Pakistan Veterinary Journal

ISSN: 0253-8318 (PRINT), 2074-7764 (ONLINE)
Accessible at: www.pvj.com.pk

RESEARCH ARTICLE

Appropriate Usage Level of Shrimp Waste Meal as Chitin Source for Feeding Young Crayfish (*Astacus leptodactylus* Esch. 1823)

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ARTICLE HISTORY

Received: September 28, 2010
Revised: November 16, 2010
Accepted: December 02, 2010

Key words:
Chitin
Crayfish
Growth
Shrimp Waste Meal

ABSTRACT

This study was conducted to determine effects of shrimp waste meal as natural chitin source at different rates (0 (control), 10, 20, 30 and 40%) on growth, feed conversion ratio (FCR), survival of young crayfish (1.61±0.04 g and 3.74±0.03 cm) for 60 days. Fifteen glass aquariums (70x30x40 cm) were used in the experiment with 20 crayfish each. The highest of final weight and weight gain were obtained in feed with 10% shrimp waste meal group (3.29±0.23 and 1.66±0.23 g), while the lowest of final weight and weight gain was obtained in fed with 40% shrimp waste meal group (2.75±0.35 and 1.18±0.37 g), respectively. However, non-significant differences were found between final weight, weight gain, specific growth rate, final total length, feed conversion ratio, survival percentage among groups at the end of experimental period. It was concluded that shrimp waste meal as natural chitin source can be used in young crayfish diets up to 40% without adverse effect influence on growth.

To Cite This Article: Koca SB, NO Yigit, A Dulluc, G Erol, N Cılbız and R Kucukkara, 2011. Appropriate usage level of shrimp waste meal as chitin source for feeding young crayfish (*Astacus leptodactylus* esch. 1823). Pak Vet J, 31(3): 207-210.

INTRODUCTİON

There are over 400 crayfish species in the world, but 10 species of these are economically important (Huner, 1995). The most important crayfish species cultured in world belong to 3 different family. Cambaridae and Astacidae family are found in North hemisphere while Parastacidae family is found in south hemisphere (Huner, 1989). *Astacus leptodactylus* species is distributed in Turkey, Austria, Ukrain, Russia, Kzakstan, Belarus, Slovakia, Azarbaijan, Bulgaria, Serbia, Bosnia-Herz., Croatia, Greece, Moldova, Georgia, Romania and Hungary. This species was also introduced to Czech Republic, Poland, Germany, Finland, Armenia, Belgium, Denmark, Netherlands, England, Lithuania, Latvia, France, Switzerland and Italy (Holdich *et al*., 2009). *A. leptodactylus* is an important part of the market and also in aquacultural, either as imports or from introduced populations (Harlıoglu, 2009).

Much information about the use of granule food in culture of *Astacus astacus* and *Pacifactacus leniusculus* is available, however, there is scanty information on *A. leptodactylus*. In the most of the studies, trout pellet feeds have been used for *A. leptodactylus* (Koksal *et al.,* 1992; Zaikov *et al.*, 2000; Ulikowski and Krzywosz, 2004; Ulikowski *et al*., 2006). Special diets are not available for crayfish, therefore, the studies related to special nutrition about the need of crayfish such as chitin are needed. Chitin is is required by most of the crustaceans. Chitin is usually obtained either through insects or other crustaceans (Kumar *et al*., 2006). Chitin exists abundantly in marine diatome, krill, crayfish, shrimp, crap shell and insect epiderm (Synowiecki and Al-Khateeb, 2003; Youn *et al*., 2007; Khempaka *et al*., 2011).

Chitin is a glucosamine polymer found in fungus, yeast and invertebrate epiderms. It is the basic substance of crustacean exoskeleton and is composed of calcium oxide and protein. About 50-80% of organic compounds in crustacean shell are chitin (Shiau and Yu, 1998; Leal *et al*., 2010). Chitin obtained from arthropods is protein polysaccharide complex and contains various lipid, pigment and minerals. In a study, shrimp meat meal was used as natural chitin source in shrimps feed and it had positive results on growth (Kumar *et al.*, 2006). This study was planned to study the shrimp waste meal as natural chitin source on growth and survival rates in crayfish.

