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Effects of Replacing Fish Meal with Soybean Meal in Diet on Some Morphometric Indices of Persian Sturgeon, *Acipenser persicus*

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Abstract: This experiment was conducted on Persian sturgeon with average weight of 352.07±5.51g, to determine the weight gain (WG), feed efficiency (FE), specific growth rate (SGR), condition factor (CF) following in combined effects of Phytase (SpH) and Phytase and magnesium (SpHMg) in the diet. No obvious difference in the diet acceptance between the control and experimental diets was noticed during the feeding trial. The mortality of the experimental fish during the feeding trial was lower than 5% in all the dietary groups. Inclusion Mg and phytase content within soybean diets did not improve feed efficiency and still the control diet containing fishmeal showed better weight gain and feed efficiency. Among soybean meal groups, feed efficiency and specific growth rate were significantly improved for fish fed the diet containing just phytase (SpH). It was true for specific growth rate and condition factor. Phytase significantly enhanced growth.

Key words: Morphometric · Sturgeon · Fish meal · Soybean meal

INTRODUCTION

Looking for replacing fish meal by cheaper and more sustainable protein sources is essential for reducing the cost of fish feeds. With high digestibility and relatively well-balanced amino acid profile as well as lower price and more supply than fish meal makes soybean meal as a suitable ingredient for fish feed [1].

Although soybean diet is known to be one of the most nutritious plant protein sources, it contains antinutritional factors that may affect bioavailability of minerals and lead in reduced growth. The main antinutrient factor affects on minerals availability is phytic acid [2].

Phytase, an enzyme that hydrolyzes the ortho-phosphate groups from the phytate molecule, have been used as a feed additive in livestock feeds as well as aquaculture feeds to enhance the bioavailability of phytate-P and several studies have demonstrated that phytase can also successfully improves bioavailability of phytate phosphorus in diets [3-5].

Phytic acid chelates di cations such as magnesium at intestinal pH and reduced the availability of it [1]. Magnesium acts in enzyme systems and is essential in skeletal tissue metabolism, osmoregulation and neuromuscular transmission [6].

Persian sturgeon, *Acipenser persicus*, is a native species of Iran. Because wild stocks are getting declined, its farming is of great importance. Therefore, preparing promising diets for good health and growth is necessary for its production. Achieving a cost effective diet which doesn't have negatively effects on growth is the goal of aquaculture programs. So an experiment was conducted with the aim at evaluating growth and feed utilization of Persian sturgeon under diets including fish meal as a control diet (C), fish meal replacing by soy bean meal along with supplementing with magnesium and phytase.

MATERIALS AND METHODS

Fish: Juvenile Persian sturgeon was obtained from Aquaculture Research Center of Gorgan University (average weight: 352.07±5.51g), acclimatized to the experimental condition and diets for about two weeks before beginning the trial. Fish were stocked in groups in 400-L aquariums in an indoor facility. Water temperature

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was 20-23°C, pH = 8 and NH4-N < 0.5 mg L^{-1}. Aeration was supplied to each tank with air stone to keep dissolved oxygen throughout the trial. Fish were kept under natural photoperiodic conditions, fed twice a day at a rate of 3% of body weight. Every group was fed for 10 weeks with experimental diet in triplicates. Water replaced at a rate of 80% volume per day in each aquarium and uneaten feed and faeces removed by siphoning daily. Uneaten feed dried, weighted and subtracted for more exact calculation of FCR, FI and PER [7].

Diets: Based on the protein requirement of Acipenser [8] and the suitable ingredients composition, one control diet with fish meal and six experimental diets in which soy bean meal replaced and supplemented with tested ingredients [Phytase (SpH), Phytase and magnesium (SpHMg), were formulated (Tables 1, 2).

Analysis: Moisture, crude protein and crude lipid of experimental diets and muscle were determined by standard methods [9]. Moisture determined by drying in an oven at 105°C for 24 hours; Crude protein by Kjeldahl method and crude fat by ether extraction by Soxtec System. To determine the ash and mineral contents, dried samples were placed in a muffle furnace at 550°C for 24 h. Minerals in feed and muscle determined by atomic.

Statistical Analysis: All data were subjected to one-way ANOVA in SPSS version 11.0 and presented as means ± standard deviations. If significant differences among group means identified, differences were compared using Duncan's multiple range test.

RESULTS

Analyses data of Formulation and proximate composition of reference and the experimental diets are in Table 1. However, Mg and phytase content of experimental diets are separately in Table 2.

Initial and final body weight, weight gain (WG), feed efficiency (FE), specific growth rate (SGR), condition factor (CF) was calculated and shown in Table 3. No obvious difference in the diet acceptance between the control and experimental diets was noticed during the feeding trial. The mortality of experimental fish during the feeding trial was lower than 5% in all the dietary groups. The proximate composition of Carcass is shown in Table 4.

