



Effect of salinity level on embryonic development, hatchability and survival potential of reciprocal hybrid larvae of Clariid catfish (*Clarias gariepinus* x *Heterobranchus bidorsalis*)

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Abstract

Fertilized eggs of reciprocal crosses of *C. gariepinus* x *H. bidorsalis* were incubated in different concentrations of sodium chloride i.e. 0 (control), 2, 4, 6, 8 and 10 ppt respectively in duplicate treatments. Rate of embryonic developments, hatching percentage and time, percentage deformity, survival, rate of yolk absorption and development of hatchlings after yolk sac absorption were monitored in the different salt concentrations. Results show that embryonic development and hatching was faster in the *C. gariepinus* (f) x *H. bidorsalis* (m) in all the treatments. Percentage hatch was also higher in the *C. gariepinus* (f) x *H. bidorsalis* (m) hybrid cross in all treatments over its reciprocal. Proportion of hatched larvae reduced progressively in both crosses as the salt concentration increased. Percentage of deformed larvae also increased with increasing salinity in both hybrid crosses though the *C. gariepinus* (m) x *H. bidorsalis* (f) cross had higher percentage of deformed hatchlings in all treatments. Rate of yolk absorption decreased progressively with increasing salt concentrations for both crosses. Rate of development in length was higher in the *C. gariepinus* (m) x *H. bidorsalis* (f) cross and increased as salinity increased while the reverse occurred in its reciprocal cross. Statistical analysis revealed significant differences in all the results ($P < 0.05$) both within treatments and among both crosses. Results indicate that for incubating the eggs and rearing larvae of Clariid hybrids in aquaculture under brackish water conditions salinities should be less than 8 ppt and the *C. gariepinus* (f) x *H. bidorsalis* (m) hybrid cross should be a better species for brackish water aquaculture.

Key words: Clariid catfish, *Clarias gariepinus*, *Heterobranchus bidorsalis*, embryonic development, hybrid larvae, hatchability, salinity, survival.

Introduction

Clariid catfishes occur in Middle-East, South-East Asia and in Africa¹⁹. In this family of fishes there are two main genera i.e. *Clarias* and *Heterobranchus*. The highest generic diversity of *Clarias* is found in the African continent where 14 genera have been reported²³ as against two in South-East Asia, i.e. *Clarias scopoli* and *Encheloclarias*²³. Over 120 nominal species of *Clarias* out of which 32 valid species have been described while four *Heterobranchus* species are endemic to Africa²³.

Generally, differences between *Clarias* and *Heterobranchus* species are well marked. For example, *C. gariepinus* has a single dorsal fin with 65-80 rays which extends to the caudal peduncle whereas *H. bidorsalis* has two distinct dorsal fins namely a rayed dorsal fin with a ray count of between 39 to 45 and a fleshy adipose fin of about half the length of the rayed dorsal fin. The barbels of *H. bidorsalis* are also longer than those of *C. gariepinus*, the longest reaching the pelvic fins^{19,23}. The reciprocal hybrids of both species *C. gariepinus* and *H. bidorsalis* display an intermediate morphometry for the characters discussed above¹⁹ i.e. the possession of a smaller adipose fin with much longer rayed dorsal fin and average length of barbels when compared to that of both parents. There is no major difference in appearance between the reciprocal hybrids of the two parents^{2, 19, 21}.

Fish species differ in their osmotic pressure requirements and tolerance to environmental salinity. Performance is often reduced drastically when fish are exposed to stressful salt concentrations and death may result. Compounding the physiological impacts of

salt concentration on aquaculture animals is the corrosive nature of salt water²². Salinity is therefore regarded as one of the predominant factors responsible for the distribution, survival, reproduction and growth performance of fish species¹. Salinity regulates the survival of fish by interacting with temperature, dissolved oxygen and other environmental factors¹². However, to ensure proper development and better survival, eggs are normally subjected to incubation conditions favorable to normal development. Though, the time taken the eggs to develop generally varies in different fishes⁹. This depends on various other factors such as salinity, temperature etc. The manipulation of these factors would improve the time taken for development in each of the various fishes involved.

