International Journal of Sustainable Agriculture 1 (1): 06-09, 2009
ISSN 2079-2107

Effect of Diet Quality on Seed Production of the Spotted Snakehead *Channa punctatus* (Bloch)

[1]K. Marimuthu, [2]A. Jesu Arokiaraj and [3]M.A. Haniffa*

[1]Department of Biotechnology, Faculty of Applied Sciences,
AIMST University, Semeling, Kedah Darul Aman, Malaysia
[2]The Bengis Centre for Desert Aquaculture, The Albert Katz Department of Dryland Biotechnologies,
The Jacob Blaustein Institute for Desert Research, Ben-Gurion University of the Negev,
Sede Boker Campus 84990, Israel
[3]Centre for Aquaculture Research and Extension (CARE), St. Xavier's College,
Palayamkottai - 627 002 Tamilnadu. India

Abstract: Reproductive performance of spotted snakehead (spotted murrel), *Channa punctatus* was investigated through a feeding trail fed with three different sources of animal bio wastes lasting for 60 days. Three groups of 5 male and 5 female fishes (50-90g) were selected. The fishes were stocked separately in outdoor cement tanks (3X1X1 M) (each tank bifurgated into two compartments). One group of fishes was fed with chicken intestine; a second group was supplied a fish waste; a third group of fishes received the beef liver only. The fishes were fed respective diets *ad libitum* daily at 14.00 - 16.00 hr. At the end of 60 days feeding regime, all the fishes were assessed for gonad maturation and three breeding trials were made for each feeding regime by injecting ovaprim at (0.4 ml/kg. bw). Significantly highest egg output (6215±144) was obtained in fish fed with chicken intestine when compared to other sources fed fishes. No significant difference was noticed with regard to fertilization rate and egg diameter in all the diets fed groups. Highest hatching rate (92.3±2.5) was observed in fish fed with chicken intestine when compared to other sources of feed offered.

Key words: Snakehead % *Channa punctatus* % Breeding % Brood stock

INTRODUCTION

In many cultivable fish species, particularly in those new for aquaculture, unpredictable and variable reproductive performance is an important limiting factor for the successful production of fingerlings and culture. The ability to fully control sexual maturation and spawning is a primary requirement for successful aquaculture enterprise. The artificial induction of spawning either by hormonal or environmental manipulation enables supplies of eggs and fry, to be made available even from those fish which do not naturally spawn in captivity; this avoids the problems of collecting wild broodstock from natural water bodies. Successful seed production also demands a thorough understanding of the special husbandry and nutritional requirements of broodstock fish because diet and management procedures can have significant effects on fecundity, egg size and egg and larval quality or survival. Broodstock nutrition and dietary requirements in several cultivable fish species is poorly understood when compared to other area of research in aquaculture. Izquierdo [1] opined that, to a large extent, this area of research has not been so successful due to several reasons including suitable indoor or outdoor culture facilities for maintaining large groups of adult and matured fishes and higher maintenance cost for running broodstock nutrition experiments under captivity. Nutrition is known to influence gonadal growth and fecundity and it has been generally agreed that quality and quantity of feed as well as feeding regime are important for spawning and egg quality [2]. During the last decade, increasing attention has been paid to the role of the different components of broodstock diets [3]. Nutritional manipulations such as ration size [4-6], energy content [7,8], lipid and fatty acid composition [9,10], protein [11-13]and protein: carbohydrate ratio [14] in fishes have been reported by several workers.

Corresponding Author: K. Marimuthu, Department of Biotechnology, Faculty of Applied Sciences,
AIMST University, Semeling, Kedah Darul Aman, Malaysia

The spotted snakehead *Channa punctatus* is one among the highly priced freshwater air breathing fish species in India. The fish well known for its taste, high nutritive value, recuperative and medicinal qualities, is some times recommended as a diet during convalescence. The fish breed naturally during southwest monsoon and north- east monsoon in flooded rivers and ponds in southern parts of India. But, monsoon failure often limits the seed production. Hence, to facilitate a steady supply of seeds, oocytes maturation and ovulation need to be induced under captivity. Captive seed production and larval rearing of this species have been accomplished experimentally, but are not presently done on a large scale [15]. Precise information on the nutritional requirements for gonadal maturation and seed production is lacking, there has been a general consensus that the nutritional requirements of broodstock varies from species to species and varies from the juvenile stages. Further, in contrast to carps and other freshwater fish species information available on broodstock nutrition in snakeheads is almost lacking. Hence the present study was carried out to assess the influence of three different animal bio waste based diet on reproductive performance and seed production and to identify the best protein source for *C. punctatus* broodstock development for breeding.

