Increase in body weight and protein retention on meat chicken due to the addition of probiotics and digestive enzymes in fermented diet containing maggot flour and local materials

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Abstract. The purpose of this study was to determine the growth response of meat chickens due to the addition of probiotics and digestive enzymes in the fermented diet containing maggot flour and local materials. The research was carried out at Field Laboratory of Animal Science, University of Syiah Kuala-Banda Aceh, Indonesia for 66 days. A total of 100 meat chickens were designed using a completely randomized design (CRD) consisting of 5 treatments, namely P0 = 100% fermented ration (control), P1 = 0.5% probiotic + 0% digestive enzymes + 100% fermented diet, P2 = 0% probiotic + 0.5% digestive enzymes + 100% fermented diet, P3 = 0.5% probiotic + 1% digestive enzymes + 100% fermented diet, P4 = 1% probiotic + 0.5% digestive enzymes + 100% fermented diet with 4 replications. The data obtained were analyzed using ANOVA (Analysis of variance) and significant difference of data was analyzed by Duncan's multiple distance test. The results showed that the addition of probiotics and digestive enzymes with different levels of administration in the fermented diet had a significant effect ($P<0.05$) on the increase in final body weight and percentage of protein retention. The best results were obtained on chicken fed on fermented diet contained
0,5% digestive enzymes by increasing on final body weight, protein retention, feed conversion and feed efficiency which were higher than fermented feed containing probiotics. In conclusion, it was well known that digestive enzyme effected synergistically on fermented diet in increasing protein retention resulted a higher final body weight of meat chicken.

1. Introduction

Broiler chicken is a meat type chicken that is widely raised for business and a cheap source of animal protein for the community including in Indonesia. Broiler chickens have the characteristics of a larger body shape than local chickens, fast growing chicken and they have a very high conversion rate and ration efficiency. The main obstacle in small-scale broiler businesses in Indonesia is preparation of diet which is able to meet the nutritional requirement of broiler but low cost. Currently, commercial diet of broiler made by poultry diet factories in Indonesia is very expensive, making it difficult for poultry farmers to get high business profits. For this reason, one of the efforts to overcome this problem by producing broiler diet derived from local ingredients and uses other cheap protein sources. However, local material for chicken diet has low digestibility and high crude fiber content of local diet ingredients as a limiting factor for use in large quantities [1].

Probiotics and digestive enzymes are necessary to increase total nutrient digestibility by the degradation of crude fiber into simple forms for stimulating growth of broilers. Probiotics are products that contain non-pathogenic live microorganisms that will provide opportunities for microorganisms from probiotics to stabilize functions in the digestive tract of broiler which increase growth rate, meat production, diet conversion and efficiency and digestibility of diet materials [2]. This will be done through activity and balance of beneficial microorganisms in digestive tract of chickens. Probiotics prevent gastrointestinal infections and increase nutrient absorption by attaching to the intestinal mucosa which will form a barrier layer from the attachment of pathogenic bacteria to the walls of the digestive tract [3] and [4].

In other hand, digestive enzymes are protein compounds that have an important role as a catalyst for chemical reactions that occur in digestive system of chicken and it has the ability to stimulate a chemical reaction without changing or affecting the final product of the reaction during digestive process. Diet material of chicken with a level of digestibility that is not optimal will be optimized by adding digestive enzymes [5]. Previous study has been observed that diet must have properties such us: high digestibility of diet, the balance of protein and energy, the presence of minerals and vitamins which are required for chicken growth [6].

Based on above background, it was necessary conducting research about effectiveness of addition of probiotics and digestive enzymes in fermented diet containing magot flour and local ingredients to observe broiler growth in relation to change in protein retention, diet conversion and diet efficiency.

2. Materials and methods

The present research was carried out at the Animal Husbandry Field Laboratory (LLP) of the Faculty of Agriculture, University of Syiah Kuala, Darussalam, Banda Aceh for 66 days, of which 14 days were the rations making period, 42 days for maintenance, and 10 days for data processing. The material used in this study was 100 chicks which were kept in postal cages equipped with dieter, drinker and brooder. Chicks were grouped based on different treatments fed on fermented diet containing probiotics and digestive enzymes.

All treatment rations used the same diet ingredients, only differing in the addition of probiotics and digestive enzymes. Treat research is as follows:

1. P0: Fermented ration (control)
2. P1: Fermented ration + 0.5% probiotics
3. P2: Fermentation ration + 0.5% digestive enzymes
4. P3: Fermented ration + 0.5% probiotics + 1% digestive enzymes
5. P4: Fermented ration + 1% probiotics + 0.5% digestive enzymes

Table 1. Formulation and composition of fermented diet as a basal diet.

