Effect of Dietary Modified-Banana-Tuber Meal (M-BTM) Substituting Dietary Corn on Growth Performance, Carcass Trait and Dietary-Nutrients Digestibility of Coloured-Feather Hybrid Duck (Pekin x Khaki Campbell Ducks)

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ABSTRAK

Sjofjan O, Adli DN, Natsir MH, Nuningtyas YF, Wardani TS, Sholichatunnisa I, Ulpah SN, Firmansyah O. 2021. Pengaruh pakan tepung bonggol-pisang-modifikasi (TBP-M) sebagai bahan pengganti jagung pada kinerja pertumbuhan, karakter karkas dan daya cerna pakan itik hibrida (Peking x Khaki Campbell)

Penelitian bertujuan untuk mengetahui pengaruh penggunaan tepung bonggol pisang modifikasi (TBP-M), hasil perlakuan tepung bogol pisang dengan enzim selulase, dan di stabilkan nilai nutrisinya menggunakan tepung daging-tulang, DL-methionin, dan lisyne terhadap nilai nutrisi, performans produksi, kualitas karkas dan kecernaan pakan itik hibrida (Peking x Khaki Campbell). Materi dalam penelitian ini 196 itik pedaging hibrida] dengan rataan bobot hidup (421.31 ± 0.183g). Metode penelitian yang digunakan adalah Rancangan Acak Lengkap dengan 5 perlakuan dan 4 ulangan. Pakan percobaan terdiri dari kontrol (tanpa substitusi TBP-M), TBP-M25 (Pakan basal + TBP-M 25% substitusi jagung), TBP-M50 (Pakan basal + TBP-M 50% substitusi jagung), TBP-M75 (Pakan basal + TBP-M 75% substitusi jagung), TBP-M100 (Pakan basal + TBP-M 100% substitusi jagung). Data hasil penelitian dianalisis secara statistik dengan analisis keragaman (Anova, analysis of variance). Dilanjutkan dengan uji Duncan’s Multiple Range Test untuk mengetahui perbedaan rataan antar perlakuan dengan menggunakan perangkat lunak SAS. Hasil penelitian menunjukkan bahwa substitusi jagung dengan TBP-M berpengaruh nyata (P<0,05) terhadap kecernaan bahan kering dan protein kasar pakan. Disimpulkan bahwa penggantian TBP-M dapat diberikan sebagai pengganti jagung tanpa menimbulkan *efek negatif pada itik hibrida.*

Kata Kunci: Itik hibrida, bogol pisang modifikasi, karkas, kecernaan gizi pakan

ABSTRACT

Sjofjan O, Adli DN, Natsir MH, Nuningtyas YF, Wardani TS, Sholichatunnisa I, Ulpah SN, Firmansyah O. 2021. The effect of dietary modified-banana-tuber meal (M-BTM) substituting corn on growth performance, carcass traits and dietary-nutrients digestibility of coloured-feather hybrid duck (Pekin x Khaki Cambell)

In this experiment, we investigate the effect modified banana tuber meal (M-BTM) to substitute dietary maize in growing-finisher colored-feathered hybrid duck. One hundred and ninety six hybrid ducks (Pekin x Khaki Campbell) with 421.31 ± 0.183g 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-soyabean-meal based diet), BTM25 (25% maize was replaced by M-BTM-), BTM25 50% (maize was replaced by M-BTM5 (75% maize replaceed by M-BTM), BTM100 (100% maize was replaced by M-BTM). The experimental design conducted using completely randomize design (CRD). Data of experiment were statistically analysed by using the one-way-analysis-of-variance of SAS University version 4.0 red hat (64-bit) University Online Edition. The result of the study demonstrated the M-BTM improved significantly (p< 0.05) digestibility of dry matter and crude protein.It can be concluded the enhancement apparently growth performaces and digestibility parameters of colored-feathered hybrid duck (Pekin x Khaki Campbell) fed modified banana tuber meal (M-BTM) diets.