It is important to note that while temperature of the incubator water influences the development and hatching of eggs in Clariid catfishes, salinity tolerance is dependent on the stage of development of the fish⁸. Legendre et al.¹⁹ reported a faster growth and higher survival in a higher salinity of 8 ppt for the hybrids of *C. gariepinus* and *H. longifilis* when compared with their parental crosses. Fingerlings and adults of *C. gariepinus* can tolerate salinities up to 10 and 15 g/l respectively¹⁰. Nwigwe²⁰ gave values greater than 12 ppt for *C. gariepinus* fingerlings. The optimum range of salinity for adult *C. gariepinus* and *H. bidorsalis* is 0-3 ppt which indicates that this species is stenohaline^{8, 14, 15}. *Heterobranchus longifilis* has been described as mixohaline (tolerating average salinity) and proved to be highly suitable for

culture under saline conditions up to 10 ppt¹⁹. Fagbenro et al.¹⁴ reported its close relative *Heterobranchus bidorsalis* as being found only in salinities not greater than 9 ppt in nature. Haylor¹⁵ opined that salinity up to 5 ppt is acceptable for *C. gariepinus* fry growth and that survival is good up to 7.5 ppt. Borode et al.⁴ however reported optimum salinity for *C. gariepinus* eggs and larvae as between 0 and 2 ppt and acceptable up to 6 ppt. Although, these and several other workers have reported on the salinity tolerance of some Clariids, there is in the literature, however, very little information on how these environmental salinities affect the breeding and embryonic development of fertilized eggs and larvae of this group of catfishes, especially the fast growing hybrids. Knowledge of the tolerance limits and embryonic development of the larvae of these hybrids in environmental salinities would be very helpful in determining their suitability for propagation in coastal brackish water aquaculture systems. The objective of this study therefore was to determine the salinity conditions needed for the optimum development and survival of the reciprocal hybrids of *C. gariepinus* x *H. bidorsalis* at their embryonic and early larval stages.

Materials and Methods

Hormone injection and stripping: Sexually mature female broodstocks of *C. gariepinus* and *H. bidorsalis* (average weight 500 g) were induced to spawn using homoplastic hypophysis at ratios of 2:3 (recipient:donor) weights in a single intramuscular injection. Upon the completion of ovulation at 12 hours post-injection, eggs of each of the two different species were stripped manually into two separate dry plastic bowls. Egg quantities were estimated by weighing each egg mass and multiplying the weight by 700 to give the quantity of eggs stripped per fish (one gram of Clariid catfish eggs equals approximately 700 eggs). Sexually mature males (average weight 500 g) of both species were sacrificed and their ripe testes were removed. Each collected egg mass was then fertilized artificially with fresh milt collected from the opposite cross by incising the testis at the lobes with a sharp stainless blade then squeezing the testis and distributing the milt onto the egg mass. Fresh aerated water from the incubation troughs was added to each bowl of eggs and gently mixed with a feather. The mix was then allowed to stand for about 2 minutes for fertilization to be completed. Eggs were then rinsed in several changes of clean aerated water to wash off the excess milt before spreading them into the various incubation troughs.

Egg incubation and embryonic development: 100 fertilized eggs were counted for each cross and distributed into separate four-liter capacity circular incubation troughs containing various concentrations of salt, 0, 2, 4, 6, 8 and 10 ppt, prepared by

dissolving 0, 2, 4, 6, 8 and 10 g of sodium chloride in a liter of spring water in duplicate treatments respectively at 23-24°C. Immediately upon fertilization, three egg samples were taken randomly for each cross from each treatment in duplicates and on an hourly basis until first hatching. These were immediately preserved in 10% formal saline solution to arrest further embryonic development. Developmental stages were then studied a few hours later under an electric light microscope.

Hatching and development: The time taken for incubation and hatching was monitored for each treatment at the prevailing temperature. Percentage fertilization was estimated for each cross at the blastopore stage when all unfertilized eggs turn white (i.e. 14 h post-fertilization). This was done by counting the number of dead and unfertilized eggs and subtracting their number from the total number of eggs. This was then expressed as a percentage of the total number of eggs incubated per treatment.

