



IJMIRD 2015; 2(1): 134-138
www.allsubjectjournal.com
Received: 05-12-2014
Accepted: 25-12-2014
e-ISSN: 2349-4182
p-ISSN: 2349-5979
Impact Factor: 3.762

Minette Tabi Eyango Tomedi
Institute of Fisheries and
Aquatic Sciences at Yabassi, the
University of Douala, P.O.Box
2701, Douala, Cameroon.

Claudine Tekoungning Tiogué
Laboratory of Applied
Ichthyology and Hydrobiology,
Department of Animal
Productions, Faculty of
Agronomy and Agricultural
Sciences, the University of
Dschang, PO. BOX 222
Cameroon.

Joseph Eben Penkem
Laboratory of Applied
Ichthyology and Hydrobiology,
Department of Animal
Productions, Faculty of
Agronomy and Agricultural
Sciences, the University of
Dschang, PO. BOX 222
Cameroon.

Eric Mialhe
Aquasol S.A. Structure,
Irad of Kribi, Department of
Ocean Southern-Cameroon.

Correspondence:
Claudine Tekoungning Tiogué
Laboratory of Applied
Ichthyology and
Hydrobiology, Department of
Animal Productions, Faculty
of Agronomy and Agricultural
Sciences, the University of
Dschang, PO. BOX 222
Cameroon.

Effect of salinity on survival and growth performances of juveniles of marine shrimp *Penaeus notialis* (Perez Farfante, 1967) under controlled conditions in the tropics

Minette Tabi Eyango Tomedi, Claudine Tekoungning Tiogué, Joseph Eben Penkem, Eric Mialhe

Abstract

Effect of salinity on survival and growth performances of marine shrimp *Penaeus notialis* fingerlings was carried out between April and September 2011 at AquaSol structure in IRAD of Kribi in Cameroon. A pregnant female with total weight 32 g and 15 cm total length has been collected in the natural environment by a fisherman using a bottom thread. Thirty 20 days old post larvae (PL20) born from this progenitor were seeded in triplicate in plastic bins at 15‰ (S0), 20‰ (S1), 25‰ (S2) and 30‰ (S3) salinity. Survival rates were high regardless of salinity. However, the higher survival rates (94.44 and 96.67%) were respectively recorded from 25 ‰ and 30 ‰ salinity. The higher feed conversion ratio, mean weight and weight gain were obtained at 15 ‰ salinity. The best specific growth rate was recorded at 20 ‰.

Keywords: Exogenous factors, *Penaeus notialis*, growth, survival, Cameroon

1. Introduction

Aquaculture involves several types of livestock including shrimp culture. According to [1] shrimp is the most consumed product in the world [2]. Aquaculture farms provide 20 to 25% of the world's marine shrimp production [3]. Asia is the largest supplier of shrimp in the world with 88% of production, 41% from China alone [1]. The rest (12%) is largely provided by the Latin America. According to [4] shrimp farming is recent in Africa and in most cases, African farms produce the shrimp *Penaeus monodon*; highly appreciated in the world market for its growth performances [1]. In Cameroon the data available on the shrimp fishery were merely within the marine capture [5]. Despite the production of freshwater shrimp; shrimp production increased from 2000 tons in 1972 to around 250-450 tons in 2006 [5]. This drastic decline in shrimp production is the result of overexploitation, climate change, pollution and destruction of mangroves for shrimp spawning grounds; associated with rapid population increase [2]. To this context, the need for domestication and biodiversity conservation of endogenous shrimp was imposed; therefore the first potential breeding structure of shrimp was constructed in Cameroon [6]. The breeding success of all living species implies a good control of its environment. According to [7], physico-chemical water conditions are essential to the vital functions of aquatic species. The study on the effect of salinity in survival, growth, and osmotic capacity of early juveniles of *Farfantepenaeus brasiliensis* have shown that when juvenile shrimp are exposed to environmental variations, there occur changes in the osmotic and ionic balance as well as assimilation and growth [8]. Furthermore, domestication and breeding of a species depends on the knowledge of the factors promoting its growth and survival [9]. The basis of the shrimp farming relies on the availability of larvae / post larvae [10]. Temperature and salinity are among the most important environmental factors affecting the breeding of post-larval penaeid [11]. In Cameroon, some studies have already been conducted in captivity on the effects of environmental factors on shrimp reproduction and growth to the mysis and post-larvae1 stages [12, 13, 14, 15, and 16]. To our knowledge no study has been done on the effects of these factors on juvenile rearing. This work is therefore devoted to evaluate the effect of salinity on the survival and growth of juveniles of marine shrimp *Penaeus notialis* in captivity.

