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The effect of increasing levels of palm kernel meal containing α-β-mannanase replacing maize to growing-finishing hybrid duck on growth performance, nutrient digestibility, carcass trait, and VFA

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ABSTRAK

Penelitian bertujuan untuk mengetahui pengaruh penggunaan bungkil sawit yang diberi perlakuan enzim terhadap nilai nutrisi, performans produksi, dan kualitas karkass bebek hibrida. Materi dalam penelitian ini 196 DOD Itik pedaging [(Peking x Khaki Campbell)] dengan KK (410.52 ± 95.25 g). Metode penelitian yang digunakan adalah percobaan lapang dengan Rancangan Acak Lengkap dengan 5 perlakuan dan 4 ulangan. Pakan kontrol (tanpa substitusi BIS), BIS25 (Pakan basal + substitusi Jagung dengan 25% BIS penambahan α-β-mannanase), BIS50 (Pakan basal + substitusi Jagung dengan 50% BIS penambahan α-β-mannanase), BIS75 (Pakan basal + substitusi Jagung dengan 75% BIS penambahan α-β-mannanase), BIS100 (Pakan basal + substitusi Jagung dengan 100% BIS penambahan α-β-mannanase). Data hasil penelitian dianalisis variansi menggunakan rancangan acak lengkap (RAL) dengan perlakuan tingkat penggunaan BIS-enzim. Dilanjutkan dengan uji Duncan's Multiple Range Test untuk mengetahui perbedaan rataan antar perlakuan menggunakan *SAS University*. Hasil penelitian menunjukan bahwa substitusi jagung dengan BIS yang di tambahakan enzim α-β-mannanase tidak berpengaruh nyata (P>0,05) terhadap penampilan produksi. Namun, berpengaruh nyata (P<0,05) terhadap kecernaan dan mampu menurunkan lemak perut pada daging bebek hibrida. Disimpulkan bahwa penggantian bungkil inti sawit sebanyak 25% dengan penambahan enzim α-β-mannanase mampu meningkatkan kecernaan dan menurunkan lemak perut bebek hibrida.

Kata kunci : bebek hibrida, bungkil inti sawit, enzim α-β-mannanase, jagung, substitusi

ABSTRACT

In this experiment, we investigated the effect of increasing levels of palm kernel meal containing α-β-mannanase replacing maize to growing-finishing hybrid duck on growth performance, nutrient digestibility, and carcass trait. One hundred and ninety- six hybrid ducks [(Peking x Khaki Campbell)] with 410.52 ± 95.25 g BW) were allotted to 5 dietary treatments with 9 ducks (unsexed) per pen and 4 replicates per treatments. These dietary treatments were: NC (negative control; maize-soybean-meal based diet), PKM25 (maize replacement with PKM α-β-mannanase 25%), PKM50 (maize replacement with PKM α-β-mannanase 50%), PKM75 (maize replacement with PKM α-β-mannanase 75%), PKM100 (maize replacement with PKM α-β-mannanase 100%). There was a curve linear decrease in the growing phase and finisher phase in feed intake as the level of α-β-mannanase palm kernel meal increased in the diet. Curvilinear, the result was presented no significant difference (P>0.05) on the initial body weight, growing and finishing phase body weight. The result of this study showed the used α-β-mannanase in the palm kernel meal presented a significant difference ($P < 0.05$) on the nutrient digestibility of dry matter and crude protein. Furthermore, Carcass traits showed the reflection in line with the final weight and internal organs were better to compare to control 0.5% using α-β-mannanase in the palm kernel meal. In summary, the increase of the level of palm kernel meal with α-β-mannanase enzyme was had a positive effect on the hybrid ducks and the replacement of palm kernel meal by 25% with the addition of the α-β-mannanase enzyme was able to improve digestibility and reduce abdominal fat of hybrid ducks.