On completion of hatching, percentage hatch was estimated by counting the number of hatched larvae under each treatment for each cross per replicate, finding the average and expressing this as a percentage of the number of eggs per treatment. Percentage deformed larvae was also enumerated for each treatment under each crosses by counting the number of deformed larvae under each treatment and expressing this as a percentage of the total number of hatchlings for each treatment under each cross. Rate of yolk absorption for each cross under each treatment was determined daily until final yolk absorption. This was done by daily measuring the size of the yolk sac of two samples each from each treatment using an ocular micrometer mounted on a light microscope. The average rate of daily yolk absorption was then determined using the formula: $\Sigma(nI - nF)/t$, where nI = initial yolk size per day, nF = final yolk size per day, t = rearing period. The rate of development in length till the end of yolk absorption was also determined daily by measuring the length of three sampled larvae from each treatment using an ocular micrometer mounted on a light microscope. The average rate of development in relation to the various salt treatments were then calculated using a similar formula as above: $\Sigma(Li - Lf)/t$, where Li = initial daily length of larvae, Lf = final daily length of larvae, t = rearing period.

Water quality parameters: Water quality parameters (Table 1) were measured daily as temperature (mercury in glass thermometer in °C), dissolved oxygen (digital dissolved oxygen concentration meter in mg/l), pH (digital pH meter) and electrical conductivity (digital conductivity meter) in each replicate troughs on a daily basis throughout the period of the experiment.

Data analysis: Data analysis was done by analysis of variance (ANOVA) and using Fisher's least significant difference (LSD)

Table 1. Mean water quality parameters in incubation troughs under different salinities. (DO₂ = dissolved oxygen)

Day	Parameter	0 ppt	2 ppt	4 ppt	6 ppt	8 ppt	10 ppt
1 - 4	Temperature °C	23	23	23	23	23	23
	DO ₂ (mg/L)	2.4 ± 0.15	2.6 ± 0.2	2.3 ± 0.21	2.5 ± 0.15	2.5 ± 0.2	2.4 ± 0.20
	pH	6.7 ± 0.3	7.04 ± 0.41	7.05 ± 0.4	6.96 ± 0.31	7.55 ± 0.4	7.6 ± 0.4
	Electrical conductivity mS cm ⁻¹	1.8x10 ⁻³ ± 0.21	2.86x10 ⁻³ ± 0.25	6.6x10 ⁻³ ± 0.32	8.31x10 ⁻³ ± 0.34	8.31x10 ⁻³ ± 0.33	8.8x10 ⁻³ ± 0.41

Table 2. Embryonic development rate of *C.g. (m) x H.b.(f) (A)* and *C.g.(f) x H.b.(m) (B)* under different salinities.

	0 ppt (Control)		2 ppt		4 ppt		6ppt		8 ppt		10 ppt	
	A	B	A	B	A	B	A	B	A	B	A	B
Fertilized egg stage	0-30 min.	0-30 min.	0-40 min.	0-35 min.	0-45 min.	0-40 min.	0-50 min.	0-45 min.	0-1hr	0-50 min.	0-1 hr	0-1 hr
Two cells to early gastrula stage	45-5 hr	35-6.10 hr	45-5 hr	40-6.30 hr	50-5 hr	40-7 hr	1-6 hr	50-7.30 hr	1-6 hr	1-8 hr	1-7 hr	1.20-9hr
Gastrula stage	7 hr	6.20-8 hr	7 hr	6.45-8.30 hr	7.15 hr	7-8.45 hr	7.45 hr	8.50 hr	8 hr	9 hr	8 hr	8 hr
Late gastrula to end of gastrulation	8 hr	8.30 hr	8 hr	8.45 hr	8.30 hr	9.30 hr	9 hr	11 hr	10 hr	11 hr	10 hr	10 hr
Start of organogenesis	9-10 hr	9 hr	9-11 hr	9-10 hr	12-13 hr	11-12 hr	14 hr	12 hr	15 hr	12 hr	14 hr	14 hr
Head and tail bud formation	13 hr	13 hr	13-30 hr	13-45 hr	14 hr	14 hr	15 hr	15 hr	16 hr	15 hr	15 hr	15 hr
Embryo elongates	16 hr	15 hr	16 hr	15-30 hr	17 hr	16-30 hr	18 hr	17 hr	19 hr	17 hr	17 hr	17 hr
Caudal section develops	20-21 hr	19.30 hr	21 hr	20 hr	22.30 hr	21 hr	21.22 hr	21.30 hr	22 hr	21.30 hr	21.30 hr	21.30 hr
Close to hatching	22 hr	21 hr	22 hr	21.30 hr	22.30 hr	22 hr	23 hr	23 hr	24 hr	23 hr	23 hr	23 hr
First hatching	27.35 hr	27.25 hr	29 hr	27.40 hr	30 hr	28.50 hr	30 hr	28.55 hr	30 hr	28.55 hr	28.55 hr	28.55 hr