2. Materials and methodes

2.1 Study area

The study was carried out in the AQUASOL SA structure, IRAD Kribi, Department of Ocean in Southern Cameroon region (latitude 2°56'N et longitude 9°54'E), between April and November 2011. The climate is classic guinean type with maritime predominance. It offers two main climatic shades: maritime nuance and shade within Guinea, respectively introduced by the proximity of the sea and continentality^[17]. In fact, the oceanian climate is warm and rainy. There are four seasons reducing in the coastal area into two main seasons: a long rainy season (March to October) and a long dry season (November to February); there are no completely dry months. Average rainfall and temperature are respectively 2970 mm and 26 °C. This Department is characterized by a particularly dense hydrographical network, with many rivers (Kienké, Lokoundjé, Lobe, Nyong and Ntem), most of which are rooted in the South Cameroon Plateau and all flow into the Atlantic Ocean^[17]. The hatchery is located in the border of the sea and far enough away from rivers joining it

to prevent the influx of fresh water (greater than 25 ppt salinity) and water too loaded with suspended solids.

2.2 Origin and maintenance of spawning stock

A pregnant shrimp (total weight 32 g and 15 cm total length) was collected in the natural environment (sea) by a fisherman using a bottom mesh. In the hatchery, it was kept in a concrete storage basin, of cylindrical shape of 3.14 m³ volume. This basin was filled with sea water filtered through a 5µm pocket attached to the water supply piping for seawater. Aeration was provided by two air-lifts maintaining a dissolved oxygen level of 3 mg / L in the tank (with a temperature of 28 ° C, the salinity of 29 ‰, pH 7.8 and a NO₂ rate of 0.8 mg / L). The spawner was fed daily to 3% of its body weight in a compound feed (crab gonads, crab meat, granules for breeding, mollusks and sardines); in a 4 hour gap. Siphoning of leftover food and feces was performed every morning to reduce the organic contamination of water and raise the level of ammonia. The water renewal was done once a day to less than 100% of the volume of the basin

2.3 Egg laying and hatching

The spawner was transferred to the cover with a tarp breeding tsank to create a dark environment and thus ensure better conditions for spawning. Spawning was observed at 02:30 the next day. While the female was removed from the tray and marked in the eye by a numbered ring and then returned to the concrete storage basin. Egg collection was made by siphoning through the drain device installed at the tank bottom. Eggs were then rinsed with water filtered at 5 µm for 5 min at the same salinity and temperature as the water in the hatching tank. They were then transferred into a bucket of 100 liters using hatching tray, filled with filtered water to 5µm, salinity of 28 ‰, and at a temperature of 30 ° C (optimum) obtained and maintained by an electrical resistance at 300W. Hatching occurred between 12 and 15 hours after laying (J0).

2.4 Production of 20 days old post larvae (PL20) of *P. notialis*

Larval rearing had lasted 28 days and consisted in obtaining PL20 through the Nauplii phases, Zoe, Mysis and post-

larvae. During the Nauplii phase, Nauplii (1 to 5 hours) feed on their yolk reserves, mutate and move on to the Zoe phase from 18h (J1). Zoe larvae were able to feed on living and purified diatomaceous algae (*Thalassiosira pseudonana*), microparticles (Larval AP 100, Zeigler) powder, size < 50µm and imported nauplii of *Artemia salina*. At the end of this phase, the larva becomes Mysis to fairly strict carnivorous diet. Mysis were fed to Nauplii of *Artemia salina*. Following a metamorphosis, Mysis III becomes a young shrimp very similar to the adult animal, called Post larvae (PL1). The young post larvae lead a pelagic life, but changes gradually in behavior. Obtaining PL20 lasted for 20 days and the seeding density was 20 PL / liter, whether 2000 PL1 per plastic tray of 100 liter. The food distribution period varied according to the type of food (dry food or Nauplii of *Artemia salina*).

2.5 Experimental design: Survival and growth of 20 days old post-larvae (PL20) of *P. notialis* at different salinities

The approach was that of^[18]. The survival and growth were conducted in four concentrations of saltwater (15, 20, 25 and 30 ‰), in triplicate and at 27.7 ° C of temperature.

