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Comparative study of two incubation methods to produce low cost seed of African catfish (*Clarias gariepinus*, Burchell 1822)

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Abstract
This study was conducted to compare between two simple technical methods to produce low cost catfish seeds for small-scale producers. This species is able to tolerate a wide range of environmental conditions and has fast growth rates, making it a suitable candidate for aquaculture in such countries. This activity has been hampered by a number of problems and constrains, includes shortage of good quality fingerlings and lack of well technical operational hatchery. Two incubation systems were used in similar eggs capacity. The hatchability percentage was calculated and the total cost of each was evaluated. The hatching percentage means of indoor incubation method (75.4%) is significantly higher than (p<0.05) outdoor base method (56%) in five trails. The total cost of incubations construction and materials was higher (221.5$) in indoor incubation method than outdoor happa base (48.6$). In the outcomes, use of happa base method is economically feasible than indoor incubation method.

Keywords: Low cost, *Clarias gariepinus*, small scale

1. Introduction
Aquaculture is the world's fastest growing food production among the other production systems. It's expected to bridge the growing gap between demand and supply for fish and to contribute to food security and community settlement. The greatest production occurs in developing communities, characterized by small-scale operations. Besides being sustainable and environmentally friendly, therefore professional aquaculture technologies should started in a base of small scale producers who are the backbone of the advance aquaculture industry. Recently aquaculture development has been hampered by a number of problems and constrains, such as shortage of good quality fish seed and lack of well technical operational hatchery special for catfish. Most farmers in Sudan depend on wild catfish seed with low quality due to mix species, size variation, inbreeding, stunting in growth and disease transfer [1]. In recent years, the African catfish *Clarias gariepinus* has been cultured extensively [2, 3]. Due to its high market value, rapid growth, tolerance to high stocking densities, utilization of atmospheric oxygen and low fat, high protein and minerals content [4, 5]. The production of *C. gariepinus* finger-lings required hand induction because this fish does not spawn in captivity [1]. Many studies has succeeded in induce breeding of *C. gariepinus* in hatchery facilities with control environment. Other researchers and producers were succeeded in induced breeding under semi natural environment although, the hatching rate was poor [6]. More over the incubation of fertile eggs in the indoor system under control water flow is power and technicality needs while in outdoor the collection of the hatchling is time-consuming and laborious however low cost, simple technique is and easily applied practically by small scale producer. This scientific handout describes a cheaper and low cost breeding technique for production of African catfish *C. gariepinus* fry targeting the small scale producers.

2. Materials and Methods
2.1 Selected brood stock
This experiment was conducted at small scale farm, a total of 10 pair brood stock of *C. gariepinus* was obtained from the White Nile River. Ripe female were selected on the basis of their distended abdomen, while males, are selected on the base of size and seasonality. Selected brood stoch was kept in plastic tanks for two days without feeding, before the start of the experiment.

2.2 Hatching Procedures
Similar weight and size fish pair were maintain, male were sacrificed and their pituitaries collected for induce of spawning. Each female was injected with pituitary extract collected from a similar sized male. The injected female was released into especial tank with well oxygenated condition. The female spawned within 9-12 hours after injection with stripped process into dry enamel bowl. Each female laid around 5,000 -8,000 eggs. Milt was obtained from male after sacrificed. Fertilization was take place by dry method followed Ibrahim, (2016) [4].

2.3 Experimental process
The fertile eggs were divided and distributed into two incubation types. First one is 80×40 cm woody frame with fin mesh, placed on recirculating system at flow rate of 0.5 L per minute. Plate (1). Water temperature and other important parameters are adjusted according to principle described by (Otubusin, *et al*, 2009) [7]. The costs of construction and maintenance of these incubation systems are usually considered. The second incubation types are pond based happa method in similar fine mesh and same dimension (80×40 cm). Plate (2). The cost and purpose of these items are listed and considered. This experiment were replicated and done in 5 trails.

2.4 Statistical analysis
The data on hatching rate were statistically compared used SPSS program (Version 22), the significantly differences between means was determine and the cost estimate of two systems was evaluate.

Plate 1: Try incubation method

Plate 2: Happa incubation method

3. Results and Discussions
Within 36 – 42 hours the eggs were hatching, the variation in hatchability time may refer to variation in water quality in the two incubation systems (Table 1). However the flow rate in earth pond not exceeded 5 L per minute, the oxygen level is around 4.7 mg/l and the temperature was fluctuated between 25 – 31 ^{0}C during a day. While in the indoor incubation system the water flow was in 0.5 L per minute, the dissolved oxygen range 4.5 – 6.2 mg/land the temperature was in range of 23 – 28 ^{0}C.