Keywords: α-β-mannanase, carcass trait, digestibility, hybrid ducks, palm kernel meal

INTRODUCTION

The World Health Organization (WHO) announced the coronavirus novel (COVID-19) as a global pandemic outbreak as of March 11, 2020. A total of 4.87 million cases have been confirmed worldwide, with 1.66 million people recovering and 321 thousand people die. The pandemic spread over the world and faced developing countries e.g. Indonesia. COVID-19 impact to livestock sector especially poultry production. Intensive poultry production systems demand a supply of high protein- and easily available in developing countries. To fulfill the requirement, the efficiency on poultry production must be developed (Sjofjan and Adli, 2020). Duck demand increase due it ease and fulfillment in developing countries like Indonesia. The statistical data demand on the poultry market increased nationally (Adli *et al.,* 2018). The data until the fourth quarter of 2019, broilers increased about 4.9% compared to the population in 2018 (1.4 billion heads) (BPS-RI, 2020). Generally, poultry rearing keys were dependent on breed, feed, and management to the purposes the profitable. The golden triangle was giving 86% including also feed intake, live weight, and gain/ratio for each breed of ducks. Feed costs were giving huge around 65-75% of total production in the poultry industry. According to the newest regulation Permendag/10/2020 to anticipate the COVID-19, the Indonesian government has imposed a ban on the import of live animal species and imported by-product originating from China or transiting into Indonesian territory (BPS-RI, 2020). The rules made the researchers or farmers develop an alternative to reduce the cost of maize as main feed in farming. One potential feed to replace maize was palm kernel meal since thus palm kernel meal had similar energy content and protein but high in the crude fiber (Wilkinson and Young, 2020). Indonesia was at the top level in the world to produce the palm kernel meal above 40.56 MT in 2019-2020, following with Malaysia in the second place (BPS, 2020). Thus, conditions produce agro-industrial waste from palm kernel meal (PKM) included in poultry diets that had a low price and nutritional content. The palm kernel meal is imported into the European land (EU), cited from (BPS-RI, 2020) the statistics show that 34,064 tons of PKM were imported in 2018/2019. The production of palm kernel meal as animal feed in Europe at the level of 0.48 tonnes in 2018-2019 (Wilkinson and Young, 2020).

Indonesia Imports large quantities of staple components of feed for broilers both maize and fishmeal (BPS, 2020), which imported 200 thousand tons in 2020 for maize and 800 tonnes/year. Reducing imports of feed ingredients is one way of reducing greenhouse gas emissions to which sea freight is a major contributor. A potential local feed Indonesia ingredient that could be used to replace maize is PKM. Even though, the PKM had high crude fiber the breed can be adapted more to the high crude fiber that was a duck (Jang *et al.,* 2020).

Indonesia has developed meat ducks that have a fast growth rate, namely Hybrid ducks with a short maintenance period of 45 days. Hybrid ducks are the result of a cross between a Peking duck (male) and a Khaki Champbell duck (a female). A cross between Peking ducks and Khaki Champbell ducks were conducted to produce Day Old Duck (DOD) of final stock broiler duck's quality. Peking ducks have rapid weight gain, while Khaki ducks Champbell has a high body weight and high egg production compared to other local ducks. The major non-starch polysaccharide (NSP) component in poultry were α-β-mannanase, which is linear with polysaccharide (Jang *et al.,* 2020). However, there have some limitations to giving into duck's diet. To combat this limitation, an exogenous enzyme of α-β-mannanase had been combined with PKM diet as replacing for maize of growing-finishing ducks. The addition of α-β-mannanase helps the palm kernel meal to stimulate the releasing of volatile fatty acid in the caecum of the ducks

(Sharmila *et al.,* 2014). In addition, the α-β-mannanase was given to reduce the crude fiber in accordance to improve nutrient digestibility in the gut of duck. When the nutrient digestibility the palm kernel meal in feed should be increase palatability and continued to increase the feed intake and give a positive impact on the growth performance of the ducks.

The study was carried out to investigate the effect of increasing levels of palm kernel meal containing α-β-mannanase replacing maize to growing-finishing hybrid duck on growth performance, nutrient digestibility, and meat quality. Then, the most suitable level of treatments that able to apply in the duck farm was chosen.

MATERIALS AND METHODS

Ducks Rearing Condition

One hundred and ninety-six hybrid ducks [(Peking x Khaki Campbell)] with 410.52 ± 95.25 g BW were allotted to 5 dietary treatments with 9 ducks (unsexed) per pen and 4 replicates per treatments with completely randomized design (CRD) for the experimental design.