test ($P \leq 0.05$) to compare treatment means. The differences were further assessed at 5% probability levels ²⁵.

Results

Hormone injection and stripping: The use of homoplastic hypophysis at ratio 1:1.5 (recipient: donor weights) successfully induced ovulation and spawning in both broodstocks without mortality. Latency time between hormone injection and stripping was 15.30 h at 22-23°C.

Embryonic developments: The fertilized egg stage appeared when the germinal vesicle became visible. This occurred within 1 hour of fertilization in both crosses and treatments. It appeared earlier in treatments with lower salt concentrations and was much delayed in higher salinities up to 1 hour in 8 ppt and 10 ppt for both crosses.

The 2-cell and early gastrulation stages occurred after the fertilized egg stage. At 35 minutes after egg fertilization, the 2-cell stage was seen in the 0 ppt for *H.b.(m) x C.g.(f)* while it occurred at 45 minutes in the reciprocal cross. Early gastrulation was completed earlier under all treatments in the *H.b.(f) x C.g.(m)* than in the reciprocal hybrid cross (Table 2). The gastrula stage was seen between 7 to 8 hours for all treatments in the *H.b.(f) x C.g.(m)* while it was seen later at between 8 and 9.30 hours in the *H.b.(m) x C.g.(f)* cross. Between 8.30 and 14 hours, gastrulation had been completed in the *H.b.(m) x C.g.(f)* cross depending on salinity while gastrulation was completed earlier between 8 to 10 hours in the *H.b.(f) x C.g.(m)* cross.

At between 9-10 hours, the start of organogenesis was observed under the control treatment for the *H.b.(f) x C.g.(m)* cross while at 14 hours all embryos were observed dead under 10 ppt for this cross. Organogenesis was seen for the *H.b.(m) x C.g.(f)* cross at 9 hours under the 0 ppt treatment while it occurred later at 16 hours under the 10 ppt treatment for this species. At the end of organogenesis, the head and tail buds of the embryo first ridged out at 13 and 16 hours under 0 and 8 ppt respectively for the *H.b.(f) x C.g.(m)* cross while it occurred at 13 and 15 hours under 0 and 8 ppt for the reciprocal cross respectively.

After the formation of the head and tail buds, a general lengthening of the embryo took place. This was observed in the *H.b.(f) x C.g.(m)* cross at 16, 17 and 19 hours under 0, 4 and 8 ppt respectively. In the reciprocal hybrid cross it was seen at 15, 16.30 and 17 hours at 0, 4 and 8 ppt respectively. The development of the caudal section of the embryo followed at between 20 and 22 hours in the *H.b.(f) x C.g.(m)* cross while it was seen at between 19.30 and 21.30 hours in the *H.b.(m) x C.g.(f)* cross respectively.

