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Induced Spawning and Larval Rearing of African Catfish, *Clarias gariepinus* (Burchell 1822), in Saudi Arabia

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ABSTRACT The African catfish, *Clarias gariepinus* (Burchell 1822), introduced in Saudi Arabia in 1987 was grown to maturity in outdoor concrete tanks, and induced to spawn.

African catfish (*C. gariepinus*) larvae were reared for four weeks on a combination of dry feed (crude protein, 51%) and live food comprising of freshly hatched *Artemia salina nauplii* and cultured *cladocerans*. Excellent growth was recorded when the larvae were fed *Artemia* nauplii for one week and dry feed for the following three weeks. The final average weight was 1468 mg with a survival rate of 44%. With other combinations (dry feed only; *Artemia* nauplii only; *Artemia* and *cladocerans*) the final average weight ranged from 355 mg to 1390 mg to 1390 mg and the survival rate varied between 41% to 75%

Similarly the combination of *Artemia* nauplii and a prepared dry diet also gave good results (final av. wt. 1530 mg in five weeks; survival 68%).

Neither *Artemia* nauplii nor the dry feed alone proved to be suitable diets for larval rearing.

Fingerlings weighing about 0.75 g and reared at three densities reached to average weights of 12.6 g (200 fish/m^3), 11.7 g (400 fish/m^3) and 11.0 g (600 fish/m^3) in 35 days, and there was no significant effect of density on growth, survival and feed conversion of *C. gariepinus*.

There has been a considerable interest in the cluture of African catfish, *Clarias gariepinus* (Burchell 1822) during the past twenty years and a number of studies on its breeding, larval rearing and aquacultural potential have been made (El Bolock and Koura 1969, Micha 1971, De Kempe and Micha 1975, Hogendoorn and Wieme 1975, Richter 1976, Hogendoorn 1979, 1980, 1981, Hogendoorn and Vismans 1980, Hogendoorn and Koop 1983, Hogendoorn *et al.* 1983, Hecht 1985, Hecht and Applebaum 1987). Studies on induced spawning and aquacultural potential of *C. gariepinus* under laboratory conditions have also been undertaken in the

Netherlands (Huisman and Richter 1987), and the results have been tested in field conditions in West Africa (Viveen *et al.* 1985). Presently the species is succesfully cultured in Palestine and in many countries of Africa.

Research efforts (Siddiqui 1983, Siddiqui and Howlader 1987) and extension services of Fish Culture Project, King Abdulaziz City for Science and Technology, Riyadh, helped to prove that inland fish farming in Saudi Arabia is feasible. Consequent to it a number of private fish farms culturig tilapia have been establsihed. As the cutlure of tilapia is a success, it is felt there is need to introduce other culturable fish species to provide variety to cunsumers. Therefore the present study was undertaken to introduce the African catfish, *C. gariepinus*, in Saudi Arabia, and grow it to maturity; to induce maturation and spawning, and to rear the larvae to fingerling size for stocking into growout tanks.

Materials and Methods

Origin and maintenance of brood stock

In October 1987, 120 *C. gariepinus* with an average weight of 700 g were imported from a catfish farm in Ismailia, Egypt. The fish were stocked in two concrete tanks (3.6x2.8x1.2m) and maintained on a commercial fish feed until used for the present study. On April 1, 1989, 20 females and 20 males were selected and stocked in four tanks (3.6x2.8x1.2m), each tank having 5 females and 5 males. The fish were fed a commercial fish feed with 34% dietary protein supplemented with fresh fish meat at 2% body weight once daily at 16.00 h, six days a week.

