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Research Article

Digestible energy requirement for females of *Rhamdia quelen* on reproductive activity fed with ration based on vegetal ingredients

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ABSTRACT. The present experiment was carried out to evaluate the growth and reproductive parameters of *Rhamdia quelen* females fed with pelleted ration containing different levels of digestible energy, and to evaluate the vigor of their offspring. The breeders were placed in tanks under conditions of photoperiod and natural temperature. The fishes were fed for 255 days with isoproteic rations pelleted containing 35% of crude protein (CP) and five levels of the digestible energy (DE) (2700, 2950, 3200, 3450, 3700 kcal kg^{-1}). The fishes were distributed in a randomized experimental design compounded by five treatments and three repetitions. A 16-m^2 tank containing six females and three males was considered as one experimental unit. The weight and weight gain was evaluated. During the reproductive season the females were induced to breeding by hormonal manipulation and were evaluated the percentage of spawning females, the total fecundity, relative fecundity (number of oocytes per gram of spawning females), the fertilization ratio, the time to hatching and the vigor of larvae. The growth and reproductive parameters were not influenced ($P > 0.05$) by the increasing levels of digestible energy of the rations. The feeding of *R. quelen* females in breeding fit can be carried out with 2700 kcal kg^{-1} pelletized ration based on vegetal ingredients, without damage to reproductive performance.

Keywords: *Rhamdia quelen*, eggs, fertilization, larvae, nutrition, reproduction, aquaculture.

Requerimientos de energía para la reproducción de hembras de *Rhamdia quelen* alimentadas con dietas a base de ingredientes vegetales

RESUMEN. El presente estudio se efectuó para evaluar el crecimiento y reproducción de hembras de bagre (*Rhamdia quelen*) alimentadas con dietas con diferente contenido de energía, elaboradas con ingredientes vegetales. Además, se evaluó el vigor de las crías. Los reproductores se colocaron en estanques en condiciones de fotoperiodo y temperatura ambiente. Los peces fueron alimentados durante 255 días con raciones isoproteicas que contenían 35% de proteína cruda (PC) y 2700, 2950, 3200, 3450 y 3700 kcal de energía digestible (ED) kg^{-1}. Los peces se distribuyeron en un diseño completamente al azar con cinco tratamientos y tres repeticiones. Para el experimento se emplearon estanques de ~16 m^2 con seis hembras y tres machos. Se evaluó el peso medio final y la ganancia media de peso. Durante el período reproductivo se evaluó el porcentaje de hembras que desovan, número total de ovocitos, número de ovocitos por gramo en hembras reproductoras, tasa de fertilización, tiempo

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necesario para que la eclosión de los huevos y tiempo de supervivencia de las larvas. El crecimiento y los parámetros reproductivos no fueron afectados ($P > 0,05$) por el aumento de los niveles de energía de las raciones. Se concluye que para obtener mejor reproducción de bagre (*R. quelen*) se recomienda emplear raciones peletizadas de 2700 kcal kg^{-1}.

Palabras clave: *Rhamdia quelen*, huevos, fertilización, larvas, nutrición, reproducción, acuicultura.

INTRODUCTION

The nutrition has always shown its value to the aquaculture, in view of its influence on growth and on the quality of the meat (Santos & Oba, 2009). However, in the last years, a lot of attention has been given to the effects of fish diets on breeding (Coldebella *et al*., 2011) and about the quantitative and qualitative production of the offspring (Parra *et al*., 2010).

Attention is given to the knowledge of the direct or indirect influence of nutrition on the reproductive performance of fresh water fishes (Izquierdo *et al*., 2001), due the expressive growth of the Latin America aquaculture in recent years (FAO, 2012). In this set, where fishes constitute the main group reared and their production have been increased 97% between 2003 and 2009 in some countries (Lopera-Barrero *et al*., 2011), it is verified the imminent necessity of guarantee the production of offspring in quantity and quality to attend the productive demand (Bombardelli *et al*., 2009).

Some researches on nutrition of fish breeder have been carried out with different species and suggest that the breeder nutrition promotes influences on reproductive performance of the females (Ng & Wang, 2011) or males (Bombardelli *et al*., 2010) and influence the offspring quality (Sink & Lochmann, 2008; Sink *et al*., 2010). In addition, the diet composition can influence the reproductive physiology (Navas *et al*., 1998), limiting the juveniles production in quantity and quality (Izquierdo *et al*., 2001).