Materials	%	EM	Protein	Fiber	Fat	Ca	P	Meth	Lysine
Maggot Flour	5	2700	47,34	10,1	20	2,34	2	1,7	6,5
Fish meal	4	2219	67,8	1,7	10,82	5,2	2,8	2	5,9
Vegetable waste	6	2900	12,64	20,76	2	6,4	2,6	0	0
Soybean meal	15	2216	44	4,4	1,8	0,3	0,65	0,65	2,75
Rice brain	11	2100	13	12	0,6	0,1	1,7	0,35	0,58
Meat Chicken Concentrate	31	3100	21	5	5	0,9	0,6	0,2	0,22
Yellow Corn	22,5	3862	10,3	2,5	4,7	0,03	0,26	0,21	0,34
Topmix	1,5	0	4,46	0	0	25	0	0	0
Molases	1	1960	3,95	0,45	0,1	0,9	0,1	0	0
Oil	3	8000	0	0	0	0	0	0	0
Total nutrient Contents[1]		3050[3]	20,80[4]	2,13[4]	7,60[4]	1,43[3]	0,89[3]	0,41	1,18

[1]Total nutrients requirement of broilers referred to NRC (2004).

The research design used was a completely randomized design consisting of 5 treatments and 4 replications. Parameters observed were: final body weight, weight gain, ration consumption, protein retention, ration conversion, and ration efficiency. Carcass protein analysis was carried out by enzymatic reactions and measured by spectrophotometer. The data obtained were analyzed by analysis of variance (ANOVA) and Duncan's multiple test [7].

3. Results and Discussions

3.1. Final weight and diet consumption

Fed on fermented diet containing probiotics and digestive enzymes had a significant effected (P<0.05) on final body weight of broiler where the P2 treatment containing only 0.5% digestive enzymes resulted in higher final body weight than other treatments. However, addition of 1% probiotic combined with 0.5% digestive enzymes in fermented diet was also effective in increasing the final weight of broiler higher than the control treatment (fed only commercial diet). This phenomenon showed that the role of DE was more useful than probiotics in increasing the digestibility of nutrients in fermented diets containing maggot flour and local materials with high crude fibber content.

The result of present study was in accordance with previous study that the addition of the phytase enzyme significantly increased digestibility of chicken diet [8]. This indicated that the provision of digestive enzymes in the ration is beneficial to assist the efficiency of use nutrients required by chickens. The other study also reported that uses soybean meal as a source of protein but contains trypsin-inhibitor anti-nutritional substances that interfere with the growth of broiler, but the trypsin- inhibitor will be damaged by protease enzymes resulted protein content will be easily absorbed by chickens. The addition of protease enzymes in the ration will hydrolyse complex proteins into simpler compounds and it will be absorbed and utilized by the body of poultry to provide maximum productivity [9].

Table 2. Final body weight and diet consumption of broiler dieting fermented diet containing probiotic and digestive enzyme.

Replication	Diet Treatments				
	P0	P1	P2	P3	P4
Final Body Weight (gram)	1826,0±100[b]	1849,8±77,44[b]	2006,4±55,59[d]	1761,5±137,85[a]	1935,4±44,61[c]
Total Diet Consumption (gram)	3611,6±99,78	3626,9±88,96	3812,9±94,19	3605,3±215,59	3725,9±100,60

a, b, c, d: different letters in the same column indicated significant differences (P<0,05).
P0 = 100% of fermented Diet; P1 = 0,5% Probiotic and 0% digestive enzyme, P2 = 0% Probiotic and 0,5% digestive enzyme; P3 = 0,5% Probiotic and 1% digestive enzyme; P4 = 1% Probiotic and 0,5% digestive enzyme.

In other hand, fed on fermented rations containing probiotic and digestive enzyme did not affect total diet consumption of broiler. The strongest assumption regarding this result due to the addition of digestive enzymes in diet stimulated absorb energy and protein to meet the nutritional requirement of broiler chickens to increased consumption rates to maximize production achievements. However, this was not in line with the research conducted by [10] that the addition of digestive enzymes showed significantly effect on diet consumption of broiler chickens because in terms of the workings of digestive enzymes to degrade antinutrients contained in diet. It also suggested that maggot flour has a distinctive aroma increased diet palatability. It was well known that chicken requires protease, phytase, amylase, lipase, hemicellulose and trypsin for the digestive process of diet materials [11],[12] and [13].