Key Words: Hybrid ducks, modified banana tuber meal, digestibility of energy, carcass

INTRODUCTION

Demand for poultry products have raised every year, according to Sjofjan et al. (2021) the poultry protein needed raised year to year. Poultry especially broiler were give more than 50% protein requirement in Indonesia. One of secondary protein can be fulfilled as meat were waterfowl (Sjofjan et al. 2021). One of the popular waterfowl as meat in Indonesia were Hybrid duck. Hybrid ducks are the offspring of a cross between a male Peking duck and female Khaki Champbell duck. Peking ducks have rapid weight gain, while Khaki

Champbell ducks have a high body weight and high egg production compared to other local ducks (Sjofjan et al. 2021). Duck has a considerable high feed consumption compared to chicken; therefore feed has to be considered seriously. At least 65-75% of total productivity in poultry industry is allocated for feed (Ali et al. 2014).

Continued impacted from COVID-19 the Indonesia government imposed the regulation Permendag/10/2020 to anticipate the COVID-19, the Indonesian government has undertaking strict quarantine measures on the import of live animal species and imported feed material originating from Tiongkok or transiting into Indonesian territory (Badan Pusat Statistik 2020; Sjofjan et al. 2021). Thus, regulation causes reducing supply of raw material for poultry such as maize (Sjofjan & Adli 2021). Fourthly quarter (Q4) data from Badan Pusat Statistik (2020) reported that Indonesia imported maize at the amount of 911.194 tonnes/year or equally to a total rate of US$ 233.47 million. The maize is a main feed ingredient for poultry industries in Indonesia. Later, the industrial of feed mill, institution, academic, researcher, and farmers in Indonesia took an alternative to help maintenance this condition by using local material potential in area scopes. The used of tuber meal in poultry diet are in partial replacement of maize. This was expected since the cost of tuber meals much lower than that maize (Beckford & Bartlett 2015; Achilonu et al. 2018).

One potential feed to replace maize were banana tuber meal since thus root meal had similar energy content and low protein but high in the crude fiber. The Indonesia had potentially agro-industrial waste from banana plant. According to Hapsari et al. (2017), Indonesia is homeland of banana both wild species and cultivars. According to Hapsari et al. (2017) banana is most famous fruit plant through worldwide. Being part of primary data of origin and biodiversity of banana, Indonesia has played a crucial role in supporting available of the banana (Hapsari et al. 2017). The banana plant had tuber or rhizome, which is a basal part of banana stem. Rhizome grew after reproductive organ were formed as modification of the peduncle, white in color, with smooth surface. Rhizome consists of epidermis, periphery zone and center zone (Sumardi & Wulandari 2010; Libatique 2020).

There is a negative effect of utilizing banana tuber which causes gizzard erosion, low palatability, and low nutrient content. Thus, tuber meal needs to be modified in accordance to overcome the weakness. To equally it nutrient content, the modification utilize β-cellulose enzyme. The banana tuber contents 50% undigestible non-starch polysaccharide (NSP) component in poultry. The local resources as an alternative feed ingredient for poultry was reported to stimulate the releasing of volatile fatty acid in the caecum of the ducks and reduced crude fiber in the gut of waterfowl (Sharmila et al. 2014). However, its use in conventional feed is limited by some factors and need to maintain well before use as commercial livestock feed (Dei et al. 2011).

Accordingly, this study was carried out to investigate the effect modified banana tuber meal to promote replacement of maize in growing-finisher rations of colored-feathered hybrid. Then, choosing the most suitable level of treatment which was able to apply in duck farm is considered to be a novelty of the result of the experiment.

MATERIALS AND METHODS

Ducks rearing condition

First experiment were used one hundred and ninety six colored-feathered hybrid ducks (Pekin x Khaki Campbell) with average 421.31 ± 0.183 g of body weight) were allotted to 5 dietary treatments with 9 ducks (unsexed) per pen and 4 replicates per treatments. Furthermore, the second experiment for digestibility using 20 hybrid ducks (Pekin x Khaki Campbell) aged 64 days (unsexed). The total 20 metabolic cages used. Each cage consisted of one duck. The experiment was conducted at conventionally-farm-controlled environmentally, at Batu, East Java Province, Indonesia (latitude 7°55′06″S, longitude 112°34′35″E, elevation 813 m). The climate is tropical with a wet season and average rainfall around 3230 mm. The average room temperature and humidity were 26°C and 71%, respectively. Rice hull was used as litter floor pens. The lighting program was set at 16 hours light. Ducks were reared under supervision of a veterinarian and was approved by the University of Brawijaya Animal Ethics Committee. The hybrid duck were taken from commercial farmer from Blitar Regency, East Java, Indonesia.