In females of several species the diet influence the size, the composition and the color of oocytes (Tyler & Sumpter, 1996; Wiegand, 1996). A few authors relate the effect of the diet on the fertilization ratio in "black sea bass" (*Centropristis striata*) (Bentley *et al*., 2009), on the vigor and the survival of the Nile tilapia offspring (*Oreochomis niloticus*) (Bombardelli *et al*., 2009) and on the growth of the *Rhamdia quelen* larvae (Parra *et al*., 2008, 2010). However, the relationship between the breeding and nutrition of fishes is not clear (Bobe & Labbé, 2010) and dealing with Neotropical species, the quantity of available information is reduced or almost absent.

The efforts to develop the technological package to *R. quelen* are due to its wide distribution in Central America and South America (Gomes *et al*., 2000), and its importance for commercial aquaculture (Baldisserotto, 2009). These actions are corroborated by the technological limitations used in the production systems of Neotropical fishes, as the silver catfish, that difficult the enhancement of production. In these bounds, the lack of technologies focused to the production of juveniles (Andrade & Yasui, 2003) and the absence of appropriate nutritional and reproductive management may be pointed as responsible for this scenario.

In this sense, this research was carried out to feed *R. quelen* females with pelletized rations containing different levels of digestible energy and formulated with food of vegetal origin to evaluate the female growth parameters, the female reproductive performance and to evaluate the vigor of their offspring.

MATERIALS AND METHODS

The experiment was conducted in the Laboratory of Reproductive Technology for Farmed Aquatic Animal (LATRAAC), at the Institute for Research in Environmental Aquaculture (InPAA), Western Parana State University (UNIOESTE).

During 255 days, 90 silver catfish females (*R. quelen*) (44.67 ± 0.60 g) and 45 males (44.22 ± 1.17 g) were allocated in excavated tanks covered by brickwork with total area of 16 m^2 and fed with experimental rations containing different levels of digestible energy. The fishes were distributed in a randomized experimental design, compound by five treatments and three repetitions, totalizing 15 experimental units. Treatments were constituted by the individuals feeding with diets containing 35% of crude protein (CP) and 2700, 2950, 3200, 3450 and 3700 kcal digestible energy (DE) kg of $ration^{-1}$ (Table 1). It a 16 m^2 tank, containing six females and three males, was considered as one experimental unit.

Previously, the formulation of rations ingredients were evaluated by their nutritional composition. The value of protein and digestible energy were calculated according to Oliveira-Filho & Fracalossi (2006). For the manufacture of the rations, the ingredients were crushed in a hammer mill, sieved in a mesh of 0.5 mm, and submitted to a pelletization process in a pattern of 3 mm of diameter (Bombardelli *et al.*, 2010).

Table 1. Ingredients and feed formulation (wet basis) of experimental rations containing different levels of provided to the breeders of the silver catfish (*Rhamdia quelen*). *Composition of product milligram per kilogram (Folic acid - 200 mg, pantothenic acid - 4,000 mg, biotin - 40 mg, copper - 2,000 mg, iron - 12,500 mg, iodine - 200 mg; manganese - 7,500 mg; niacin - 5,000 mg, selenium - 70 mg, vitamin A - 1,000,000 UI, vitamin B1 - 1,900 mg, vitamin B12 - 3,500 mg, vitamin B2 - 2,000 mg. vitamin B6, 2,400 mg; vitamin C - 50,000 mg, vitamin D3 - 500,000 UI, vitamin E - 20,000 UI, vitamin K3 - 500 mg, zinc - 25,000 mg).

Ingredient (g kg^{-1})	Digestible energy (kcal kg^{-1})				
	2700	2950	3200	3450	3700
Soybean bran	629.5	630.9	632.2	633.6	638.7
Corn for grain	226.4	226.4	226.3	226.3	197
Corncobs	97.7	68.8	40	11.2	0
Bicalcic phosphate	23	23	23	23.1	23.3
Limestone	5.3	5.3	5.4	5.5	5.3
Vitamin and mineral supplement*	10	10	10	10	10
DL – methionine	2.9	2.9	2.9	2.9	2.9
Salt	5	5	5	5	5
BHT	0.2	0.2	0.2	0.2	0.2
Soybean oil	0	27.3	54.7	82.1	117.5
Nutrients and proximate composition (% dry matter)					
Starch	15.99	16.00	16.00	16.00	16.00
Calcium	1.00	1.00	1.00	1.00	1.00
Ash	8.10	7.94	7.79	7.63	7.58
ED silver catfish (kcal kg^{-1})	2700.00	2950.00	3200.00	3450.00	3700.00
Crude fiber	6.41	5.49	4.57	3.65	3.26
Total phosphorus	0.90	0.90	0.90	0.90	0.90
Fat	1.19	3.89	6.58	9.28	12.71
Isoleucine	1.44	1.44	1.44	1.45	1.45
Leucine	2.51	2.51	2.52	2.52	2.51
Mineral matter	4.11	4.12	4.13	4.14	4.13
Dry matter	88.73	88.97	89.21	89.45	89.85
Total Met+Cystine	1.25	1.25	1.26	1.26	1.25
Total methionine	0.75	0.75	0.75	0.75	0.75
Digestible protein	30.45	30.51	30.58	30.64	30.68
Crude protein	35.00	35.00	35.00	35.00	35.00

