DOI: https://doi.org/10.67390/gjids.2015.lh8ecz34
Gashua Journal of Irrigation and Desertification Studies
Available online at www.gjidsfugashua.org.ng
Maiden Edition: Vol 1, Nos. 1 & 2

COMPARATIVE STUDIES OF SOME SEMEN PHYSICAL CHARACTERISTICS OF CULTURED AND WILD AFRICAN CATFISH (*Clarias gariepinus*, Burchell, 1822) BROODSTOCK

[1]Yusuf, O.Y., [1]Adeshina, I. and [2]Adewale, A.Y.
[1]Department of Aquaculture and Fisheries, University of Ilorin
[2]Department of Biotechnology, Deakin University, Australia
Corresponding Author:Padibra4all@yahoo.co.uk

Abstract

The aim of this study was to compare some semen physical characteristics of both wild and cultured *Clarias gariepinus* broodstocks in order to know their relative economic advantages to farmers. Nine male broodstocks were selected with their weight ranges between 700g to1250g, with total length ranges between 51.50cm to 61.00cm. The fish were sacrificed by spinal transaction, after which the fish were dissected and the gonads were removed. The gonads were examined after weighing, and were evaluated for pH, motility, volume and sperm concentration. Descriptive statistics was used to find their minimum and maximum values. Student t-test was used to analysed the differences of their means. Also, the relationships between semen parameters were tested using the bivariate correlation coefficients of pearson. Significant differences ($P<0.05$) were observed in semen mean progressive motility (%), pH, volume (ml), weight of gonads (g) of Cultured (88.00±6.96%, 7.22±0.26, 8.01±1.13ml, 4.16±1.59g) and Wild (56.30±42.30, 6.89±0.33, 5.80±0.40, 2.01±1.02) broodstocks, respectively. There was significant correlation ($P<0.05$) between pH and progressive motility, volume and concentration, weight of gonads and volume of the Cultured broodstocks. There was a significant correlation ($P<0.05$) between weight of gonads and concentration of both Cultured and Wild African Catfish. The semen quality of the cultured broodstocks was higher than that of wild broodstocks and this may be due to differences in their environment and their feeding conditions. It is recommended that further research should be done on evolutionary and genetic performance of wild African catfish.

Key words: *Cultured and wild African catfish, broodstocks, semen, parameters.*

INTRODUCTION

Catfishes are an economically important group of fresh and brackish water fish worldwide. Several species have been successfully introduced in aquaculture (Teugels, 1996), and African catfish, *Clarias gariepinus* is perhaps the most important one, not only in Africa but also in South Asia (e.g., Thailand) and Europe (e.g., Netherlands). The availability of gametes throughout the year is important to ensure a constant supply of fish. In captivity (25^{o}C, 12h light per day), *C. gariepinus* gametogenesis is continuous once sexual maturity is reached (Huisman and Richter, 1987). However, the female can be induced with any of these exogenous hormone such as carp pituitary extracts, human chorionic gonadotropin, ovaprim, frog pituitary extract, etc to strip of the eggs after treatment (Efe *et al.*, 2015). Spermiation and male reproductive behaviour do not take place spontaneously (Adeyemo *et al.*, 2007) even after hormonal therapy. To obtain spermatozoa it is necessary to sacrifice male brood fish or surgically removed part of their testes (Adeyemo *et al.*, 2007).

Fingerling production and availability of quality fish seeds have been bottlenecks for development of fish farming in Nigeria for the past 40 years (NSPFS, 2006). Over the past several years, private sector fingerling production has increased from some 3 million per year in 2001 to more than 30 million per annum at present with several large producers delivering more than 300,000 fingerlings monthly (NSPFS, 2006). There are 24 species of Clarias (Idodo-Umeh, 2003) in Nigeria and only the *Clarias gariepinus* has been singled out as the best fish for culture instead of

the *Clarias Lazera* from central Africa which was first cultured intensively by Dutch Scientists working in Bangui, Central African Republic in the late 1970's. The cultivation of many economically important species has been helping greatly by the growing use of artificial fertilization and incubation. The artificial spawning and fertilization of many species to which this technique could not be apply formerly is now possible due to hypophysation. The eggs of the fish obtained in this way are generally incubated artificially to guarantee success.

In fish reproduction under controlled conditions, attempts are made to obtain sperm of the highest quality and hence to produce the highest possible numbers of good quality fingerlings (Enuice *et al.*, 2010).