At the end of the development of the caudal section of the embryo, the mobile state of the developing embryo appeared. This was a stage when the first visible sign of movement was noticed in the embryo thus indicating the readiness of the embryo to hatch. This stage was observed earliest in the 0 ppt at 21 and 22 hours for *H.b.(m) x C.g.(f)* and *H.b.(f) x C.g.(m)* crosses respectively while it occurred at 23 and 25 hours under 8 ppt for *H.b.(m) x C.g.(f)* and *H.b.(f) x C.g.(m)* respectively.

Hatching was noticed in 0 ppt treatment at 27.25 h in *C.g.(f) x H.b.(m)* and at 27.35 h in *C.g.(m) x H.b.(f)* crosses respectively and closely followed by the 2 ppt treatment. However, hatching was faster in the *C.g.(f) x H.b.(m)* in all the treatments than in its reciprocal cross. In both crosses hatching and embryonic development was delayed in the higher salinities, and all embryos

died between 10 and 16 hours at 10 ppt for both crosses (Fig. 1). Statistical analysis showed significant differences ($P \leq 0.05$) mostly between the control and the other treatments. Detailed results are shown in Table 2.

Percentage hatch: Percentage hatch was highest in 0 ppt treatment of *C.g.(f) x H.b.(m)* and reduced progressively as the salt concentration increased but with a sharp drop at 6 ppt and rising slightly again at 8 ppt. For the *C.g.(m) x H.b.(f)* cross, percentage hatch was highest at 6 ppt treatment followed by the control treatment, 2 ppt, 4 ppt and 8 ppt respectively. There were significant differences among treatments for each cross and also among crosses (Fig. 2).

Percentage deformity: At 0 to 8 ppt deformity ranged from 0 to 7% in *C.g.(f) x H.b.(m)* and from 17 to 79.6% in *C.g.(m) x H.b.(f)* crosses respectively. Significant differences were found within the treatments and also among both crosses. Percentage deformity for both crosses show that increasing salinity seems to increase the number of deformed hatchlings progressively though at 8 ppt, the *C.g.(f) x H.b.(m)* did not show any deformed

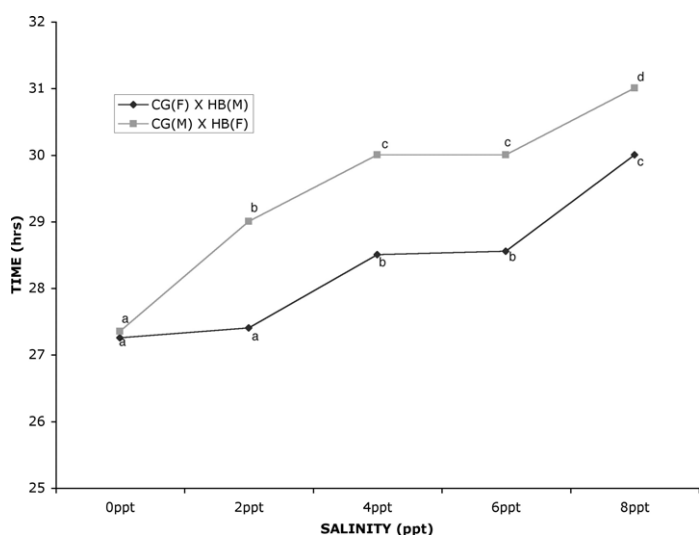


Figure 1. Effect of salinity on hatching time of hybrids. Values (mean±SD) with different letters for same cross are different ($P < 0.05$).

larvae (Fig. 3). Also at 6 ppt for both crosses there were slightly reduced percentage deformed larvae.

Mean yolk size and absorption rate: Average yolk sizes of both crosses were monitored in the different salt concentrations. Statistical analysis revealed significant differences ($P \leq 0.05$) in yolk sizes of both crosses in the various treatments. There were significant differences ($P \leq 0.05$) in the daily yolk absorption rates. Also between day 0 to day 3, significant differences were found in the rate of change for all crosses in the various salt concentrations. There were also significant differences ($P \leq 0.05$) in the yolk absorption rates among crosses. Results of mean yolk sizes and yolk absorption rates are presented in Fig. 4.