The fishes were fed twice a day, in a predetermined schedule (10:00 and 15:00 h). Fortnightly, all fishes were separated by sex and weighted to correct the feeding rates. At the end of the experimental period the body weight of the females were individually measured (Marte AS2000C ± 0.01 g). From these data, the parameters of corporal weight and weight gain were calculated (Tessaro *et al*., 2012).

The water supply, where the fishes were confined, was maintained only to compensate the evaporated and infiltrated water. The water temperature was measured daily with a thermometer of maximum and minimum, with accuracy of ±0.1°C. Fortnightly, the pH of the water was measured (Tecnal® Tec 5) and the water dissolved oxygen (YSI 550A), both at 10:00 and 16:00 h (Reidel *et al*., 2010).

During the reproductive period, all females of each experimental unity were submitted into the protocol of artificial breeding to the evaluation of the reproductive parameters. The female were individually weighted and allocated in tanks endowed of aeration and recirculation of water, under controlled temperature (24 ± 1.0ºC) by electric heating. The hormonal induction for the synchronization of ovulation was conducted by the protocol employing carp pituitary extract (CPE) (Woynarovich & Horváth, 1983) applied intramuscularly in the dorsal region. The hormonal dosage used was of 5.5 mg CPE per kg of female, distributed in two applications, being 10% in the first applications and the rest 12 h after the first one (adapted from Tessaro *et al*., 2012). The oocytes gathering of each female were realized by an abdominal massage, after 240 hour-

degree (10 h; water at 24ºC) counted from the second hormonal application (Bombardelli *et al*., 2006).

The semen used on the artificial fertilization procedures were from another males that were not submitted to the experimental diets. The procedure of hormonal induction of the males and the gathering of the semen were similar to the females, but they received only one dose of 2.5 mg CPE per kg of male (Bombardelli *et al*., 2006).

The weight of oocytes bulk released by each female was measured (Marte AY220; ± 0.0001 g), hereupon, three samples of approximately 0.1 g of oocytes were separated and weighted to quantify the number of present oocytes in one gram of released oocytes. Finally, were calculated and evaluated the percentage of spawning females (percentage of females that released oocytes after the hormonal induction and the abdominal massage), the absolute fecundity (total number of oocytes released per female) and the relative fecundity (number of oocytes released by each female in relation of body weight).

All of oocytes from each spawning female, from each experimental unity, were mixed originating a "pool" of oocytes. Hereupon, for the fertilization essay, 2.0 g of oocytes from each "pool" were fertilized (Sanches *et al*., 2011) with 0.1 mL of semen ($1.74x10^{10}$ ± $0.32x10^{10}$ spermatozoa mL^{-1}; 97.65 ± 1.53% of alive spermatozoa; 25.44 ± 3.34 s to loss of 50% of sperm motility). The amount of 10 mL of water was used to accomplish the fertilization of the oocytes (adapted from Witeck *et al.*, 2011). The water used in the incubation of the eggs was originated from an artesian well of the research station and presented the values: pH = 6.96 (digital pH m Tecnal® Tec 5), dissolved oxygen = 4.01 mg L^{-1} (digital oximeter YSI® 550A); alkalinity = 945.10 µEq L^{-1} (Carmouze, 1994); hardness = 53.23 mg L^{-1}; ammonia = 0.134 mg L^{-1} (Korollef, 1976); nitrite = 0.0045 mg L^{-1} (Strickland & Parsons, 1972); nitrate = 0.31 mg L^{-1} (Mackereth *et al.*, 1978).

After the fertilization, the eggs were distributed in 15 experimental hatchery made in PVC, cone-shaped and volume of 2.5 L. The water used in the hatchery was kept warm at 24 ± 1.0ºC by electrical heat.

