BROILER SMALL INTESTINE VILLI RESPONSE TO FEED CONTAINING PALM KERNEL CAKE WHICH FERMENTED WITH *RHIZOPUS SP*
(Respon Vili Usus Kecil Ayam Broiler Terhadap Ransum Yang Mengandung Bungkil Inti Sawit Difermentasi Dengan Rhizopus sp)

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ABSTRAK

Sudah dilakukan penelitian untuk mengevaluasi respon villi usus halus ayam broiler terhadap pakan yang mengandung bungkil inti sawit yang difermentasi dengan *Rhizopus sp.* Penelitian menggunakan d.o.c. broiler strain Arbor Acres CP 707 sebagai materi ternak yang dirancang kedalam Rancangan Acak Lengkap (RAL) dengan 5 perlakuan dan 4 ulangan dan setiap unit percobaan terdiri dari 4 anak ayam, sehingga dibutuhkan sejumlah 80 ekor anak ayam. Perlakuan terdiri dari: A, penggunaan FPKC (bungkil inti sawit fermentasi) dalam ransum 0 %, B, penggunaan FPKC 9 %, C, penggunaan FPKC 18 %, D, penggunaan FPKC 27 % dan E, penggunaan FPKC 36 %.

Perlakuan A, B, C, D dan E berturut-turut menghasilkan rata-rata tinggi villi 1.443, 1.435, 1.423, 1.410 dan 1.405 mm pada duodenum, 0.998, 0.990, 0.978, 0.975 dan 0.973 mm pada jejunum dan 0.578, 0.575, 0.565, 0.558 dan 0.545 mm pada ileum. Kerapatan villi dengan urutan yang sama dengan perlakuan adalah 1.01, 0.99, 0.97, 0.95 dan 0.93 unit/mm^2 untuk duodenum, 1.60, 1.53, 1.50, 1.35 dan 1.33 unit/mm^2 untuk jejunum serta 1.58, 1.50, 1.41, 1.38 dan 1.28 unit/mm^2 untuk ileum.

Sidik ragam respon usus kecil terhadap perlakuan A, B, C, D and E menghasilkan perbedaan yang nyata ($p < 0.05$) pada tinggi dan kerapatan villi dalam duodenum, jejunum dan ileum. Penghitungan dengan DMRT menghasilkan bahwa usus kecil merespon FPKC pada level > 9 % dengan penurunan tiggi vili jejunum, sementara pada level > 18 % dengan penurunan tinggi dan kepadatan vili dalam duodenum, jejunum dan ileum. Hasil penelitian dapat disimpulkan bahwa pemakaian 9 % FPKC dalam ransum ayam broiler dapat dilakukan.

Kata kunci: broiler, bungkil inti sawit fermentasi, villi usus kecil

ABSTRACT

An experiment was conducted to evaluate the response of broiler small intestine villi to feed containing palm kernel cake which was fermented with *Rhizopus sp.* The experiment used broiler d.o.c. of strain Arbor Acres CP 707 as animal material and was arranged in Completely Randomized Design (CRD) with 5 treatments and 4 replications and each experimental unit consisted of 4 chicken, then sum of 80 chicken were required. Treatments in the experiment were: A, utilization of FPKC (fermented palm kernel cake) 0 % in the ration, B, utilization of FPKC 9 %, C, utilization of FPKC 18 %, D, utilization of FPKC 27 % and E, utilization of FPKC 36 %.

The treatments A, B, C, D and E respectively resulted in average of villi height 1.443, 1.435, 1.423, 1.410 and 1.405 mm for duodenum, 0.998, 0.990, 0.978, 0.975 and 0.973 mm for jejunum and 0.578, 0.575, 0.565, 0.558 and 0.545 mm for ileum. Villi density with the same treatment order were 1.01, 0.99, 0.97, 0.95 and 0.93 unit/ mm^2 for duodenum, 1.60, 1.53, 1.50, 1.35 and 1.33 unit/ mm^2 for jejunum, 1.58, 1.50, 1.41, 1.38 and 1.28 unit/ mm^2 for ileum.

