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Evaluation of The Use of Cassava Based Complete Ration Silage on Nitrogen Retention and Metabolizable Energy Male Duck

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Abstract

The purpose of this study was to evaluate the effect of complete ration silage made of cassava biomass on nitrogen retention and metabolizable energy of male ducks. Control diet consisted of corn, rice bran, coconut meal, soybean meal, vegetable oil, fish meal and premix. While the treatment of silage ration of cassava based (BBS) consisted of leaves, peel, and tubers of cassava, as well as a mix of fish meal, vegetable oil, premix, DL-methionine and L-lysine. The experimental design used was completely randomized design with 5 treatments and 4 replicates i.e. S0 (100% control diet), S25 (75% control diet + 25% BBS silage), S50 (50% control diet + 50% BBS silage), S75 (25% control diet + 75% BBS silage), and S100 (100% BBS silage ration). Measurement of metabolizable energy and nitrogen retention was conducted using 25 male ducks aged 10 weeks maintained in metabolic cages and adapted to experimental diets for seven days. Ducks were fasted for 24 hours before the experimental diets were offered. Metabolizable energy and nitrogen retention were measured. The results showed a decline in nitrogen retention and metabolizable energy along with the increasing level of BBS silage in the rations. The conclusion of this study was the use of up to 75% BBS silage generated metabolizable energy and nitrogen retention that do not differ from the control ration.

Keywords: cassava silage, complete ration, male duck, metabolizable energy, nitrogen retention

Abstrak (Indonesian)

Tujuan penelitian ini adalah untuk mengevaluasi pengaruh penggunaan ransum komplit silase berbahan baku singkong terhadap retensi nitrogen dan energi metabolis itik jantan. Sebanyak 25 ekor itik jantan umur 10 minggu dipelihara dalam kandang metabolik dan diadaptasikan selama tujuh hari. Setelah puasa 24 jam itik diberi ransum perlakuan. Energi metabolis dan retensi nitrogen diukur. Ransum kontrol terdiri dari jagung, dedak halus, bungkil kelapa, bungkil kedelai, minyak sayur, tepung ikan dan premix. Sedangkan ransum perlakuan silase bahan baku singkong terdiri dari daun, kulit, umbi dan onggok, serta campuran tepung ikan, minyak sayur, premix, DLmetionin dan L-lisin. Rancangan yang digunakan adalah Rancangan Acak Lengkap dan setiap perlakuan terdiri atas 2 ulangan, yaitu S0 (100% ransum kontrol), S25 (25% ransum silase BBS), S50 (50% ransum silase BBS), S75 (75% ransum silase BBS) dan S100 (100% ransum silase BBS. Hasil pengamatan menunjukkan adanya penurunan retensi nitrogen dan energi metabolis itik jantan seiring dengan peningkatan taraf penggunaan silase berbahan baku singkong dalam ransum ternak itik. Kesimpulan dari penelitian ini adalah penggunaan sampai 75% silase berbahan.

Kata Kunci: itik jantan, ransum kompit, silase singkong, Energi metabolisme, retensi Nitrogen

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INTRODUCTION

The preparation of rations right and suitable for the need every period age duck influenced by nutritional value feedstuff is used. Chaos wherever possible use of that is easily obtained, prices are relatively cheap and its quality qualified. One alternative feed ingredient with the potential to be used is the non-conventional feed ingredients from agricultural waste which is widely known and has been tested on animals such as cassava (tubers, leaves and peel) and waste from tapioca industry. Utilization of cassava, especially the leaves and peel are still limited by the presence of cyanide (HCN) and high crude fiber [1]. One method to reduce the cyanide content is the processing technology through the production of cassava-based silage with enzyme addition of rumen fluid and bacteria *Leuconostoc mesenteroides*. The use of silage is one strategy to optimize the use of cassava-based feed to achieve optimal productivity of duck.

The composition of substances feed in rations ducks is one of the factors that can affect growth and the production of duck, therefore material feed authors it is important to note the womb nutrition, among others value energy/calories to determine rations to suit the needs of energy metabolic (EM) that will be consumed ducks. Like duckling to achieve growth and the production of the duck meat which is optimal takes energy metabolize different based on the level for themselves and for their ducks, or period of ducks (a starter, grower, and, finisher). The measurement of energy content directly at ducks was calculated using metabolic energy prices on feed ingredients before arranging rations so that the metabolic energy (EM) on the type of rations for consumption ducks could meet the standards of the needs of ducks. The purpose of this study trying to evaluate the use of a complete ration of silage made from cassava on the retention of nitrogen and metabolizable energy of male of duck.