Selection of breeders and induction of spawning

The fish were either spawned semi-naturally in tanks or by stripping the eggs from females and sacrificing males for the milt. The fish were induced to spawn in May, July and August, 1989. On May 23 and July 31 at 17.00 hr 2 sexually mature females and 2 males weighing 1.0 - 1.5 kg were selected. The selected females had distended, soft and reddish abdomen while the males had a large pointed genital papilla. Both females and males were injected intramuscularly (just lateral of the dorsal fin) with a carp pituitary homogenate. The pituitary was obtained from sexually mature carps *(Cyprinus carpio)* weighing 1 to 2 kg and dried in acetone. 4 mg pituitary per kg body weight was macerated in 1 ml 0.9% Nacl solution in a glass mortar and the homogenate was administered to the fish. Methodologies of Hogendoorn and Vismans (1980) and Viveen *et al.* (1985) were followed for induced spawning. Two circular fiberglass tanks (diam 1.2m; height 1.5; water level 30 cm) were used to pair one female and one male in each tank. After 12 hr the spawning was complete (ambient water temperature 22-28°C) and the females had spawned all the eggs. The fertilized eggs were collected at 7.00 hr.

In August 1989 the selection of breeders and the procedures used for induced spawning were the same except that the 2 females were stripped for eggs by gently pressing the abdomen in an anterior to posterior director after 12 hr of the treatment at an ambient water temperature of 22-28°C. The eggs from each female were collected in separate stainless steel bowls of 2 L. capacity. At the same time a male was sacrified, testes taken out and the milt squeezed on the eggs after making incision in the testes. The milt was mixed with the eggs by a feather and a little water was added to ensure fertilization. The fertilized eggs were washed to remove extra milt. In all trials the fertilized eggs were poured on 0.5 mm nylon netting spread in fiberglass tanks (900 l) receiving a continuous supply of water at 1 L/min. Intensive aeration was provided in each tank. The hatching was complete within 24 to 36 hr at ambient water temperature of 24 to 30°C.

To determine the hatching rate two samples of 200 - 250 fertilized eggs from each female were sampled and spread in a monolayer in a stainless steel tray (30x25x4 cm). The trays were immersed in plastic troughs (52x42x23 cm) with a gentle water flow through it. The outlets from the troughs were covered with0.5 mm gauze to prevent escape of larvae. After 40 hr post fertilization the larvae and dead eggs were counted.

Larval Rearing

Two experiments were conducted with 3 days old post-hatch larvae. *Artemia, cladocerans,* dry feed and a prepared dry diet were tried in different combinations and proportions for the rearing of larvae.

Experiment 1

Six 900 L capacity oval-shaped fiberglass tanks with a water level of 20 cm and a volume of about 200 L were used. 200 larvae (3 days old post-hatch) weighing 5 ± 1 mg were stocked in each tank and reared for 35 days, May 28 to July 1, 1989, at ambient water temperature of 22 to 30°C. The water exchange in each tank was 0.5 L/min, and the water was continously aerated. The larvae were fed in excess of satiation twice daily at 8.00 and 18.00 hr. They were considered satiated when they stopped searching for food. A prepared diet (Table 1), freshly hatched *Artemia salina* nauplii (Great Salt Lake strain) and locally cultured cladocerans (mostly *Daphnia* and *Moina)* passed through a 1-mm seive were used as food (Table 4). In the first week of the experiment the larvae in all six tanks received *Artemia,* but in the following four weeks two tanks received *Artemia,* two tanks cladocerans and the remaining two tanks a prepared dry diet. Dry diet (200-750 um in size) was prepared from eel fingerling feed in powder form, milk powder and egg yolk powder obtained by grinding oven-dried egg yolk (1:1:1).

Experimant 2

Eight 900 L fiberglass tanks were used; each tank with 200 L water was stocked with 400 3-days old posthatch larvae (av. wt 6 ± 1 mg) and reared for 30 days. (August 5 to September 3, 1989). A dry feed (eel fingerling feed imported from Taiwan; proximate composition (crude protein 51.1%, fat 6.9%, fiber 0.6%) and live food were used in four different combinations (Table 5); other procedures were the same as employed for Exp. 1 except that 10 larvae were measured and weighed individually on the 10th and 20th day of the experiment. These larvae were discarded and not counted to determine the survival rate. The fish larvae were fed upto satiation four times a day between 6.00 and 18.00 hr. In the third week of the experiment the fish were fed only three times a day. The treatments were randomly replicated.

