PJN
ISSN 1680-5194

PAKISTAN JOURNAL OF NUTRITION

ANSInet
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Pakistan Journal of Nutrition 11 (4): 375-378, 2012
ISSN 1680-5194

The Effect of Shrimp Waste Hydrolysate on Broiler's Tibia Weight, Calcium and Phosphorous Content

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Abstract: An experiment was conducted with 80 unsexed broilers of Arbor Acress CP 707 strain to determine the effect of shrimp waste hydrolysate on tibia bone weight, calcium and phosphorus content. This study involved a Completely Randomized Design (CRD) with 4 treatments (0, 4, 8 and 12% of shrimp waste hydrolysate) and 5 replicates for each treatment. Diets were isonitrogenous (22% of crude protein) and isocaloric (2900 kcal/kg diet). Measured variables were weight of tibia bone, calcium and phosphorus content of tibia bone. Data were analyzed by analysis of variance for CRD. Result shown that increasing of shrimp waste hydrolysate levels in diet had no effect ($p>0.05$) on tibia bone weight and calcium content, but decreasing of phosphorous content ($p<0.01$). In conclusion, the utilization of shrimp waste hydrolysate up to 12% in broiler diet had no affected on weight and calcium of tibia bone but decreased phosphorous content.

Key words: Shrimp waste hydrolysate, tibia bone, weight, calcium, phosphorous

INTRODUCTION

The shrimp waste is a byproduct of the shrimp processing industry into skinless frozen shrimp to meet export demand from Japan, America and countries in Europe from Indonesia. In Padang city (one of major in Indonesia) also found the shrimp waste as by product from shrimp skinless which was sold in traditional market. The shrimp waste is not used and thrown away without consideration of environmental aspects, giving rise to bad smell and pollute the surrounding environment. The availability of shrimp waste is abundance, from the fresh shrimp body, 35 to 70% are waste after processing become skinless frozen shrimp (Animal Feed Resources Information System, 2002). The shrimp waste contain high protein content and it could be used as an alternative source of animal protein in replacing fish meal in poultry diet. According to some researchers, the protein contain in shrimp waste is 24.03 to 52.70% (Mirzah, 1990; Rosenfeld *et al*., 1997; Gernat, 2001; Fanimo *et al*., 2004; Okoye *et al*., 2005; Mahata *et al*., 2008). The problem for using the shrimp waste in poultry diet is anti-nutritional compound chitin. This compound form a complexes with inorganic salts ($CaCO_3$) and protein (Carroad and Tom, 1978; Knor 1991). In the digestive tract of poultry, the chitinase is produced not enough for digesting chitin. Our last research shown, the shrimp waste from *Penaeus merguensis* which was hydrolized by chitinase from *Serratia marcescesns* (shrimp waste hydrolysate) could be included as much as 8% or it was substituted of the fish meal to 40% in broiler diet (Mahata *et al*., 2008). Beside contain of high protein, the shrimp waste also high in Calcium (Ca) and Phosphorus (P) content, which compose the materials of the shrimp waste. Some researchers said the shrimp waste content of 15.64-24% of ash total and 5.21% is Ca and 15.77 is P (Rosenfeld *et al*., 1997; Gernat, 2001; Fanimo *et al*., 2004; Okoye *et al*., 2005). According to NRC (1994), the Ca content of shrimp waste is 16 or 50 multiple higher then Ca in fish meal. Mahata *et al*. (2008) found the Ca in shrimp waste hydrolysate was 16.35% and P is 0.83%. The Ca and P have an antagonistic relationship in the process of absorption in the small intestine of broilers. The high Ca content in the broiler's diet will affect the lower absorption of P and the higher P in diet will reduce the absorption of Ca. The Ca and P disposition will determine the form of hydroxyapatite bone compactness during the mineralization process. The purpose of this study was to determine the effect of the use of shrimp waste hydrolysate in broiler diet which containing high Ca and low P content for tibia bone weight and the disposition of Ca and P in broiler tibia.

MATERIALS AND METHODS

Preparing shrimp waste hydrolysate: The shrimp waste was dried under the sun light until it's water content was 14% and then it was grinded become powder with particle size 2 mm. Shrimp waste powder was sterilized by autoclave for 20 min before hydrolyzed by 4 Unit chitinase, at pH 5, temperature 50°C for 24 hrs. Chitinase hydrolyzation was stopped by drying the shrimp waste powder at 80°C in oven (Mahata *et al*., 2008).

Experimental animals and diet composition: A total eighty day old chicks of strain of Arbor Acress CP 707 were assigned to experimental diets of 4 levels of shrimp waste hydrolysate (0, 4, 8 and 12%) in

Table 1: Composition nutrient (%) and metabolizable energy (kcal/kg diet) of experimental diets

	Experimental diets			
Feedstuffs (%)	A	B	C	D
Yellow corn	45.00	45.00	45.00	45.00
Rice bran	21.00	15.00	10.50	5.25
Soybean meal	8.00	10.00	13.00	16.00
Fish meal	20.00	16.00	12.00	8.00
Shrimp waste hydrolysate	0.00	4.00	8.00	12.00
Copra meal	3.00	7.00	8.50	10.75
Coconut oil	3.00	3.00	3.00	3.00
Total	100.00	100.00	100.00	100.00
Calculated analysis				
Crude protein (%)	22.69	22.42	22.28	22.20
Ether extract (%)	7.84	7.52	7.23	5.25
Crude fiber (%)	3.70	4.19	4.74	6.90
Ca (%)	1.32	1.78	2.21	2.63
P Total (%)	0.63	0.56	0.48	0.41
Metabolizable energy (kkal/kg)	2912.92	2914.48	2918.79	2924.10
Chitin (%)*	0.00	0.28	0.57	0.86

*Calculated by multiple of shrimp waste hydrolysate amount in experiment diet with chitin content in shrimp waste hydrolysate

completely randomized design with 5 replications for each treatment. Diets were formulated in iso-nitrogenous (22% crude protein) and iso-caloric (2900 kcal/kg diet) as described in Table 1. Diet and water were provided *ad-libitum*.