All ducks were kept in an environmentally controlled room with a fan and air facility. The housing relatively temperature and humidity among 29°C and 64%, respectively. The rice hull-littered floor pens with a height of 3.3 (1.9 x 1.9) m2 per pen. The lighting program was set at 23 hours light and one-hour darkness. Ducks were reared under the supervision of a veterinarian. The hybrid duck was taken from a commercial farmer from Blitar Regency, East Java, Indonesia.

Feeding Treatment Programmed

The nutrient composition of diet ingredients is presented in Table 1. The ducks (male and female) were ad libitum feed and watering facilitated. At 24 days to 38 days of age (feeding growing phase); at 38-64 days of age (feeding finishing phase). The Composition of Feed in the experiment showed in Table 2 and Table 3.

Preparation Palm Kernel Meal containing α-β-Mannanase

The palm kernel meal was sifted to separate the meal from the remaining shells, then placed on the floor that had been coated with trash bags and sacks. Suspensions of α-β-mannanase are homogenized in a blender then added at 0.010% per 1 kg of PKM. The last step was putting the PKM in a sack with holes to allow entry of air and storing it for 12 hours at room temperature after which it was sun-dried adapted from (Adli *et al.,* 2020). The dietary treatments were: NC (negative control; maize-soybean-meal based diet), PKM25 (maize replacement with PKM α-β-mannanase 25%), PKM50 (maize replacement with PKM α-β-mannanase 50%), PKM75 (maize replacement with PKM α-β-mannanase 75%), PKM100 (maize replacement with PKM α-β-mannanase 100%). A commercial α-β-mannanase and palm kernel meal from Pt. Wilmar Cahaya Indonesia Tbk was used for this experiment.

Growth Performances

The ducks were individually weighed at the growing phase in time to determine the coefficients variation, weekly at days of 24, 31, 38, 45, and final week (64). The body weight gain (BWG) of duck were determined by weighed difference amount at the initial and previous weeks. The feed intake calculated routine by deviation feed offered to ducks and remained feed every week where areas, after calculated the dead broiler remain in the current experiment. Feed/gain determined by feed intake divided by body weight gain of the ducks during the

Table 1. Nutrient Compositions of Diet Ingredients (g / kg, as-fed basis)

Item	Maize	Soybean meal	Palm kernel meal
Dry Matter	93.4	92.2	93.5
Crude protein	8.7	44.5	16
Fat	4	1.5	1.5
Crude fibre	2	3.5	1.67
Ash	1.5	6	6.6
Nitrogen free extract	70.5	30	53.5

Table 2. Nutrient Compositions of Diet Ingredients of Growing Phase Ducks (g / kg, as-fed basis)

Ingredients, g/kg	Treatments				
	NC	PKM 25	PKM50	PKM75	PKM100
Maize	540	515	490	465	440
Rice bran	150	150	150	150	150
Soybean meal	120	120	120	120	120
MBM 50	50	50	50	50	50
F.M. 60	50	50	50	50	50
PKM	-	25	50	75	100
Powder Limestone	30	30	30	30	30
Grit	41	41	41	41	41
Betaine	1	1	1	1	1
Palm oil	10	10	10	10	10
α-β-mannanase	-	1	1	1	1
Premix	5	5	5	5	5
Analyses composition, g/kg					
Dry matter	87.05	87.18	87.30	87.43	87.55
Crude protein	16.83	17.01	17.19	17.38	17.56
Fat	6.42	6.35	6.29	6.23	6.17
Crude Fibre	3.63	3.95	4.28	4.60	4.93
Ash	6.20	6.27	6.33	6.39	6.45
Nitrogen Free extract	48.33	47.90	47.48	47.05	46.63
Metabolizable energy (Kcal/kg)	2683.48	2635.73	2587.98	2540.23	2492.48
Lysine	0.92	0.92	0.93	0.93	0.94
Methionine	0.51	0.52	0.52	0.53	0.53
Met. + Cystine	0.78	0.79	0.79	0.80	0.80
Calcium	3.71	3.72	3.72	3.73	3.73
Total Phosphorus	0.85	0.85	0.86	0.87	0.88
Av. Phosphorus	0.39	0.40	0.41	0.42	0.44
Bulk density, g / L	585	584	580	569	565

[1] NC (negative control; maize-soyabean-meal based diet), PKM25 (maize replacement with PKM α-β-mannanase 25%), PKM50 (maize replacement with PKM α-β-mannanase 50%), PKM75 (maize replacement with PKM α-β-mannanase 75%), PKM100 (maize replacement with PKM α-β-mannanase 100%). Bulk density = the weight of experimental feed per unit volume (g / L).