Mean body length of yolk sac larvae: Results of mean body lengths of yolk sac larvae are presented in Fig. 5. Significant differences were found between the various body lengths for both crosses in the salt treatments. There were also significant differences in body length among crosses and treatments. Significant differences were found in the rate of yolk sac larval development between all treatments in both crosses and also among crosses. Developmental rate was highest in the

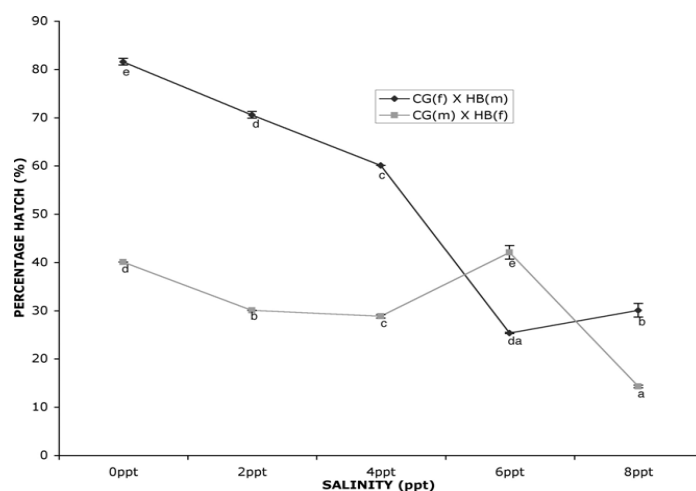


Figure 2. Effect of salinity on percentage hatch of hybrids. Values (mean±SD) with different letters for same cross are different ($P \leq 0.05$).

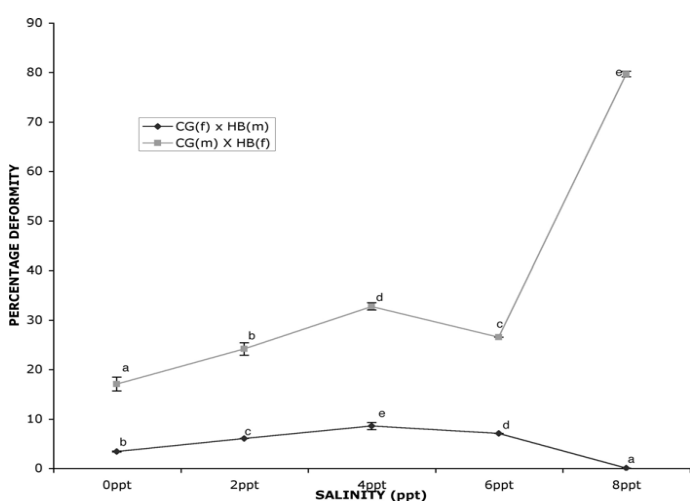


Figure 3. Effect of salinity on percentage deformity of hybrids. Values (mean±SD) with different letters for same cross are different ($P \leq 0.05$).

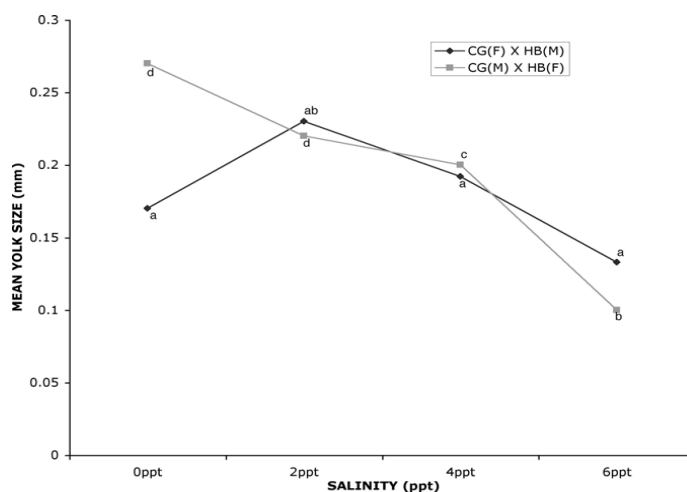


Figure 4. Effect of salinity on mean yolk size of hybrid larvae. Values (mean±SD) with different letters for same cross are different ($P \leq 0.05$).