MATERIALS AND METHODS

Adult male (50-60g) and female (75-90 g) *C. punctatus* were collected from the stocking pond of CARE aquafarm (Centre for Aquaculture Research and Extension, St. Xaviers College, Palayamkottai, Tamilnadu, India). Three groups of 5 male and 5 female fishes were randomly selected. The male and female fishes were stocked separately in three outdoor cement tanks (3X 1 X1 m, each tank bifurgated into two compartments). Fresh chicken viscera collected from the local market daily and fish waste and beef liver collected weekly once were cleaned and stored in a deep freezer (-20ºC). The proximate composition of the feed ingredients was analyzed following standard methods [16]. One group of fishes were fed a chicken intestine only; a second group was supplied a fish waste; and a third group of fishes received the beef liver only. The proximate composition of the animal protein sources are given in Table 1. The test individuals were fed with respective diets *ad libitum* daily at 14.00 - 16.00 hr for a period of 60 days. Water in each tank was renewed daily before the first feed was offered. Water quality parameters like temperature, pH and dissolved oxygen were monitored weekly once. At the end of the experiment, test fishes were assessed for reproductive performance. Three breeding trials were conducted for each feeding regime. Each breeding set consist of one male and one female were injected with a single intramuscular injection of ovaprim at the rate of 0.4ml/kg body weight [15,17]. Immediately after injection, the hormone administered fishes were introduced into the breeding tank (3 X 1X 1m). Few aquatic macrophytes *Hydrilla verticillata* were introduced in to the breeding tank for hiding purposes. After spawning percentage of fertilization and percentage of hatching were recorded. Average diameter of the egg was calculated by measuring 100 eggs at random irrespective of the fertility, from each treatment. Fertilization rate was estimated by examining three replicates of 100 eggs collected from each feeding group. Hatching rate was calculated based on the number of eggs hatched out by maintaining three replicates of 100 fertilized eggs from each feeding regime separately in 500 ml glass beaker. Changes in latency period, number of eggs spawned, fertilization rate and hatching rate in each treatment were analyzed by analysis of variance (ANOVA) and means were compared using Duncan multiple comparisons using SPSS package version 13.

Table 1: Proximate composition of different feed sources used in the experiment

Feed types	Protein (%)	Carbohydrate (%)	Lipid (%)	Ash (%)
Chicken intestine	69.6	1.80	13.85	12.90
Fish waste	56.0	1.10	7.15	15.95
Beef liver	62.8	5.56	2.48	10.8

RESULTS

Dissolved oxygen and pH values ranged with in the optimal level (DO: 6.1 mg/l; pH 7.5 -8.2 and water temperature 29±1ºC) and generally water quality parameters did not vary largely between the feeding regimes and there were no significant difference observed among the experimental groups. The number of eggs spawned, latency period, percentage of fertilization, hatching rate and egg diameter in different treatment are presented in Table 2. No significant difference regarding the spawning behaviour was found irrespective of the diets. However, there were significant differences in the latency period of *C. punctatus* due to diet quality. Among the different diets used the lowest latency period of (24.5±0.5 hr) was observed in fish fed on chicken intestine followed by fish waste (26.5±1.5 hr) and beef liver (29.0±2.0 hr) and statistical analysis confirmed that the

Table 2: Effect of different feeds on induced spawning and seed production of *C. punctatus* using ovaprim (0.4ml/ kg.bw)

Feed type	Fish Weight (g)	Latency Period (hr)	No of eggs spawned	Fertilization rate (%)	Egg diameter (mm)	Hatching rate (%)
Chicken intestine	75.5±07.6[a]	24.5±0.5[a]	6215±144[a]	93.3±1.5[a]	1.314±0.011[a]	92.33±2.5[a]
Fish waste	73.33±10.3[a]	26.5±1.5[ab]	5416±180[b]	92.6±3.6[a]	1.216±0.089[a]	88.66±1.5[a]
Beef liver	80.50±12.4[a]	29.0±2.0[b]	4514±165[c]	89.3±2.5[a]	1.220±0.067[a]	84.33±2.0[b]

*In a column numbers with different superscript alphabet are significantly different at $P < 0.05$.

difference was significant ($P < 0.05$) in fish fed on chicken intestine when compared to beef liver. However the difference ($P > 0.05$) was not significant between beef liver versus fish waste; and fish waste versus chicken intestine.