[2]: Vitamin A: 2,500,000 UI; Vitamin D3: 600,000 UI; Vitamin E: 4,000 mg; Vitamin K3: 400 mg; Folic acid: 80 mg; Choline: 100,000 mg; Mangan: 14 g; Zn: 40 g; Fe: 32 g; Cu: 48 g; Iodine: 0.5 g; Co: 0.28 g; Se: 0.04 g

experiment. Mortalities were recorded per pen as well in (%) from the beginning until the end of the experiment (Sjofjan *et al.,* 2020). The 24 ducks from the group, with range nearest live BW, were separated at the days 64 weeks ducks will be sacrificed of the experiment. Ducks were slaughtered ready to cook method to obtain relatively organ weight, and scalded after.

Table 3. Nutrient Compositions of Diet Ingredients of Finishing Phase Ducks (g / kg, as-fed basis)

Ingredients, g/kg	Treatments				
	NC	PKM 25	PKM50	PKM75	PKM100
Maize	550	515	500	475	450
Rice bran	170	170	170	170	170
Soybean meal	90	90	90	90	90
MBM 50	50	50	50	50	50
F.M. 60	50	50	50	50	50
PKM	-	25	50	75	100
Powder Limestone	30	30	30	30	30
Grit	41	41	41	41	41
Betaine	1	1	1	1	1
Palm oil	10	10	10	10	10
α-β-mannanase	-	1	1	1	1
Premix	5	5	5	5	5
Analyses composition, g/kg					
Dry matter	86.96	87.09	87.21	87.34	87.46
Crude protein	15,81	1599	16.17	16.35	16.54
Fat	6.66	6.60	6.54	6.47	6.41
Crude Fibre	3.76	4.08	4.41	4.73	5.06
Ash	6.15	6.21	6.28	6.34	6.40
Nitrogen Free extract	48.91	48.48	48.06	47.63	47.21
Metabolizable energy (Kcal/kg)	2695.68	2647.93	2600.18	2552.43	2509.68
Lysine	0.84	0.85	0.85	0.86	0.86
Methionine	0.50	0.50	0.51	0.51	0.52
Met. + Cystine	0.75	0.76	0.76	0.77	0.78
Calcium	3.71	3.71	3.71	3.72	3.72
Total Phosphorus	0.86	0.87	0.88	0.89	0.89
Av. Phosphorus	0.39	0.40	0.41	0.42	0.44
Bulk density, g / L	585	584	580	569	565

[1]NC (negative control; maize-soyabean-meal based diet), PKM25 (maize replacement with PKM α-β-mannanase 25%), PKM50 (maize replacement with PKM α-β-mannanase 50%), PKM75 (maize replacement with PKM α-β-mannanase 75%), PKM100 (maize replacement with PKM α-β-mannanase 100%). Bulk density = the weight of experimental feed per unit volume (g / L).

[2]Vitamin A: 2,500,000 UI; Vitamin D3: 600,000 UI; Vitamin E: 4,000 mg; Vitamin K3: 400 mg; Folic acid: 80 mg; Choline: 100,000 mg; Mangan: 14 g; Zn: 40 g; Fe: 32 g; Cu: 48 g; Iodine: 0.5 g; Co: 0.28 g; Se: 0.04

Digestibility's Analysis

Excreta samples were collected and stored in plastic trays. Then, immediately placed in a combination of liquid of NA_2PO_4 2%; $NA_2H_2PO_4$ 2%, 24% Formaldehyde; and 900 ml reverse osmosis water for digestibility's analysis. The data were used to calculate AME, AMEn, TME, and TMEn values according to the following formulae:

AME=IE-FE

TME=AME+FEL

Where IE=ingested energy; FE=fecal energy voided by the fed birds; while FEL=fasting energy loss by the unfed birds.

