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Influence of Dietary *Bacillus* Sp. Fermented Shrimp Waste on Broiler Meat Quality

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Abstract: An experiment was conducted to evaluate the effect of the inclusion of different levels of Fermented with *Bacillus sp*. Shrimp Waste Meal (FSWM) in diets on meat quality of broilers. A total of 75 d-old chicks were randomized in 5 (five) treatments with 3 replicate pens of 5 birds each. Treatments consisted of FSWM inclusion of 0 (control) and 5, 7.5, 10 and 12,5% in the diets. Birds were raised under standard condition and provided with feed and water *ad-libitum*. Feed and birds were weighed weekly up to 35 days and in the end of experimental period, the birds were sacrificed dan dress up to determine meat quality. The texture, lightness, redness and yellowness values of breast meat were increased and cooking loss and water holding capacity were decreased. The pH, water and ash content of breast meat was similar for all treatment, fat content was decreased and protein content was increased as compared to the control. The present result indicated that FSWM be potential feed ingredient to supply part of dietary protein requirement of broiler without any differences in broiler meat quality.

Key words: Shrimp waste meal, broiler, *Bacillus* sp., meat quality

INTRODUCTION

The protein component cost of broiler ration is high. By using a conventional costly feedstuff such as soybean meal and fish meal, the cost of broiler ration is also high. The broiler ration cost should be reduced with the use of non conventional feedstuff by proper waste treatment technology such as marine industrial byproduct, one of such is Shrimp Waste Meal (SWM).

Shrimp waste meal was a shrimp processing industry byproduct consist of shell and head parts and small shrimp (Rosenfeld *et al*.,1997). The SWM have been used as salmon feed for good color fillet. The quality and nutrient content of SWM varied depend on the proportion of shell and head, the head part containing higher protein and lower chitin compared to shell part. Naturally, a shell and head shrimp contain chitin, a linear polymer polysaccharide N-acetil glucosamine with β glicosidic (1, 4) bond on protein complex (Minoru *et al*., 2002).

The SWM was potentially as protein sources feedstuff with a high protein, for fish meal substitution. Some researcher reported that protein content varied, 24, 39, 45, 52 and 70% (Mahata, 2007; Gernat, 2001; Fanimo *et al*. 2004; Okoye *et al*., 2005). The utilization of SWM in broiler feed was controversial, Romziah *et al*. (1981), Islam *et al*. (1994) and Arellano *et al*. (1997) stated that SWM could be used upto 15, 14, 25 and 90% in broiler ration. The result indicated that the broiler fed SWM did not show similar performance: 1) feed consumption and Average Body Weight (ABW) were decreased (Oduguwa *et al*., 2004), feed consumption increased and ABW decrease (Fanimo *et al*., 2004) and 3) no negative effect (Islam *et al*., 1994; Rosenfeld *et al*., 1997). Ingweye *et al*. (2008) reported that replacement of fish waste meal with shrimp waste meal was directly proportional to the feed consumption rate, feed conversion ratio and organ weights but indirectly proportional to weight gain, and they suggested that 0 and 25% level of replacement of fish meal with shrimp waste meal were optimum for broiler chicken performance. Khempaka *et al*. (2006) stated that the decreasing of dry matter digestibility of broiler fed by SWM due to a low SWM chitin digestibility (24%), and tended using as meat colour promoter, produced from asthaxantin (natural red carotenoid), then broiler consumed SWM has a bright red meat.

The quality of SWM can be improved by using some methods (Fox *et al*., 1994). Heating method destructed fat, vitamin dan pigment; slow sun drying caused increasing pathogen microbes and formic acid treatment was expensive and the mineral from silage acid should be neutralized before use. Hydrolyzation of SWM chitin by crude chitinase of *Serratia marcescens* (SWM hydrolysate) decrease chitin until 61% and increase protein content 26% (Mahata, 2007). Rodriguez *et al*. (2005) found that utilization of *Aspergillus oryzae* product (Fermacto) increase digestive efficiency and *Lactobacillus* sp. growth in the broiler intestine. Replacement of groundnut cake with fermented *Parkia Biglobosa* seed meal up to 100% reduced the cost without adverse effect on growth performance, digestibility and organs weight (Obun, 2008). Limited information was available on SWM treatment to improve

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nutritional quality of broiler feed. This study was aimed to investigate the effect of inclusion of *Bacillus* sp. fermented SWM (FSWM) on feed to physical and chemical properties of broiler meat.