MATERIALS AND METHODS

The cage for DOD maintenance and metabolic cages used to measure metabolizable energy and nitrogen retention were cleaned up and spray by disinfectant to kill germs and pathogens. The cages were then left for two weeks. Rice husks were used as a litter. Each cage was equipped with buckets for feed and drinking water as well as lights bulb.

Silage Making and Ration Formulation

Each material of silage ration of cassava-based BBS silage i.e. leaves, bark, roots was cut to the size of 1-2 cm and then mixed with tapioca processing waste and placed in a plastic bag. Rumen fluid enzyme with a dosage of 1% (w/v) was added to the silage material, mixed until homogeneous and incubated for 24 hours at room temperature. After BBS silage (moisture content 60-70%) hydrolysis with rumen fluid enzymes, the materials were put into a silo and then added *Leuconostoc mesenteroides* inoculum dose of 1% (10-6sel / ml) by spraying it gradually and repetitively. Silo was then compacted, sealed and incubated for 30 days. After that the silage was harvested and dried in an oven for three days. Dry BBS silage was milled with a milling machine to be used later as a mixture of duck feed. Making ration was begun by analyzing the nutrient content of feed ingredients using proximate analysis. Rations were formulated with protein content of 16% and metabolizable energy of 2900 kcal/kg as recommended by the NRC [2]. The composition and nutrient content of the experimental ration presented in Table 1 and Table 2.

Then enzyme rumen fluid with a dosage of 1% (w/v) was added to the silage material, mixed until homogeneous and incubation carried out for 24 hours at room temperature. After BBS silage (moisture content 60-70%) being hydrolyzed with enzymes rumen fluid, the material was then put into a silo and then added *Leuconostoc mesenteroides* inoculum dose of 1% (10-6 cell/ml) by spraying little by little repetitively. Silo then compacted and sealed and fermented for 30 days. Harvested silage was then dried in an oven for three days. Dry BBS silage was milled with a milling machine and would be used later as a mixture of duck feed. Ration formulation began by analyzing the nutrient content of feed materials using proximate analysis. Rations were formulated with protein content of 16% and metabolizable energy (2900 kcal/kg) as recommended by the NRC [2].

Table 1. The ingredients composition of experimental rations

Feed Ingredients	Control ration (%)	BBS silage ration (%)
Corn	50.60	-
Rice bran	21.75	-
Coconut meal	3.65	-
Soybean meal	10.00	-
Cassava leaves	-	35.00
Cassava peels	-	23.00
Cassava Tubers	-	17.10
Tapioca processing waste	-	10.20
Fish meal	10.00	10.00
Vegetable oil	3.31	3.31
Premix	0.69	0.69
DL-methionine		0.35
L-lysine		0.30

Table 2. Nutrient content of experimental rations

Nutrient	Treatments				
	S_0	S_{25}	S_{50}	S_{75}	S_{100}
Dry matter (%)[1]	88.34	88.50	88.09	88.21	87.53
Crude Protein (%	19.91	17.24	17.30	18.50	18.25
Ether extract (%)	8.68	7.83	7.62	4.91	4.35
Crude fiber (%)[1]	7.73	7.06	7.21	7.58	7.91
Ca (%)[2]	1.22	1.07	0.82	0.77	0.68
P (%)[2]	0.48	0.40	0.41	0.41	0.40
GE (Kkal/kg)[3]	4091.55	4085.92	4054.93	4008.45	4019.72
HCN (ppm)[2]	0	15.69	21.77	25.07	27.80
Methionine (%)[4]	0.37	0.37	0.37	0.37	0.37
Lysine (%)[4]	0.99	0.89	0.92	0.94	0.85

Note: S_0 (100% Control ration), S_{25} (25% BBS silage ration), S_{50} (50% BBS silage ration), S_{75} (75% BBS silage ration) and S_{100} (100% BBS silage ration).
[1]Analysis result of PAU IPB Laboratories (2008), [2] Analysis result of Dairy Nutrition Laboratory of Faculty of Animal Science of IPB (2008), [3] Analysis results of Feed Industry & Technology Laboratories of Faculty of Animal Science of IPB (2008). [4]Calculation result

Measurement of Metabolizable Energy and Nitrogen Retention

Twenty male ducks were placed in individual cages for each treatment and each replication. Before collecting excreta, ducks were adapted for one week to the experimental feed. The feeding was done by applying the methods of forced feeding of Sibbald and Wolynets [3]. Once adapted, all the ducks were fasted for 24 hours. The ducks were forced to consume treatment feed as much as 50 g with the aid of a funnel. Four other ducks remained fasted (not given a drink and treatment feed at all) to get energy and endogenous nitrogen. Twenty-four hours after the administration of rations, excreta were collected.