Analysis of variance of response of small intestine, in term of villi height and density in duodenum, jejunum and ileum, to the treatments A, B, C, D and E resulted in significantly difference ($p < 0.05$). There were results of DMRT computation that small intestine responded FPKC at level > 9 % first by decreasing jejunum villi height while at level > 18 % then by decreasing height and density of villi in duodenum, jejunum and ileum. It could be concluded that utilization of 9 % FPKC level in the broiler ration is applicable.

Keywords : broiler, fermented palm kernel cake, small intestine villi

INTRODUCTION

Cost in poultry production has being increased continously due to the limited supply of good quality raw material such as soyabean, maize and others. An alternative feedstuff which relatively remain scarce in utilization is palm kernel cake (PKC). As by-product of palm oil extraction, PKC could be gained in the rate of 2 to 3 % from a bunch of fresh palm fruits (Maskamian, 2005). Although high in crude protein content, due to its inferiorities (such as low in digestibility, palatability and possibly also availability of anti nutrients) PKC use in poultry feeding has not been very much encourage. Its high crude fibre content and gritty nature is the reason of this low quality (Onwundike, 1986)

Inprovement of low PKC quality could be attempted through fermentation with highly proteolitic *Rhizopus sp* (Fardiaz and Winarno, 1980). According to Wang and Hesseltine (1982) the fermented product would have special flavour and texture and contain antioxidant as well as antibiotics *peneciline* which could inhibit growth of pathogenic microorganism

Fogarty (1983) declared that feedstuff which was fermented by inoculation with *Rhizopus sp* could produced enzymes protease, lipolise and amilase.The fermented feedstuff would be digested and absorbed better by animal.

Ration which containing fermented PKC (FPKC) would be mainly absorbed through epithelial cells of villi in duodenum, jejunum and ileum after had been digested by broiler chicken. Feed containing high crude fiber caused intestine villi to be smaller in surface, width and height (Moharrery and Mohammadpour, 2005). The density and size of villi and microvilli of small inestine are directly related to the absorptive capacity of the birds (Macari,1995, cit. Fischer da Silva, 2007). According to Ferrer *et al.* (1995) villi height and microvilli density are the best measurements to show the changes on surface area of absorptive cells.

Therefore, an experiment had been conducted with objective to find out the applicable level of FPKC in broiler ration through studying its small intestine villi response. There was hyphothesis in the experiment that broiler small intestine villi, in term of height and density, did not respond differently to the ration containing FPKC until level 36 percent.

MATERIAL AND METHOD

Material

In the research 80 broiler chicken strain Arbor Acres CP 707 were used since 5 days old until finishing of 6 weeks experimental period . The chicken were maintained in 20 unit stables that each had dimension 75 x 60 x 70 cm and in the stables were placed feeding as well as drinking water utensils. The stable had also 40 watt lamp for 2 weeks as warm resource and since then only light resource was avail-

Table 1. Nutrient content of palm kernel cake (PKC) and fermented one (FPKC) after Sabrina (2002)

	PKC	FPKC
Protein	16.80	18.98
Fat	2.05	1.38
Crude fiber	21.97	18.68
Calcium	0.97	0.89
Phospor	0.80	0.79
ME(kkal/kg)	1750*)	2739

*) Misrawati (1999)

able until the end of experimental period.

Other utilized utensils consisted of writing facilities, knife, tweezers, embedding cassete, bottles 500 ml, incubator, microtome, flow water facilities and object glass with cover. In experimental work were also needed stuffs such as formalin, alcohol, Harris-Hematoxylin dilution, Eosin dilution, aqudest and paraffin.

Nutrient contents of PKC (palm kernel cake) and fermented one (FPKC) are displayed in Table 1. Fermentation with *Rhizopus sp* increased crude protein content and humiliated fat and crude fiber level of the PKC. Its metabolizable energy (ME) content also increased.

Feedstuffs and nutrients of the rations for broilers in each treatment could be looked at Table 2. The rations were formulated according to their requirement and attempted to be the same in protein percentage and energy quantity.

perimental period. Ovserved variables consisted of height and density of villi in duodenum, jejunum and ileum.