After the closing of the blastopore (eight hours after the fertilization) (Amorim *et al.*, 2009), the percentage of the artificial fertilization were gauged. These were estimated by the count of three samples of 300 eggs of each experimental unity (Sanches *et al.*, 2011). The necessary time to occur the hatching of eggs from each experimental unity was measured by the evaluation of thermal unities accumulated (Woynarovich & Horváth, 1983).

After the hatching of the eggs, were used 1500 post-larvae with three days age, to evaluate the effects of rations provided to the breeders on the post-larvae vigor (Bombardelli *et al.*, 2009). The post-larvae were distributed in 15 aquariums of 50 L, where each aquarium contained 100 post-larvae of *R. quelen*. To the mensuration of this parameter was considered the necessary time to occur the mortality of 100% of the fishes present in the aquarium and submitted to the fasting (adapted from Lavens *et al.*, 1999).

Data of the growth and reproductive parameters of *R. quelen* females and the vigor parameters of their offspring were submitted to analysis of variance at 5% level of significance. In case of evidence of effects of treatments would be applied analysis of regression. The assumptions of normality and homoscedasticity were checked and, when necessary data transformations were accomplished as suggested by Quinn & Keough (2002). The used software was the Statistica 7.0© (StatSoft, 2007).

RESULTS

The physical and chemical parameters of the water did not presented differences ($P > 0.05$) among the treatments. The water temperature varied from 18.75 ± 2.87°C (winter and beginning of spring) to 24.14 ± 2.53°C (spring and summer) and presented 20.99 ± 3.91°C as medium value during the experimental period. The electrical conductivity of the water was 42.29 ± 17.19 µS cm^{-1}. The averages of pH and of dissolved oxygen were 7.34 ± 1.00 and 5.67 ± 1.75 mg L^{-1}, respectively.

The different levels of digestible energy of ration did not influence ($P > 0.05$) the growth of fishes during the experimental period (Table 2). The female presented middle-weight between 118.24 and 148.47 g, representing weight gains between 73.58 and 103.58 g, during the experimental period (Table 2).

The percentage of spawning females was above 63.33% and was not influenced ($P > 0.05$) by the rations (Table 2). The same way, the reproductive parameters related with the fecundity and the fertility did not suffer the effects ($P > 0.05$) of levels of digestible energy in rations (Table 2). In general, the females produced between 177 and 269 oocytes per gram of spawning female, with taxes of artificial fertilization between 72.2 and 88.4% (Table 2) and time to hatching above 499.04 hours-degree (20 h 47 min 36 s; water at 24ºC). Finally, the vigor of the offspring measured by the time of survival of the larvae to the fasting also was not influenced ($P > 0.05$) by the

Table 2. Growth and reproductive index of *Rhamdia quelen* females fed with ration containing different levels of digestible energy and parameters of offspring quality. BW: final body weight, WG: weight gain, SF: spawning female, $O.SF^{-1}$: oocyte.spawning $female^{-1}$, $O.GSF^{-1}$: oocyte.g of spawning $female^{-1}$, FR: fertilization ratio, HD: hour-degree to hatching and TSF: time of survival of the larvae to the fasting. * *P* = *P*-value.

Parameters	Digestible energy (kcal kg^{-1} of ration)					*P**
	2700	2950	3200	3450	3700	
BW (g)	118.24 ± 2.84	131.07 ± 29.18	132.10 ± 8.34	131.64 ± 31.05	148.47 ± 3.83	0.50
WG (g)	73.58 ± 2.84	86.40 ± 28.86	87.66 ± 7.70	86.97 ± 30.41	103.58 ± 2.66	0.49
SF (%)	8.89 ± 19.25	78.33 ± 20.21	63.33 ± 21.86	88.89 ± 19.25	83.33 ± 28.87	0.62
$O.SF^{-1}$ ($x10^3$)	17.86 ± 5.88	18.34 ± 2.61	12.93 ± 7.52	21.64 ± 11.50	22.56 ± 20.14	0.52
$O.GSF^{-1}$	225.00 ± 27.00	269.00 ± 99.00	177.00 ± 75.00	242.00 ± 44.00	254.00 ± 118.00	0.41
FR (%)	85.15 ± 4.35	88.39 ± 6.45	72.24 ± 8.02	73.17 ± 22.54	84.61 ± 10.29	0.40
HD (h°C)	545.00 ± 65.89	517.39 ± 23.79	499.04 ± 63.72	527.47 ± 43.04	522.83 ± 44.44	0.86
TSF (days)	6.99 ± 0.77	7.43 ± 1.22	7.22 ± 1.06	7.24 ± 0.60	7.10 ± 0.52	0.98

rations provided to the females of silver catfish (Table 2).