During the collection of excreta, every two hours excreta was sprayed with a solution of dilute H2SO4 (0.01N). Here in after collected excreta was put in a sealed plastic bag and stored in the freezer. For measurement of gross energy and nitrogen, excreta were removed from the freezer and dried in a 600oC oven for 24 hours and after that the dried excreta was crushed. Gross energy content was measured using a bomb calorimeter and nitrogen with Kjeldhal method.

Variables measured

The parameters measured were consumption of nitrogen, nitrogen excretion, nitrogen retention, true metabolizable energy, apparent metabolizable energy, and nitrogen corrected apparent metabolizable energy calculated using formulas according to Wolyntez and Sibbald [4].

Experimental Design

The experimental design used was completely randomized design (CRD) with 5 treatments and 4 replicates. The treatment consisted of S0 (100% control diet), S25 (25% ration of BBS silage), S50 (50% ration of BBS silage), S75 (75% ration of BBS silage), S100 (100% ration of BBS silage). Data were analyzed by ANOVA using SAS 6:12, and if it showed significant differences were further tested with Duncan Multiple Range Test.

RESULT AND DISCUSSION

Nitrogen Retention

Nitrogen retention is evaluated to measure the efficiency of protein utilization in an ingredient. Nitrogen retention is the differences between nitrogen consumption and nitrogen excreted after it is corrected with endogenous nitrogen. The calculated nitrogen consumption, excreted nitrogen, and nitrogen retention of male ducks fed rations containing BBS silage are presented in Table 3.

Table 3. Nitrogen consumption, excreted nitrogen, and nitrogen retention of male ducks fed rations containing BBS silage

Variable	Treatments				
	S_0	S_{25}	S_{50}	S_{75}	S_{100}
N consumption (g)	1.41	1.22	1.22	1.31	1.28
N excretion (g)	0.86	0.83	0.84	0.92	1.08
N retention (g)	0.88	0.71	0.71	0.71	0.53
N retention (%)	62.58± 6.81[a]	58.53± 4.74[a]	58.41± 6.58[a]	54.41± 2.92[a]	41.83± 3.26[b]

S_0 (100% control ration), S_{25} (75% control ration+25% BBS silage), S_{50} (50% control ration+50% BBS silage), S_{75} (75% control ration+25% BBS silage) and S_{100} (100% BBS silage ration). Endogenous Nitrogen = 0.33 g. Different superscripts in the same row mean significantly different (P<0.05).

Nitrogen excretion for all treatments was lower than nitrogen consumption. This means that there was some nitrogen deposited in the animals, so that nitrogen retention had positive value. Positive nitrogen retention indicated that nitrogen consumption has exceeded the minimum animal's requirement. The deposited nitrogen will be utilized by the animals for maintenance and production [5]. The amount of nitrogen deposited for S0, S25, S50, S75 and S100 was 0.88 g (39.01%), 0.71 g (31.97%), 0.71 g (31.15%), 0.71 g (29.77%) and 0.53 g (15,62%), respectively.

Nitrogen excretions for S0, S25, S50, S75 and S100 were 0.86, 0.83, 0.84, 0.92 and 1.08 g, respectively. The nitrogen excretions obtained in this experiment were higher than those reported by Setiowati [6] with the value of 0.46 g. The differences might be related to way of collecting the excreta. Sibbbald [7] reported that the collection of excreta for 0-24 hours and 24-48 hours yielded different amount of excreta. In addition, the amount of nitrogen excretion was influenced by body weight.

Nitrogen excretion and nitrogen retention were lower than nitrogen consumption (Table 3). This means that part of consumed nitrogen was retained in the ducks. Sutardi [8] reported that not all nitrogen consumed will be retained in the body, part of them will be excreted through feces and urine, but the excreted nitrogen is not fully from undigested feed, some of them are from intestine mucosal cell, bile and digestive tracts. Higher nitrogen retention indicated higher nitrogen absorbed and utilized by the animals [2].

The use of BBS silage in the rations reduced ($P<0.05$) nitrogen retention. The highest nitrogen retention was shown by control ration (ration without BBS silage) that was 62.38% or 0.88 g and the lowest were obtained from ration with 100% BBS silage, the value was 41.83% or 0.53 g. The correlation between the level of BBS silage (X) and nitrogen retention (Y) showed linear reduction with the equation:

$Y = -4.56x + 68.83$,

with determinant coefficient of R2= 0.82. This indicates that the increasing level of BBS silage decreases the nitrogen retention from 62.58% in control to 41.83% in the ration with 100% BBS silage. Khempaka [1] reported that nitrogen retention linearly decreases with the increasing level of cassava meal in the broiler rations.