Spawning was complete in all the diet fed groups. With regard to the number of eggs spawned, *C. punctatus* fed on chicken intestine showed maximum egg output (6215±144) followed by fish waste (5416±180) and beef liver (4514±165) and the difference among the three groups due to food quality was statistically significant ($P < 0.05$). The highest fertilization rate (93.3±1.5%) was obtained in fish fed with chicken intestine followed by those fed on fish waste (92.6±3.6%) and beef liver (89.3±2.5%) but the difference was not statistically significant ($P > 0.05$). The diameter of egg size was greatest in fish fed chicken intestine (1.314±0.011 mm) followed by those fed on beef liver (1.222±0.067 mm) and fish waste (1.216±0.089mm). Similarly hatching rate (92.33±2.5%) was also the highest in the case of chicken intestine fed individuals followed by beef liver (84.33±2.0%) and fish waste (88.66±1.5%) fed fishes and the difference was statistically significant ($P < 0.05$) only between the chicken intestine and beef liver fed groups.

DISCUSSION

Among the different diets used, the maximum egg output was observed in fish fed on chicken intestine indicating that the composition of the diet influenced the reproductive performance. The best reproductive performance in chicken intestine fed groups could be due to large amounts of protein (69.6%) and lipid (13.35%) available. Egg output is determined genetically and controlled by hormones, while some extent maturation of oocyte and percentage hatching is dependent on food quality. For instance the acceleration of gonad maturity using improved diet in *Catla catla* [18] and with powdered cotton seed containing vitamin E in Indian major carps [19,20] was reported. According to Dahlgren [21] and [11] dietary protein level did not produce significant difference in fecundity of *Oreochromis niloticus* and *Poecilia reticulata* respectively. On the other hand the trend was vice versa in the case of big head carp, *Aorichthys nobilis*, in red sea bream [19,12] and *O. niloticus* [22]. Bromage *et al*. [23] suggested that a number of parameters are involved (biological, genetic, physiological and endocrinological), in controlling egg production in fish. Moreover it is well known that, in teleost fishes, gonodotrophin hormone (GtH) governs oogenesis and spawning and in this regard two distinct forms of the hormone (GtH-I and GtH – II) were identified by Suzuki *et al*. [24,15]. It is also suggested that live solid food alone carries some micronutrients essential for the secretion of one or both GtHs. Another possibility is that the diet affects steroids that are important to oogenesis and the reproductive cycle [26,27]. But these hypotheses require a detailed study, before they can be established.

ACKNOWLEDGEMENTS

We are grateful to the University Grants Commission, New Delhi, for the financial Assistance [F.3-73/2001(SR-II)]. Thanks are due to Rev. Fr. Dr. A. Lourdusamy, S.J., Principal, St. Xavier's College, Palayamkottai for providing necessary facilities.

REFERENCES

1. Izquierdo, M.S., H. Fernandez–Palacious and A.G.J. Tacon, 2001. Effect of broodstock nutrition on reproductive performance of fish. Aquaculture, 197: 25-42.
2. Lie, O., A. Mangor–Jenson and G.I. Hemre, 1993. Broodstock nutrition in cod (*Gadus morhua*) effect of dietary fatty acids. Fishekeridir. Skr. Ser. Ernaer., 6: 11-19.
3. Bromage, N., 1995. Broodstock Management and Seed Quality-General Considerations. In: Bromage, N.R, Roberts, R.J. (eds.), Broodstock Management and Egg and Larval Quality. University Press, Cambridge, UK, 1-24.
4. Tyler, A.V. and R.S. Dunn, 1976. Ration growth and measures of somatic and organ condition in relation to meal frequency in winter flounder, *Pseudopleuronectes americanus* with hypotheses regarding population homeostasis. Journal of Fisheries Research Board of Canada, 33: 63-75.