Experiment 3

Fingerling culture at three densities

The objective of this study was to grow *C. gariepinus* fingerlings weighing about 0.75 g to a size of about 10 g for stocking into growout tanks and to determine the desired stocking rate for mass production. Six concrete tanks (3.6x2.8x1.2m) with a water level of 30 cm were used. The tanks were stocked with 30 days old fingerlings (post-yolksac absorption) at three densities (200/m^3, 400/m^3, 600/m^3), and the treatments were randomly replicated (Table 6). The fish were fed a pelleted (1.0-1.5mm) commercial fish feed (crude protein 34.0%, fat 3.4% and fiber 3.0%). The rate of feeding during five weeks (September 4 to October 8, 1989) trial was 20, 10, 6, 5 and 4% of body weight being adjusted every 7 days after subsampling about 30 fish from each tank and determining their length and weight. The feed was offered twice daily at 8.30 and 16.30 hr. At the end of experiment all fish were counted. Forty fish from each tank were measured and weighed individually.

Table 1. Proximate composition of a dry prepared diet (Diet C, Table 4)

Proximate compostion	**%** **(Dry Weight)**
Moisture	3.75
Protein	39.18
Fat	8.70
Fiber	0.05
Ash	7.55
Gross energy K cal/g (Calculated)	5.42

Ingredients: Eel fingerling feed imported from Taiwan, dry powder milk and dry egg yolk (1 :1 : 1)

The water in each tank was almost completely changed each day in the morning. The accumulated leftover feed and excreta were removed by siphoning from the tanks as far as possible. The tanks were aerated continuously.

Water Quality

Maximum - minimum water temperatures were recorded daily using a maximum - minimum thermometer. Dissolved oxygen, pH, alkalinity and ammonia were determined at weekly intervals and total hardness and salinity at monthly intervals. All parameters were determined using HACH Fish Farming Test Kit, Model FF2. In the beginning the salinity was determined by the hydrometer method (APHA 1975), but later on a salinity refractometer was used.

Statistical Analyses

Statistical analyses of the data on growth, survival rate and feed conversion ratio were made by using one way analysis of variance and Scheffe's range test was used to evaluate the mean differences among individual diets at 0.05 significance level (Statgraphics 1986).

Results

Induced spawning was attempted in 6 *C. gariepinus* females; all fish ovulated whether paired with males for seminatural spwaning in tanks or by stripping 12 hr after pituitary homogenate injection. The hatching rate of eggs of 6 females ranged between 45% to 66%, with a mean hatching rate of 53% (Table 2). Water quality variations recorded during the present investigations (May to October, 1989) are given in Table 3.

Table 2. Hatching rate and method of spawning of *C. gariepinus*

Month	Fish No.	Body wt. of fish (kg)	Hatching rate (%)	Method of spawning	Ovulation response
May, 89	1	1.05	54	Semi-natural	Complete
	2	1.50	59	in tank	"
July, 89	3	1.35	66	"	"
	4	1.16	51	"	"
August, 89	5	1.10	47	Hand stripping	"
	6	1.12	45	"	"

The larvae accepted exogenous food when they were 3 days old posthatching. The combination of *Artemia* and dry prepared diet and *Artemia* and *cladocerans* gave better survival rate (68% and 75% respectively) than *Artemia* alone (16%, Exp. 1). Because of low rate of survival with *Artemia* only, the growth rate of few surviving larvae was very good and it can not be compared with the growth rates obtained from other two diets. The combination of *Artemia* and dry diet gave better growth rate than the combination of *Artemia* and *zooplankton* (Table 4).

In experiment 2 *Artemia*, cladocerans and dry feed (eel fingerling feed) were used in different combinations and proportions to prepare four diets. The combination of *Artemia* and dry feed (diet 1, Table 5) with increasing amount of dry feed every week was significantly better than the combination of *Artemia*, *cladocerans* and dry feed (diet 2), *Artemia* and dry feed (diet 3) and dry feed alone (diet 4) in terms of survival (Table 5). The best growth was obtained with diet 3 where a combination of *Artemia* (first week) and dry feed (3 weeks) was used, followed by diet 2, diet 1 and diet 4 in a dcreasing order and the final weight at the end of 30 days rearing period ranged between 1468 ± 548 mg and 355 ± 17 mg (Table 5, Fig. 1).

