Zoology* 2: 6.

[3] Adeyemo OK, Ganiyu O and Olugasa BO. 2011. Comparative evaluation of productivity and cost effectiveness of catfish fingerling production in Earthen pond and Recirculation system in Ibadan, Nigeria. Nigerian Veterinary Journal, 32(1): 5-8.

[4] Ali H, Rahman MM, Murshed-e-Jahan K and Dhar GC. 2018. Production economics of striped catfish (*Pangasionodon hypophthalmus*, Sauvage, 1878) farming under polyculture system in Bangladesh. www.elsevier. com/open-access.html retrieved 26/8/2021.

[5] Bagenal TB and Tesch FW. 1987. Fecundity Methods for the Assessment of Fish Production in Fresh Waters. *Blackwell Scientific Publications* , 3rdedition, *pp*. 93-123.

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[6] Bradley B, Byrd KA, Atkins M, Isa S, Akintola SL, Fakoya KA, Ene-Obong H and Thilsted SH. 2020. Fish in food systems in Nigeria: A review. Penang, Malaysia: WorldFish. Program Report: 2020-06. http://fish.cgiar.org/ publications accessed 29/08/2021.

[7] Chow KW. (1980). Microencapsulated egg diets for fish larvae 1, Fish seed Technology Chp. 24. *FAO, ADCP/REP/80/11.*

[8] Ekelemu JK and Nwabueze AA. 2011. Comparative studies on zooplankton production using different types of organic manure. *International Journal of Science and Nature* 2(1):140-143.

[9] Kumar G and Engle C. 2017. Economics of intensively aerated catfish ponds. *Journal of the World Aquaculture Society*, 48 (2):320-332. https://doi.10.1111/jwas.12385

[10] Legion C, Dunham RA, Jolly C, Crews J, Argue B, Liu Z, Yant R, Benfrey J & Gagalac F.2008. Economics of production of channel catfish, *Ictalurus punctatus*, female x blue catfish, *I. Furcatus*, male hybrid fingerlings and food fish. 253-267. https://doi.org/10.1080/13657300409380368

[11] NACA. 1989. Integrated Fish Farming in China. A World Food Day Publication of the Network of Aquaculture Centres in Asia and the Pacific. *NACA Technical Manual* 7: 278.

[12] Okunsebor SA and Sotolu AO. 2011. Growth Performance and Survival Rate of *Clarias gariepinus* Fry Fed On Live Feeds *Brachionus calyciflorus, Ceriodaphnia reticulata* and Shell Free Control. *Production, Agriculture and Technology Journal* 7(2): 108-115.

[13] Okunsebor SA, Shima KG and Sunnuvu TF. 2015. Effect of water volume on growth, survival rate and condition factor of *Clarias gariepinus* hatchlings cultured in different enclosures. *American Journal of Experimental Agriculture* 7(3): 150-154.

[14] Olurin KB, Iwuchukwu PO and Oladapo O. 2012. Larval rearing of African catfish, *Clarias gariepinus* fed decapsulated *Artemia*, wild copepods or commercial starter diet. *African Journal of Food Science and Technology* 3(8):182-185.

[15] Peteri A, Nandi S & Chowdhury SN 1992. Manual on seed production of African Catfish (*Clarias gariepinus*). FAO, Rome.

[16] Premono MD, Ferichani M and Rahayu ES. 2017. The analysis of factors influencing catfish seed (*Clarias gariepinus*) production in Wonogiri District. *American Scientific Research Journal of Engineering, Technology and Sciences*, 28(1): 30-48.

[17] Salehi H. 2011. Analysis of factor costs contribution change for fingerling production of Kutum fish (Rutilus frisii kutum Kamensky, 1901) in Iran. *IJFS*, 10 (4) :727-739 URL: http://jifro.ir/article-1-280-fa.html.

APPENDICES - A

List of table

Table 1: Time Spent in Sanitation (Mean±S.E)

Treatments	Time spent (s)
Yeast-fed Rotifer	1043±34.37
Algae-fed Rotifer	1204.8±24.20
Whole egg	1022±31.95
Control	2348±49.65

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Table 2: Daily Cost of Labour Spent in Sanitation (Mean±S.E)

Treatments	Labour Cost (₦)	Labour Cost Range (₦)
Yeast-fed Rotifer	72.38	70.00-74.77
Algae-fed Rotifer	83.56	81.88-85.24
Whole egg	70.93	68.71-73.14
Control	162.95	159.51-166.40

Table 3: Total and Prorated fingerling Sanitation Labour Costs for 16 Days

Treatments	TSLC (₦)	%TSCL:control	SLC/SDSF (₦)	% SLC/SDSF:control
Yeast-fed Rotifer	1158.08	44.41	11.94	79.71
Algae-fed Rotifer	1336.96	51.28	6.86	45.79
Whole egg	1134.88	43.53	70.93	473.49
Control	2607.20	100	14.98	100

SLC: sanitation labour cost; SDSF: sixteen-day-old survived fry; TSLC: total sanitation labour costs

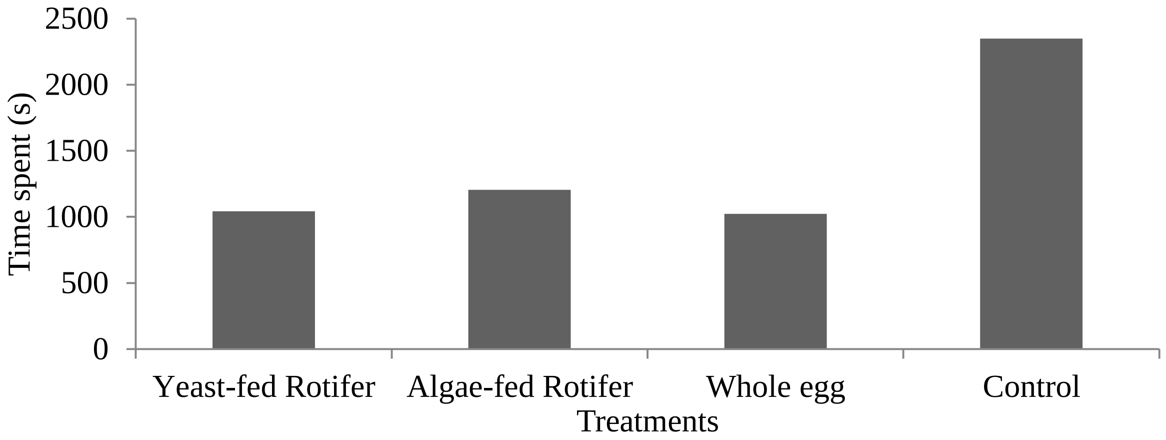

Figure 1:Time spent in sanitation of *C. gariepinus* fry nursery tanks treated with yeast-fed rotifer, algae-fed rotifer, whole egg and decapsulated *Artemia*.

Table 4: Survival, condition and benefits of *Clarias gariepinus* hatchlings nursed with yeast-fed rotifer, algae-fed rotifer, whole-chicken egg and shell-free *Artemia* for 16 days.

Parameter	Yeast-fed rotifer	Algae-fed rotifer	Whole-chicken egg	Control
No. Stocked	400	400	400	400
Total survival (S)	97	195	16	174
% survival	24.25	48.75	4.00	43.5
Condition factor	1.39	1.67	1.12	1.53
Price/fingerling (P)	₦5.00	₦5.00	₦5.00	₦5.00
Total Value (S x P)(₦)	485	975	80	870
Benefits/Loss (TV-TSLC) (₦)	-673.08	-361.96	-1054.88	-1737.2

Control: shell-free *Artemia*; -: implies loss