

# ECONOMIC EVALUATION OF FOUR HORMONAL PREPARATIONS IN THE ARTIFICIAL PROPAGATION OF *Heterotisniloticus* (Cuvier, 1829)

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## ABSTRACT

The economic evaluation of four hormonal preparations: *Heterotisniloticus* pituitary extract, ovaprim, *Clariasgariepinus* pituitary extract and carp pituitary extract (C.P.E) in artificial propagation of *Heterotisniloticus* was investigated. Total of twenty four fishes (twelve females and twelve males) of twenty four months old were used for the experiment. The females were divided into four groups. Each group was induced to spawn with the same hormone. Sperm from one male was used to fertilize the eggs obtained from individual females. Effects of the hormones on the fecundity were investigated to help address the economic values. The results showed that the cost of inducing 2.20kg female to yield 30.33g, 47.00g, 30.00g and 29.33g of eggs, were ₦200, ₦700, ₦300 and ₦480, for *Heterotisniloticus* pituitary extract, ovaprim, *Clariasgariepinus* pituitary extract and C.P.E, respectively. Profitability index for *Heterotisniloticus* pituitary extract, ovaprim, *Clariasgariepinus* pituitary extract and C.P.E was 7, 10, 6.8 and 6.6, respectively. Indicating that, cost of production accounted <10% for ovaprim, <15% for CPE, and <14% for both HnPE and CgPE of the total variable cost. The production was more profitable with ovaprim than HnPE, CgPE and C.P.E. The study has provided data, comparing the effectiveness of the hormones, revealing that the four hormones can be used for artificial propagation of *H. niloticus* with varied degree of economic implication. However, ovaprim is highly recommended to hatchery users for optimum performance.

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**Keywords:** *H. niloticus*, hormones and economic evaluation.

## INTRODUCTION

The process in agricultural production system as in other sectors of the economy requires that some cost is incurred. This may be due to some scarce resources that attract high prices hence, the need for cheaper non-conventional alternatives (reference). The factors of production in aquaculture are traditionally classified into breeding facilities, labor, capitals and managements. The contributors to cost of aquaculture production includes the returns to all factors committed to production, such as the wages of hired labors, rents on land or hatching facility, interest on capitals, cost of machines hired and expenses on feeds for the hatched fingerlings in fishery enterprise (Asangusung *et al.*, 2020).

The success in large-scale production of any organism for human consumption demands, that the resources be easily renewable (reference). It is clearly disadvantageous to cultivate any organism when the supply of the young cannot be easily replenished (Asangusung and Uka, 2016). The high demand for fish fingerlings in the phenomenal growing aquaculture industry has stimulated the need for artificial propagation of ~~cultural~~ cultured warm water fishes, as statistics of global fish production shows that fish farming represents about 15% of the global fish yields and was expected to exceed 20% by the year 2000 (FAO, 2016).

The African bonytongue "*Heterotisniloticus*" belongs to the family – *Arapaidae*, order *Osteoglossidae*, generally called "Bonytongue" and locally named as "Ecomog fish", with a maximum size of 100cm in its standard length (SL) and a maximum weight of 10.2kg. This fish is a pelagic freshwater dweller considered as mud feeders, which serves a purpose in aquaculture and for commercial seed also, as it is normally found in the tropics of 25-30 and 18 -22 in the Nile (Sveinsdottir, 1998). The male has anal and urogenital openings just anterior to the anal fin whereas the female has a genital orifice separate from the urinary opening. Family characteristics also include: thick scales on the body

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46 with a scale-less head, a large mouth usually turned upwards, pointed pectorals and small pelvic fins, a  
47 small or reduced caudal and a mosaic-like pattern of large bony scales (Aditeet *al.*, 2006; Froese and  
48 Pauly, 2012).