In experiment 3 the survival and final weight of fingerlings stocked at three densities were 67% and 12.6 g (200/m^3) 62% and 11.7 g (400/m^3) and 64% and 11.0 g (600/m^3) and were not significantly different ($P > 0.05$) for fishes cultured at different densities. The feed conversion ratios were also not significantly different ($P > 0.05$) (Table 6, Fig. 2).

Discussion

The Water quality with respect to dissolved oxygen levels, pH, alkalinity, ammonia, salinity remained within tolerance limits of catfish culture (Viveen *et al.* 1985) during the period of present investigations (Table 3).

The results of the present study indicate that a single injection of 4 mg/kg weight of acetone dried carp pituitary was suitable and reliable method for induced spawning of *C. gariepinus* confirming other studies (Hogendoorn and Vismans 1980). In *C. macrocephalus* the spawning was induced by a single injection of 7.0 mg and 3.5 mg/100 g body weight of homoplastic pituitary homogenate with a latency period of 13-16 hr at a temperature of 26-31°C (Mollah and Tan 1983), Zooneveled *et al.* (1988) induced spawning in *C. batrachus* by giving a doze of 6 mg/kg body weight and stripping after 17 hr at 25°C.

The average hatching rate of eggs of 6 females was 53%, ranging between 45% and 66% (Table 2). The hatching rate of seminaturally tank spawned fish was