Data were analysed with analysis of variance (Steel and Torrie, 1980) and difference between treatments were computed with DMRT (Duncan's Multiple Range Test).

Experimental work

The field (stable) works consisted of making the FPKC (fermented palm kernel cake), formulating the rations, preparing the stable, arranging the animal (chicken) material in CRD with 5 treatments and 4 replications, and managing the chicken as long as 6 weeks of experimental period based on feeding trial.

The laboratory works consisted of making histlogical small intestine objects for microscopic observation as well as determining microscopically height and density of vill.

Table 2. Feedstuffs and feed nutrients (in %) and energy of the rations used in the experiment

	Treatment				
	A	B	C	D	E
Feedstuffs					
Rice brand	8.5	7.2	5.7	4.7	3.2
Maize	52.5	48.5	44.0	39.5	35.0
Soy bean	23.5	20.0	17.0	13.5	10.5
FPKC	0	9.0	18.0	27.0	36.0
Fish	14.50	14.0	14.0	14.0	14.0
Palm oil	0.50	0.3	0.3	0.3	0.3
Premix A	1.00	1.0	1.0	1.0	1.0
*Nutrients *)*					
Protein	21.89	21.78	21.79	21.68	21.69
Fat	4.69	4.24	3.97	3.97	3.45
Crude fiber	4.91	6.08	7.24	8.42	9.49
Calcium	1.14	1.16	1.19	1.21	1.24
Phospor	0.73	0.75	0.78	0.81	0.84
ME(kkal/kg)	2976.1	2962.8	2958.15	2949.8	2945.2

*) Computed based on proximately analysis result of Sabrina *et al. (*2002)

Method

The experiment was constructed in Completely Randomized Design (CRD) with 5 treatments and 4 replications. The rations A, B, C, D and E as treatment contained FPKC levels 0, 9, 18, 27, and 36 % respectively. One unit treatment consisted of 4 chicken those were maintained in each stable. One of them that had the smallest weight difference to its unit average weight, was slaughtered for making histological intestine preparation at the end of the ex-

RESULT AND DISCUSSION

Response of villi height

Average height of small intestine villi of the broiler is in Table 3 displayed and for the treatments A, B, C, D and E respectively resulted in 1.443, 1.435, 1.423, 1.410 and 1.405 mm for duodenum, 0.998, 0.990, 0.978, 0.975 and 0.973 mm for jejunum and 0.578, 0.575, 0.565, 0.558 and 0.545 mm for ileum. Their height approximately the same as what Whittow

Table 3. Average Height of Villi in Each Part of Intestine (mm), After 6 Weeks Experimental Period

Treatment	Duodenum	Jejunum	Ileum
A	1.443[a]	0.998[a]	0.578[a]
B	1.435[a]	0.990[ab]	0.575[ab]
C	1.423[ab]	0.978[bc]	0.565[ab]
D	1.410[b]	0.975[bc]	0.558[bc]
E	1.405[b]	0.973[c]	0.545[c]

Different superscript at the same column means significantly different ($p < 0.05$)

(2000) description that Gallus species had villi which decrease in height from 1.5 mm in the duodenum to 0.4 – 0.6 mm in the ileum. In addition it is informed that the number of villi remained constant since 10 days old of chicken. Table 3 also shown that the more FPKC in the ration was the lower the villi in all three parts of intestine.

Analysis of variance (in term of villi height) shown that response of broiler small intestine villi to the treatment was significantly different ($p < 0.05$). The difference was probably caused by increasing of crude fiber through raising of FPKC level in the ration.

In special condition, salt acid reacted on villi to secrete hormon villikinin that affected to icrease frequency of villi movement many times. Energy radiation and administering of cytotoxic substances inhibited the renewal of epithel cell of villi, through which intestine villi would be shorter and the surface area of absorbing mucous membrane decreased (Kolb, 1989). Cheeke (2005) declared that it was posible that highly crude fiber feedstuff containing negative associative effects or anti nutritions such as tannin and so on those could humiliate its digestibility as well as its nutrient absorption ability

There were results of DMRT computation that height of villi of duodenum and ileum between treatments A, B and C and height of villi of jejunum between treatments A and B was nonsignificantly different, but significantly from that of treatments D and E and from that of treatments C, D and E respectively. It could then be declared that duodenum as well as ileum at FPKC level 18 % and jejunum at FPKC level > 9 % responded by decreasing their villi height.