The values corrected to zero N balance, AMEn and TMEn, are calculated as follows:

AMEn=AME-(8.22×ANR/FI)

TMEn=TME-(8.22×FNL/FI) - (8.22×ANR/FI)

Where ANR=apparent N retention; FI=feed intake; and FNL=fasting N loss by the unfed bird; The factor 8.22 kcal/g for N retained in the body has been used according to Mustafa *et al.,* (2003).

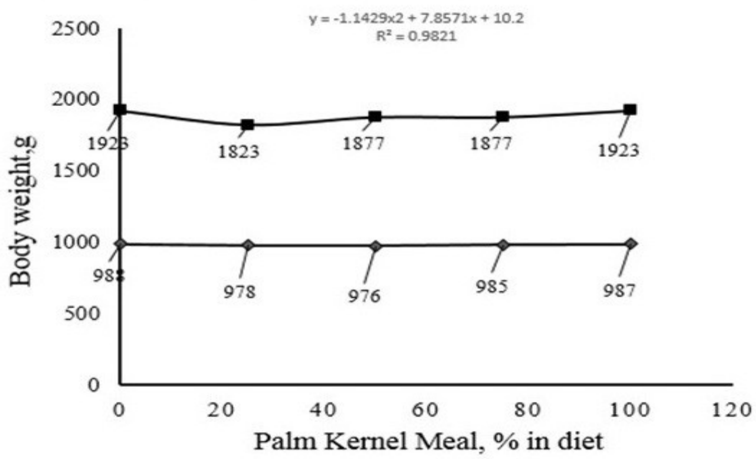

Figure 1. The effect of increasing levels of palm kernel meal containing α-β-mannanase replacing maize on the growth performance of ducks. The symbols represent growing body weight (♦) and finishing body weight (■).

VFA Analysis

The VFA analyses were following procedure by (Sharmila *et al.,* 2014) and (Adli and Sjofjan, 2020). The chyme from ileum were taken approximately one gram and diluted with distilled water (1:1 wt/vol) in a tube. Later, homogenization and centrifugation, 1 mL of clear supernatant was transferred into ampula, around 0.2 mL metaphosphoric acid solution was added and subjected to another homogenization before it was placed on ice for at least 30 min to allow the protein to settle. Then analyses it on the gas chromatography (Agilent 69890 N series: USA).

Continually, the analyses of proximate of the feed sample were determined dry matter, ash, crude fiber, fat, and crude protein was used association of official analytical chemists method. On the other hand, the amino acid using HPLC (HP Agilent 1200 series, USA); crude protein were used (Kjeltech analyses, Foss Detector, Switzerland) and gross energy using (Parr Oxygen Bomb 1108; USA).

Data Analysis

Data of the first experiment were statistically analyzed using SAS University version 4.0 red hat (64-bit) and the differences among treatment means ($p < 0.05$) were determined using Duncan's multiple range test (Sjofjan *et al.,* 2020).

RESULTS AND DISCUSSION

There was a curve linear decrease in the growing phase and finisher phase in feed intake as the level of α-β-mannanase palm kernel meal increased in the diet (Table 4). Curvilinear, the result was presented no significant difference ($P<0.05$) on the initial body weight, growing and finishing phase body weight. The results of this study presented α-β-mannanase palm kernel meal had improvement the daily gain, feed/gain ratio both growing and finishing phase compared to control (growing phase at 3.31; 2.97; 2.96 vs. 3.34 (control)) and (finishing phase 3.21; 2.93; 2.93; 2.87 vs. 3.45 control). Compared with the study from Park *et al.,* (2018) that study the used β-mannanase in the palm gives an improvement on the growth performance of white Pekin ducks compare to control. The trends used β-mannanase also used in other poultry to increase performance (Park *et al.,* 2018). The use of α-β-mannanase inhibits the negative effect of NSP in the duck intestinal. α-β-mannanase is an endogenous enzyme in the cell wall that supporting-agent in breaking down the NSP in the palm kernel meal. In addition, α-β-mannanase increasing of NSP can reduce lower nutrient digestibility and mortalities. In these studies, the percentage of the mortalities were at a better level compared with the control (3.43; 0.00; 1.26; and 3.43 vs. 4.26 (control)). The previous researcher had shown the palm kernel meal must be treated by enzyme since a lot of non-starch polysaccharides (NSPs) e.g. mannan and xylene, together with anti-nutritional factors. In this study, α-β-mannanase helps degrades into shorter chains, which, more absorptive well in the nutrients. According to Wilkinson and Young