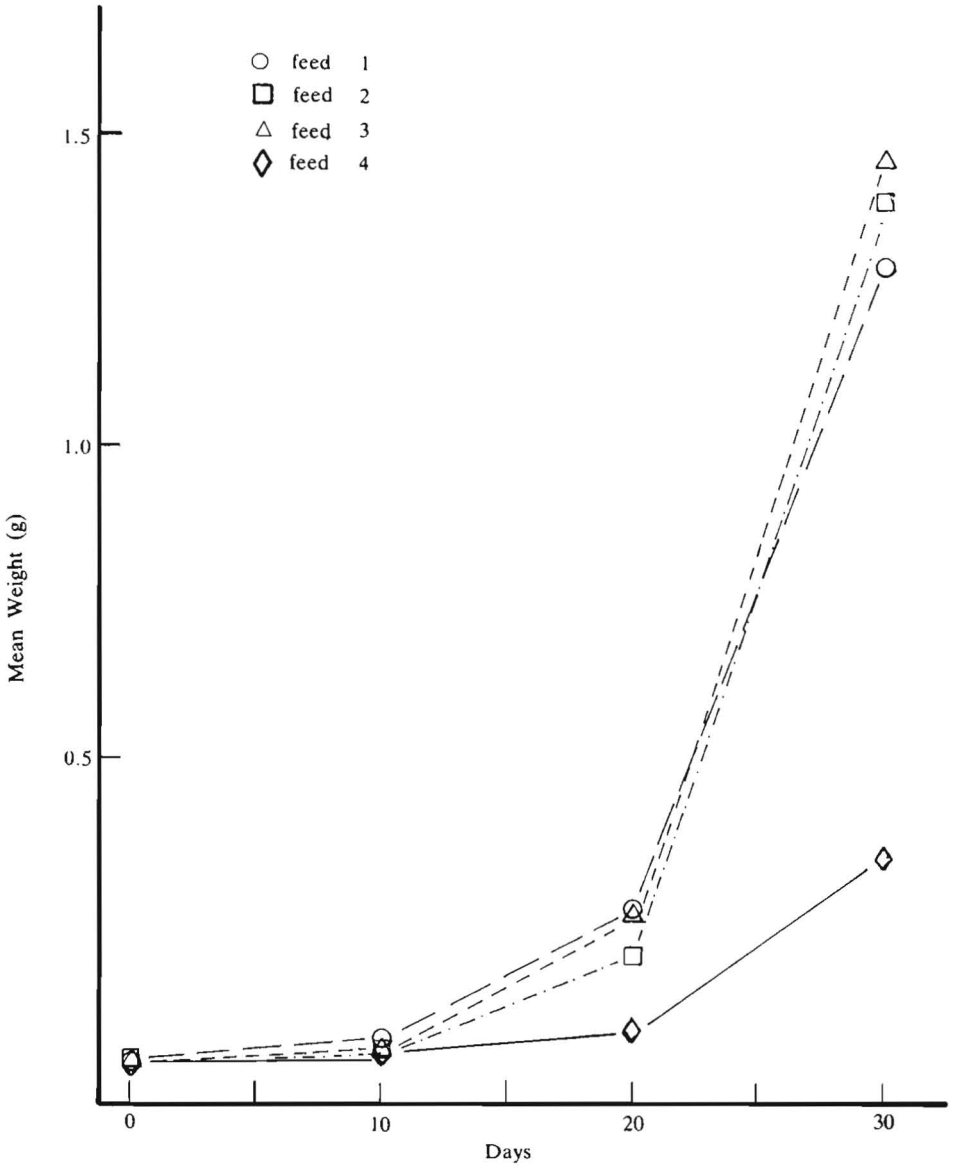

Fig. 1. Growth in weight of *C. gariepinus* larvae over a 30 days period post yolksac absorption receiving four types of diets (for details see Table 5, Exp. 2).

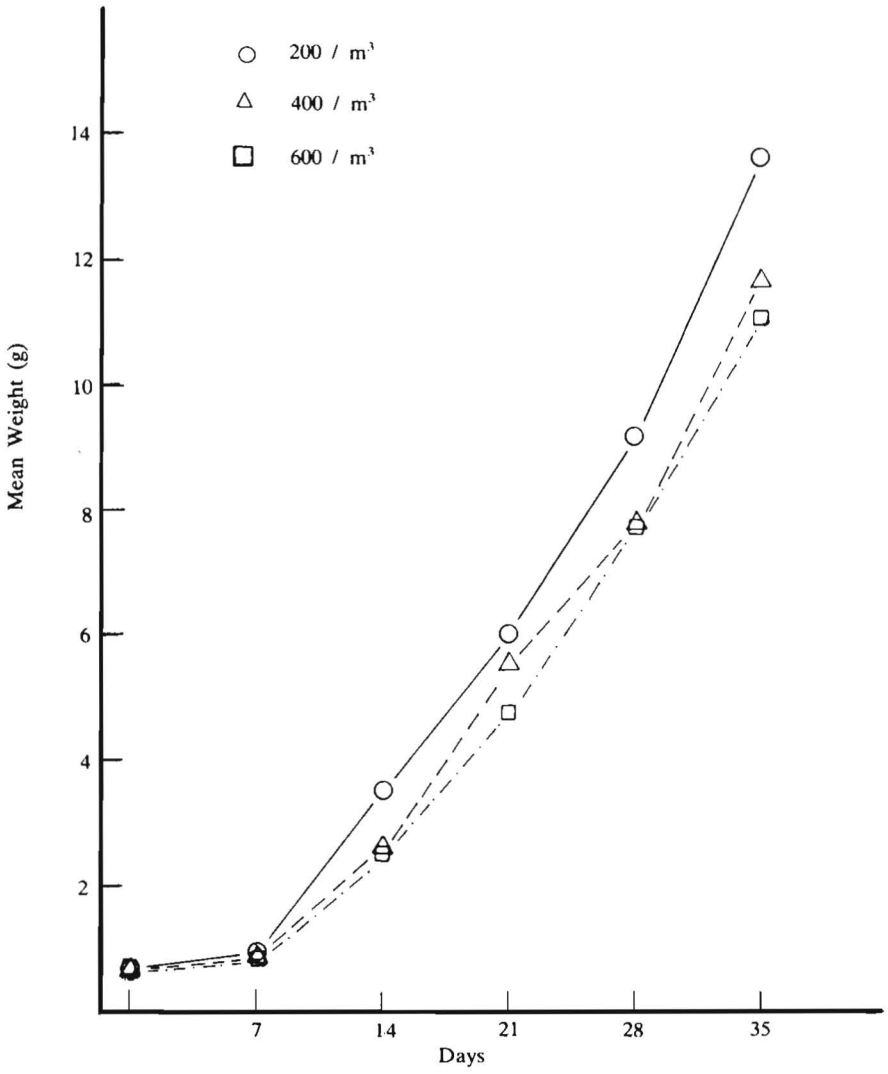

Fig. 2. Growth in weight of *C. gariepinus* fingerlings stocked at three densities (Exp. 3).

