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True Amino Acid Digestibility of Fermented Shrimp Waste in Broiler Chicks

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Abstract: Thirty 55 days old of MB-202 male broiler chicken were used in a completely randomized design to evaluate the digestibility of *Aspergillus* sp. fermented shrimp waste (FSW) by force feeding technique. There were 4 dietary treatments, each having 6 replicates. Three diets each of *A. niger* FSW (FSWn) , *A. oryzae* FSW (FSWo) and *A. sojae* FSW (FSWs) were formulated and one raw SW diets as control. The birds were fasted for 24 h and force feeding as quickly as possible and total excreta sampling for amino acids digestibility evaluation. The amino acid digestibility of FSW groups were higher as compared to the raw SW. Among FSW groups treatment, the digestibilities FSWn were higher for all amino acid. Supplementation of the diets with lysine have more attention in order to utilization of FSW as broiler feedstuff.

Key words: Digestibility, amino acid, fermentation, shrimp waste

INTRODUCTION

The digestibility of amino acids is one of the important factors for estimating the nutritive value of protein feedstuff for poultry to fed balance diets. It can be affected by many factors, some of which have been investigated (Parsons, 1990). However, limited information has been reported concerning physiological effects of fermentation and microbe species. A deficiency of an essential amino acid caused poultry performance reduction and excess of amino acids in the diet above requirement will be excreted as uric acid and costly wasting.

The Shrimp Waste (SW) 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). Khempaka *et al*. (2006) stated that the decreasing of dry matter digestibility of broiler fed by SW due to a low SWM chitin digestibility (24%).

Fermentation process could be improving the nutrient digestibility. 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. Limited information was available about SW treatment to improve nutrient digestibility as broiler feed. This study was aimed to estimate the true amino acids digestibility of *Aspergillus* sp. Fermented SWM (FSWM) by broiler chicken.

MATERIALS AND METHODS

Fermented shrimp waste preparation: Shrimp waste var. *Vanamei* was taken from local shrimp processing industry in Malang, East Java, Indonesia. An *Aspergillus* sp. culture was obtained from Food laboratory of PAU, Gadjahmada University, Jogyakarta. 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. The growth of cell biomass was conducted using *Aspergillus* sp. media: Glucose 40 g, $(NH_4)_2SO_4$ 2.0 g, KH_2PO_4 1.5 g, $MgSO_4$ 1.0 g, Yeast extract 1.5 g, shrimp waste meal 3.5 g and 1000 ml aquadest, on pH 7 for 20 h. These process was done using a *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.

A three fermented SW treatment diets: FSWn (fermented shrimp waste by *Aspergillus niger*), FSWo (*A. oryzae*) and FSWs (*A. sojae*) and non fermented SW (as control) were formulated as individual diets test with different microbe species as treatment (Table 1). The research was designed using completely randomized design with 4 treatment and 6 replication, each.

Table 1: Composition of treatment feeds (%)

	Treatments			
Ingredients	SW	FSWn	FSWo	FSWs
Shrimp Waste (SW)	96.5	-	-	-
Fermented SW (FSW)	-	96.5	96.5	96.5
Mineral premix	0.1	0.1	0.1	0.1
Vitamin premix	0.5	0.5	0.5	0.5
NaCl	0.4	0.4	0.4	0.4
$CaCO_3$	1.0	1.0	1.0	1.0
DCP	1.5	1.5	1.5	1.5
Total	100.0	100.0	100.0	100.0

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Birds and management: Thirty 55 days old of MB-202 male broiler chicken with relative similar weight 3.2-3.4 kg (variance coefficient < 5%) was used as animal digestibility trial by force feeding. They were reared from day old chick fed commercial diet (BR-1) and housed in the 30 individual wire metabolic cage. The chick were then fasted for 24 h in order to ensure a complete emptying of their digestive tracts. They were then force-fed approximately 50 g air dry basis of each diet tested (Table 1) using moistened force feeding method. The ratio of diets and water was about 1:1. Water was added carefully to the diet and mixed in order to obtain homogenous paste. During the force feeding experimental period, drinking water (1:1 water + 20 g dextrose) was available for *ad-lib*. intake and tray was positioned under cages for excreta collection.