30 animals in triplicates were randomly distributed in 12 plastic containers of 100 l at a density of 1PL20 / liter. These larvae were fed on commercial diet with 50% protein pellet 1mm in diameter and 0.75 g ration by ferry, 5 times a day to 4 hours interval. Bromatological characteristics of the food were as follows: 10% moisture, 50% protein, 10% fat, 3% fiber, 12% of vitamin and 0.8% P / Ca. The foods were weighed using an electronic balance of 0.01 g accuracy, brand Sartorius Competence.

The salinity was measured by a salinometer. The photoperiod was artificial (100% artificial light). Other physical and chemical parameters of the water (temperature, dissolved oxygen, pH, and nitrite) were measured daily during the test using respectively a mercury thermometer, oxy-meter mark "Oxy-check-HI, 9147" and JBL pH TEST and Tetra Test NO₂.

The cleaning was done by siphoning with a hose every morning; and the water renewal every two days. The control fishing took place every ten days. At day 30, all tanks were emptied. At the beginning of the test, at each control fishing and at end of the experiment, shrimp were counted and weighed using an electronic balance, with precision 0.01g and brand Sartorius Competence.

The following parameters were studied: Survival rate (SR (%)) = (Nf/Ni) X 100 with Ni and Nf : number of shrimp at the beginning and at the end of experiment respectively; Food conversion rates (FCR = Rd / (Bf – Bi) where Rd (g): ration distributed for a fixed period, Bf (g) and Bi (g) : initial and final biomass of shrimp) ; initial (imW) and final (fmW) mean weights, gain weight

(WG (mg) = fmW – imW); mean daily gain weight (mDGW (mg/j) = (fmW – imW)/t ,with t : time in day) and specific growth rates was calculated according to^[19] formula (SGR (%)) = 100 * [Ln fmW – Ln imW] / t where Ln : logarithm Neperian).

2.6 Statistical analysis

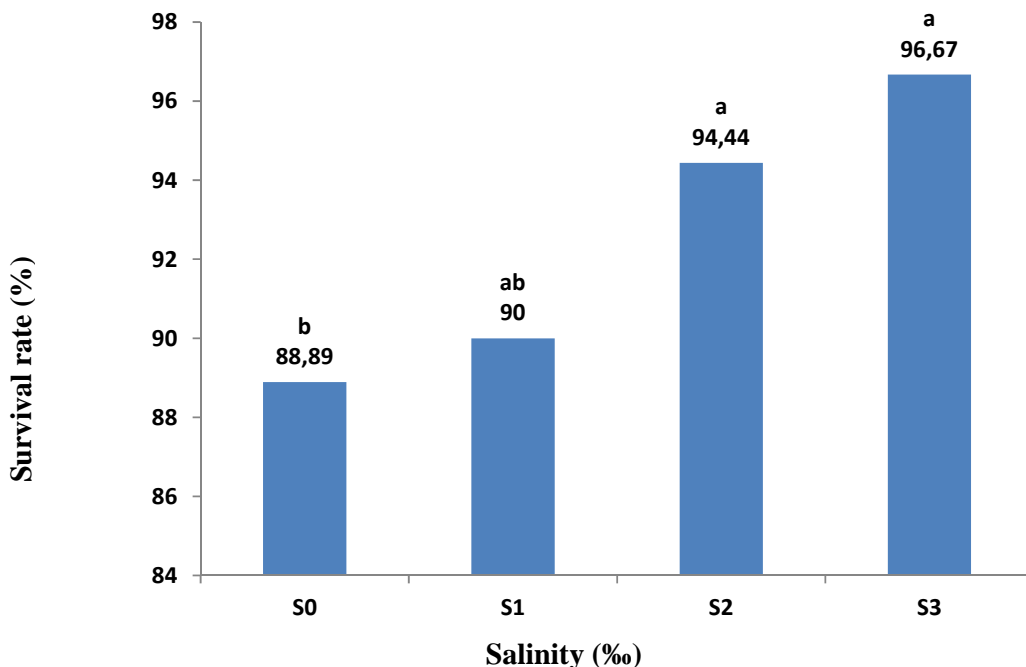
Data were subjected to analysis of variance (ANOVA I), and when the differences were significant, means were separated using the LSD test at 5% probability level. ARC-VIEW software was used for this analysis.