slightly better than the stripped eggs after 12 hr of pituitary homogenate injections. These hatching rates are comparable to those reported for *C. fuscus* from Hawaii (Young *et al.* 1989), but lower than those reported for *C. gariepinus* by Hogendoorn and Vismans (1980) and for *C. macrocephalus* (Mollah and Tan 1983).

The larvae showed very good growth when fed on a combination of *Artemia* and dry feed and attained an average final weight of 1468 mg in 30 days. Very poor growth was obtained with dry feed only, though the survival rate was 41%. 100% mortality of larvae was reported when larvae were fed on dry feed only (Hogendoorn 1980). Polling *et al.* (1988) reported better growth for *C. gariepinus* fry raised on *zooplankton* than when fed dry feed. Poor growth and low sruvival rate obtained using dry feeds only in this and other studies (Sitasit and Fedoruk 1981, Knud-Hansen *et al.* 1990) suggest their inadequacy for larval nutrition. There was considerable variation in individual growth of larvae. The differential rate of growth causes cannibalism, and most of the mortality appears to be because of it. The lowest survival rate was recorded for fish receiving *Artemia* only. Besides cannibalism, the nutritional value of *Artemia* affected the survival of larvae. Sorgeloos *et al.* (1988) reported that the enrichment of *Artemia* with 20:5 w 3 fatty acids enhanced the survival of seabass larvae upto 25%, otherwise all larvae died after 35 days when fed on non-enriched Great Salt Lake *Artemia*. In an other study all *C. batrachus* fry died by day 21 of culture period when fed on *Artemia* nauplii, though a survival rate of above 90% was maintained through day 17 (Knud-Hansen *et al.* 1990). Therefore it was concluded that the catfish larvae can be successfully reared on a combined diet of *Artemia* for initial few days and then followed by a dry feed with a dietary protein level of about 50%.

Table 3. Range of water quality parameters in tanks during the larval and fingerling rearing experiments

Parameters		**Range**
Maximum temperature	(°C)	28-31
Minimum temperature	(°C)	22-26
Dissolved oxygen	(mg/L)	5.5-6.2
Ammonia	(mg/L)	0.02-0.20
pH		6.5-7.1
Alkalinity	(mg/L)	150-250
Total hardness	(mg/L)	790-950
Salinity	(ppt)	1.5-2.0

Table 4. Growth and survival of *C. gariepinus* larvae over a 5 weeks experimental period (Mean ± SD based on a sample of 30 fish)

Treatment	Final weight (mg)	ADWG (mg/d)	Final length (mm)	ADLG (mm/d)	Survival %
Initial Size	Mean 5 ± 1	--	8 ± 1	--	--
Diet A	2300 ± 686	66 ± 20	68 ± 6	1.7 ± 0.2	20
Artemia	2600 ± 498	74 ± 17	69 ± 5	1.7 ± 0.1	13
	Mean 2442 ± 623[a]	70 ± 18[a]	68 ± 3[a]	1.7 ± 0.2[a]	16[c]
Diet B					
Artemia	1300 ± 630	37±18	55±1	1.3 ± 0.3	72
and					
Cladocerans	1150 ± 520	33 ± 15	54 ± 1	1.3 ± 0.2	78
	Mean 1220 ± 579[c]	35 ± 17[c]	54 ± 1[c]	1.3 ± 0.3[b]	75[a]
Diet C					
Artemia	1470 ± 600	42 ± 18	58 ± 1	1.4 ± 0.2	86
and		46 ± 20	63 ± 1	1.4 ± 0.2	51
prepared dry	1610 ± 710				
diet					
	Mean 1534 ± 671[b]	44 ± 19[b]	60 ± 1[b]	1.6 ± 0.2[a]	68[b]

ADWG = Average daily weight gain
ADLG = Average daily length gain
Figures in the same column having different letters are significantly different ($P < 0.05$).