Therefore, the use of high quality gametes from captive fish broodstock is of great importance for ensuring production of valuable offspring and increased production in aquaculture (Bromage, 1995). In order to have controlled and successful production in aquaculture systems, it is necessary to have adequate knowledge of the physical characteristics of the semen of either wild or cultured catfish (*Clarias gariepinus)*. The cultured African catfish *Clarias gariepinus* is the most popularly culture fish in Nigeria. This study was initiated to compare some semen physical characteristics of both cultured and wild broodstocks in order to know their relative economic advantage to farmers by determine their sperm concentration (sperm count) and sperm motility, pH, and volume of semen and parameters determined.

MATERIALS AND METHODS

Experimental site

This was conducted at the Department of Animal Science, Ahmadu Bello University Zaria. The sample sites were Zaria Dam located in Zaria town, Kaduna State and Tee Jay Fisheries located at Ajibesin Ogidi Ilorin, Kwara State. Zaria Dam is a man made reservoir located on latitudes 11°07'45"E to 11°08'20"E and longitudes 07°46'N to 07°48'N. It has a designed live reservoir capacity of 15.875 million m^3, length of 900 metres and a maximum height of 15 metres from the river bed (Tanko *et al.*, 2012). Tee Jay Fisheries is one of the prominent private fish farm in Ilorin the capital of Kwara State that consistently supplied farmed fish and broodstock to Nigeria fish market. The majority of fish fingerlings producers in Kwara State and its environs rely on the farm for broodstocks.

Experimental Procedure

Semen samples of broodstocks of *Clarias gariepinus* obtained randomly from the selected farm and wild environment were subjected to physical analysis in order to evaluate their semen characteristics.

Sample collection

Samples were collected from fishermen landing at Zaria Dam and from the broodstock market section at Tee jay fish farm during August – September, 2010. The collection from Zaria Dam and Tee Jay fish farm represented the farm raised and wild sample respectively. *C. gariepinus* was identified using taxonomic guide presented by Teugels (1986). Matured male samples were identified following FAO (1996) using redness of the genital papilla as a guide.

Broodstock transportation and Conditioning

Samples were collected inside a plastic bowl covered with sack and transported to fish tanks of Livestock and Fisheries Department of National Agricultural Extension Research and Liaison Services (NAERLS) of Ahmadu Bello University Zaria, Nigeria for conditioning. The broodstocks samples of cultured *Clarias gariepinus* were acclamatized for two weeks while the wild samples were not acclimatized. The fish were fed

maintenance ration on once per day during the acclimatization period.

SEMEN COLLECTION

The male broodstocks of African catfish *Clarias gariepinus* of both wild and cultured were sacrificed by using a standard laboratory method called percussive stunning, after which the abdomen were dissected and the gonads were removed. Blood clots and other tissues were rinsed away using the normal saline solution. The gonads were placed in the buffer solution pending the time of semen release in a test tube (Adeyemo *et al.*, 2007). The gonads were transported to and examined at Artificial Insemination section laboratory of National Animal Production Research Institute (NAPRI) of Ahamadu Bello University Zaria, Kaduna state. Gonad samples were transported in separate bottles and labeled according to the samples identity and packed inside an ice packed container. Upon arrival at the Laboratory, gonads were punctured and semen released into freshly labelled sample bottles.

Post collection examination

The collected gonads of *Clarias gariepinus* were evaluated for gonads weight, pH, motility, and volume and sperm concentration. Immediately the gonads were removed, it was weighed with sensitive weighing balance to get the actual weight of the gonads. The pH of semen was measured with a semi-microelectrode pH Meter (SM102 pH Meter) as describes by (Saeed *et al.*, 2009).

Motility Assessment

Spermatozoa motility was assessed by placing the slides containing semen on an inverted microscope stage of either 10x or 20x objective lens. Estimation of spermatozoa motility was started immediately after the semen was gently crushed on the slides and the movement was observed till 2mins. Motility were analysed by using descriptive and numerical scales for evaluation of microscopic wave pattern of semen. In this method, the motility was recorded and expressed as the percentage based on the wave pattern movement of sperm cells. Only forward-moving sperm were judge motile, those simply vibrating or turning on their axes were considered immotile (Aas G.H, *et al*., 1991).