Table 4. The Effect of Increasing Levels of Palm Kernel Meal containing α-β-mannanase Replacing Maize on the Growth Performance

Performance	0.10% α-β-mannanase					SEM	P-values NC vs PKM
	NC	PKM 25	PKM50	PKM75	PKM100		
Body weight, g							
Initial body weight, g	415	418	417	422	433	2.22	0.31
Growing phase body weight, g	988	978	976	985	987	0.22	0.22
Finishing phase body weight, g	1,923	1,823	1,877	1,877	1,923	12.33	0.0015
Daily gain, g	56.5[b]	59.2[a]	58.7[ab]	57.8[b]	58.9[ab]	4.55	0.0001
F/G ratio							
Growing phase	3.34[a]	3.31[a]	2.97[b]	2.96[b]	2.95[b]	3.32	0.0001
Finishing phase	3.45[a]	3.21[a]	2.93[b]	2.93[b]	2.87[b]	0.88	0.0012
Mortalities %	4.26	3.43	0.00	1.26	3.43	0.23	0.0015
Growing phase feed intake, g	1,923	1,824	1,727	1,562	1,453	0.21	0.0012
Finisher phase feed intake, g	2,023	1,923	1,825	1,725	1,726	0.19	0.0023

[ab] Mean values in the same row without common superscript differ at P<005

[1] NC (negative control; maize-soyabean-meal based diet), PKM25 (maize replacement with PKM α-β-mannanase 25%), PKM50 (maize replacement with PKM α-β-mannanase 50%), PKM75 (maize replacement with PKM α-β-mannanase 75%), PKM100 (maize replacement with PKM α-β-mannanase 100%).

(2020) that palm kernel meal had low digestibility at the range of 65-75%, to help that some enzyme was added to bind the phytase. The replacement of up to 15% for maize by palm kernel meal was made balancing for digestible amino acids, total phosphorus, and metabolizable energy (Wilkinson and Young, 2020). In addition, from Natsir *et al.* (2018) the feed intake of untreated PKM higher compare with PKM treated by the enzyme at the level (3242.34 vs. 3097.91 gram/live bird), the results due to energy content lower compared to PKM treated by the enzyme. The increased the broiler body weight during the experiment due to metabolism from the enzymatic cycles, the enzyme that absorbs nutrient content combine with metabolism to produce and grow the organs in the ducks. The curve linear of live weight gain may be impacted by feed consumption day by day. The curve linear were affected from feeding programmed, one factor when feeding method designed ad-libitum both of sex (male and female). However, relatively temperature also helps to increase feed intake during research the average temperature 1-35 days were (26.19º morning and 28.63º afternoon) with humidity (88.94º morning and 88.69º afternoon). The lower temperature at the chicken house may help increase feed intake to eat more the experimental diets. Contrast findings to a study from Stęczny and Kokoszyński (2020) interactions between enzyme and palm kernel meal were no interaction for 35 days of age (2880 experimental vs. 2886 control group).

The digestibility reflected the impact of the F/G ratio (Table 5). The result of this study showed the used α-β-mannanase in the palm kernel meal presented a significant difference (P>0.05) on the nutrient digestibility of dry matter and crude protein. The α-β-mannanase help to give improvement (42.20; 41.30; 44.11; and 42.13 vs 40.20% (control)) for dry matter. In line with nutrient digestibility of crude protein were also increasing (42.20; 41.30; 44.11; 42.13 vs. 40.20% (control)) for crude protein. In this study, α-β-mannanase has stimulated the result of crude protein and dry matter by using methyl donor in the cycle. The methyl donor of α-β-mannanase reduce the phytase content and absorb the nutrients well. While the β-mannanase must be transformed into α-β-mannanase first before inside to mitochondria in the synthesis cycle. The latter was significantly affected (P<0.05) with Mustafa *et al.* (2003) in percent digestibility of palm kernel meal treated by the enzyme (44.09 vs. 41.20 (untreated)). Mustafa *et al.* (2003) stated the PKM treated by an enzyme found increasing it was due to adequate amino acid levels that arginine, isoleucine, valine, and methionine. In addition, from (Pasaribu *et al.,* 2019) the increase of palm kernel meal using microbial fermented that produced mannanase enzyme were at 24-32%.