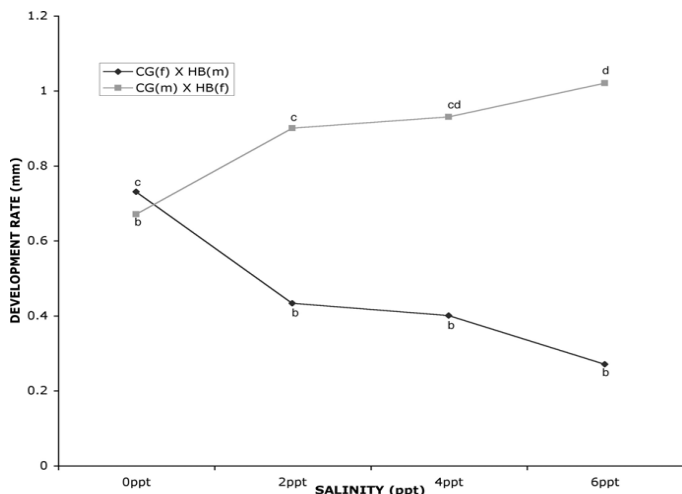


Figure 5. Effect of salinity on rate of larval development. Values (mean±SD) with different letters for same cross are different ($P \leq 0.05$).

C.g.(m) x H.b.(f) among both crosses though it had the lower value in the control (0 ppt) treatment. No values were obtained under the 8 ppt treatment for both crosses as total mortality of all larvae under this treatment was recorded for both crosses shortly after hatching.

Discussion

Reciprocal hybridization between *Clarias gariepinus* and *Heterobranchus bidorsalis* was successful. This finding agrees with those^{14, 16} for successful induced spawning of *Clarias gariepinus* and *Heterobranchus longifilis*. Embryonic development of the fertilized eggs started immediately after fertilization for both crosses in the various salt treatments with the accumulation of the cytoplasm at the animal pole causing the perivitelline membrane to swell, as was reported by several authors^{16, 21}. The slower rate of development at the higher salinities for both crosses though more pronounced in the *C.g.(m) x H.b.(f)* cross could be due to increasing maintenance requirements at salinity as also reported by Kilambi and Zdinak¹⁸ and Brett⁵.

At the gastrula stage, earliest time recorded was at 6.20 h at 0 ppt for *H.b.(m) x C.g.(f)* and 7 h for *C.g.(m) x H.b.(f)* crosses and extending up to between 8 and 9.30 h at 8 and 10 ppt for crosses. The mortality observed at 10–14 h of embryo growth at the start of organogenesis in 10 ppt treatment shows that the species cannot withstand such high salinity at the egg stage. Nwigwe²⁰ has also reported that Clariid fingerlings tolerate salinity less than 12 ppt.

The result of percentage hatch indicates that the hybrid *C.g.(f) x H.b.(m)* would have better hatchability when reared in salinities not greater than 8 ppt than its other reciprocal. This finding for this cross shows the predominant effect of the paternal *Heterobranchus* male parent on growth/development since *Heterobranchus* frequents brackish waters and tolerates higher salinities than *Clarias gariepinus* and is known to be suitable for brackish water culture even up to 10 ppt¹⁹. The same trend as in hatching percentage was also followed in the percentage deformity among both crosses for both treatments. The much higher percentage deformity values obtained under all treatments for the *C.g.(m) x H.b.(f)* also points to the effect of paternal predominance on development and vigour since *Clarias gariepinus* is stenohaline and possesses only a limited ability to withstand an

increase in the ambient salinity due to the limited ability of its regulatory mechanisms¹⁷. Borode et al.⁴ found high percentages of deformed *C.gariepinus* larvae up to 71.9% under 8 ppt salinity. They also reported considerably low percentage hatch at higher salinity of 8 ppt for the species. Significant differences were found within the treatment results for individual cross and also among the results of both hybrid crosses when compared.