49 Hormones are “chemical messengers in the body of living organisms”, also defined as chemicals  
50 that are produced in an organ or gland and then carried by the blood to another part of the body where  
51 they produce a special effect for which they were designed. The term hormone is derived from a Greek  
52 word meaning “to excite”. The use of synthetics and natural hormones brings about quick ovulation,  
53 high percentage of hatched fish, though synthetic hormones give higher yield than the natural hormones  
54 (Asangusung and Uka, 2016).

55 The present study was initiated to ascertain the cost implication of these hormonal preparations;  
56 *Heterotisniloticus* pituitary extract, ovaprim, *Clariasgariepinus* pituitary extract and C.P.E, as hatchery  
57 propagation of *Heterotisniloticus* has not been in existence in Nigeria before now, because of some  
58 factors. Therefore, most hatchery users find it difficult to domesticate (commercialize) the existence of  
59 this species, during breeding. More often than not, the choice and cost in the use of these hormonal  
60 preparations among many farmers in Nigeria is almost entirely based only on cost and availability.  
61 There was therefore, need to match the commercially available hormonal preparations with economic  
62 value of their usage for profitable decision and rewarding recommendations in choice of hormonal  
63 preparations and most importantly the cost implication over each hormonal agents used and establish  
64 a suitable environmental regime that helped in setting pace for the production of this species; since their  
65 natural reproductive habitats (nursery grounds) are gradually going into extinction via destruction of  
66 mangroves swamps in Nigeria (in the quest for wealth). Acknowledging the fact that, these mangrove  
67 swamps and floodplains in fresh water environment: serves as their breeding and nursery ground (Froese  
68 and Pauly, 2012).

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Comment [A7]: delete and replace with “using artificial propagation method”

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## 69 MATERIALS AND METHOD

70 Earthen pond raised 24-months old gravid brood stock were selected. All brood fish were selected  
71 by external morphological characteristics, using the method of Asangusung and Uka (2016). Twelve (12)  
72 males and females with average weight of 2.20kg were selected. The hormonal agents were injected  
73 intramuscularly into the dorsal muscles above the lateral lines and below the anterior part of the dorsal fin  
74 of each brood fish, as no scale was injured. The selected gravid females were injected with 5.0mg/kg  
75 *Heterotisniloticus* pituitary extract, 0.5ml/kg ovaprim, 5.0mg/kg *Clariasgariepinus* extract and 6.0mg/kg  
76 C.P.E as Treatment A, B, C and D respectively.

Comment [A10]: Total of 24 or? I think this information is different from what is at the abstract section

Comment [A11]: Shorten it i.e H. niloticus, C. gariepinus

78 Each treatment was replicated thrice, as the injected fish were returned separately into their  
79 respective 50 liters aquaria. The ovulated female were carefully caught with a hand net and held tightly  
80 by two persons using wet towel. The main operator, held the spawners head with one other hand from the  
81 anterior to the pectoral fin onto the genital papilla with a slight pressure. The second operator held the tail  
82 of the female fish, as the hormone treatment caused the ovulated eggs to flow out easily (in a thick-jet  
83 form) from the genital papilla, and the eggs were collected into a dry plastic. At completion of stripping  
84 only few eggs were ejected and some blood together with translucent eggs appeared, which was a sign  
85 that all or nearly all the ovulated eggs has been released (Asangusung and Uka, 2016). The following  
86 parameters were calculated:

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87 Fecundity was estimated as follows (Asangusung and Uka, 2016)

88 Fecundity (Total no. of eggs stripped per fish) = 00.00g

90 The Pseudo Gonad Somatic Index (PGSI) also taken as sensitivity to *Heterotisniloticus* pituitary  
91 extract, ovaprim, *Clariasgariepinus* pituitary extract and CPE was calculated according to Asangusunget  
92 *al.* (2020) thus:

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$$\text{PGSI} = \frac{\text{Weight of eggs collected by stripping}}{\text{Body wt. of injection} - \text{Wt. of stripped eggs}} \times 100$$
  