The PKM treated by enzyme didn't help apparent metabolizable energy (AME) and apparent metabolizable energy n-correction due to ME value in the ducks might be higher than broiler (Mustafa *et al.,* 2003). In this study, the AME, AMEn, TME, and TMEn might be different at growing and finishing periods. The AME and AMEn were better compared to control (1,754; 1,756; 1765; 1777 vs. 1,752 (control)) and (1,844; 1833; 1,823; 1844 vs 1,855 (control)). Furthermore, additional study is required to confirm these issues. Compared with Mustafa *et al.* (2003) that the no significant difference found in the AME and TME valued to higher NDF result that ranged between 36-41%. The value of AME was 1,870 kcal/kg continued AMEn, TME, and TMEn values were line 1,743; 2053; and 1874 kcal/kg (Mustafa *et al.,* 2003). Park *et al.* (2018) stated with increasing β-mannanase concentration on the nutrient digestibility also increased significantly (P<0.0001). The nutrient digestibility in line increasing due to amino acid histidine and threonine stimulated the mucin secretion. The goblet cell mucin secretion function was developed by the discharge of histamine from cell E linked with O-linked glycosylation in the intestine (Park *et al.,* 2018).

Carcass traits showed the reflection in line with the final weight and internal organs were better to compare to control 0.5% using α-β-mannanase in the palm kernel meal. It (Table 6) was not only affected by final weight and internal organs but also depend on exogenous factors in these conditions were using α-β-mannanase in the palm kernel meal. Moreover, the breed in these studies were hybrid ducks [(Peking x Khaki Campbell)] also one factor affected to carcass trait. Relatively organ weight in this study was

Table 5. The Effect of Increasing Levels of Palm Kernel Meal containing α-β-mannanase Replacing Maize on the Nutrient Digestibility

Nutrient Digestibility (%)	0.10% α-β-mannanase					SEM	P-values NC vs PKM
	NC	PKM 25	PKM50	PKM75	PKM100		
Dry matter	40.20[b]	42.20[a]	41.30[b]	44.11[a]	42.13[a]	0.88	0.002
Crude protein	52.27[b]	53.39[b]	54.49[a]	55.56[a]	52.24[b]	1.23	0.004
AME (kcal / kg)	1,855	1,844	1,833	1,823	1,844	123.23	0.003
AMEn (kcal/kg)	1,752	1,754	1,756	1,765	1,777	111.11	0.011
TME (kcal/kg)	2,073	2,074	2,075	2,077	2,073	55.4	0.33
TMEn (kcal/kg)	1,893	1,844	1,906	1,852	1,888	54.5	0.22

[ab] Mean values in the same row without common superscript differ at p<005

[1] NC (negative control; maize-soybean-meal based diet), PKM25 (maize replacement with PKM α-β-mannanase 25%), PKM50 (maize replacement with PKM α-β-mannanase 50%), PKM75 (maize replacement with PKM α-β-mannanase 75%), PKM100 (maize replacement with PKM α-β-mannanase 100%).

Table 6. The Effect of Increasing Levels of Palm Kernel Meal Containing α-β-mannanase Replacing Maize on the Carcass Traits and Relatively Organ Weight

	0.10% α-β-mannanase					SEM	P-values NC vs PKM
	NC	PKM 25	PKM50	PKM75	PKM100		
Gizzard	2.69	2.94	2.83	3.25	2.99	0.88	0.002
Heart	0.63	0.59	0.67	0.60	0.63	1.23	0.004
Liver	2.04	1.90	2.05	2.19	1.92	123.23	0.003
Spleen	0.066	0.063	0.081	0.067	0.067	111.11	0.011
Pancreas	0.32	0.26	0.25	0.30	0.26	55.4	0.33
Abdominal fat	2.2	2.0	2.0	1.6	1.5	54.5	0.22
Caeca length (cm)	15.53	16.16	16.48	17.01	16.56	2.22	0.001
Caeca width (cm)	1.88	1.70	1.56	1.86	1.75	0.11	0.002
Carcass weight (g)	1203.75	1301.50	1260	1293	1192.25	234.5	0.003
Carcass (%)	61.47	65.87	63.70	63.23	61.72	2.22	0.004
Breast meat (%)	27.09	28.82	29.60	26.45	25.14	0.22	0.0015