DISCUSSION

Information about the environmental requirements to guarantee the suitable development of silver catfish suggests that the physical and chemical variables of the water remained into the bounds recommended to the suitable development of the specie (Baldisserotto & Radünz-Neto, 2004). However, there is no factual information about the environmental demand of females to the reproductive phase.

In spite of tested rations showing great variation between the highest and the lowest energetic level (1000 kcal kg^{-1}) and expected changes in the growth rate, the results of these variables did not suffer the effects of rations. Recent researches verified similar results, confirming the present work. Parra *et al.* (2008) studying the different effects lipid sources in rations to females of silver catfish (*R. quelen*) in reproductive activity also did not verify the effects of the rations over the growth. The absence of this effect also was verified by Reidel *et al.* (2010), when extruded rations were tested containing different levels of protein and energy in female of silver catfish raised in net cages. Coldebella *et al.* (2011) also did not verify the effect of pelleted rations containing different levels of crude protein (28, 34 and 40%) over the growth of females of this specie in reproductive activity.

The levels of digestible energy of rations also did not influence the reproductive parameter. Solid information about the percentage of spawning females of silver catfish (*R. quelen*) is scarce in the literature. Recently, Tessaro *et al.* (2012) verified that 76 to 89% of females of silver catfish, fed with pelleted rations containing different levels of energy presented release of oocytes after the hormonal induction. However, these authors did not verified effects of rations over the percentage of spawning females. The same was reported by Bombardelli *et al.* (2009) on female of Nile tilapia (*Oreochomis niloticus*) fed with rations made with foods of vegetal origin and containing between 2700 and 3700 kcal kg^{-1}.

The fecundity is one of the most important parameter to be considered in the reproduction of captivity fishes (Godinho, 2007) because it represents the animal reproductive condition and subsidizes the production planning. Levels of energy influenced none of the parameters linked with the fecundity of females of silver catfish, evaluated in the present experiment. This was also verified by Coldebella *et al.* (2011) when females silver catfish (*R. quelen*) were fed with pelleted rations containing 28, 34 and 40% of crude protein.

The fecundity may present variations in results due to factors as: age of breeder, the season of gametes gathering and, the procedures used for hormonal handling and the oocytes gathering. Considering that females used in this research presented age correspondent to the first maturation, the values of relative fecundity suggest values within the pattern of the species or slightly higher. Generally, the captivity females produce between 116 (Bombardelli *et al.*, 2006) to 177 ± 15 oocytes.g of $female^{-1}$ (Sanches *et al.*, 2011) or wild females until 254 oocytes.g of $female^{-1}$ (Gomieiro *et al.*, 2007).

The fertilization is also an important event in the artificial breeding of fishes, because it defines the meeting of male and female gametes and the fusion of its pro-nuclei and the beginning the embryonic development (Murata, 2009). Despite its importance, the results of the present experiment suggest that the levels of digestible energy of the rations do not interfere over the de taxes of artificial fertilization of the oocytes

of *R. quelen*. Parra *et al.* (2010) feeding the females of silver catfish with different protein sources also did not evidenced the effect of rations over the taxes of fertilization, but have documented mean values between 81.3 and 82.1%. Coldebella *et al.* (2011) also tested rations containing different levels of gross protein and verified similar effect, with taxes of 82.42 ± 7.97% or 92.37 ± 1.58%.

The necessary time to occur the outbreak of the eggs also deserves highlight, because it is directly related to the conditions that promote embryonic development. This variable defines the moment when occur the rupture of the chorion (Nwosu & Holzlöhner, 2000), caused by muscle contractions of the tail and of the body of the embryo, initiating the larval development (Amorim *et al.*, 2009). Although this parameter did not suffer influence of the feed, the time period measured in thermal accumulated unities to occur hatching were below the standards suggested for the species, corresponding to between 600 (Amorim *et al.*, 2009) and 720 h°C (Pereira *et al.*, 2006). Despite its importance, the information about the thermal unities accumulated (h°C) to occur the hatching of *R. quelen* were scarce and, especially as regards their relationship with the nourishment of reproducers, these information are unavailable in the literature.