Volume determination

The gonads were placed in a normal saline (5ml) in a test tube and were left for about 24 hours. After which the volume was measured by calibrated volumetric test tube.

Semen concentration determination

The semen concentration was determined by using haemocytometer counting chamber according to (Caille *et al*., 2006). The counter was used to determine the actual number of sperm cells in the gonads.

STATISTICAL ANALYSIS

All parameters were analysed by using descriptive statistics to find there means and standard deviation. T-test was used to establish differences between groups. The pearson correlation was used to established the level of relationship between parameters using SPSS (IBM SPSS 2009, Version 19).

RESULTS AND DISCUSSION

The minimum and maximum values of semen physical characteristics of Cultured and Wild African Catfish are presented in Table 1 in which minimum value of 0% motility and maximum value of 92.50% was recorded for wild male broodstock fish. The mean values and standard error of the parameters (sperm concentration, progressive motility, pH, semen volume, gonads weight, fish weight and total length) are shown in Table 2 at which concentration ($x10^9$/ml), weight of fish (g) and total length (cm) are not significant ($P \geq 0.05$). Significant differences ($P < 0.05$) were shown in motility (%), pH, volume

(ml) and gonads weight (g). Correlations between the parameters are shown in Table 3, for both cultured and wild African catfish.

The 0% progressive motility recorded for wild African catfish agrees with Alavi and Cosson (2006) that reported similar finding and asserted that motility is induced after the spermatozoa are released into the aqueous during natural reproduction or into the diluents during artificial reproduction. There was a significant difference ($P<0.05$) in the progressive motility of the spermatozoa and this may be as a result of individual male depending on ripeness as reported by (Akcay *et al*., 2002) who stated that spermatozoa motility varies in vigour and duration not only among males but also within an individual male depending on ripeness. Most studies on fish also show that duration and motility of semen may vary seasonally (Benau and Terner, 1980; Akcay *et al*., 2004).

There was a significant different ($P<0.05$) between mean progressive motility (%), mean pH, mean semen volume (ml) and mean gonad weight (g) of the cultured and wild male broodstock. These differences may likely be due to age, feeding condition, water quality, and different environmental conditions and spawning season (Stockley *et al.,* 1996).

The pH values for both cultured and wild male broodstock ranged between (7 - 7.5) and (6 – 7) respectively, while the mean pH values for both fish samples are (7.22±0.26 and 6.89±0.33). Similarly, Ingerman *et al.* (2002) and Williot *et al*. (2000) reported a range of pH values of (6.0 – 7.0) for *Acipenser transmontanus* in Kootenai River, USA. There was no correlation ($r = -0.321$) between the pH values and progressive motility of wild male broodstock and this agrees with the result reported by Ingerman *et al.*(2002) and Williot *et al*. (2000) for wild Salmonids and *Acipencer baeri* respectively. However, there was a correlation ($r = 0.766$, $P<0.01$) between the pH and progressive motility of cultured male broodstock, this may be likely due to their feeding controlled environmental condition and time of spawning.

The semen volume value for both cultured and wild male broodstock ranged between (6.50 – 9.80ml) and (5.30 – 6.40ml) respectively, while the mean semen volume value for both fish samples (8.01±1.13 and 5.80±0.41) show a significant different ($p<0.05$) in the means which may be as a result of feeding and environmental conditions. There was a significant correlation ($r = 0.726$, $p<0.05$) between the semen volume and sperm concentration of culture male broodstock, this agrees with Enuice *et al*., 2010 who reported that the sperm volume increased with decrease in sperm concentration when *Clarias gariepinus* was fed with *Kigelia africana.* There was low correlation ($r = 0.353$) between semen volume and sperm concentration of wild male broodstock.

The gonad weight value for both cultured and wild male broodstock ranged between (1.60 – 6.30g) and (1.12 – 3.76g) respectively, while the mean gonad weight value for both fish samples (4.16±1.59 and 2.01±1.02) show a significant different ($P<0.05$). This could be that sperm allocation tactics can vary according to the size and status of a male or its amount of available sperm in gonads (Kazkov, 1981 and Tarbosky, 1998). There was a significant correlation between gonad weight and concentration ($r = 0.717$, $P<0.05$ and $r = 0.607$, $P<0.05$) of both cultured and wild male broodstock respectively. There was also correlation ($r = 0.980$, $P<0.01$) between gonad weight and volume of cultured male broodstock, this could be that the increase of sperm density with increasing body mass suggest an upper limit for density, probably due to physiological constraints (Stockely *et al*., 1996). However, there was a low correlation ($r = 0.413$) between gonad weight and volume of wild male broodstock which may likely be due to

age, gonad size, environmental conditions and feeding.