MATERIALS AND METHODS

Astacus leptodactylus (Eschsholtz, 1823) young crayfish with mean weight (1.61±0.04 g) and length (3.74±0.03 cm) were used in the experiment. Fifteen glass aquariums (70x30x40 cm) were used with 20 crayfish in each (95/m^2). Bricks were placed in every aquarium as a shelter. The experiment diets were prepared according to nutritional needs of crayfish (Carmona-Osaldea *et al.*, 2005). The shrimp waste meal used in diets was obtained from a special food processing plant in Turkey. Chitin concentration of shrimp waste meal was determined by methods of Bolat *et al.* (2010). The shrimp waste meal used in the experiment had 3.09% protein, 8.64 % lipid and 15.80% chitin. The ingredients and chemical composition of the experimental diets is given in Table 1.

Table 1: Ingredients and chemical composition of the experiment diets prepared from Shrimp waste meal

Ingredients (g 100 g^{-1})	Control	Shrimp waste meal (%) 10	20	30	40
Fish meal	37.88	32.41	26.94	21.47	16.01
Shrimp waste meal	0.00	10.00	20.00	30.00	40.00
Soybean pulp	20.20	20.20	20.20	20.20	20.20
Wheat meal	14.50	14.50	14.50	14.50	14.50
Maize starch	17.22	12.89	8.66	4.33	0.09
Lipid	3.70	3.50	3.20	3.00	2.70
Vitamin	1.00	1.00	1.00	1.00	1.00
Mineral	0.50	0.50	0.50	0.50	0.50
Pellet binding	5.00	5.00	5.00	5.00	5.00
Chemical composition					
Crude protein (g 100 g^{-1})	36.90	36.85	36.81	36.77	36.73
Crude lipid (g 100 g^{-1})	8.81	8.87	8.83	8.89	8.85
Crude cellulose (g 100 g^{-1})	1.98	1.88	1.78	1.68	1.59
Digestible energy (kcal/kg)	3298	3228	3151	3081	3004
Chitin (g 100 g^{-1})	0.00	1.58	3.16	4.74	6.32

Crayfish were fed 2% of their body weight twice a day, i.e., morning and evening with two days interval. Waste of feed and feces in aquariums were cleaned with siphon and 2/3 of aquarium water was changed with fresh water. The aquariums were aerated during the experiment. The measurements of weight and length were done by using grading ruler with 0.1 mm sensitivity and digital scale with 0.01 g sensitivity for 20 days. The pH was determined monthly with a WTW pH 330-İ electronic device; magnesium and calcium and total hardness of water were determined monthly with EDTA titration method; water temperature and oxygen content were measured daily with an WTW Oxi 320 electronic device during the experimental period.

The temperature of water was fixed at 18±1°C during the experiment. The pH and dissolved oxygen of water ranged 7.70-8.50 and 7.50-8.00 mg.l^{-1}, respectively. The content of magnesium and calcium in water were 65.78 and 11.35 mg.l^{-1}, respectively. Total hardness was 77.12 mg.l^{-1} (Erençil and Koksal, 1977).

Growth parameters

The growth parameters were calculated by following formulas:

- Survival percentage(%) = (Final crayfish number/ Initial crayfish number) x100
- Feed conversion ratio = amount of feed consumed (g)/ [final weight (g)- initial weight (g)]
- Specific growth rate (%) = (Ln W_t - Ln Wi) x 100/T (T: Duration).

Statistical analysis

Data were analyzed using one-way ANOVA and Duncan's multiple range tests at 5% level of significance with SPSS (version 11) (SPSS Inc., Chicago, IL, USA).

RESULTS

The highest final weight (3.29±0.23 g) and weight gain (1.66±0.23 g) were obtained in crayfish with 10% shrimp waste meal group while the lowest weight (2.75±0.35 g) and weight gain (1.18±0.37 g) was obtained in crayfish fed 40% shrimp waste meal (Table 2). Although, growth parameters decreased by increasing shrimp waste meal levels in diets of young crayfish, however, there was no significant difference in final weight, weight gain, specific growth rate, final total length, food conversion rate and survival percentage in all groups (P>0.05).