3. Results

3.1 Survival rate of juveniles of *P. notialis* by age depending on water salinity

Figure 1 shows the survival rate of *P. notialis* juveniles at

different salinity. It appears that whatever the salinity, survival rates were high (> 80%). However, the S2 and S3 salinity showed similar survival rates and significantly higher ($P < 0.05$) than the other concentrations.



(a, b, c) : each column with same superscript were not significantly different ($P > 0.05$).

Fig 1: Average survival rate of *P. notialis* juveniles rearing in trays within 30 days depending on water salinity.

3.2. Feed conversion ratio of *P. notialis* juveniles by age and depending on water salinity

Figure 2 illustrates the feed conversion ratio in *P. notialis* juveniles by age and depending on water salinity. It follows that whatever the water salinity, 50 days old post larvae

(PL50) less converted significantly ($P < 0.05$) the food than younger. Furthermore, the 30 days old (PL30) and 40 days old (PL40) post larvae significantly ($P < 0.05$) better converted food respectively on S3 and S1 salinities.

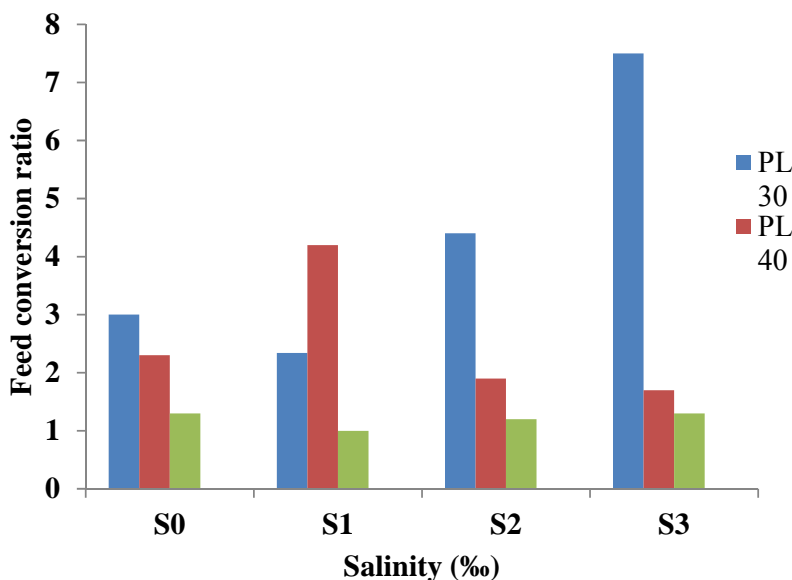


Fig 2: Evolution of feed conversion ratio depending on water salinity and age of *P. notialis* juveniles in trays

3.3 Growth performances of *P. notialis* juveniles depending on water salinity

From Table 1 shows growth performances of *P. notialis* juveniles depending on water salinity, it appears that shrimp

rearing in S1 salinity, recorded ($P < 0.05$) the higher growth performances, except the specific growth rate (SGR) which was significantly higher at 25‰ salinity (S2). S3 salinity recorded the weakest growth performances ($P < 0.05$).

Table 1: Growth performances of juveniles of *P. notialis* in function of water salinity in plastic bowls

Growth parameters	Water salinity (‰)			
	S0	S1	S2	S3
mWi (mg)	10 ± 03 ^b	22 ± 05 ^a	7 ± 00 ^c	13 ± 00 ^b
mWf (mg)	242 ± 00 ^a	240 ± 02 ^a	224 ± 07 ^a	202 ± 09 ^b
mGW (mg)	116 ± 02 ^b	131 ± 04 ^a	113 ± 06 ^b	97 ± 07 ^b
mDWG (mg/j)	7,7 ± 0,4 ^a	7,3 ± 1,15 ^a	7,2 ± 2,3 ^a	6,3 ± 3,10 ^a
SGR (%/j)	10,56 ± 4,78 ^a	7,98 ± 2,84 ^b	11,55 ± 4,24 ^a	9,14 ± 2,26 ^{ab}

(a, b, c) : each line with same superscript were not significantly different ($P > 0.05$).

mWi = mean initial weight (PL20), mWf = mean final weight (PL50), mGW = mean gain weight, mDWG = mean daily weight gain, SGR = specific growth rate, (S0, S1, S2 et S3) = Salinity rate at 15, 20, 25 et 30‰