CONCLUSION AND RECOMMENDATION

The result of this study has shown that wild male *Clarias gariepinus* broodstocks can also be used for artificial insemination despite the importance of the cultured broodstock interms of semen quality. The use of wild male *Clarias gariepinus* in breeding should be encourage as it will minimize the dependence on cultured *Clarias gariepinus* and also to optimize the income of farmers, as the wild male broodstocks is cheaper than the cultured male broodstocks.

Breeding of wild male broodstocks with the female of cultured fish should be done in order to know the performance of the fish based on size, weight, length and rate of growth. Further study should also be done in comparing the physical characteristics of female gonads of cultured and wild African catfish broodstocks.

REFERENCES

Aas, G.H, Refstie, T and Gjerde, B., (1991). Evaluation of milt quality of Atlantic salmon. *Aquaculture*, 95:125-132. http://www.fao.org/agris/search/display.df=./1991/v1714/NL9106842.xml;NL910642.

Adeyemo, O. K., Adeyemo, O. A., Oyeyemi, M.O., and Agbede, S. A., (2007). Effect of semen extenders on the motility and viability of stored African catfish (*Claria gariepinus*) spermatozoa. *Journal of Applied Science and Environmental Management.* 11 (1) 13-16. www.bioline.org.br/ja

Akcay, E., Bozkurt, Y., Tekin, N and Secer, S. (2004). Cryopreservation of mirror carp spermatozoa. *Turkish Journal of Veterinary and Animal Science.*, 28(5): 1-7.

Akcay, E., Bozkurt Y. and Kayam S, (2002). Cryopreservation of mirror carp (Cyprinus carpio L. 1758) semen with emphasis on postthaw motility. pp. 5. In: *1st Int. Cong.*

Aquacult. - Fish. Technol. Environ. Management. June 8-10, 2002. ECEP, Book of Abstracts, Athens.

Alavi, S.M.H and Cosson, J. (2006). Sperm motility in fishes: (II) Effects of ions and osmotic pressure. *Cell Biology International.*, 30: 1-14. DOI: 10.1016/j.cellbi.2005.06.004

Benau, D and Terner, C**. (**1980). Initiation, prolongation and reactivation of the motility of salmonid spermatozoa. *Gamete Resource,* 3: 247-257.

Bromage, N.R. (1995). Broodstock management and seed quality, general consideration In: N.R. Bromage and R.J. Robert (Eds.), Broodstock Management and Egg and LarvalQuality. Blackwell, Oxford: 1- 24.

Caille, N., Kocour, M., Gela, D., Flajshans, M and Linhart, O. (2006). Quality, motility and fertility of tench (Tinca tinca) sperm in relation to LHRH analogue and carp pituitary treatments. *Aquaculture International*, 4:75-87.

Efe, O., Ebere, S.E. and Nenibarini, Z. (2015). Evaluating the Efficacy of Pituitary Gland Extracts and Ovaprim in Induced Breeding and Fry Quality of *Clarias gariepinus*, Burchell (Pisces: Claridae). Agriculture, Forestry and Fisheries, 4(2): 71-76

Enuice, O.A., Adekunle, A.D. and Olakunle, V.A. (2010). Effect of Medicinal Plant (Kigelia Africana) on Sperm Quality of African Catfish *Clarias gariepinus*. *Journal of Agricultural Science.* Vol. 2, No 1

Huisman, E.A. and Richter C.J.J. (1987). Reproduction, growth, health control and aquacultural potential of the African cattish, *Clarias garieninus* (Burchell 1822). *Aquaculture* 63:1-14.

IBM SPSS (2009), Version 19.

Idodo-Umeh G. (2003). Fresh water fishes of Nigeria. Idodo Umeh pub. Ltd. Benin City. 1-232.

Ingerman, R.L., Holcomb, M., Robinson, M.L. and Cloud, J.G. (2002). Carbondioxide and pH affect sperm motility of white sturgeon (*Aspencer transmonanus*. *Journal of experimental biology* 205, 2885-2890 (2000)

Kazakov, R. V. (1981). The effect of the size of Atlantic salmon, *Salmo salar* L., eggs on embryos and alevins. *Journal of Fish Biology* 19, 353–360.