Feeding treatment programmed

The ducks were also given free access (*ad libitum*) to fresh water and feed throughout the study period twice a day at 07; 30 AM and 15; 30 PM. Experimental diets were formulated according to growing phase of day 24 to day 38 for first phase, day 39 to day 52 for second phase and day 53 to day 64 for finisher phase. The Composition of Feed in the experiment showed in Table 2, 3 and 4, respectively for first, second and finisher phases.

Preparation modified banana tuber meal

The banana tuber meal (BTM) were taken from local merchant at the wet-local-market, in Trenggalek

Table 1. Nutrient composition of diet ingredient (g/kg, as-fed basis)

Item	Maize	Soybean meal	Banana tuber meal
Dry Matter, (g/kg)	91.4	91.3	86.3
Crude protein, (g/kg)	8.3	41.5	36.1
Fat, (g/kg)	40	16	45
Crude fibre, (g/kg)	17	34	16.7
Ash, (g/kg)	25	58	6.7
Nitrogen free extract, (g/kg)	554	300	435

town, East Java, Indonesia. The tuber meal was sifted to separate the meal from the remaining stem-foliage, then placed on the floor that had been covered with trash bags and plastic. Suspensions of β-Cellulose are homogenized in a blender with 0.5% of meat-bone-meal then added at 0.010% per 1 kg of BTM. The treated BTM was the named as modified TBM (M-TBM). The last step was formulation with DL-Meth and Lysine on total feed formulation that are presented in Tables 2,3, and 4. The dietary treatments were: NC (negative control; maize-soya bean-rice bean-meal based diet), M-BTM25 (25% of maize was replaced with M-BTM), M-BTM50 (50% of maize was replaced with M-BTM), M-BTM75 (75% of maize was replaced with M-BTM), M-BTM100 (100% of maize was replaced with M-BTM).. Diets were formulated to contain 2900 kcal metabolizable energy (ME)/kg, 18% crude protein, 0.75% total methionine and 0.28% total lysine. The other nutrients were formulated to meet or slightly exceed the nutrient requirement as suggested by *Badan Standardisasi Nasional* (2018). Experimental diets were formulated using Universitas Brawijaya (UB) Feed Formulation Software for Poultry following Badan Standardisasi Nasional (2018) requirement.

Data collection and sampling procedures

Daily feed consumption was recorded by measuring daily weight difference between feed offered and feed left. The weekly live weight of the duck was measured every week morning at 06:00 AM. The feed efficiency was then calculated by dividing the total feed consumption by the live weight gain of the ducks during experiment (Abel et al. 2015). Duck mortality was recorded per flock from the beginning until the end of the experiment (Sjofjan et al. 2021). Twenty-four ducks from each pen which had weight to the nearest final live weight gain were taken to be sacrificed for carcass analyses.

Digestibility's analyses

The digestibility method was carried out by sampling the homogenized feces collected and stored in plastic trays. Then, immediately placed mixture of liquid of NA_2PO_4 2%; $NA_2H_2PO_4$ 2%, 24% formaldehyde; and 900 ml reverse osmosis water for digestibility's analysis following Sjofjan et al. (2021) method. The data were used to calculate digestibility parameters 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, apparent metabolizable energy (AME), nitrogen-corrected apparent metabolizable energy (AMEn), total metabolizable energy (TME), nitrogen-corrected total metabolizable energy (TME). The values corrected to zero N balance, AMEn and TMEn, were calculated as follows:

$$AMEn=AME-(8.22\times ANR/FI)$$
$$TMEn=TME-(8.22\times FNL/FI) - (8.22\times ANR/FI)$$

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. (2004) and Sjofjan et al. (2021). Continually, the analyses of proximate of the feed sample was carried out to determine dry matter, ash, crude fibre, fat, and crude protein contents (Sjofjan et al. 2021). Crude protein was determined using Kjeltech analyses of Foss Detector, Switzerland and gross energy was determined using Parr Oxygen Bomb 1108; USA (Sjofjan et al. 2021).