MATERIALS AND METHODS

Fermented SWM preparation: Shrimp Waste Meal (SWM) var. *Vanamei* was taken from local shrimp processing industry in Malang, east Java. The SWM was oven dried 55°C for 2 days and ground in 1.5 mm sieves. Then, SWM sterilized using autoclave apparatus for 4 h and cool down. The growth of cell biomass was conducted using bacterial media: $Na_2HPO_4.12H_2O$ 15 g, KH_2PO_4 3 g, $MgSO_4.7H_2O$ 0.2 g, $NaNO_3$ 1 g, NaCl 0.5 g, NH_4Cl 0.1 g, Glucose 1 g, Casein 10 g, yeast extract 0.5 g and aquadest, on pH 7 for 20 h. These process on the *shaker bath*. The culture media inoculated on SWM with 1: 5 ratio (v/w) and put in incubator 30°C, for 72 h. The FSWM was oven dried 70°C for 48 h.

Feed composition and animal trial: A five iso-caloric and iso-protein feed treatments formulated based on broiler requirement (NRC, 1994), with an inclusion level of FSWM: 0 (P0); 5 (P1); 7.5 (P2); 10 (P3) and 12.5% (P4) as treatment. The feed treatment composition is presented in Table 1.

A seventy five unsexed DOC broiler MB-202 of PT. Multi Breeder Adirama Indonesia Tbk. purchased from local distributor. The research arranged by completely randomized design and the chick weighed individually and randomly allotted to plot cage of 5 treatment ration (1 control and 4 feed test), 15 chicks each as replication. A litter cages were used, feed and water drinking were provided *ad-libitum*. The birds vaccines for ND disease 2 times (4 days old using Medivac ND Hitctner B1, and 18 days old using Medivac ND La Sota). The chick brooder using gas gasoline and 25 watt lamp in every cage plot.

Data collection: The chick reared for 5 weeks and weighted individually every week to calculate body weight gain, feed consumption and conversion. At the end of research period, the animal were sacrificed and taken the breast meat sample for meat analysis. The physical properties calculated are: Water Holding Capacity (WHC), tenderness, cooking loss and meat color (Soeparno, 1998) and chemical properties: pH, water, fat, ash and protein calculated using *Liebermann-Burchard* method (Sudarmadji *et al*., 1997). The breast meat color analyzed using *reflectance colorimeter* (Chrom-meter CR-200b, Minolta, Japan). The value was estimated by CIE system: L*, a* and b* means lightness, redness and yellowness, respectively. This system based on color standard table of CIE (*Commission Internationale de l'Eclairage*) which transformed from X, Y and Z value to L, a and b value. The data represent an average of 10 different taken samples. The data was analyzed by analysis of variance of linear model (SAS Institute, 1996) and the significant differences were tested by Duncan's test.

RESULTS AND DISCUSSION

The result of SWM studies showed that the nutrient compositions were varied: crude protein ranged from 40% (Oduguwa *et al*., 2004) until 62% (Rosenfeld *et al*., 1997), ash from 12% (Rosenfeld *et al*., 1997) until 23% (Gernat, 2001), crude fiber from 11% (Rosenfeld *et al*., 1997) until 13% (Gernat, 2001) and fat from 4.8% (Oduguwa *et al*., 2004) until 7.7% (Rosenfeld *et al*., 1997). Those variations were due to shrimp species differences, origin and different process treatment. This research using shrimp waste containing a high fiber, ash, fat and protein, it was mixture of shell and head part.

The effect of FSWM on the physical broiler meat was presented in Table 2. The FSWM inclusion significantly ($p<0.05$) affected the texture, cooking loss, WHC, lightness, redness and yellowness of broiler meat. The texture, lightness, redness and yellowness values were increased and cooking loss and WHC were decreased as compared to control.

The highest texture value was 7.5% FWSM inclusion and the lowest at 5%. The cooking loss and WHC of control was highest and lowest at 12,5% and 5% FSWM inclusion, respectively. This result showed that inclusion of FSWM improved texture, cooking loss and WHC of broiler meat. It is well established that meat quality influenced by amount level of crude fiber and chitin content of broiler feed (Khempaka *et al*., 2006).

The highest lightness (L*) value was 5% FSWM inclusion and lowest at 12.5% and redness (a*) and yellowness (b*) of 12.5% and 5% were highest and lowest at 7.5 and 10%, respectively. The broiler meat was looked brighter as compared to control, due to asthaxantine pigment of FSWM. These results supported by Khempaka *et al*. (2006), that shrimp waste containing asthaxantine, a natural carotenoid with red pigment, then, broiler consumed a SWM produced red bright meat.