Natural Special Programme for Food Security (NSPFS) (2005). *Farming Nigeria's water*. A compilation of the newsletter of aquaculture and inland fisheries project; (21) 1-87.

Saeed, H., Bagher, M.A. and Ali, R.M. (2009). Effect of Stripping Frequency on Semen Quality of Endangered Caspian Brown Trout, *Salmo trutta* caspius. *American Journal of Animal and Veterinary Sciences* 4 (3): 65-71.

Stockley, P., Gage, M.J.G., Parker, G.A. and Moller, A.P. (1996). Female reproductive biology and the coevolution of ejaculate characteristics in fish. *Proceedings of the Royal Society of London Series* 263, 451–458

Taborsky, M. (1998). Sperm competition in fish: 'bourgeois' males and parasitic Spawning. *Trends in Ecology and Evolution* 13, 222–227.

Tanko, J.A., Oluwadamisi, E.A., Abubakar,I. (2012).Agrochemical Concentration Level in Zaria Dam Reservoir and Ground Waters in the Environs. *Journal of Environment Protection* 3: 225-232

Teugels, G.G. (1996). Taxonomy, phylogeny and biogeography of catfishes *(Ostariophysi, Siluroidei)*: an overview. *Aquatic Living Resources* 9: 9-34...

Teugels, G.G. (1986). A systemic revision of the African species of the genus Clarias (Pisces; Claridae). *Annual Museo del Resources del African Center, Science Zool*olgy, 247:199.

Williot, P., Kopeika, E. F. and Goncharov, B. F. (2000). Influence of testis state, temperature and delay in semen collection on spermatozoa motility in the cultured Siberian sturgeon (*Acipenser baeri* Brandt). *Aquaculture* 189, 53-61.

Table 1. Minimum and maximum values for semen physical characteristics of cultured and wild African Catfish (*Clarias gariepinus)*.

	Cultured African Catfish		Wild African catfish	
Parameters	Min	Max	Min	Max
Semen Concentration ($x10^9$/ml)	1.64	3.76	1.13	3.90
Progressive motility (%)	77.50	97.00	0.00	92.50
pH	7.00	7.50	6.00	7.00
Semen Volume (ml)	6.50	9.80	5.30	6.40
Gonad weight (g)	1.60	6.30	1.12	3.76
Weight of fish (g)	800.00	1250.00	740.00	1180.00
Total length (cm)	51.90	61.00	51.50	55.00

Table 2. Mean value for Semen physical characteristics of Cultured and Wild African Catfish (*Clarias gariepinus)* broodstock.

Parameters	Cultured	Wild
Semen Concentration ($x10^9$/ml)	2.53 ±0.69	1.92 ±0.95
Progressive Motility (%)	88.00 ± 6.96^a	56.30 ± 42.30^b
pH	7.22 ± 0.26^a	6.89 ± 0.33^b
Semen Volume (ml)	8.01 ± 1.13^a	5.80 ± 0.41^b
Gonad weight (g)	4.16 ± 1.59^a	2.01 ± 1.02^b
Weight of fish (g)	1016.67±154.10	977.78±150.40
Total length (cm)	55.10±2.73	53.6±1.20

Data are expressed as mean

Values having different letters differ significantly in a row ($p<0.05$)

Table 3. Correlation coefficient of semen physical characteristics of Cultured and Wild African catfish (*Clarias gariepinus)* (n=9 semen samples)

Parameters	Catfish	Semen Concentration ($x10^9$/ml)	Progressive motility (%)	pH	Semen Volume (ml)	Gonad weight (g)
Progressive	Cultured	0.067				
Motility (%)	Wild	0.512				
Ph	Cultured	0.303	0.766**			
	Wild	-0.206	-0.321			
Semen	Cultured	0.726*	-0.033	0.410		
Volume (ml)	Wild	0.353	0.065	0.000		
Gonad weight	Cultured	0.717*	0.077	0.519	0.980**	
(g)	Wild	0.607*	0.570	-0.576	0.413	
Weight of fish	Cultured	-0.329	0.154	0.051	-0.051	-0.425
(g)	Wild	-0.151	-0.170	-0.055	0.246	0.244

* Correlation is significant at the 0.05 level (1-tailed)

** Correlation is significant at the 0.01 level (1-tailed)