DISCUSSION

The published information about the usage of pure chitin or natural chitin source (such as shrimp head meal) in crayfish is not enough. However, there are few reports available related to using of pure chitin (Kona *et al.*., 1987; Akiyama *et al.*, 1992; Clark *et al.*, 1993; Fox, 1993; Shiau and Yu 1998; Powell and Rowley 2006) or natural chitin (Kumar *et al.*, 2006) in shrimp, crap and fish diets. Some of these researchers stated that pure chitin or natural chitin can promote growth when used at certain levels. According to Akiyama *et al.* (1992), minimum 0.5% chitin can be used in shrimps diets. Shiau and Yu (1998) determined that the group supplemented with 5% pure chitin had better growth than groups supplemented with 2% and 10% chitin in grass shrimp (*Penaeus monodon*) diets.

Table 2: Growth parameters of young crayfish fed on different rates of shrimp waste meal (mean±SE)

	Control	Shrimp Waste Meal (%) 10	20	30	40
Initial weight (g)	1.63±0.09	1.65±0.09	1.60±0.08	1.63±0.09	1.59±0.08
Final weight (g)	2.98±0.13	3.29±0.23	3.23±0.30	3.18±0.47	2.75±0.35
Weight gain (g)	1.37±0.15	1.66±0.23	1.64±0.28	1.56±0.45	1.18±0.37
Specific growth rate (%)	0.78±0.07	0.89±0.09	0.90±0.11	0.84±0.17	0.69±0.19
Initial total length (cm)	3.77±0.07	3.75±0.07	3.74±0.07	3.75±0.07	3.70±0.07
Final total length (cm)	4.76±0.04	4.86±0.13	4.88±0.12	4.72±0.15	4.60±0.19
Feed conversion rate (%)	2.30±0.15	2.06±0.26	2.11±0.36	2.56±0.19	2.46±0.53
Survival percentage (%)	48.33	55.00	58.33	42.50	53.33

Kumar *et al.* (2006) studied the effects of pure and natural chitin source at different levels (control; 5 and 10% pure chitin; 22% shrimp head meal containing 5% chitin - 44% shrimp head meal containing 10% chitin) on growth and survival of post-larvae *Macrobrachium rosenbergii*. They indicated that 5% pure chitin and 22 - 44 % shrimp head meal increases growth while 10% pure chitin decreases growth. Shiau and Yu (1998) suggested the use of 5% pure chitin in shrimp diets. In present study, the pure wasn't used but shrimp waste meal was used as natural chitin source. We found that shrimp waste meal can be used as natural chitin source in young crayfish diets until 40% without negative influence on growth.

In a study made on fish, Kona *et al.* (1987) reported that the growth rate of all fishes fed with the 10% chitin was recorded the best. Powell and Rowley (2006) studied the effects of dietary pure chitin supplementation (0, 5 and 10% chitin) on the survival and immune reactivity of the adult male shore crabs (*Carcinus maenas*) diets. Mortality in the control group was found significantly greater than those fed 10% chitin. These researchers indicated that enhanced survival of crabs fed chitin is probably as a result of the removal of potentially pathogenic bacteria (*V. alginolyticus*) from the hepato-pancreas. On the contrary, in present study, survival ratio didn't vary among the groups. The reason of this might be that natural chitin source wasn't used against a pathogen in our study.

On the other hand, Clark *et al.* (1993) indicated that chitin digestibility decreases as the level of pure chitin increases in panaeid shrimps diets and the cause of this could be because of the limits to the enzyme hydrolyzing capacity of panaeid shrimp. Fox (1993) stated that increasing in pure chitin levels in *P. monodon*'s diets did not influence weight gain, specific growth, food conversion rate and survival rate. In addition, it was pointed out that nutritional value of natural chitin sources such as shrimp head meal might be better than that of pure chitin. In another study made in fish, Shiau and Yu (1999) studied the effects of chitin and chitosan on growth and nutrient digestibility in tilapia, *Oreochromis niloticus* X *O. Aureus.* They fed diets containing fiber chitin at 0, 2, 5 or 10% of a basal diet for 8 weeks. Lower body weight gains were observed in fish fed chitin and chitosan containing diets than fish fed the control diet regardless of the supplementation level.

From the present study it can be concluded that shrimp waste meal as natural chitin source in young crayfish diets can be used upto 40% (6.32 g chitin) without negative influence on their growth.

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