4. Discussion

4.1. Survival rate

The value of $96.67 \pm 4.43\%$ is the best survival rate which implies the best salinity to 30 ‰. Survival rates in this study are significantly higher than 5.57% and 16.67%, respectively, reported by [18] and [20] in Mexico. This superiority could be due to differences in experimental conditions [10]. Indeed, these authors worked at a water temperature of 25 ° C, photoperiod of 12 hours of daylight and 12 hours of artificial light, and food to 37% protein. In contrary for this study, the mean temperature was 27.7 ± 0.05 °C with 100% of artificial illumination and a food to 50% protein. However, our study respected the optimal conditions of temperature (between 17 and 28 °C) and salinity (between 15 and 30 ‰) were different for salinity levels (between 20 and 38 ‰) as indicated by [21].

4.2. Feed conversion ratio

The feed conversion ratio is the efficiency of a food on shrimp production; higher it is, the food is less efficient. At the juvenile stage, the mean values (3.5, 2.5, 2.51 and 2.2) obtained at different salinity are greater than 1.8 which is the optimum value [18]. However these values are similar to 2.5; which is the tolerated value and beyond which the profitability random deviate [18]. These results are different from those reported by [3]. Contrary to environmental conditions in our study, the tests of these authors were conducted at the optimum temperature for breeding and the animals were fed with a food protein level below 50%.

4.3. Growth performances

The best mean final weight was recorded at 15‰. These results are different to those of [16] reported to the salinity of 30‰, a temperature of 25 °C and from 60 days old post larvae (PL60). They are moreover similar to those of [11] from *Litopenaeus stylirostris* at the same salinity. The specific growth rate recorded in this study varied depending on the water salinity. These rates were higher than those reported by [18] in *Penaeus vannamei*. This would probably be due to differences in experimental conditions, or to intrinsic factors related to the species. In fact, these authors worked under optimum conditions of temperature, pH, dissolved oxygen, nitrite and nitrate.

5. Conclusion

At the end of this study on the effect of salinity on the survival and growth performances of *P. notialis* (Perez Farfante, 1967) juveniles, the main conclusions are as follows: The survival rate was high regardless of the level of salinity. The highest survival rates were obtained at salinity 25 ‰ and 30 ‰. The very best weight growth performance has been recorded on the group of animals subjected to the 15 ‰ water salinity in terms of the FCR, mW and WG. The highest SGR was recorded in the group of animals subjected to the treatment 25 ‰. In short, the rate of salinity 25 ‰ and 30 ‰ may be recommended for improved survival and high growth performance of *P. notialis* juveniles in tropical conditions. However, to complete this study it would be desirable to assess in this species, the combined effect of temperature and salinity on the survival and growth performances of juveniles at same age.

6. Acknowledgments

The authors gratefully acknowledge all the staff of the structure AQUASOL SA and IRAD station in Kribi for their honest collaboration. In particularly we thanks to Mr Guillaume Gaudin for his technical assistance.

7. References

1. CSAO. Crevetticulture durable en Afrique de l'Ouest : opportunités économiques et coopération Sud-Sud (Rapport de réunion). 4Bld des îles ; France, 28. sara.minard@oecd.org, 2006.
2. FAO. La situation mondiale des pêches et de l'aquaculture. Rome, 2010, 224.
3. Avalle O, Millous O, Virmaux JF. L'élevage de la crevette en zone tropicale. Centre pour le Développement de l'Entreprise, Bruxelles, Belgique, 2003, 94.
4. ACP Fish II. Structuration des moyens intra-institutionnels (privés et publics) et des relations inter-institutionnelles aux niveaux national et international dans la filière crevetteicole au Cameroun. Rapport Technique Final, Projet N° CU/PE1/GB/10/005, 2011, 192.
5. MINEPIA/DPA. Revue sectorielle aquaculture au Cameroun, MINEPIA-FAO, 2009, 44.
6. Penkem EJ. Effet de la salinité sur les performances de croissance et de survie des juvéniles de *Penaeus notialis*

