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SHORT COMMUNICATION

Influence of dietary protein levels on growth and egg quality in broodstock female bagrid catfish (*Mystus nemurus* Cuv. & Val.)

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Bagrid catfish, *Mystus nemurus* (Cuv. & Val.) is a popular catfish currently being produced in both semi-intensive and intensive culture systems in Malaysia fetching a higher price than tilapia (*Oreochromis* sp.) and clariid catfish (*Clarias gariepinus*). Although the technique for induced breeding of *M. nemurus* has been developed, the problems of low egg hatchability and larval survival rate remain a major hindrance to further increase the production of this species. Furthermore, there is no information on the reproductive biology of this species in natural habitats. Egg quality is a useful indicator to the viability and subsequent quality of newly hatched larvae (Brooks, Tyler & Sumpter 1997). Various reports have emphasized the importance of broodstock nutrition to enhance reproductive performance of cultured species (Cerda, Carillo, Zanuy, Ramos & Higuera 1994; Coward & Bromage 2000). Among dietary nutrients, protein has been reported to influence reproductive parameters in both marine and freshwater broodstock fish (Watanabe, Itoh, Satoh, Katajima & Fujita 1985; Eskelinen 1989; El-Sayed, Mansour & Ezzat 2003; Chong, Ishak, Osman & Hashim 2004). These studies mainly showed that dietary protein levels influenced parameters such as weight gain and proximate composition of brood fish, quantity and quality of eggs and larval viability. As differences exist in nutrient requirements between grow-out and brood fish, its desirable to ensure that nutritional requirements of broodstock be fulfilled to optimize reproductive performance (Izquierdo, Fernandez-Palacios & Tacon 2001). As a prerequisite to develop a cost-effective diet that fulfills the requirements of *M. nemurus* broodstock, we report here findings from a study conducted to determine the effects of different dietary protein levels on growth, body composition and egg quality in female broodstock.

Three semi-purified isoenergetic diets (395 kJ g^{-1}) containing 30%, 35% and 40% crude protein were formulated using casein, gelatin and fishmeal as protein sources (Table 1). Ingredients were mixed in a Hobart mixer with the resulting dough being extruded through a pelleting machine to produce 3–4 mm diameter pellets. Proximate analysis of diets, fish carcass and eggs was conducted according to AOAC (1990) for verification of nutrient levels.

Twelve-month-old *M. nemurus* females (average weight 620.3 $\pm$ 3.7 g) were collected from a local farm and evenly distributed in nine outdoor flow-through concrete raceway tanks (2 $\times$ 1.2 $\times$ 1 m and water level 0.90 m) at a density of 4 fish $tank^{-1}$ with three replications per treatment. Feeding was done once a day at 3% body weight day^{-1} at 18:00 hours. This schedule is based on our unpublished observation on feeding behaviour of this species in our laboratory conditions (Z. A. Muchlisin, unpubl. obs.). The feeding experiment lasted 16 weeks. At the end of the feeding trial, all females were sacrificed for further analyses. Eggs were removed from the ovary and mixed with working buffer solution comprising of 60 mL ethanol, 30 mL formaldehyde and 10 mL glacial acetic acid. Fecundity, percentage of ripe eggs, mean egg diameter (mm), and mean dry weight of egg (mg) were measured. Proximate analysis of eggs, fish carcass (without eggs) and diets was conducted according to AOAC (1990). All data were subjected to

analysis of variance (ANOVA), followed by comparison of means using Duncan's multiple range test (Zar 1984). Percentage data were arcsine transformed prior to analysis. All statistical analyses were performed using SPSS ($P < 0.05$) (Table 2).

Overall results indicate that higher growth rates and egg quality were obtained with the 35% and 40% dietary protein treatment. Fish fed the 35% protein diet had the significantly highest final weight and specific growth rate ($P < 0.05$). An important contribution of dietary protein level toward broodstock performance relates to the effect on body size, with several studies reporting maturation of gonads and eggs occur earlier in larger broodstock (El-Sayed *et al.* 2003; Chong *et al.* 2004). Fish fed the 30% protein diet had the lowest carcass protein composition, indicating that this level is insufficient to fulfill the requirement of the female and hence, the need to utilize body reserves for gonadal development and maturation (Gunasekera, Shim & Lam 1996; Al Hafedh, Siddiqui & Saiady 1999). Furthermore, the 30% protein diet group exhibited the lowest relative fecundity. In contrast, significant increases were observed in weight gain and fecundity in fish fed the 35% protein diet. In tilapia and swordtail, provision of inadequate dietary protein resulted in inferior growth and fecundity (Al Hafedh *et al.* 1999; Chong *et al.* 2004). Our study also showed that eggs from fish fed the 40% protein diet had the highest protein content in eggs. Studies on tilapia and grass carp (*Ctenopharyngodon idella*), also reported increased protein content in eggs with increasing levels of dietary protein (Gunasekera, Shim & Lam 1997; Khan, Jafri & Chadha 2004). Consequently, feeding female broodstock the 40% protein diet contributed to both highest egg diameter and dry weight values. It has been reported that dietary protein level affects common carp egg diameter (Manissery, Krishnamurthy, Gangadhara & Nandeesha 2001). However,