Table 5. Growth and survival of *C. gariepinus* larvae after 30 days experimental period (Mean ± SD based on a sample of 30 fish)

Treatment	Final weight (mg)	ADWG (mg/d)	Final length (mm)	ADLG (mm/d)	Survival %
Initial size	6 ± 1	--	8 ± 1	--	--
Diet 1	1276 ± 655	42 ± 22	54 ± 9	1.5 ± 0.3	80
Week 1 *Artemia*	1249 ± 592	41 ± 20	54 ± 9	1.5 ± 0.3	70
2 *Artemia* + dry feed 1:1					
3 *Artemia* + dry feed 1:2					
4 *Artemia* + dry feed 1:3					
	Mean 1262 ± 625[C]	42 ± 21[C]	54 ± 9[C]	1.5 ± 0.3[C]	75[C]
Diet 2					
Week 1 *Artemia*	1493 ± 690	49 ± 23	57 ± 9	1.6 ± 0.3	43
2 *Cladocerans* + dry feed 1:1	1287 ± 339	43 ± 11	56 ± 6	1.6 ± 0.3	60
3 *Cladocerans* + dry feed 1:2					
4 *Cladocerans* + dry feed 1:3					
	Mean 1390 ± 554[b]	46 ± 18[b]	57 ± 7[b]	1.6 ± 0.2[b]	51[b]
Diet 3					
Week 1 *Artemia*	1797 ± 504	58 ± 17	63 ± 7	1.8 ± 0.2	28
2,3 & 4-dry feed	1139 ± 361	38 ± 12	54 ± 5	1.5 ± 0.2	59
	Mean 1468 ± 548[a]	48 ± 18[a]	59 ± 6[a]	1.7± 0.2[a]	44[c]
Diet 4					
Weeks 1,2,3 and 4 dry feed	340±175	11 ± 6	36 ± 6	0.9 ± 0.2	33
	370 ± 173	12 ± 6	37 ± 6	1.0 ± 0.2	49
	Mean 355 ± 175[d]	11 ± 6[d]	36 ± 6[d]	0.9 ± 0.2[d]	41[c]

Dry feed is Taiwanese eel fingerling feed

Figures in the same column having different letters are significantly different ($P < 0.05$).

Table 6. Growth and survival of *C. gariepinus* fingerlings over a five weeks experimental period stocked at three densities (Mean ± SD based on a sample of 40 fish)

Treatment (stocking rate)	Initial weight (9)	Final weight (9)	ADWG (g/d)	Initial length (cm)	Final length (cm)	ADLG (cm/d)	Survival %	FCR
200/m	0.78 ± 0.2	12.4 ± 5	0.33	4.7 ± 0.3	11.8 ± 2	0.21	70	0.91
	0.76 ± 0.2	12.9 ± 9	0.35	4.6 ± 0.4	12.6 ± 4	0.23	65	0.91
	Mean 0.77 ± 0.2	12.6 ± 5	0.34	4.6 ± 0.3	12.2 ± 2	0.22	67	0.91
400/m	0.76 ± 0.2	11.8 ± 5	0.31	4.7 ± 0.3	11.6 ± 1	0.20	60	0.94
	0.75 ± 0.2	11.6 ± 4	0.31	4.7 ± 0.3	11.6 ± 1	0.20	65	1.10
	Mean 0.75 ± 0.2	11.7 ± 4	0.31	4.7±0.3	11.6±1	0.20	62	1.02
600/m	0.76 ± 0.2	10.0 ± 4	0.26	4.5 ± 0.2	10.9 ± 1	0.18	67	0.97
	0.84 ± 0.4	12.1 ± 5	0.32	4.8 ± 0.4	11.9 ± 2	0.20	61	1.04
	Mean 0.80 ± 0.3	11.0 ± 4	0.29	4.7 ± 0.3	11.4 ± 1	0.19	64	1.00

Final weight, Survival rate and FCR were not significantly different for fishes stocked at three densities ($P<0.05$). FCR = dry feed fed/live weight gain.