Response of villi density

Density of villi in each part of broiler small intestine is displayed in Table 4. The treatments A, B, C, D and E respectively resulted in 1.01, 0.99, 0.97, 0.95 and 0.93 unit/mm^2 of inside surface area for duodenum, 1.60, 1.53, 1.50, 1.35 and 1.33 unit/mm^2 for jejunum and 1.58, 1.50, 1.41, 1.38 and 1.28 unit/mm^2 for ileum. Table 4 shown that the more FPKC in the ration was the lower the villi density in all three parts of intestinum. Analysis of variance shown that addition of FPKC until maximum 36 % in the ration significantly affected the density of intestine villi ($p < 0.05$).

Table 4. Average of Villi Density in each Part of Intestinum (unit/mm^2) After 6 Weeks Experimental Period

Treatment	Duodenum	Jejunum	Ileum
A	1.01[a]	1.60[a]	1.58[a]
B	0.99[ab]	1.53[ab]	1.50[ab]
C	0.97[ab]	1.50[ab]	1.41[ab]
D	0.95[bc]	1.35[bc]	1.38[bc]
E	0.93[c]	1.33[c]	1.28[c]

Different superscript at the same column means significantly different ($p < 0.05$)

This difference of villi density was probably caused by increasing of crude fiber due to rise of FPKC level in the ration. Iyayi *et al.* (2005) found that intestinal length was increased in birds on the PKC diets compared to those on the control diets. Koong *et al.* (1985) also reported that chicken and other monogastrics fed on high fibrous diets usually
produced more offal. While sum of villi remained constant, increasing of inside surface area of intestine caused decreasing villi density per mm^2 of course.

There were results of DMRT computation that density of villi of duodenum, jejunum and ileum between treatments A, B and C was nonsignificantly different, but significantly from that of treatments D

and E. It could be confirmed that at FPKC level > 18 % duodenum, jejunum and ileum responded by decreasing their villi density.

General Discussion

It could be observed in Tables 2, 3 and 4 that utilization of FPKC until level 9 % in the ration (Treatment B with crude fiber content 6.08 %) nonsignificantly affected height and density of villi in all part of small intestine. From sight of all measured variables were only height of jejunum villi significantly different smaller at FPKC-level 18 % (Treatment C with crude fiber content 7.24 %). Santoso (1986) confirmed that productivity of chicken could be maximum at crude fiber content in the ration 5,5 %. This more tolerant small intestine in the experiment probably caused by contribution of FPKC-superiorities those gained from fermentation process with *Rhizopus sp*, like better palatableness (Sabrina, 2005), antioxidant and peneciline content (Wang and Hesseltine, 1982) and production of enzymes protease, lipolise and amilase (Fogarty, 1983).

Epithelial cell proliferation of intestinal villi could be pressed by high crude fiber containing feed (Moharrery and Mohammadpour, 2005). Density and size of villi were directly related to the absorbtive capacity in birds (Macari,1995, cit. Fischer da Silva, 2007). Noverandus (2005) utilized FPKC in broiler ration until level 9 % without significantly differece in body weight gain. Pond *et al.* (1988) and Gous *et al.* (1990) reported the reduction of weight of carcase and abdominal fat through high dietary fiber.

The jejunum villi reacted more sensitively to dietary crude fiber content by decreasing their height (Treatment B). It might due to the fact that jejunum is the most active part of intestine. Whittow (2000) described that most of fatty acid, glucose, phosphate, calcium and other minerals and a part of amino acid were absorbed in jejunum.

CONCLUSION

Utilization of FPKC until level 9 % in the ration nonsignificantly affected height and density of villi in all parts of small intestine, but at level 18 % only jejunum villi were significantly different lower. Therefore, conclusion could be taken that utilization of 9 % FPKC level in the broiler ration is applicable.

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