[ab] Mean values in the same row without common superscript differ at p<005

[1] NC (negative control; maize-soybean-meal based diet), PKM25 (maize replacement with PKM α-β-mannanase 25%), PKM50 (maize replacement with PKM α-β-mannanase 50%), PKM75 (maize replacement with PKM α-β-mannanase 75%), PKM100 (maize replacement with PKM α-β-mannanase 100%).

consistent in line with Chinajariyawong and Muangkeow (2011) and Huang *et al.* (2009). The abdominal fat was linearly decreasing with increasing levels of α-β-mannanase in the palm kernel meal compared to control (2.0; 2.0; 1.6;1.5 vs. 2.2 (control)). The lower abdominal fat might be consistent with increasing crude fiber content. Compared with Chinajariyawong and Muangkeow (2011) studies the palm kernel meal adjusted with β-mannanase were decrease the abdominal fat. In addition, from Barbour *et al.,* (2006) the supplemented of palm kernel meal with enzyme were decreasing of abdominal fat pat as levels of PKM increased. The higher immune organs result was supposing to enzymatic activities either mode of action and immune stimulation. The factors affected to the significantly different of the stomach is the ability of the absorption. Wang *et al.* (2018) stated the variance of the broiler are affects the absorption and the capacities of the stomach. The growth factors correlate with age, while the uses of the broiler in the relative age cause the growth of the internal organs the same. In some studies, according to Manafi *et al.* (2018) it results did not increase in liver and spleen both male and female groups (P>0.05), where areas, bursa of fabricius as immune organ were increased (P<0.05).

The number VFA presented no significant difference (P<0.05) (Table 7). The result of isobutyric of the treatment were not better than the control (16.5; 16.2; 16.3; 16.4 vs. 16.0 (control)) and followed by n-butyric were (12.1; 12.2; 11.2; 10.2 vs. 11.9 (control)). The production of VFAs depended on the caecal in caecum when crude fiber breakdown the NSPs in the palm kernel meal. The α-β-mannanase enzyme extent of the fermentation process depends on the microbial population in the caecum. Dunkley *et al.* (2007) reported that acetic acid was the primary source of VFA produced in the caecal parts followed by butyrate and propionate. The fermentation process to produce acetic acid was started with i) breakdown of the NSP to simply sugar (xylan to xylose to xylooligomers) that might escape from enzymatic digestion, later enter the caecum (Sharmila *et al.,* 2014).

Table 7. The Effect of Increasing Levels of Palm Kernel Meal containing α-β-mannanase Replacing Maize on the Volatile Fatty Acid

VFA	0.10% α-β-mannanase						P-values NC vs PKM
	NC	PKM 25	PKM50	PKM75	PKM100	SEM	
Iso butyric	16.0	16.5	16.2	16.3	16.4	0.21	0.0014
n-butyric	11.9	12.1	12.2	11.2	10.2	0.22	0.0012
Iso-valeric	8.5	8.6	8.7	8.8	8.9	0.12	0.0011

[ab] Mean values in the same row without common superscript differ at p<005

[1] NC (negative control; maize-soyabean-meal based diet), PKM25 (maize replacement with PKM α-β-mannanase 25%), PKM50 (maize replacement with PKM α-β-mannanase 50%), PKM75 (maize replacement with PKM α-β-mannanase 75%), PKM100 (maize replacement with PKM α-β-mannanase 100%).

CONCLUSION

The increase of the level palm kernel meal with α-β-mannanase enzyme wase had a positive effect on the hybrid ducks and replacement of palm kernel meal by 25% with the addition of the α-β-mannanase enzyme was able to improve digestibility and reduce abdominal fat of hybrid ducks.

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