Table 1 Ingredients formulation ($g\,kg^{-1}$) and proximate composition (%) of experimental diets used

	Dietary protein level (%)		
Ingredients ($g\,kg^{-1}$)	**30**	**35**	**40**
Danish fish meal	312.5	365.0	417.0
Casein	37.5	44.0	50.0
Gelatin	37.5	44.0	50.0
Dextrin	446.0	368.0	297.5
Fish oil	37.0	35.0	32.5
Corn oil	37.0	35.0	32.5
Cellulose	37.5	54.0	64.5
Mineral mixture*	30.0	30.0	30.0
Vitamin mixture*	20.0	20.0	20.0
Binder	5.0	5.0	5.0
Moisture	3.04	3.74	5.79
Crude protein	31.62	35.34	42.19
Crude lipid	9.04	9.25	9.27
Crude fibre	1.25	3.18	4.50
Ash	5.83	6.23	6.58
Nitrogen free extract	49.20	42.22	31.59
Gross energy ($kJ\,g^{-1}$)	3.95	3.94	3.94

*Proximate composition as of Chong *et al.* (2004).

Table 2 Growth and egg quality parameters in female *Mystus nemurus* fed diets containing 30%, 35% and 40% protein

	Dietary protein level (%)		
Parameters	**30**	**35**	**40**
Initial weight	622.3 ± 16.8^{a}	630.6 ± 12.3^{a}	610.2 ± 9.6^{a}
Final weight	670.9 ± 15.5^{a}	706.55 ± 16.5^{b}	685.5 ± 33.5^{ab}
Specific growth rate (SGR%)	0.07 ± 0.01^{a}	0.10 ± 0.03^{b}	0.10 ± 0.10^{ab}
Relative fecundity (eggs kg^{-1} body weight)	16 004 ± 114^{a}	17 690 ± 122^{b}	16 936 ± 211^{ab}
Ripe eggs (%)	81.67 ± 1.67^{a}	85.00 ± 2.89^{b}	78.33 ± 1.67^{a}
Egg diameter (mm)	1.44 ± 0.02^{a}	1.41 ± 0.02^{a}	1.48 ± 0.01^{b}
Egg dry weight (mg)	0.41 ± 0.03^{a}	0.39 ± 0.09^{a}	0.50 ± 0.02^{b}
Proximate composition (% wet weight basis)			
Moisture	74.72 ± 0.03^{a}	76.45 ± 0.19^{a}	75.98 ± 0.09^{a}
Protein	19.24 ± 0.17^{a}	21.01 ± 0.21^{b}	22.02 ± 0.14^{b}
Lipid	3.48 ± 0.23^{b}	2.96 ± 0.38^{ab}	2.74 ± 0.11^{a}
Ash	2.15 ± 0.17^{a}	1.95 ± 0.04^{a}	2.29 ± 0.08^{b}
Egg			
Moisture	55.04 ± 0.20^{a}	54.97 ± 0.11^{a}	55.12 ± 0.09^{a}
Protein	28.53 ± 0.45^{a}	30.77 ± 0.98^{b}	31.32 ± 2.23^{b}
Lipid	11.90 ± 0.13^{a}	13.63 ± 0.14^{b}	11.44 ± 0.21^{a}

Means (± SE) in the same row with different superscripts are significantly different ($P < 0.05$).

there is still a considerable debate on the advantage of producing larger eggs in fish (Ojanguren, Reyes-Gavilan & Brana 1996; Brooks *et al*. 1997). Furthermore, studies with tilapia and grass carp showed no relationship between dietary protein and egg size (Gunasekera *et al*. 1997; Khan *et al*. 2004). Although a direct comparison of broodstock dietary protein requirement among different freshwater species is not possible because of differences in experimental diet composition and methodologies, most studies higher improved growth and reproductive performance at 30–40% dietary protein levels (Shim, Landesman & Lam 1989; Gunasekera *et al*. 1997; Al-Hafedh *et al*. 1999; El-Sayed *et al*. 2003; Khan *et al*. 2004). However, very little or no information is available on the broodstock nutrition requirement of freshwater catfish. In conclusion, our results indicate that 35% dietary protein level is adequate to support both growth and suitable egg quality parameters in female *M. nemurus*.

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