The stocking rates of 200/m^3, 400/m^3 and 600/m^3 did not significantly affect the survival, growth and feed conversion of *C. gariepinus* larvae over a culture period of 35 days indicating that the production of fingerlings even at a higher stocking density is possible. Diana and Fast (1989) did not find any difference in growth of *C. fuscus* stocked at 300 or 600 fish/m^3, but a slightly higher mortality occured at high density over a culture period of 13 weeks. The growth rate and feed conversion of *C. gariepinus* recorded in the present study are comparable to that reported for the same species but cultured under laboratory conditions in the Netherlands (Hogendoorn 1980).

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تشجيع انتاج البيوض وتربية اليرقات لأسماك السلور الأفريقي *Clarias gariepinus* (Burchell 1822) في المملكة العربية السعودية

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مشروع تربية الأسماك ـ مدينة الملك عبدالعزيز للعلوم والتقنية
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لقد تمت تربية أسماك السلور الأفريقي *Clarias gariepinus* بنجاح في المملكة العربية السعودية منذ عام ١٩٨٧ م باستخدام برك خرسانية خارجية حيث تمت تربيتها إلى سن النضوج، وثم تشجيعها لإنتاج البيوض بحقنها في العضل حقنة واحدة بالهرمونات المستخلصة من أسماك الشبوط بنسبة ٤ ملغرام/ كغم من وزن السمكة. وبعد ١٢ ساعة من المعالجة تم إستخراج البيض من سمكتين من الإناث بواسطة الضغط على منطقة البطن حيث تمت المعالجة في درجة حرارة الماء ٢٢ ـ ٢٨° درجة مئوية. أما الأربع إناث الأخرى فقد تم إنتاج البيض بوضع كل أُنثى على حده مع ذَكَر في حوض دائري الشكل وكان معدل الفقس لست إناث من البيض المخصب ٥٣ ٪.

تمت تربية صغار الأسماك على غذاء مركب يحتوي على غذاء جاف ذي نسبة بروتين ٥١ ٪ وغذاء حي يحتوي على يرقات *Artemia Salina* حديثة التفقيس و *Cladocerans* مرباه. وكانت نتائج النمو المسجلة ممتازة عندما غذيت صغار الأسماك على يرقات *Artemia* لمدة أسبوع وعلى الغذاء الجاف لمدة ثلاثة أسابيع حيث كان متوسط الوزن النهائي ١٤٦٨ ملغم مع نسبة بقاء ٤٤ ٪ بينما مع تركيبات

أخرى من الغذاء كان معدل الوزن النهائي يتراوح ما بين ٣٥٥ ملغم إلى ١٣٩٠ ملغم ونسبة بقاء متفاوتة ما بين ٤١ ٪ إلى ٧٥ ٪.

وبالمثل التركيبة المكونة من يرقات *Artemia* وغذاء جاف محضر مسبقاً أعطت نتائج جيدة حيث متوسط الوزن النهائي كان ١٥٣٠ ملغم في خمسة أسابيع فقط مع نسبة بقاء ٦٨ ٪.

وبرهنت النتائج أنه سواء يرقات *Artemia* أو الغذاء الجاف لا يكونا الغذاء المناسب لصغار الأسماك في عملية التربية إذا استخدم كل واحد منهما على حده.

ولقد تم تربية الأصبعيات والتي تزن حوالي ٠,٧٥ غرام عند ثلاث كثافات مختلفة ولقد وصلت أوزانها خلال خمسة أسابيع من التربية إلى ١٢,٦ غرام عند (٢٠٠ سمكة/ متر^3)، ١١,٧ غرام عند (٤٠٠ سمكة/ متر^3) و ١١,٠ غرام عند (٦٠٠ سمكة/ متر^3). مما يشير إلى وجود تأثير على وزن الأسماك، نموها، وحياتها ومعدل التحويل الغذائي لأسماك *C. gariepinus* عند تربيتها في تلك الكثافات المختلفة خلال تلك الفترة من التربية.