The fact of the levels of energy of rations did not influenced the vigor of the offspring suggests that treatments did not affected on the reproductive physiology of females, especially on the process of vitellogenesis. The relation between the offspring vigor and the vitellogenesis is established by hepatic and extrahepatic metabolism to the mobilization of nutrients and constitution of vitellogenin (Mommsen & Korsgaard, 2008), who is incorporated into oocyte to constitute the yolk (Coward *et al.*, 2002). The yolk is considered as the main deposit or source of nutrients and energy to the initial embryonic development. This way, your quantity or quality will reflect directly on the vigor of the offspring (Bombardelli *et al.*, 2009). Despite the difficulty in accomplishing a comparison with the present research, the results of Coldebella *et al.* (2011) evaluating the dietetic protein for female of silver catfish (*R. quelen*), suggest the lack of diet effect on reproductive physiology of female, since was also not verified the effects of rations on the reproduction, either on metabolic parameters related to the reproduction process.

Despite of the results of growth and of the reproductive parameters induce the idea that the silver catfish tolerates a wide range of variation of the energetic content of rations, attention must be given to possible long-term effects, and to those that still require clarification. As an example, recent researches suggest that the dietetic energy promotes cellular alterations as vacuolization and hepatocyte hypertrophy (Tessaro *et al.*, 2012), which may interfere on the reproductive health of the animal in the medium or long term. Besides, this process of vacuolization may be potentiated and promote hepatic steatosis, as verified in "Gilthead seabream" (*Sparus aurata*), when the animals are fed with diets rich in soybean oil, due to the imbalance of fatty acids in the diet (Caballero *et al.*, 2004).

Although Tessaro *et al.* (2012) have used diets with protein foods of animal origin and present similar results with this experiment, other potentially influential factor in the results of this research is related to the fact of rations have been made with only food of plant origin. This way, especially the increase in the proportion of soybean meal in diets for Nile tilapia females reduced the levels of 17β-estradiol plasma and delayed the ovarian development from the 20th weeks of treatment (Fontaínhas-Fernandes *et al.*, 2000).

Many studies have shown estrogenic effects of foods of vegetable origin in humans, rodents and fishes. These effects are due to the fact that the endocrine systems of vertebrates are susceptible to deregulation by environmental chemicals, industrial products and components or derivatives of natural origin (Schiller *et al.*, 2013). Furthermore, the use of the experimental diets may have led to decreased metabolism related to reproductive activity through the negative effect of soy on reproduction, as observed in rainbow trout (*Oncorhynchus mykiss*) by Bennetau-Pelissero *et al.* (2001). These authors have tested three different diets and found that levels of 0.5 g of genistein kg feed^{-1} (phytoestrogen present in soy) for females, promoted the deficiency in the development of the gonads and the decrease in plasma levels of gonadotropins (LH) and 17α, 20β(OH)$_2$ progesterone during the peak of vitellogenesis. Furthermore, El-Sayed *et al.* (2012) to test the effects of phytoestrogens on sex reversal in Nile tilapia (*Oreochromis niloticus*), observed that with the increase of genistein, there was inhibition of aromatase, the enzyme responsible for the production of 17β-estradiol. Similarly, high doses of genistein also inhibited estradiol metabolism in the liver and kidney of salmonids (Ng *et al.*, 2006).

In general, the influence of nutrition on the reproductive process of fish is poorly understood (Bobe & Labbé, 2010) and the results of recent research are often contradictory and difficult to compare. The research related to nutrition of breeder of silver catfish suggest that nutrition does not exert significant influence on reproduction, at least in regard to requirements for protein, energy and fat sources (Tessaro *et al.*, 2012). Yet, speculations can be made

for some species under the influence of different diet fatty acid profiles on reproduction (Bell *et al.*, 1997; Berntsson *et al.*, 1997; Asturiano *et al.*, 2001), and not only by the level of dietary energy generated by adding foods that define a unique fatty acid profile. Also, food consumption is also important for breeding of fishes (Estévez, 2009) and should be measured, because these animals may regulate consumption depending on the level of nutrients present in the diets (Pezzato *et al.*, 2004).

In general, due to the limited amount of information available about this subject, it is premature to assert that nutrition does not affect the breeders and therefore, it is suggested that new researches be conducted to elucidate the relationships between nutrition and reproduction of silver catfish (*R. quelen*).

Finally, silver catfish females in reproductive activity can be fed with pelleted rations, manufactured based on soybean meal, soybean oil and corn, containing 2,700 ED kg feed^{-1}, without growth or reproductive performance damage.

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