Data analyses

The experimental design conducted using completely randomize design (CRD). Data of experiment were statistically analysed by using the one-way-analysis-of-variance of SAS University version 4.0 red hat (64-bit) University Online Edition (Sjofjan & Adli 2021). The differences among treatment means were determined at level of $p < 0.05$, using Duncan's multiple range test (Steel & Torrie 1990).

Table 2. Composition of dietary treatments (as fed basis) fed to second growing phase of colored-feathered hybrid ducks (Pekin x Khaki Campbell)

Ingredients	Treatments				
	NC[1)]	M-BTM 25	M-BTM50	M-BTM75	M-BTM100
Maize , (g/kg)	540	500	490	465	440
Rice bran, (g/kg)	150	150	150	150	150
Soybean meal, (g/kg)	120	120	120	120	120
Meat bone meal 50, (g/kg)	50	50	50	50	50
Fish Meal. 60, (g/kg)	50	50	50	50	50
M-BTM, (g/kg)	-	25	50	75	100
Limestone Powder, (g/kg)	30	30	30	30	30
Grit, (g/kg)	41	41	41	41	41
DL-Methionine, (g/kg)	1	1	1	1	1
Palm oil, (g/kg)	10	10	10	10	10
β-cellulase, (g/kg)	-	1	1	1	1
L-lysine , (g/kg)	5	5	5	5	5
Analysed nutrients composition					
Dry matter, (%)	87.05	87.25	87.30	87.43	87.55
Crude protein, (%)	18.01	18.11	18.19	17.38	17.56
Fat, (%)	6.41	6.53	6.36	6.23	6.17
Crude Fibre, (%)	3.63	3.78	3.60	4.60	4.93
Ash, (%)	6.10	6.25	6.13	6.39	6.45
Nitrogen Free extract,(%)	48.33	46.66	45.88	47.05	46.63
Metabolizable energy, (Kcal/kg)	2,912	2,917	2,905	2,941	3,412
Lysine, (%)	1.07	1.10	1.11	0.93	1.15
Methionine, (%)	0.41	0.45	0.48	0.53	0.55
Met. + Cystine, (%))	0.68	0.67	0.66	0.65	0.56
Calcium, (%)	3.71	3.71	3.71	3.71	3.71
Total Phosphorus, (%)	0.85	0.87	0.85	0.86	0.88
Available Phosphorus, (%)	0.39	0.39	0.39	0.34	0.44
Bulk density, (g / L)	383	381	381	345	356

NC= negative control; maize-soyabean-meal based diet; M-MBTM25 = 25% of Modified Banana Tuber Meal replaced maize; M-MBTM50 = 50% of Modified Banana Tuber Meal replaced maize; M-MBTM75 = 75% of Modified Banana Tuber Meal replaced maize; M-MBTM100 = 100% of Modified Banana Tuber Meal replaced maize

Table 3. Composition of dietary treatments (as fed basis) fed to finisher phase of colored-feathered hybrid ducks (Pekin x Khaki Campbell)

Ingredients	Treatments				
	NC[1)]	M-BTM 25	M-BTM50	M-BTM75	M-BTM100
Maize, (g/kg)	550	515	500	475	450
Rice bran, (g/kg)	170	170	170	170	170
Soybean meal, (g/kg)	90	90	90	90	90
Meat bone meal 50, (g/kg)	50	50	50	50	50
Fish Meal. 60, (g/kg)	50	50	50	50	50
M-BTM, (g/kg)	-	25	50	75	100
Limestone Powder, (g/kg)	30	30	30	30	30
Grit, (g/kg)	41	41	41	41	41
DL-Methionine, (g/kg)	1	1	1	1	1
Palm oil, (g/kg)	10	10	10	10	10
β-cellulose, (g/kg)	-	1	1	1	1
L-lysine, (g/kg)	5	5	5	5	5
Analysed nutrients composition					
Dry matter, (%)	86.96	87.09	87.21	87.34	87.46
Crude protein, (%)	15.81	15.99	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)	2696	2648	2600	2552	2510
Lysine, (%)	0.84	0.85	0.85	0.86	0.86
Methionine, (%)	0.50	0.50	0.51	0.51	0.52
Methionine + 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
Available Phosphorus, (%)	0.39	0.40	0.41	0.42	0.44
Bulk density, (g / L)	585	584	580	569	565