Table 1: Show water parameters in two incubation systems. (Mean ± SE)

Parameter	Indoor (Recirculating incubation)	Outdoor (Pond base happa)
Temperature (^{0}C)	26.05±0.22	27.37±0.77
Dissolved oxygen (mg/l)	5.4±0.85	4.7±0.32
pH	7.01±0.12	7.88±0.09
Ammonia (ppm)	0.06±0.02	0.02±0.05

The hatched eggs were calculated and hatching percentages were shown in Table (2). The incubated eggs in recirculation trays were hatching within 40 – 42 hours, while in the pond base were observed in 34 – 36 hours after fertilization, this finding same to result obtained by Musa and Hagar, 2018) [5] which are found hatching occurred after 32–37 h in open incubation environment and the hatchability time dose not significantly affected by hormones type. Fig. (1) Showed the hatching rate which is higher in the indoor incubation hatchery base system (75.4%). There was significantly difference between indoor and outdoor pond base happa system (p<0.05). Previous studies on *C. gariepinus* larvae production had hatching rates ranging from 20 - 57.1% [8-13]. The current finding in both incubation systems was higher than that obtained by the above authors.

Table 2: Hatching rate (%) in happa placed in earthen pond and recirculation incubation method

Trial	Indoor (Recirculating incubation)	Outdoor (Pond base happa)
1	81	62
2	79	66
3	86	59
4	72	55
5	59	38
Mean	75.4	56
SD	10.55	10.84

However it was evident that due to control of water quality, the hatching present in indoor base are more predictable than in pond base. The pond base method is the most appropriate for farmer despite of mortality and loss during incubation. In such a tem Mehdi and Mousavi (2011) [14] and Mylonas *et al*. (2010) [15] found that the bottleneck of outdoor hatching system are the mortality and loss during incubation, early feeding and cannibalism among larvae, juveniles and fries and deformity during this stage. The current and fluctuation of water quality in earthen pond is also cause submergence of the happa, when try to hanging up the happa the top surface of pond water negatively affected the hatching due to increase temperature level. According to (Ibrahim, 2016) [4] high mortalities during larval hatching period are common and the mortalities are often related to water quality practices which may not meet the requirements of the hatching process. To overcome and mitigate these problems, there is need to develop certain incubation techniques to insure their quality and quantity of the larvae. So, there is many efforts regarding with this attempt but the outcomes seriously encountered with problem such as cost of production in the face of falling fingerlings price.

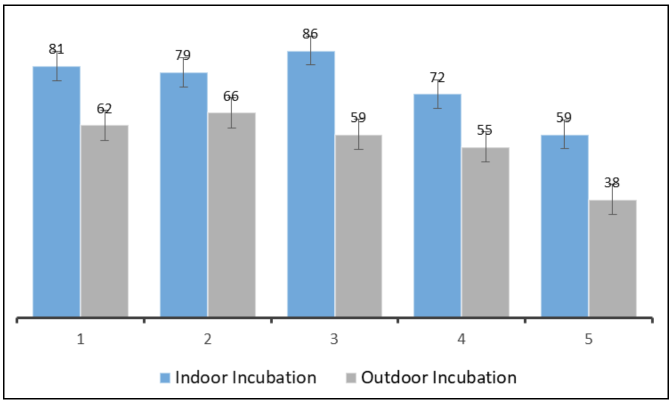

Fig 1: The hatchery rate (%) in indoor and outdoor incubation methods

The evaluation of the construction and operation are very important in total evaluation cost. In Table. (3) the estimated cost of happa base and recirculation incubation base showed highly variation and significance difference ($p<0.05$) between two incubation methods. This finding closed to finding recorded by Musa and Hagar (2018) [5] in small production unit the production cost of African catfish fingerlings farm site are economically feasible than collected from the commercial hatchery.

Table 3: Incubations construction materials, their cost and components.

Materials	Recirculate base (Cost $)	Pond happa base (Cost $)
Water pump	33.3	-
Air pump	26.6	-
Tray	14.4	-
Happa	-	16.6
Holding stand	27.7	-
Holding tank	38.8	-
Collecting tank	38.8	-
Metal stick	-	16.6
Scoop net	3.3	3.3
Plastic bowl	2.2	2.2
Power	11.1	2.2
Labour	16.5	6.6
Disinfection	5.5	-
Miscellaneous	3.3	3.3
Total	221.5	48.6

In this study used of happa incubation method made collection easer and somewhat suitable for small farmers instead of depending on commercial producers. The indoor incubation systems could easily be ameliorated if some fish farmers tend to specialized in the production of fingerlings as a complete business [4]. However the reduction of the incubation costs is and increase availability of farmers to use such method. The outcomes of this document is to develop low cost method to produce catfish fry for the small scale farmers which is expected to be highly demanded in extension bases.

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