Data collection: Data of tibia bone weight was collected by killing the broiler from each treatment and then the tibia bone is separated from meat and it was weighed by overling weigher. The Ca and P content of tibia bone were analyzed according to Official Analytical Chemist (AOAC, 1990) method.

Statistical analysis: A completely randomized design was adopted to execute this experiment and means showing significant differences in the ANOVA table were compared using the Duncan's multiple Range Test (Steel and Torrie, 1980).

RESULTS

The effect of shrimp waste hydrolysate on broiler's tibia bone weight: The mean of tibia bone weight is shown in Table 2. The broiler's tibia bone weight was not affected by shrimp waste hydrolysate in broiler's diet ($p>0.05$).

The effect of shrimp waste hydrolysate on Ca in tibia bone: The Ca content in tibia bone was not affected by shrimp waste hydrolysate in broiler's diet ($p>0.05$). The mean of Ca in tibia bone is depicted in Table 3.

The effect of shrimp waste hydrolysate on phosphorus content in tibia bone: The P in tibia bone was highly affected by shrimp waste hydrolysate significantly ($p<0.01$) (Table 4).

Table 2: The effect of shrimp waste hydrolysate on broiler's tibia bone weight

The treatment of shrimp waste hydrolysate in broiler's diet (%)	The tibia weight (g)
0	10.59
4	10.16
8	9.79
12	9.18
SE	0.66

SE = Standard Error of the Mean

Table 3: The effect of shrimp waste hydrolysate on Ca content in broiler's tibia bone

The treatment of shrimp waste hydrolysate in broiler's diet (%)	The Ca content in broiler's tibia bone (g)
0	14.39
4	14.07
8	13.84
12	13.29
SE	0.33

SE = Standard Error of the Mean

Table 4: The effect of shrimp waste hydrolysate on P content in broiler's tibia bone

The treatment of shrimp waste hydrolysate in broiler's diet (%)	The P content in broiler's tibia bone (g)
0	4.65^a
4	4.53^a
8	4.78^a
12	3.57^b
SE	0.14

SE = Standard Error of the Mean. (a,b) The different superscripts show the effect of treatment is highly significant ($p<0.01$)

DISCUSSION

In this study was found that the utilization of shrimp waste hydrolysate in broiler's diet did not affect the weight of tibia bone and Ca content in tibia (Table 2 and 3), but the P content in tibia bone decreased when the level of shrimp waste hydrolysate 12% in diet (Table 4). According to NRC (1994), the ideal composition of Ca and P in broiler's diet for absorption effectively is 2:1. In this study, the increasing of the level of shrimp waste hydrolysate in diet changed the composition of Ca and P. The composition of Ca and P in each diet (A, B, C and D) is 2:1, 3:1, 4:1 and 6:1 respectively. When the level of shrimp waste hydrolysate increased in diet, cause the Ca level more higher in comparing with P for each diet.

The crude fiber increased concomitantly with the increasing of shrimp waste hydrolysate in diet, this condition affected the lower absorption of Ca and P because the crude fiber attached a part of Ca and P and push them out from the digestive tract of broiler before it was absorbed and the weight of tibia bone and Ca content in tibia become not different among the treatment. The Ca content in tibia broiler's in this study (13.29 to 14.39%) lower than found by Kamal (1980) is 20.55% with Ca as much as 1.41% and P (0.99%) in diet and it also lower in comparing with found by Moghaddan *et al.* (2005) is 34.43 to 37.96% in broiler 7-35 days. The P content in tibia bone in this study decreased when the level of shrimp waste hydrolysate is 12% in diet. This condition was affected by the lower amount of P in diet and then it changed the composition of Ca and P become 6:1, this composition was so far from composition that recommended by NRC (1994) is 2:1 and the absorption of P in broiler's digestive tract decreased because the Ca is to high. The absorption of Ca and P in antagonist relationship, the high concentration of Ca decrease of P absorption and vice versa. This condition is in accordance with the opinion of Harrold *et al.* (1983) that the excess of Ca will reduce the availability of P due to the formation of insoluble calcium phosphate in the digestive system, as well as excess soluble of P would reduce the availability of Ca through the formation of insoluble calcium phosphate. In addition, high Ca will increase the pH from acid to alkaline in intestine, while the absorption of P in acidic conditions, so that the content of P in treatment D (12% shrimp waste hydrolysate) is noticeably lower than in A, B and C treatments. This is in accordance with the opinion of Bronner (1987) that the condition in poultry digestive tract is an acid condition and the statement of Kheiri and Rahmani (2006) that a high Ca will increase the pH of the intestine and affect the digestion and absorption of nutrients, including P. In this study was obtained the P content in tibia bone of broiler ranged from 3.57 to 4.78%.

Conclusion: The utilization of shrimp waste hydrolysate up to 12% in broiler's diet did not increased the tibia weight and Ca content in tibia, but it declined the P content.

ACKNOWLEDGEMENT

The Authors are very grateful to Department of National Education Republic of Indonesia which funded this experiment. This budget is a present from Department of National Education Republic of Indonesia for the author as the best poster presenter in National seminar of Hibah Bersaing project in 2008 at Jakarta.

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