NC= negative control; maize-soyabean-meal based diet; M-MBTM25 = 25% of Modified Banana Tuber Meal replaced maize; M-MBTM50 = 50% of Modified Banana Tuber Meal replaced maize; M-MBTM75 = 75% of Modified Banana Tuber Meal replaced maize; M-MBTM100 = 100% of Modified Banana Tuber Meal replaced maize

RESULTS AND DISCUSSIONS

Performance of Hybrid-duck

Experimental results are presented in Table 4 and Table 5 it showed that there were no significant difference ($p > 0.05$) on parameters observed. Initially, there were curve linear decrease in the growing phase 1, 2, and finisher phase in feed intake as the level of modified banana tuber meal increased in formulated diet (Figure 1). Contrast finding from the finding of Atapattu & Senevirathne (2013) who reported that the feed intake or feed conversion ratio was not affected by the type of the banana meal. In addition from Sugiharto et al. (2020) using banana peel meal up to 15% had no deleterious effect on the feed intake of the poultry.

The result of daily weight gain are presented on the Table 4, at the beginning phase were 39.1; 38.3; 37.4; 35.9 vs. 34.5 g/bird (control). The result continued at the second growing phase Table 4 were 59.2; 58.7; 57.8; 58.9 vs. 56.5 g/bird (control). For the last, at the finisher phase (Table 4) were 59.3; 58.6; 58.3; 56.1 vs. 54.3 g/bird (control).

The trends continued positive on the body weight increase, even though the data were not significant difference (p> 0.05). Table 4 showed the body weight at the beginning phase were 714; 736; 723; 747 vs. 733 (control), then followed on the growing phase 978; 976; 985; 987 vs. 988 (control), at the end phase showed that 1570; 1674; 1562; 1542 vs. 1558 (control).

The number of mortalities also decreased in accordance with increase in the day of rearing. The increased of daily gain may be in correlation with the modified banana tuber meal, the β-cellulose enzyme successfully reduced crude fiber and bind some non-starch polysaccharides (NSPs) and it helped reducing NSP content of the banana tuber meal. Contrast findings with Abouelezz et al. (2018) the treatment failed to bind the NSP content on the cassava extraction residue treatment showing that the result did not give significant difference (p> 0.05). Moreover, the cooked and uncooked banana meal that consisted of NSP could has negative effect on the animals (Atapattu & Senevirathne 2013). Sjofjan et al. (2021) stated the used of enzyme would inhibit the negative effect of NSP in the duck intestinal. The enzyme could be useful as an endogenous enzyme in the cell wall that supported in breaking dawn the NSP of feedstuff (Sjofjan et al. 2021).

The results of this study presented that β-cellulose banana tuber meal improved feed conversion ratio (FCR) in growing 1, 2 and finishing phases in

Table 4. Growth performance of colored-feathered hybrid duck (Pekin x Khaki Campbell), fed modified banana tuber meal (M-BTM) diets at growing phase

Performance	NC	M-BTM 25	M-BTM50	M-BTM75	M-BTM100	SEM
First growing phase (age of 24-38days)						
Initial body weight, (g/bird)	444	447	446	445	448	0.32
Body live weight at age of 38 days, (g/bird)	733	714	736	723	747	0.22
Daily body weight gain, (g/bird)	34.5$^{b2)}$	39.1^{a}	38.3^{ab}	37.4^{b}	35.9^{ab}	1.22
Feed conversion ratio (FCR)	3.87^{a}	3.81^{a}	3.54^{b}	3.12^{b}	3.55^{b}	4.55
Mortalities, (%)	0.00	0.00	0.00	1.26	0.00	0.12
Feed consumption, (g/bird)	1,622	1,614	1,523	1,512	1,563	0.11
Second growing phase (age of 39-52days)						
Body live weight at age of 52 days, (g/bird)	988	978	976	985	987	0.22
Daily body weight gain, (g/bird)	56.5^{b}	59.2^{a}	58.7^{ab}	57.8^{b}	58.9^{ab}	4.55
Feed conversion ratio	3.34^{a}	3.31^{a}	2.97^{b}	2.96^{b}	2.95^{b}	3.32
Mortalities, (%)	0.00	1.26	0.00	1.26	1.26	0.13
Feed consumption, (g/bird)	1,813	1,834	1,717	1,652	1,543	0.14
Finisher (age of 53-64days)						
Body live weight at age of 64 days, (g/bird)	1558	1570	1674	1562	1542	24.53
Daily body weight gain, (g/bird)	54.3^{b}	59.3^{a}	58.6^{ab}	58.3^{b}	56.1^{ab}	2.11
Feed conversion ratio	3.24^{a}	3.33^{a}	3.97^{b}	3.44^{b}	3.13^{b}	0.12
Mortalities, (%)	4.26	3.43	0.00	1.26	3.43	0.23
Feed consumption, (g/bird)	2,033	2,003	2,118	2,534	1,592	0.19