Similar finding is reported by Loe [9] in pigs that nitrogen retention is decreasing when cassava leaf silage is added to the ration. In this research, nitrogen retention of the ration with 75% BBS silage was still higher than those fed 100% BBS silage. This indicates that the use of 75% BBS silage in the male duck ration is still applicable. According to Hermentis [10] the use of fermented cassava peels up to 30% in the broiler ration, the nitrogen retention is not significantly different with control, but the use of 40% fermented cassava peel significantly reduces nitrogen retention.

The reduction of nitrogen retention in the BBS silage ration in this experiment is due to the increasing level of cyanide content. The protein utilization is not optimum in the present of cyanide because some sulfur containing amino acids are used to neutralize cyanide, so that there are amino acids imbalances in the animals. Okafor [11] and Monzona [12] reported that sulfur containing amino acids play important role in cyanide detoxification process.

Amino acids imbalances will limit the protein synthesis. Aletor [13] and Emiola [14] reported that anti nutrients will affect digestibility and absorption of nutrients. Cheeke [15] also reported that cyanide will reduce amino acids absorption in the intestine, so that reduces nitrogen retention. According to Stuempf [16], detoxification of cyanide has negative effect on energy and nitrogen balances.

Metabolizable Energy

Measurement of metabolizable energy is the most common practice in poultry nutrition, because this measurement can be used for many purposes including maintenance, growth, finishing, and egg production. Metabolizable energy is subtraction of gross energy intake and gross energy recovered in excreta. From the analysis and calculation, it is obtained Apparent Metabolizable Energy (AME), True Metabolizable Energy (TME), AME corrected nitrogen (AMEn) dan TME corrected nitrogen (TMEn). Calculated metabolizable energy (AME, TME, AMEn and TMEn) in male ducks is presented in Table 4.

High value of TME compared to AME because TME is calculated by considering the excreted endogenous energy in the ducks that are fasted for 48 hours. In this experiment, the endogenous energy was 22.06 kcal. Endogenous energy is an originated energy from intestine cells, bile salts, and metabolic enzymes that are excreted through feces and urine [7]. AME does not consider the endogenous metabolizable energy and urine.

The increasing level of BBS silage in the ration reduced the metabolizable energy (AME, AMEn, TME and TMEn), but the metabolizable energy (AME, AMEn, TME and TMEn) of ration with 75% BBS silage was higher than that of ration containing 100% BBS silage. Reduction of metabolizable energy (AME, AMEn, TME, TMEn) might be caused by the increasing level of cyanide in BBS silage rations. Amrullah [17] said that the present of toxic compound in feed will reduce the metabolizable energy.

Ukachukwu [18] shows that metabolizable energy of broiler ration decreases when the ration is supplemented with cassava pellet. According to CCDN [19], cyanide is very toxic because it binds cytochrome oxidase and interfere respiration which is a very important energy conversion in the body. In addition, the imbalances of amino acids especially methionine affects the energy loss from the animal.

Table 4. Metabolizable Energy (EMS, EMSn, EMM and EMMn) of cassava biomass silage-based ration in male ducks

Variable	Treatment Ration				
	S_0	S_{25}	S_{50}	S_{75}	S_{100}
AME (kcal/kg)	2465.69±149.58[a]	2458.93±129.82[a]	2400.39±138.89[a]	2276.99±87.05[a]	1970.71±92.23[b]
AMEn (kcal/kg)	2301.81±133.52[a]	2326.22±121.83[a]	2267.49±129.66[a]	2144.59±90.37[a]	1870.31±88.78[b]
TME (kcal/kg)	2965.12±149.58[a]	2957.46±129.82[a]	2901.25±138.89[a]	2777.16±87.05[a]	2474.76±92.23[b]
TMEn (kcal/kg)	2801.24±133.52[a]	2824.75±121.83[a]	2768.35±129.66[a]	2644.76±90.37[a]	2374.37±88.78[b]

S_0 (100% control ration), S_{25} (75% control ration+25% BBS silage), S_{50} (50% control ration+50% BBS silage), S_{75} (75% control ration+25% BBS silage) and S_{100} (100% BBS silage ration). Endogenous energy =22.06 kcal. Different superscripts in the same row mean significantly different ($P<0.05$).

If the nutrient consumption is balance, the loss of energy can be minimized. In contrast, the loss of energy will be greater when nutrient consumption is not balance especially amino acids. Pilliang and Djojosoebagio [20] reported that balance amino acids can influence digestibility and absorption of energy. Low digestibility of ration causes the increase loss of energy through excreta leading to low metabolizable energy [21].

CONCLUSION

The increasing proportion of BBS silage in the ration reduced the nitrogen retention and metabolizable energy.

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