Excreta were collected daily during sub sequence 48 h. They were freeze-dried, weighted and ground to pass through 1 mm sieves. Endogenous losses of N and amino acids were determined on 24 h fasting birds.

Chemical analysis: Samples of each meal were analyzed for amino acids content and excreta were determined in the same conditions using an amino analyzer after 24 h acid hydrolysis with 6 M aqueous HCl at 115°C. Methionine and cysteine were determined on samples oxidized with performic acid. Trypthopan was not determined. The method of Terpstra and de Hart (1974) was used to separate fecal N from urinary N for estimating protein digestibility.

Statistical analysis: The True Digestibility of Amino Acids (TDAA) calculation were based on the formula: $TDAA(\%) = ((AA_{feed} - (Aa_{excreta} - AA_{endogen}/AA_{feed}) \times 100\%$. Statistical analysis were performed using analysis of variance by linear model (SAS institute, 1996). The comparison of means was done by Duncan test.

RESULTS AND DISCUSSION

The fermentation process improve both the SW essential, except lysine and non essential amino acids content. Interestingly that the methionine digestibility of SW was moderately low as compared to others amino acids component. Improvement of an essential amino acids digestibility was almost similar with non essential amino acids (Table 2). The average highest and lowest value were 71.43% on methionine *A. oryzae* and 94.19% on valine *A. niger*.

Rutherfurd *et al.* (2007) reported that the true AA digestibility on broiler fed corn soybean based diets was a range 76% on cystine until 100% on methionine and by enzyme supplementation the digestibility value increase 86% on cystine until 102% on methionine.

The FSWn showed the highest increasing of true amino acids digestibilities as compared to FSWo or FSWs,

Table 2: True amino acids digestibility of fermented SW of broiler

Amino acid	SW	FSWn	FSWo	FSWs
Essential amino acid				
Valine	88.34[a]	94.19[b]	92.63[b]	92.46[b]
Phenylalanine	84.36[a]	90.28[c]	88.35[b]	88.67[b]
Methionine	52.65[a]	78.51[c]	71.43[b]	71.75[b]
Arginine	87.38[a]	95.00[b]	93.53[b]	93.42[b]
Tyrosine	84.06[a]	92.27[b]	89.07[b]	89.44[b]
Histidine	87.08[a]	92.70[c]	90.12[b]	90.09[b]
Isoleucine	85.97[a]	93.38[b]	91.81[b]	91.32[b]
Leucine	87.29[a]	94.02[c]	92.44[bc]	91.61[b]
Lysine	88.29[a]	90.20[b]	87.76[a]	87.48[a]
Average	84.47[a]	92.12[b]	89.77[b]	89.59[b]
Non essential amino acid				
Alanine	81.20[a]	93.77[b]	91.20[b]	91.16[b]
Aspartate	82.31[a]	90.85[b]	88.73[b]	89.26[b]
Glutamate	85.63[a]	91.49[b]	89.27[b]	88.53[b]
Serine	82.13[a]	90.96[b]	88.57[b]	89.09[b]
Threonine	85.84[a]	93.54[c]	91.16[b]	90.46[b]
Glycine	83.23[a]	92.92[c]	89.78[b]	88.46[b]
Average	84.44[a]	92.21[c]	89.92[b]	89.53[b]
Total average	84.45[a]	92.16[c]	89.85[b]	89.56[b]

[a]FSWn (fermented shrimp waste by *Aspergillus niger*), FSWo (*A. oryzae*) and FSWs (*A. sojae*) and non fermented SW (as control). [b]Value in the same row with different superscripts are significantly different ($p<0.05$)

weather on essential amino acids (92.12, 89.77 and 89.59%), non-essential (92.21, 89.92 and 89.53%), or total amino acids (92.16, 89.85 and 89.56%), respectively. On FSWn, the average increasing digestibilities value a range 2.12-32.94% (on essential amino acid) and 6.40-13.40% (non essential amino acids). A Methionine and glycine were highest increasing and the lysine was lowest on essential and non essential amino acids, respectively (Table 2).