Table 1: Formulation and proximate composition of reference and the experimental diets

	Content (g Kg^{-1} diet)	
Ingredients	Reference diet	Experimental diet
Fish meal	550	218
Soybean meal	0	500
Milk powder	150	150
wheat flour	170	0
fish oil	30	40
soybean oil	50	40
Lysine	15	15
Methionin	12.5	15
vitamin mineral premix	20	20
mold inhibitor	2.5	2
	1,000	1,000
Proximate Chemical Composition		
Dry Matter (DM)	891.81	904.49
In DM		
Crude protein	426.1	433.3
Crude fat	84.58	84.26
Ash	77.92	71.74

Table 2: Mg[a] and phytase[a] content in experimental diets

	Supplement (g Kg^{-1})		Analyzed (g Kg^{-1} dry diet)	
Diet	Mga	Phytasea	Mg	Ca
C	0.0	0.0	1.1	12.6
SpH		0.2	1.5	4.4
SpHMg	0.5	0.2	2.4	4

[a]Ca as DCP, Mg as MgO, Phytase as microbial

Table 3: Morphometric indices of Persian sturgeon on different diets

	Diets		
	C	SpH	SpHMg
Morphometry			
Initial body weight,	352.9±5	350.11±1.94	347.56±5.06
Final body weight,	681.04±38.36^{ab}	588.07±19^{abc}	492.79±5.1^{c}
Weight gain[1] (WG)	92.86±8.43^{a}	67.58±8.03^{b}	41.73±3.61^{c}
Feed Efficiency[2], (FE)	1.75±0.01^{a}	1.08±.43^{b}	.75±.08^{b}
Specific growth rate[3] (SGR)	1.09±.07^{a}	0.85±0.07^{b}	.58±0.04^{c}
Condition Factor[4] (CF)	1.54±.06	1.44±.08	1.56±.04
HSI[5]	6.16±.42^{a}	5.10±.74^{abc}	5.3±.70^{abc}

[1]WG=100× [(final body weight-initial body weight) (initial body weight)$^{-1}$], [2]FE= [body weight gain× (feed supply)$^{-1}$], [3]SGR=100× [(LnFMW-LnIMW) (duration)$^{-1}$]

[4]CF=100× [weight× (body weight)$^{-3}$], [5]HSI= 100× [liver weight × (body weight)$^{-1}$]

Table 4: Composition of carcass composition of reference and the experimental diets

	Diets		
	C	SpH	SpHMg
Composition of carcass (%)			
Moisture	76.59±7.68[a]	79.96±0.01[ab]	79.55±0.79[ab]
Protein	25.91±8.40[ab]	26.36±0.6[a]	19.12±0.22[b]
Lipid	14.65±0.57	14.34±0.53	14.47±1.14
Ash	7.5±0.81[ab]	6.41±0.5[bcd]	7.33±0.08[abc]
Calcium	0.05±0.02[a]	0.05±0.01[a]	0.39±0.01[b]
Magnesium	0.14±0.4[a]	0.1±0.15[ab]	0.12±0.04[a]

DISCUSSION

Inclusion Mg and phytase content within soybean diets did not improve feed efficiency and still the control diet containing fishmeal showed better WG and FE. Interestingly, among other treatments, WG and FE, were significantly higher in fish fed diet containing just phytase. It was true for SGR and CF. Apart from C group, phytase enhanced fish growth and final body weight without having an effect on feed intake. According to De la Higuera [10], two opposite responses are possible for fish which are fed diets deficient in a nutrient, if slightly deficiency occurs, increasing feed intake will compensate by increasing intake of the nutrient, but if severe deficiency happens, an inhibitory response is observed. Decreased feed intake in fish fed severely deficient diets may prevent or delay the onset of metabolic disorder. It can be concluded that increased availability of phosphorus due to phytase and phosphorus was the reason for increased feed intake and resulted in higher growth performance [11]. Although the increased available phosphorous due to phytase resulted in a large increase in feed intake and therefore growth, lowered growth performance of fish fed diets with soybean may be attributed to several factors such as mineral bioavailability reduction, low protein digestibility, damage caused by phytate in pyloric caeca region of intestine result in reduction of nutrient absorption [2, 11]. For example, protein digestibility reduction and partly reduction of Zn bioavailability lead to reduced growth was observed in rainbow trout [12] and in Chinook salmon [13] respectively. protein feedstuff quality and effects of gastrointestinal pH on complex formation between phytic acid and protein could contribute in part, to inconsistent results reported in the literature [14].

In this study, supplementing minerals did not apparently resulted in better growth performances with comparison to C group. It showed that fish meal is more sufficient for Persian sturgeon and soybean meal could be partly an alternative protein source if phosphorous supplied for fish by incorporation with microbial phytase or Phosphorous. It also might be attributed to the deficiency of a digestible essential amino acids in soybean meal as compare to fish meal which would lead to poor utilization of the soybean protein [15].

HSI was significantly higher in the C fed group. It might be due to the higher lipid retention as previously observed [16, 17].

The whole body protein and moisture content responded to dietary P, Mg and phytase did not exhibit any dependant manner. In the case of whole body moisture, similar results have been reported for other fish species [18]. Whole body lipid was not also correlated to dietary [17].

In conclusion, No improved growth performance was observed with supplemented P, Mg and phytase in diet among fed groups compared to the C fed group.

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