NC= negative control; maize-soyabean-meal based diet; M-MBTM25 = 25% of Modified Banana Tuber Meal replaced maize; M-MBTM50 = 50% of Modified Banana Tuber Meal replaced maize; M-MBTM75 = 75% of Modified Banana Tuber Meal replaced maize; M-MBTM100 = 100% of Modified Banana Tuber Meal replaced maize; SEM = Standard error of mean. Values with different superscript in the same row are significantly difference (p<0.05)

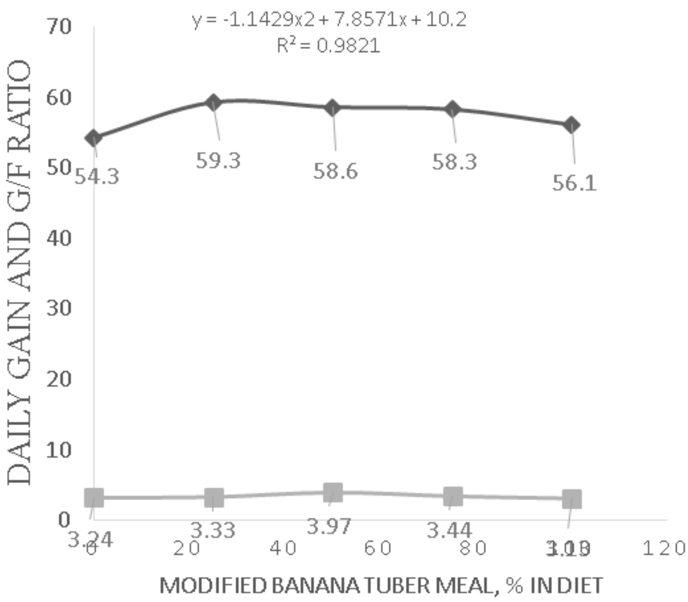

Figure 1. Growth performance of colored-feathered hybrid ducks (Pekin x Khaki Campbell), fed modified banana tuber meal at the age of 64 days. The symbols represent daily gain (●) and feed conversion ratio (■).

comparation to control diet. FCR of growing phase 1 were respectively for M-BTM25, M-BTM50, M-BTM75 and M-BTM100 of 3.81; 3.54; 3.12, 3..55 *vs.* NC (control diet) of 3.87, and of growing phase 2, that were 3.31; 2.97;2.96; 2.95 *vs.* 3.34 of NC diet and finishing phase of 3.33; 3.97; 3.44; 3.13 *vs.* 3.24 NC diet. However, since we managed controlled-trial environment the response of moderate variable value means were probably expressing the good result achievement. In addition, the breed and environmental factors were considerable evidence int modern rearing strains which had relatively similar in physiological and genetic potential. The hybrid duck used in this study were actually kept in relatively adaptive environment with relatively lower temperatures of 24.11^{0}C in the morning and 27.12^{0}C in the afternoon and humidity of 61.12% in morning and 74.22% in afternoon, had supported sufficient daily feed consumption.

