Evaluation of tofu waste treated with fermentation and enzyme supplementation in broiler chickens

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ABSTRACT: Tofu waste is a by-product of tofu production. This by-product is of limited acceptance by farmers and animal nutritionists due to high fiber content. Fermentation and enzyme supplementation have been practiced for quite a long time to improve nutritive value of feedstuffs. An experiment was conducted to evaluate the effect of levels of tofu waste, fermentation and enzyme supplementation on body weight gain and feed digestibility. This study was for six weeks. 128 unsexed Cobb chicks were used in this study. The birds were fed eight different diets. Aspergillus niger was used for fermentation and multi enzyme product was added into the diet. Feed and water were given *ad-libitum*. A completely randomised factorial design was adopted in this experiment with two levels of tofu waste (5% and 15%), fermentetaion (with and without fermentation), enzyme supplementation (with and without enzyme addition) and four replicate cages. Data indicated that increased body weight gain was achieved when unfermented tofu waste diet was supplemented with enzyme. In contrats, when the birds were fed fermented tofu waste diet, enzyme supplementation impaired body weight gain. Digestibilities of dry matter and protein decreased when a 5% tofu waste was fermented but a significant improvement was found in a15 % tofu waste diet due to fermentation. In conclusions, there were interactions between fermentation and enzyme in weight gain and between levels of tofu waste and fermentation in digestibilities of dry matter, crude protein and digestible protein intake.

Key words: Tofu waste, fermentation, enzyme, broiler

INTRODUCTION

Tofu is a curd produced by fermentation of soybeans and tofu waste is a by-product of soybean processing for tofu production. Tofu waste is mostly discarded as industrial waste. As a high concentration of crude fiber, tofu waste is mostly used for ruminant diets, while in poultry, this by-product is scarcely used due to its reputation for low quality feedstuff. Nutrients profile and problems associated with the use of tofu waste in poultry diets have been elaborated by Sundu (2010). The recommendation for using this feedstuff in broiler diets was in range between 10 and 15%.

Attempts to improve the quality of tofu waste have been made through fermentation and enzyme supplementation. Fermentation has been reported to be a relatively low cost appropriate technology. This technology accomodates proliferation of microbes which can induce microbial enzyme for breaking down glycosidic bond of dietary fibre in tofu waste. There is ample evidence that fermentation increases nutritive value of feedstuff.

Solid state fermentation technology to generate koji product has been recognized as a newest old technology (Filler, 2001). This technology begins with the selection and propagation of microbial culture. Filamentous fungi, such as *Aspergillus niger*, are commonly used and have the greatest advantages in this fermentation system. Suitable substrate and fermentation process are the steps that can influence the quality of the fermentation product. This study is to determine the possibility of fermented tofu waste partly replace soybean meal and corn and to examine the optimal level of this koji product in broiler diets.

MATERIALS AND METHODS

Birds and Diet

The study was conducted in Poultry farm at Buol Regency, Palu Sulawesi tengah, Indonesia for 49 days. A total of 192 day-old unsexed Cobb chicks was used as experimental animals and was

placed in brooder cages from days 1 to 14. On day 15, the birds were transferred into floor pens. The birds were fed the experimental starter diet up to day 21 and experimental grower diet from days 21 to 42. The basal diets were formulated to meet the nutrient requirements of broilers using the UFFF computer program version 1.11 (Pesti et al., 1986). The composition of basal diet and their protein content can be seen in Tables 1 and 2. Multi-enzyme was supplemented based on reccommended level (0.02%) and fermentation of tofu waste was carried out by using *Aspergillus niger.*

Table 1. Basal diet composition (%)

Dietary components	Diets
Corn	56.7
Full fat soybean	23.0
Fish meal	14.0
Rice bran	5.0
Dicalcium phosphate	1.0
Premix	0.3
Calculated nutrients:	
ME (MJ/kg)	3120
Crude protein	21.7

The eight different diet treatments are:
1. Basal diet + 5% unfermented tofu waste + without enzyme supplementation (D1F1E1)
2. Basal diet + 5% unfermented tofu waste + enzyme supplementation (D1F1E2)
3. Basal diet + 5% fermented tofu waste + without enzyme supplementation (D1F2E1)
4. Basal diet + 5% fermented tofu waste + enzyme supplementation (D1F2E2)
5. Basal diet + 15% unfermented tofu waste + withou enzyme supplementation (D2F1E1)
6. Basal diet + 15% unfermented tofu waste + enzyme supplementation (D2F1E2)
7. Basal diet + 15% fermented tofu waste + without enzyme supplementation (D2F2E1)
8. Basal diet + 15% fermented tofu waste + enzyme supplementation (D2F2E2)

Table 2. Nutrients profile of experimental dietst (%)