The rate of yolk absorption decreased progressively with increasing salt concentration for both crosses. Comparing both crosses, yolk absorption was higher under control treatment and 4 ppt for the *C.g.(m) x H.b.(f)* while at 2 and 6 ppt it was higher for the *C.g.(f) x H.b.(m)*. Comparing these results with the work on *H. bidorsalis*³ and *C. gariepinus* larvae⁴ reared under various salinities, it could be said that growth in saline water would be dependent on the species vigour and resistance even among stenohaline species and also on their stage of development. Only the *C.g.(f) x H.b.(m)* hatched under the 8 ppt salt treatment did not survive beyond 2–4 h after hatching in the 8 ppt treatment. Similar result was reported by Borode³ on the *H. bidorsalis* and *C. gariepinus* parental crosses. Then only the *Clarias gariepinus* parental cross hatched in the 8 ppt treatment died at close to two hours later while the *H. bidorsalis* parental cross did not hatch. The result here also indicates that with increasing salinity in water bodies species that are stenohaline would likely suffer a slower growth rate. Fagade and Olaniyan¹³ also reported that salinity influences growth and production potential by influencing osmoregulation and metabolism. Despite the optimum range of salinity recommended for *C. gariepinus* and *H. bidorsalis* fingerlings is 0–3 ppt^{8, 14}, *C. gariepinus*⁴ and *C.g.(f) x H.b.(m)* cross hatched under salinity of 8 ppt. This showed that survival and hybrid vigour were greatly influenced by the maternal parent¹⁹. The result of mean body lengths of larvae in our study shows that the length of the larvae in the treatments decreased with increasing salt concentration for the *C.g.(f) x H.b.(m)* cross while the reverse occurred in its reciprocal cross. Comparing with results^{3, 4} on *H. bidorsalis* and *C. gariepinus* parental crosses larvae under similar conditions, developmental rate in length of *H. bidorsalis* larvae also increased with increasing salinity while the reverse occurred in the *C. gariepinus* parental cross. This trend for *C.g.(f) x H.b.(m)* cross in our experiment and for *C. gariepinus*³ somehow agrees with Britz and Hecht⁸ who reported decreasing growth rate with increasing salinity for *Clarias gariepinus* larvae. This was probably due to the characteristics of freshwater stenohaline fish known for increasing maintenance requirements at higher salinities⁵ and consequent weight loss²⁴. The fact that each of the hybrids took after either of the parental stocks as in the work of Borode³ is an indication of the effect that one or both of the parents could have on growth performance and survival of offsprings.

Our findings on the rate of development indicate a prevalence of *Heterobranchus* traits on growth since *Heterobranchus bidorsalis* is known to be a faster growing species, frequent brackish waters and tolerate higher salinities than *Clarias* species¹⁹. The survival and vigour are influenced by the maternal parent while growth is influenced by the paternal parent. This also agrees with the work of Dunham et al.¹¹ who reported that the male parent of interspecific crosses between channel and blue catfish species had a controlling influence on several growth patterns. Among both hybrid crosses, statistical differences were found between results among the crosses.

Contrary to reports of earlier authors^{8, 14, 19, 23}, that the hybrids of the two parents of *C. gariepinus* and *H. bidorsalis/longifilis* exhibit slightly higher tolerance to salinity than their parental crosses, the finding in our study indicates that the *C.g.(f) x H.b.(m)* hybrid exhibits better tolerance to salinity than its reciprocal cross and there is not likely to be any major disparity in its growth performance and survival when reared in salinities between 0 and 6 ppt at the larval stages. This is further confirmed by the fact that the *C.g.(m) x H.b.(f)* cross exhibited a slower developmental rate having greater percentage of deformed larvae than its reciprocal (Fig. 5). Results of this study are clear indications that growth in saline waters would be dependent on the species vigour and resistance even among stenohaline species and also on their stage of development. Therefore in incubating and rearing larvae of Clariid hybrids in brackish water aquaculture, salinity should be less than 8 ppt and in terms of selection, *H.b.(m) x C.g.(f)* hybrid cross should be a better species for culture.

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