Experimental Diets Digestibility

The digestibility reflected the impact of Feed conversion ratio (FCR) (Table 5). The result of this study showed the used modified banana tuber meal improved significantly ($p < 0.05$) digestibility of dry matter and crude protein. The digestibility of crude protein of M-BTM diets were 68.22%, 67.22%, 62.40% and 66.43% respectively for M-BTM25, M-BTM50, M-BTM75 and M-BTM100 *vs* 52.57 % was in control diet. In line with nutrient digestibility of dry matter were also increasing, showing of 43.18%; 41.22%; 43.12%; 40.14% respectively for 25%, 50%,75%, 100% of M-TBM diets, *vs*. 41.11% for control diet. In this study discrepancy was most probably caused by the protein quality (adequate and balanced amino acid composition) and the presence of anti nutrient components in the diets. There problems in the agro industrial origin were due to anti-nutrients contents such as lectins, polyphenol, anti-nutritional amino acid, saponins, cyanogen glycoside substances, protease inhibitors, and relatively oxalate (Anwar et al. 2016). To reduce anti-nutritional factors there are several technique to increasing digestibility using heat, chemicals, machineries, enzyme supplementation, or fermentation (Anwar et al. 2016; (Najoan et al. 2020a; Tien et al. 2014). Compared with Sugiharto et al. (2020) stated the protein digestibility did not vary between banana meal treatment and control, this inference noticed better protein digestibility when feeding containing banana meal to poultry (Sugiharto et al. 2020).

The modified banana tuber meal for the hybrid ducks did not showed significant effect on the AME, AMEn, TME, and TMEn (Table 6). The AME mean values were 1,247; 1,158; 1,086; 1,987 kcal/kg respectively for 25%, 50%, 75%, 100% M-TBM *vs.* 1,280 kcal of control treatment, followed by AMEn of dietary treatments of 1,523; 1,456; 1,625; 1,647 kcal/kg *vs.* 1,666 kcal AMEn/kg of control. In addition the TME mean values were 2,122; 2,089; 2,071; 2,074 kcal/kg respectively for 25%, 50%, 75%, 100% M-TBM vs. 2,173 kcal TME of control treatment, followed by TMEn of dietary treatments of 1,544; 1,666; 1,752; 1,666 kcal/kg for 25%, 50%, 75%, 100% M-TBM *vs.* 1,777 kcal TMEn/kg of control treatment. Reported from Mohammed et al. (2020) the tuber meal

Table 5. Nutrients digestibility of experimental diets of growing-finisher colored-feathered hybrid duck (Pekin x Khaki Campbell), fed modified banana tuber meal (M-BTM) diets at age of 64 days

Nutrient digestibility	NC	M-BTM 25	M-BTM50	M-BTM75	M-BTM100	SEM
Dry matter, (%)	41.11[b]	43.18[a2)]	41.22[b]	43.12[a]	40.14[a]	0.13
Crude protein, (%)	52.57[b]	68.22[a2)]	67.22[a]	62.04[ab]	66.43[a]	2.11
AME (kcal / kg)	1,280	1,247	1,158	1,086	1,937	12.11
AMEn (kcal/kg)	1,666	1,523	1,456	1,625	1,647	10.13
TME (kcal/kg)	2,173	2,122	2,089	2,071	2,074	4.3
TMEn (kcal/kg)	1,777	1,544	1,666	1,752	1,666	4.5

NC= negative control; maize-soyabean-meal based diet; M-MBTM25 = 25% of Modified Banana Tuber Meal replaced maize; M-MBTM50 = 50% of Modified Banana Tuber Meal replaced maize; M-MBTM75 = 75% of Modified Banana Tuber Meal replaced maize; M-MBTM100 = 100% of Modified Banana Tuber Meal replaced maize; SEM = Standard error of mean. Values with different superscript in the same row are significantly difference ($p<0.05$)

Table 6. Carcass traits and organs weight of colored-feathered hybrid duck (Pekin x Khaki Campbell), fed modified banana tuber meal at the age of 64 days