Diets	Analised Protein (%)	Calculated, ME (k Cal/kg)
D1F1E1	19.2	2,900
D1F1E2	20.9	2,900
D1F2E1	20.1	3,000
D1F2E2	21.3	3,000
D2F1E1	17.6	2,990
D2F1E2	18.2	2,990
D2F2E1	19.7	3,000
D2F2E2	20.0	3,000

Sample Collection and Chemical Analysis

Representative feed samples were collected to determine dry matter (DM), nitrogen (N), and crude lipid. Total faeces was collected daily on three consecutive days (days 46 to 48) and placed into plastic bags. Total faeces was weighed after discarding any foreign material, such as feathers and feed. About 20% of the faeces was then oven-dried. Feed and faecal samples were oven-dried at 60^{o}C to measure the DM content. Prior to chemical analysis, feed and faeces were ground using a 0.5 mm screen. Crude fibre (CF), lipid and ash were determined in dry samples according to AOAC (1990) methods.

Parameters Measured and Statistical Analysis

Parameters measured in this study are : (1) body weight gain, (2) digestible protein intake, (3) dry matter digestibility, (4) protein digestibility, (5) crude lipid digestibility and (6) nitrogen free extractives digestibility. A completely randomized factorial design with two tofu waste level, fermentation and enzyme supplementation and five replicate cages of 4 birds was adopted in this study. Data were analysed by analysis of variance. The significance of difference between treatment means were tested by Duncan's Multiple range Test (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

The results of the study are shown in Tables 3 and 4. Variance analysis indicated that there was an interaction between level of tofu waste and ferementation on digestibilities of dry matter and crude protein (Table 3). Interaction was also found between fermentation and enzyme on weight gain (Table 4).

Table 3. The interaction of fermentation and enzyme supplementation on feed digestibility and weight gain of birds kept for 42 days

Parameters	F1 E1	F1E2	F2E1	F2E2
Weight gain (g)	1,720^{c}	1,920^{b}	2,061^{a}	1,809^{bc}
Konsumsi protein	639	662	667	683
DM digestibility (%)	66.0	63.2	62.9	63.0
Protein digestibility (%)	73.6	73.0	74.5	75.7
Crude fibre digestibility (%)	33.0	29.9	24.8	29.3
Lipid digestibility (%)	92.4	93.0	94.1	94.5
NFE digestibility (%)	83.9	85.6	81.5	80.9

Table 4. The interaction of level of tofu waste and fermentation on feed digestibility and weight gain of birds kept for 42 days

Parameters	D1 F1	D1F2	D2F1	D2F2
Weight gain (g)	1,677	1,788	1,969	2,080
Digestible protein intake (g)	550^{b}	621^{b}	751^{a}	729^{a}
DM digestibility (%)	72,8^{a}	64,4^{b}	56,4^{b}	61,5^{b}
Protein retention (%)	80,9^{a}	77,2^{ab}	65,6^{c}	73,0^{b}
Crude fibre digestibility (%)	38,9	24,0	22,3	31.9
Lipid digestibility (%)	95.1	90.3	95.9	93.6
NFE digestibility (%)	84.9	89.7	83.0	79.8

The results show that substitution of 15% tofu waste in a corn-soy based diet can be given to broiler diet without any reduction in live weight gain. It is interestingly birds fed the unfermented tofu waste diet with enzyme supplementation improved body weight gain significantly. On the other hand, a reduction in live weight gain due to enzyme supplementation was found in the fermented tofu waste diet. The reason behind these facts is still unclear. It is probably that enzyme supplementation did not work in fermented tofu waste diet due to fermentation itself produces enzyme (Filler, 2001). This lead to the enzyme content in the diet may become double doses.

Although dry matter and protein digestibilities of a 5% unfermented tofu waste diet were significantly higher than those of 15% tofu waste diet, its digestible protein intake was lower. An increased digestible protein intake was found when levels of tofu waste was increased. This improvement was due partly to an increased protein content of the diet and increased feed intake.

Digestibilities of dry matter and protein decreased when a 5% tofu waste was fermented but a significant improvement was found in a 15% tofu waste due to fermentation. Speculation can be made to elaborate these facts. A decreased dry matter digestibility due to fermentation in a 5% tofu waste diet may indicate that *Aspergillus niger* utilises lipid and crude fiber for its growth and produce crude

fiber that may be difficult to be digested by digestive enzyme. A research is needed to clarify this speculation.

CONCLUSIONS

The use of tofu waste in broiler diet should be promoted in a tofu waste producing country. Digestible protein intake was improved due to an increased level of tofu waste in the diet. Dry matter and protein digestibilities were affected by interaction between levels of tofu waste and fermentation.

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