3.2. Protein retention

It was well known that protein retention is the ratio between the amount of protein stored in the form of tissue in chicken body and the amount of protein consumed in diet. The percentage of protein retention in chicken is strongly influenced by age, diet quality, energy availability, dieting technique and genetic factors. The high protein retention indicates that the efficiency of protein diet by chicken production is higher than the amount of protein excreted through excreta and urine.

The results of present study indicated that the percentage of protein retention was in line with the high body weight resulted by the treatment of fermented diet containing 0.5 digestive enzymes (P2) compared to other treatments. The highest percentage of protein retention in P2 indicated that level of total digestibility of diet protein by broilers for growing process compared to that which was excreted through excreta.

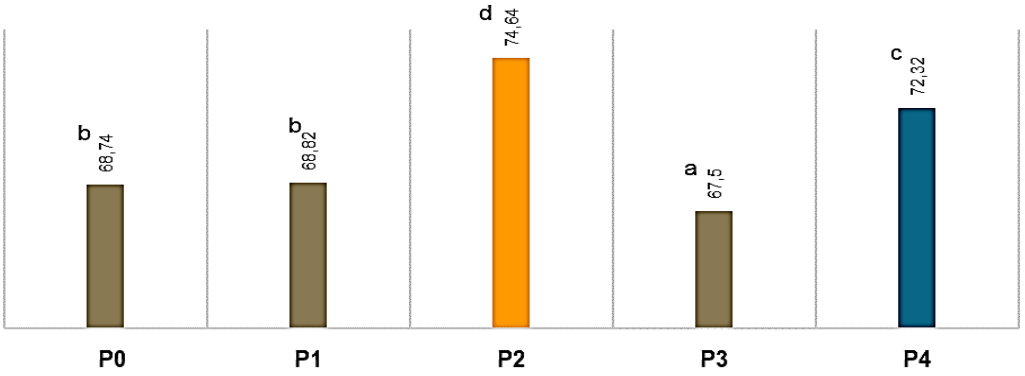

Figure 1. Differences in percentage of protein retention of meat chicken due to fed on fermented diet containing probiotics digestive enzymes.

The results of present study also showed that the role of digestive enzymes was not only in the degradation of crude fibre or increasing the digestibility of diet materials but increased the absorption of diet protein and protein content in meat and reduced the amount of protein wasted through excreta [14] and [15]. Animals fed on low protein diet move faster leave digestive tract compared to high protein diet. The movement of protein is slower to leave digestive tract getting more time to process protein denaturation and dissolution consumed [16].

The nutritional conditions greatly affected the amount of retention protein produced during the digestion and production process. Fermented diet containing digestive enzymes is able to produce higher protein retention because the efficiency of diet protein was increased due to better digestibility and absorption of protein consumption by broiler.

3.3. Feed conversion and efficiency

It was necessary to measure diet conversion and efficiency related to its ability to support growth and production of boiler chickens determining the nutritional benefits of fermented diet containing magot flour, probiotics and digestive enzymes**.** [17] stated that chicken diet that was consumed, digested and absorbed properly resulted in low conversion value and high diet efficiency compared to diet that does not meet quality requirements. The lowest level of diet conversion value indicated that the amount of diet that can be converted into production value in poultry is higher which indicated the level of quality of the diet consumed of broilers. On the other hand, to assess the ability of chicken digestive system using the amount of nutrients contained in the diet, it is indicated by the high value of diet efficiency obtained to support growth process and chicken production [18].

The results of diet conversion and efficiency in present study were in line with the results of final body weight and the percentage of protein retention where fed on fermented diet containing maggot

and local material to broiler chickens with the addition of digestive enzymes was 0.5 percent (P2) higher than other treatment with the addition of probiotics. The high diet conversion rate was due to the better digestibility of fermented diet containing digestive enzymes where chickens easily absorb all the nutritional value supplied by the magot flour and local ingredients in fermented diet. In addition, maggot and local ingredients are able to supply protein, amino acids and other ingredients according to nutritional requirement of broiler growth.