In Table 2 also presenting the effect of FSWM inclusion to the chemical properties of broiler meat. The effect of FSWM to the physical broiler meat was presented in Table 2. The FSWM inclusion did not affect the pH, ash and protein content of broiler meat, but it was significantly ($p<0.05$) affected the water and lipid content of broiler meat.

The pH and ash content of meat were similar with control and the fat and protein content were significantly effected by treatments. The pH, water and ash content are in normal range i.e. 6.15-6.40, 72.04-75.64 and 4.49-6.15%, respectively. Compared to result of Ponte *et al*. (2004) by inclusion of high level alfalfa meal as hypo

Table 1: Composition of feed treatment (%)

Feedstuff	P0	P1	P2	P3	P4
Yellow corn	55	55	55	55	55
Rice bran	8.5	9.5	9.5	9.5	9.5
Soybean meal	24.5	19.5	17	14.5	12.5
Fish meal	8	8	8	8	8
Coconut oil	1.5	1.5	1.5	1.5	1.5
FSWM	0	5	7.5	10	12.5
$CaCO_3$	1	-	-	-	-
lys-met	0.2	0.2	0.2	0.2	0.2
NaCl	0.3	0.3	0.3	0.3	0.3
DCP	0.5	0.5	0.5	0.5	0.5
premix	0.5	0.5	0.5	0.5	0.5
Total	100	100	100	100	100
Nutrient content (% DM), calculation based					
Crude protein	21.63	21.70	21.67	21.64	21.61
ME (kcal)	3006	3057	3065	3074	3082
Crude fiber	3.83	4.25	4.46	4.66	5.09
Crude fat	5.43	6.18	6.55	6.92	7.29
Ca	0.904	1.104	1.405	1.705	2.010
P	0.422	0.444	0.448	0.452	0.456
Lysine (% CP)	1.510	1.136	1.129	1.121	1.106
Methionine (% CP)	0.388	0.394	0.397	0.399	0.402

Table 2: Physical properties of broiler meat of FSWM inclusion

	Treatment rations				
Variables	P0	P1	P2	P3	P4
Physical properties					
Texture	13.60^{b}	10.58^{a}	17.38^{c}	13.65^{b}	13.15^{b}
Cooking loss (%)	28.03^{c}	26.66^{b}	26.80^{b}	26.67^{b}	24.42^{a}
WHC	38.84^{b}	38.62^{b}	29.01^{a}	30.50^{a}	31.30^{a}
Lightness, L	37.75^{ab}	37.48^{ab}	39.55^{c}	38.20^{b}	36.45^{a}
Redness, a*	10.68^{a}	10.70^{a}	10.03^{a}	11.30^{b}	12.25^{b}
Yellowness, b*	14.95^{b}	16.08^{c}	15.38^{bc}	11.30^{a}	14.68^{b}
Chemical properties					
pH	6.20	6.40	6.30	6.15	6.35
Water (%)	75.64^{b}	75.41^{b}	75.22^{b}	74.86^{b}	72.04^{a}
Ash (%)	4.49	4.92	5.37	6.15	4.79
Lipid (%)	7.15^{b}	3.37^{a}	4.29^{a}	4.58^{a}	3.95^{a}
Protein (%)	22.56	21.52	20.42	20.90	20.42

Value in the same column with different superscripts are significantly different ($p<0.05$)

cholesterolemic agents, the meat pH and water content of present study was slightly higher, its range was 5.5 and 74%, respectively.

The total meat lipid was significantly decreased by FSWM inclusion treatment as compared to control, but among the FSWM inclusion treatment groups does not show any differences, a range 3.37% on 5% FSWM until 4.58% on 10% FSWM. The total lipid content of meat originating from birds subjected to the higher level of FSWM group, was significantly lower than control. This decrease might be related to the nutritional stress imposed by increasing chitin level, which increased constantly by increasing level of FSWM in the diet.

The protein content broiler meat numerically was tend to decrease by higher FSWM inclusion as compared to control, although statistically was not different. Broiler meat derived from 7.5 and 12.5% FSWM inclusion has a lowest protein content (20.42%).

Conclusion: The inclusion of FSWM in the broiler ration can be used until 7.5% total feed, in order to increase texture, lightness (L*), redness (a*) and yellowness (b*) of broiler meat. The pH, water and ash content similar to control, fat was lower and protein was higher compared to control.

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