- (Perez Farfante, 1967). Mémoire d'Ingénieur des Eaux et Forêt. Faculté d'Agronomie et des Sciences Agricole. Université de Dschang-Cameroun, 2011, 57.
7. Tiogue C. Reproduction et croissance de deux souches sauvage et domestique du poisson chat africain *Clarias gariepinus* (BURCHELL, 1822) et de leurs croisés. Thèse de Master of science en biotechnologie et productions animales. Faculté d'Agronomie et des Sciences Agricoles. Université de Dschang- Cameroun, 2006, 88.
 8. Brito R, Chimal ME, Rosas C. Effect of salinity in survival, growth, and osmotic capacity of early juveniles of *Farfantepenaeus brasiliensis* (decapoda: penaeidae). *Journal of Experimental Marine Biology and Ecology* 2000; 244:253–263.
 9. Fontaine P, Legendre M, Vandeputte M, Fostier A. Domestication de nouvelles espèces et développement durable de la pisciculture. *Cahiers Agricultures* 2009; 18 (23):119-124.
 10. Alvarez AL, Racotta IS, Arjona O, Palacios E. Salinity stress test as a predictor of survival during grows out in pacific white shrimp (*Litopenaeus vannamei*). *Aquaculture* 2004; 237:237–249.
 11. Díaz F, Re AD, Sierra E, Díaz-Iglesias E. Effects of temperature and salinity fluctuation on the oxygen consumption, ammonium excretion and osmoregulation of the blue shrimp *Litopenaeus stylirostris* (STIMPSON). *Journal of Shellfish Research* 2004; 23(3):903–910.
 12. Njifonjou O, Mialhe E. Projet « Biotechnologies pour le développement d'une filière pénéicole compétitive et pérenne au Cameroun », 2009, 159.
 13. Kenfack TC. Titre : Effet du niveau de la salinité et de la température sur l'éclosion des œufs de *Penaeus kerathurus*. Mémoire d'Ingénieur des Travaux halieute, département d'Aquaculture, Institut des Science Halieutique, Université de Douala Cameroun, 2012, 82.
 14. Tekou G. Détermination de la concentration optimale d'artémies (*Artemia salina*) pour l'alimentation de la crevette marine *Farfantepenaeus notialis* (Pérez Farfante, 1967) des stades Mysis 1 à Post larve 1 en captivité. Mémoire d'ingénieur des Travaux Halieute, Département d'Aquaculture, Institut des Sciences Halieutique à Yabassi, Université de Douala Cameroun, 2013, 60.
 15. Tekou G, Gaudin G, Zango P, Tomedi EM, Tiogué C, Tchoumboué J. Concentration optimale d'artémies (*Artemia salina*) pour l'alimentation de la crevette marine *Farfantepenaeus notialis* (Pérez Farfante, 1967) des stades Mysis 1 à Post larve 1 en captivité. Quatrième Conférence des Sciences de la vie (JSV2014) organisées par Cameroon Forum for Biological Sciences (CAFBIOS), du 07 au 08 Aout 2014, Dschang – Cameroun, Livret des Abstracts, 2014, 72.
 16. Nwamo RD, Kenfack TC, Ajonina G, Tomedi EM, Dibong SD. Effets de la salinité et de la température sur le taux d'éclosion des œufs de *Penaeus kerathurus* (Kribi, Cameroun). *Journal of Animal & Plant Sciences*, 2014; 23(1):3510-3520. Disponible en ligne à <http://www.m.elewa.org/JAPS>; ISSN, 2071-7024.
 17. MEAO (Mission d'Etude pour l'Aménagement de l'Océan). Schéma d'aménagement durable du département de l'Océan : bilan diagnostic volume I (Draft). Kribi, meao@minpat.gov.cm, 2003, 152.
 18. Ponce-Palafox J, Martinez-Palacios CA, Ross LG. The effects of salinity and temperature on the growth and survival rates of juvenile white shrimp, *Penaeus vannamei*, Boone, 1931. *Aquaculture*, 1997; 157:107-115.
 19. Ricker WE. Computation and interpretation of biological statistics of fish populations. *Bulletin of Fisheries Research Board of Canada* 1975; 191:1-382.
 20. Ndaye N. Contribution à l'étude de l'exploitation des crevettes en république du Sénégal. Thèse de Docteur Vétérinaire. Ecole Inter-Etats des sciences et médecines vétérinaires. Université de Dakar, 1985, 81.
 21. Fiches techniques Grossissement de crevette impériale de Charante –Maritime. <http://www.lyceebourcfranc.fr/.../document-99.pdf>. 10 décembre, 2014.