Meat quality	NC	M-BTM 25	M-BTM50	M-BTM75	M-BTM100	SEM
Gizzard (%)	2.59	2.85	2.90	2.94	3.27	0.21
Heart (%)	2.50	2.47	2.84	2.40	2.13	0.15
Liver (%)	1.92	2.40	2.54	2.56	2.71	3.11
Spleen (%)	0.036	0.030	0.332	0.286	0.265	0.01
Pancreas (%)	1.22	1.33	1.17	1.33	1.22	0.14
Abdominal fat (%)	8.47	7.55	7.85	7.66	7.56	4.11
Caeca length (%)	2.88	3.33	3.28	3.44	3.22	0.07
Caeca width (%)	1.88	1.70	1.56	1.86	1.75	0.11
Carcass weight (%)	45.22	46.11	47.22	46.13	45.33	4.5
Carcass (%)	41.12	41.22	43.10	43.13	41.12	0.22
Breast meat (%)	11.11	12.12	14.12	14.45	15.14	0.33
Gizzard (g)	55.99	58.05	54.26	54.60	53.67	2.33
Heart (g)	13.03	12.63	12.59	13.53	12.59	6.13
Liver (g)	38.78	36.89	41.25	38.78	40.25	3.41
Spleen (g)	1.27	1.65	1.38	1.4	1.23	0.22
Pancreas (g)	5.38	5.64	5.73	5.93	6.04	3.1
Abdominal fat (g)	35.97	36.80	40.29	41.26	40.33	3.2
Caeca length (cm)	12.25	13.10	12.75	13.08	13.10	5.44
Caeca width (cm)	1.96	1.80	1.85	2.15	1.35	0.22
Carcass weight (g)	1204	1302	1260	1293	1192	235
Carcass (g)	61.33	62.11	61.00	63.11	62.12	0.12
Breast meat (g)	25.11	26.12	26.12	26.13	24.14	0.12

NC= negative control; maize-soyabean-meal based diet; M-MBTM25 = 25% of Modified Banana Tuber Meal replaced maize; M-MBTM50 = 50% of Modified Banana Tuber Meal replaced maize; M-MBTM75 = 75% of Modified Banana Tuber Meal replaced meize; M-MBTM100 = 100% of Modified Banana Tuber Meal replaced maize; SEM = Standard error of mean containing bitter toxic called gum later called terpenes. These anti-nutritional factors reduce the digestibility when the raw feed made from tuber when given to animals (Mohammed et al. 2020).

Carcass traits

Carcass traits and relative organ weight emphasis the result of the influence of the modified the banana tuber meal whether it causes damaged or not. The result did not show negative effect on the relative organ weight, and the difference of the treatment means were not significant (p>0.05). Apparently, there were no negative effect detected even in the gizzard. The growth factors correlate with age, while the poultry uses in the relative age cause the same internal organ's growth (Sjofjan et al. 2021). In agreement with Blandon et al. (2015) who stated that the used of banana peels meal replacing maize, were no significant difference (p>0.05) both carcass trait and relative organ weight. The factors affected this result might be due to that banana tuber meal contains secondary compounds like terpenoids, flavonoids and others phenolic compounds with a important physiological activity as reported by Blandon et al. (2015) and Fitroh et al. (2018) in banana peels. The terpenoids and flavonoids are anti-nutritional factors that are obstacle in the poultry, this phenolic compounds are hard to balance with other raw materials as a feed (Blandon et al. 2015). There was only slight reduction (p>0.05) in abdominal fat of the duck fed modified banana tuber meal (7.55%; 7.85%; 7.66%; 7.56%, respectively for M-BTM25, M-BTM50, M-BTM75 and M-BTM100 *vs*. 8.47% for control. The use of plantain plant in poultry has been limited because of possibility deleterious effects arising from the presence of tannin (Blandon et al. 2015). Blandon et al. (2015) stated that tannin existed in two forms, namely; (a) free active form caused bitter taste and (b) bound tannin form which are insoluble, supposedly inert and has little or no effect on the palatability but can be useful to reduce abdominal fat (Blandon et al. 2015). In other hand, the reported from Najoan et al. (2020b) stated the flavonoid act can eliminated the abdominal fat which bound into glycine and taurine. The next step is forming glycine and taurine into bile salt and secreted to duodenum which is degraded by microbes (Najoan et al. 2020b).

CONCLUSION

The result provided by this study demonstrates the enhancement apparently growth performances and digestibility parameters of colored-feathered of hybrid duck (Pekin x Khaki Campbell) after fed modified banana tuber meal (M-BTM) diets.

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