5. Hislop, J.R.G., A.P. Robb and J.A. Gauld, 1978. Observations on effects feeding level on growth and reproduction in haddock, *Melanogrammus aeglefinus* (L.) in captivity. Journal of Fish Biology, 13: 85-98.
6. Springate, J.R.C., N.R. Bromage and P.R.T. Cumararanatunga, 1985. The effect of different ration on fecundity and egg quality in the rainbow trout (*Salmo gairdeneri*). In: Cowey, C.B., Mackie, A.M. and Bell, J.A. (eds.) Nutrition and Feeding in Fish. Academic Press. London. pp: 371-393.
7. Smith, C.E., M.D. Obsorne, R.G. Piper and W.P. Dwyer, 1979. Effect of diet composition on performance of rainbow trout broodstock during a three year period. Progressive Fish Culturist, 41: 185-188.
8. Takeuchi, T., T. Watanable, T. Ogino, M. Satio, K. Nishimura and T. Nose, 1981. Effects of low protein, high calory diets and deletion of trace elements from a fishmeal diet on reproduction of rainbow trout. Bulletine of Japanese Scociety of Fisheries Science, 47: 645-654.
9. Watanable, T., T. Arakawa, C. Kitajima and S. Fujita, 1984a. Effect of nutritional quality of broodstock diets on reproduction of red sea bream. Bulletine of Japanese Scociety of Fisheries Science, 50: 495-501.
10. Santiago, C.B. and O.S. Reyes, 1993. Effects of dietary lipid source on reproductive performance and tissue lipid levels of Nile tilapia *Oreochromis niloticus* (Linnaeus) broodstock. Journal of Applied Ichthyology, 9: 33-40.
11. Santiago, C.B., A.S. Camacho and M.A. Laron, 1983. Effects of varying dietary crude protein levels on spawning frequency and growth *Sarotherodon niloticus* breeders. Fisheries Research Journal of Philippines, 8: 9-18.
12. Watanable, T., A. Itoh, C. Kitajima and S. Fujita, 1984b. Effect of dietary protein levels on reproduction of red sea bream. Bulletine of Japanese Scociety of Fisheries Science, 50: 1015-1022.
13. Shim, K.F., L. Landesman and T.J. Lam, 1989. Effect of dietary protein on growth, ovarian development and fecundity in the dwarf gourami *Colisa talia* (Hamilton). Journal of Aquaculture in the Tropics, 4: 111-123.
14. Cerda, J., M. Carrillo, S. Zanuy, J. Ramos and M. Higuera, 1994. Influence of nutritional composition of diets on sea bass. *Diacentrarchus labrax* L., reproductive performance and egg and larval quality. Aquaculture, 128: 345-361.
15. Marimuthu, K., M.A. Haniffa, M. Muruganandam and A. Jesu Arockiaraj, 2001. Spawning and parental behaviour of the induced bred murrels. Indian Journal of Fisheries, 48(4): 409-411.
18. Somashekarappa, B., H.N. Chanadrashekariah and M.C. Nandeesha, 1990. Spawning response of an Indian major carp (*Catla catla*) to diet manipulation and water quality management. In: Keshavanath, P., Ramakrishnan, K.V (eds.). Carp Seed Production Technology, Special Pub.no.2. Asian Fisheries Society, Indian Branch, Mangalore, pp: 29-33.
19. Lovell, R.T., 1981. Nutrition and feeding of fish. Van Nostrand Ruinhold. New York. 60.
20. Chondar, S.L., 1994. Induced carp breeding 3rd Edition CBS Publishers and Distribtors, New Delhi.
21. Dahlgren, B.T., 1980. The effects of three different dietary protein levels on the fecundity in the guppy, *Poecilia reticulate* (Peters). Journal of Fish Biology, 16: 83-97.
22. Gunasekara, R.M., K.F. Shim and T.J. Lam, 1996. Influence of protein content of broodstock diets on larval quality and performance in nile tilapia *Oreochromis niloticus* (L.). Aquaculture, 146: 245-259.
23. Bromage, N., N. Jones, C. Randall, M. Thurush, B. Davies, J. Springate and G. Barker, 1992. Broodstock management, fecundity egg quality and the timing of egg production in the rainbow trout *Oncorhynchus mykiss*. Aquaculture, 100: 141-166.
24. Suzuki, K., H. Kawauchi and X. Nagahama, 1989a. Isolation and characterization of two distinct gonadotropins from chum salmon pituitary gland. Genaeral and Comparative Endocrinology, 71: 292-301.
25. Suzuki, K., H. Kawauchi and X. Nagahama, 1989b. Isolation and characterization of sub unit of two distinct salmon gonadotropins. Genaeral and Comparative Endocrinology, 71: 302-306.
26. Degani, G. and R. Boker, 1992a. Vitellogenesis level and the induction of maturation in the ovary of the Blue gourami *Trichogaster trichopterus* (Anabantidae, Pallas 1770). Journal of Experimental Zoology, 263: 330-337.
27. Degani, G. and R. Boker, 1992b. Sensitivity to maturation - inducing steroids and gonadotropin in the oocytes of blue gourami *Trichogaster trichopterus* (Anabantidae, Pallas, 1770). General and Comparative Endocrinology, 85: 430-439.