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Biological performance of African Catfish (*Clarias gariepinus*) cultured in recirculating system in Ibadan

A.O. Akinwole *, E.O. Faturoti

Department of Wildlife and Fisheries Management, University of Ibadan, Nigeria

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Abstract

This study reports the biological performance of the African Catfish (*Clarias gariepinus*) in commercial recirculating systems in Ibadan, Nigeria. Water temperature recorded in rearing tanks ranged from 23 to 25 °C in fingerlings systems, 23–26 °C in juvenile system and 22–28 °C in grow-out rearing tanks. SS, DO, and NH_3-N concentration in rearing tanks are within tolerable range for fingerlings and juvenile systems. DO levels fell as low as 2.0 mg/l while SS rose to as much as 36 mg/l in grow-out systems. Fish mortality had positive significant correlation ($p < 0.05$) with nitrite concentration in cultured water ($r = 0.88$). The facilities operated at a mean density of 98.1 and 176.6 kg/m^3 of juvenile and adult fish respectively. Density was not significantly different from one facility to another ($p > 0.05$). Stocking densities are 20,000–31,000; 6000–9000 and 150–300 fish/m^3, while survival rates varies from 75 to 80% for fingerlings, 75–93% for juveniles and 77–88% for adult fish. Feed conversion ratio ranged from 0.60 to 0.78 for fingerlings, 1.01–2.08 for juveniles and 1.15–1.68 for adult fish while mean harvest weight for fingerling, juvenile and adult fish were 4.2, 11.2 and 981.0 g reared on the average for 28, 30 and 154 days, respectively.

Keywords: African Catfish; Recirculation; Fish production; Ibadan; Growth parameters

1. Introduction

The African Catfish (*Clarias gariepinus*) is choice food fish species in Nigeria. It commands high demand from consumers and is mostly preferred by food fish aquaculturists. This is due to the ideal characteristics of this species (Eding and Kamstra, 2001), which includes high growth rate at high stocking densities, a high food conversion, good meat quality and smoking characteristics as well as year round production. Fish culture production in Nigeria includes lake stocking and production in ponds, cages and tanks (Ita, 1985). Pond culture is the most prevalent. Virtually all aspects of pond culture of African Catfish (*C. gariepinus*) in Nigeria has been developed and documented to ensure profitable production of the species. The appreciable quantity of water and large expanse of land required for pond culture has however limited the expansion of African Catfish culture in Nigeria.

Intensive culture of finfishes in recirculating aquaculture system (RAS), a production technique that reuses fish culture water more than once, thereby saving space and water requirement for fish culture, has been adopted to culture African Catfish (*C. gariepinus*) in Europe and America. Reports by Eding and Kamstra (2001) confirm that RAS has been adopted to successfully culture the African Catfish (*C. gariepinus*) at full commercial scale in Denmark and The Netherlands.

* Corresponding author. Tel.: +234 8033600554; fax: +234 28103043.
E-mail address: haayor@yahoo.com (A.O. Akinwole).

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These reported successes in use of RAS for African Catfish production notwithstanding; its adoption in Nigeria has been limited to a few commercial operations. This is due to the uncertainty about RAS technology in Nigeria as well as the lack of data on the performance of the species in RAS in the Nigerian climate. This study reports the biological performance of the African Catfish (*C. gariepinus*) in some of the most promising commercial recirculating systems presently available for aquaculture production in Ibadan, Nigeria.

2. Materials and methods

2.1. Study area and facilities selection

The study, undertaken between November 2001 and March 2004 covers the eleven RAS-based African Catfish production facilities within Ibadan metropolis. Ibadan, the capital city of Oyo state, Nigeria is the largest city in black Africa. Average daily temperature ranges between 21 and 31 °C almost throughout the year.

Fish production operations in all the facilities under review were monitored by physical inspection of facilities and farm records, observation and measurement of systems components and operations, during the period of study. Owing to a myriad of problems, seven of the facilities closed business within 12 months of commencement of operation and were abandoned when their system could not support repeated culture of fish (Akinwole, 2005). Four facilities (GAF, IFZ, OFF, SOF) reared fish for more than 12 months and three facilities (GAF, IFZ, OFF) reared fish over the whole study period (29 months). All facilities are indoor and are commercially rearing African Catfish (*C. gariepinus*).

The operational characteristics of the recirculating systems in use in the farms are as detailed in Tables 1–3. Process flow arrangement varies from one or two rearing tank RAS unit for fingerling and juvenile systems to four tank modules for grow-out systems. Wide ranges of material are used to hold the fish. Fiberglass and polyvinyl chloride (PVC) plastic are commonly used to hold advanced fry to fingerlings while PVC, solid blockwall and reinforced concrete are used to rear juveniles and adult fish. In all the facilities, sedimentation tank is divided into three compartments; the inlet zone which receives water from the rearing tanks, settling zone (of various media), which serves to improve waste solids entrapment and the outlet zone which contain a relatively clear water. This last compartment also doubles as a pump section end and serves as sump for the pump to lift water out of the settling basin to the biofilter. Cleaning frequency for sedimentation tank varies from one facility to the other, but the range is twice a day for fingerling and juvenile systems to 2–4 times per week for grow-out. The biofilter media in use varies. The filter media are encased in framed rectangular enclosure with tarpaulin wrappings. Water pumped from sedimentation tank is sprayed over the filter media while filter outflow trickles down into a collector tank preparatory to movement to rearing tank. RAS components were placed such that only one

Table 1
System summary of the African Catfish fingerling RAS facilities (up to 4.0 g)

Facility acronyms	GAF	IFZ	OFF
Average stocking density (fish/m^3)	22700	31250	29400
Average duration of culture (days)	28	28	30
Number of feeding per day	15	6	9
Feeding rate (% BW)	3	6	6
% Crude protein in feed	45	45	45
No. of rearing tanks per unit	3	2	2
Volume of each rearing tank (m^3)	0.84	2.40	0.34
Rearing tank volume exchange (min)	186	632	159
Rearing tank material	PVC	Fiberglass	10 mm thick plain glass
Sedimentation tank (volume, material, media)	0.93 m^3, concrete, polypropylene media	2.00 m^3, concrete, polypropylene media	0.33 m^3, concrete, plastic crates with gravel stones
Biofilter tank (volume, media, type)	0.93 m^3, polypropylene media, Trickling	5.00 m^3, polypropylene media, Trickling	0.20 m^3, plastic crates with lava stones, Trickling
Typical mean ± S.D.			
TSS (mg/l)	1.92 ± 0.23	4.00 ± 0.20	7.33 ± 0.72
NO_2-N (mg/l)	0.06 ± 0.03	0.24 ± 0.05	0.41 ± 0.09
NH_3-N (mg/l)	1.35 ± 0.19	0.57 ± 0.08	1.89 ± 0.36
DO (mg/l)	8.48 ± 0.32	5.41 ± 0.73	6.64 ± 0.73
Number of culture cycles monitored	15	11	14