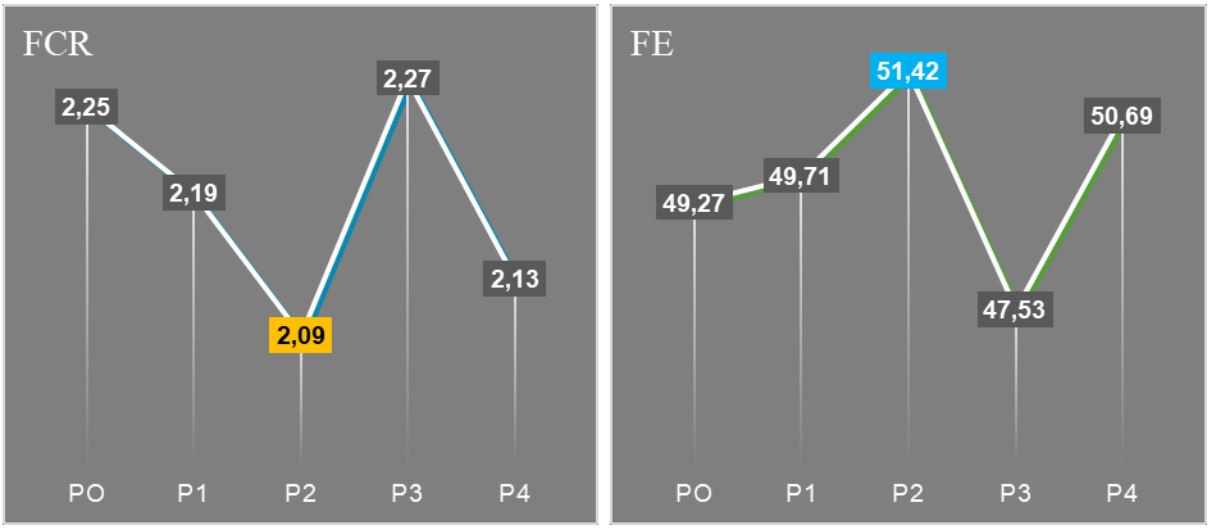

Figure 2. Increase in feed conversion and efficiency of meat chicken due to fed on fermented diet containing probiotics digestive enzymes.

Strong reasons obtained in this present study indicated that maggot flour in fermented diet contained a viable source of protein, good fats, and trace elements. Amino acids in maggots that are higher than fish meal include the essential amino acids leucine, histidine, phenylalanine and lysine were very suitable for the growth of broiler chickens. In addition, local materials in fermented diet also contained a lot of carbohydrates which is the primary source of organic carbons during digestion, digestible carbohydrates are ultimately broken down into glucose and used to provide energy of chicken through metabolic pathways where the role of digestive enzymes becomes very important.

It was well known that hydrolytic enzymes such us proteases, cellulases, amylase, beta-glucanase, phytases have arisen as feed additions in order to increase the digestion and absorption of poorly available nutrients of chicken diet. The possible uses of phytase in diet treating and it has been largely used as animal feed additives in diets mostly for swine and poultry and for fish [19] The small intestine of chicken has only a very low ability to hydrolyze phytate due to the lack of significant endogenous phytase activity and little microbial population in the upper part of the digestive tract. Proteases have ability to break down the bonds at certain sites of amino acids. The activities from endogenous proteases are site specific because their activity in the incorrect location can lead to destruction of the animal's own tissues [20]. Amylase breaks polysaccharides (carbohydrates) into smaller disaccharides, finally converting them into monosaccharides such as glucose, fructose, galactose and others. All these digestive enzymes must be added in appropriate amounts in fermented feeds containing maggot flour and local ingredients to stimulate growth and production of broiler chickens equivalent to commercial complete feeds. The present results also indicated that nutritional digestibility of fermented feed was strongly influenced by the availability of digestive enzymes in appropriate quantities according to the type of feed materials to increase conversion and efficiency of broiler feed.

4. Conclusion

It was very clear that the function of digestive enzymes in increasing the utilization of fermented feed containing maggot flour and local materials play important role than probiotic. Broiler fed on fermented feed prepared from local ingredients resulted the final body weight that was comparable to commercial feed. Fermented diet without probiotics and 0.5% digestive enzymes containing maggot and local ingredients resulted in highest body weight, conversion and feed efficiency than other treatments due to increase of protein retention. This phenomenon indicated that digested enzymes was able to increase in total digestibility of protein in fermented diet.

The positive effect of probiotics was also observed on fermented diet containing 1% of probiotics and 0.5% digestive enzymes. Addition of probiotics as much as 1% affected to activated all bacteria during protein digestion on broiler chickens fed on fermented diet. However, digestibility of fermented feed was strongly influenced by the availability of digestive enzymes in appropriate quantities according to the type of feed materials.

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