The study of dietary supplementation with Chitosan Oligo-Saccharide (COS) on broiler as broiler probiotic (Huang *et al.*, 2005) enhanced the ileal digestibilities of all amino acids component (except for alanine on 21 days old and phenylalanine, glutamate and glycine on 42 days old birds). These enhance explained by the following finding: 1) COS supplementation reduced the number of pathogenic bacteria (e.g *Escherichia coli, Salmonella)* and increase a benefial bacteria (e.g. *Lactobacilli)* di dalam usus ayam (Wang *et al.*, 2003); 2) COS may stimulate the secretion of digestive enzyme from the stomach, páncreas and intestinal mucosa. The COS supplementation reduced faecal N and P excreted, thus the N retention increase (Huang *et al.*, 2005).

The FSWo and FSWs treatment caused improvement both of essential and non essential amino acid digestibilities ($p<0.05$) except lysine (-0.61 and -0.92%). On essential AA The improvement value a range 3.37-26.29% (FSWo) and 3.34-26.62%.(FSWs). A methionine was highest increasing and the histidine was lowest.

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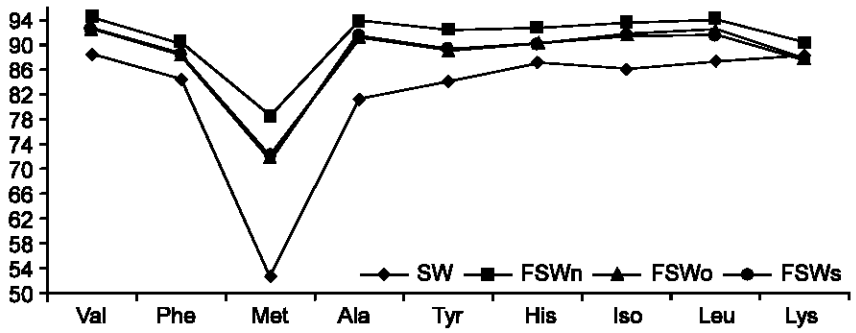

Fig. 1: True essential amino acids digestibilities of SW and FSW

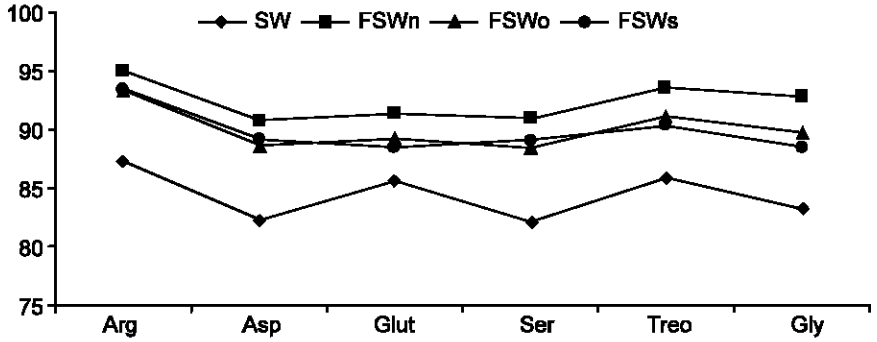

Fig. 2: True non essential amino acids digestibility of SW and FSW

On essential AA The improvement value a range 3.37-26.29% (FSWo) and 3.34-26.62% (FSWs). A methionine was highest increasing and the histidine was lowest. These digestibilities values was confirmed by study of Rutherfurd *et al.* (2007), by supplementation of xylanase, α-amylase and β-glukanase on broiler fed corn soybean based diet significantly increasing all amino acids digestibilities, around 4% on arginine and glutamate until 12% on cystine.

Generally, increasing values of true EAA and NEAA of FSW was improve the SW quality as feedstuff. In order to utilization the FSW as broiler feed, attention should be focused on the lysine availability, because lysine digestibility was decrease on FSWo and FSWs treatments.

Conclusion: The amino acids digestibility of FSW are higher than that raw shrimp waste. The *Aspergillus* sp. fermentation process improve the amino acids digestibility of shrimp waste, then improve the protein quality of shrimp waste to enhance the utilization of this feedstuff of high potential in the broiler feed. The lysine has to supplemented by using FSW as broiler feedstuff.

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