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### 97 **Evaluation of Cost Benefits Indices**

98 The following economic variables were estimated in order to ascertain the economic implication  
99 of the four hormonal preparations thus:

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101 Cost of eggs produced = Number of eggs @ 2.00naira per egg

102 Number of eggs = 1g of egg counted to obtain 850eggs

103 Profit Index = Ratio of the cost of egg produced to total expenditure

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### 105 **Statistical analysis**

106 Data collected were compared using a one-way analysis of variance (ANOVA) and Duncan  
107 Multiple Range Test (DMRT) to determine significant differences among means ( $P < 0.05$ ).

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## 109 **RESULTS AND DISCUSSIONS**

110 The financial implication of the four hormonal agents used in the successful propagation of  
111 *Heterotisniloticus* were significantly different ( $p < 0.05$ ) as this was addressed by, calculating the cost of  
112 brood stock, cost of facility, cost of feeding and other miscellaneous against the total outcome (financial  
113 turnover) of the eggs stripped (Table 1) and compared to justify the best hormonal agent that can  
114 successfully provide a farmer with a high profit. This was carried out using profitability index (PI)  
115 principle, as the cost of inducing 2.20kg weight of *Heterotisniloticus* fish with HnPE, ovaprim, CgPE  
116 and CPE were ₦200, ₦700, ₦300, and ₦480, respectively. The result of the economic analysis (Table  
117 1) reveals that Ovaprim treated fish produced the highest number of eggs (39,950eggs) with the highest  
118 profit index of 10, this was followed by HnPE treated group producing 25,780eggs with a profit index of  
119 7; while CgPE and CPE treated fish gave 25,500 (PI of 6.8) and 24,930 (PI of 6.6) respectively. The  
120 results of profitability index recorded in this work showed a high economic benefit with the use of  
121 ovaprim when compared to those of HnPE, CgPE and CPE; as this agrees with the reports of  
122 Asangusunget *al.* (2020), Oni (2017) and Ugwumba (2011).

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135 **Table 1: Economic benefit analysis of *Heterotis niloticus* injected with *Heterotis niloticus* pituitary**  
 136 **extract, ovaprim, *Clarias gariepinus* pituitary extract and CPE.**

PARAMETERS	Hn.PE	Ovaprim	CgPE	CPE
Cost of Brood stock (₦)	5,000	5,000	5,000	5,000
Cost of hormone, per fish (₦)	200	700	300	480
Cost of feeding & Misc. (₦)	180	180	180	180
Cost of facilities (₦)	2,000	2,000	2,000	2,000
Total Expenditure (₦)	7,380	7,880	7,480	7,560
Total wt. of eggs produced (g)	30.33	47.00	30.00	29.33
(1g of egg ≡ 850eggs)	(25,781eggs)	(39,950eggs)	(25,500eggs)	(24,931eggs)
Cost of eggs produced (₦)	51,562	79,900	51,000	49,860
(1egg ≡ 2naira)				
Profitability Index (₦)	51,562:7,380	79,900:7,880	51,000:7,480	24,931:7,560
	7:1	10:1	6.8:1	6.6:1
	7	10	6.8	6.6

137 The average water quality parameter recorded during the study, showed no significant differences  
 138 ( $p > 0.05$ ) amongst the water parameter during the experimental period. Number of environmental factors  
 139 such as temperature, pH, dissolved oxygen and TDS; play decisive roles in ovulation, as temperature is of  
 140 vital importance. It has been observed that activity of dosage administered actually defines the readiness  
 141 of the females, their age, size, sensitivity amongst other factors (Woyhavorish and Horvath, 1980).

142 An average temperature of 28°C, dissolved oxygen of 9mg/l and a pH of 6 was recorded  
 143 throughout the experiment as this conforms with the result recorded with Uka *et al.* (2019) in the effects  
 144 of different synthetic hormonal preparation on fertilization and hatching in *C. gariepinus* and also  
 145 validates the work of Asangusung and Uka (2016), they observed *H. longifilis* exhibiting latency period  
 146 with the best results at 25-28°C. The pH of 6.00 to 8.00 was within normal range for culture fishes  
 147 (Asangusung and Uka, 2016), as the pH obtained, in this study were lower than the pH obtained by  
 148 Asangusung *et al.* (2018). The temperatures obtained in this study are slightly higher than the temperature  
 149 obtained by Asangusung *et al.* (2018), and that of Asangusung and Uka (2016). The essence of measuring  
 150 water quality in this research work was to ensure that we do not introduce variables other than the ones to  
 151 be evaluated.

**Comment [A13]:** Revise this sentence and include the obtained pH values. Do the same for temperature values.

## 152 CONCLUSION

153 The result obtained, indicated the possibility of achieving a minimal cost of controlled  
 154 reproduction in *Heterotis niloticus* using this hormonal preparation in stimulation of the female fish.  
 155 However, ovaprim gave outstanding and impressive performance, while *H. niloticus* pituitary extract  
 156 gave average performance relative to *C. gariepinus* pituitary extract and CPE.

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 160 study.  
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163 **REFERENCES**

- 164 Adite, A., Winemiller, K. O. and Fiogbe, E. D. (2006). Population structure and reproduction of the  
165 African bonytongue *Heterotis niloticus* in the Sô River-floodplain system (West Africa):  
166 implications for management. *Ecology of Freshwater Fishes*, 15:30-39.
- 167 Asangusung, P. S and Uka, A (2016). Efficiency of three hormonal preparations in the artificial  
168 propagation of *Heterobranchus longifilis*. *Journal of Aquatic Science*. 31 (2C): 521 – 528.
- 169 Asangusung, P. S., Uka, A and Amafil, O. P (2018). Effects of illumination on egg hatching and  
170 fertilization on *Clarias gariepinus*. *Journal of Aquatic Science*. 33 (1): 77 – 82.
- 171 Asangusung, P. S., Uka, A and Otoh, A. (2020). Economic evaluation of three hormonal preparations in  
172 the artificial propagation of *Heterobranchus longifilis*. *Journal of Aquatic Science*. 35 (2): 173 –  
173 179.
- 174 FAO, 2016. *Food and Agriculture – Key to achieving the 2030 Agenda for Sustainable*  
175 *Development*. Rome. 31p. (also available at [www.fao.org/3/a-i5499e.pdf](http://www.fao.org/3/a-i5499e.pdf)).
- 176 Froese, R. and Pauly D. (2012). Fish Base. <http://www.fishbase.org>
- 177 Oni, T. O. (2017). Profitability Analysis of Small-scale Fishery Enterprise in Nigeria. *Journal of*  
178 *Agricultural Sciences*. Vol. 9, No. 3: 107-116.
- 179 Sveinsdottir, K. (1998). The Process of Fish Smoking and Quality  
180 Evaluation. M.Sc Disertification, University of Denmark (Unpublished).
- 181 Ugwumba, C. O. A. (2011). Technical Efficiency and Profitability of Catfish Production in  
182 Anambra State, Nigeria (Unpublished Ph.D Thesis). Department of Agricultural  
183 Economics, Delta State University, Abraka, Nigeria.
- 184 Uka, A., Asangusung, P. S., and Okoro, G. G. (2019). Effects of different synthetic hormone  
185 preparations on fertilization and hatching in *Clarias gariepinus* (Burchell, 1822). *Journal*  
186 *of Aquatic science*. 34 (1): 1-6.
- 187 Woynarovich, E., and Horvath, L. (1980). The artificial propagation of warm water finfishes – a  
188 manual for extension. Food and Agriculture Organization of the United Nations, Rome,  
189 Italy. Fisheries Technical Paper 201:183pp.

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