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Hasanuddin J. Anim. Sci.
Vol. 3, No. 2:78-84 November 2021
pISSN 2621-9182 eISSN 2621-9190
DOI:10.20956/hajas.v3i2.19173

Apparent Metabolizable Energy of Corn and Rice Bran for Philippine Mallard Duck

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Abstract

The metabolizable energy (ME) value of common feedstuffs for Philippine mallard duck (PMD) need to be established to formulate specific and balance diet for PMD. For this, the study was conducted to determine the apparent ME expressed in classical ME (AME) and nitrogen corrected ME (AMEn) of corn and rice bran for PMD. Eight PMD were used in the energy assay using the total collection method. An improvised digestibility cage was fabricated and used in the experiment modifying the basin technique in excreta collection. The homogenous wet mashes of corn and rice bran were tube-fed to the PMD twice with an interval of six hours. Excreta collection was done for 54 hours from the last scheduled tube feeding. Feed and excreta samples were sent to UPLB for protein and gross energy analyses. The experiment was carried out using the Completely Randomized Design. The calculated AME and AMEn of corn and rice bran for PMD were 3.63 and 3.61 kcal/g and 1.97 and 1.95 kcal/g, respectively. Corn tends to have a higher ME value than rice bran. The ME value of corn and rice bran for PMD is greater than the data of PHILSAN, which is the reference standard for poultry and livestock nutrient requirements in the Philippines. The result show that corn and rice bran have higher energetic value for growing PMD than book values for poultry. PMD is efficient in utilizing the energy content of corn and rice bran as manifested by the higher ME value.

Keywords : Metabolizable energy, Corn, Rice bran, Mallard duck

INTRODUCTION

Duck production in the Philippines is considered a specialized poultry enterprise that focuses on egg production that supplies a niche market of “balut” (an embryonated egg of 16-18 days old) and salted eggs. Mallard duck or “itik” is mainly raised for this purpose and traditionally reared in the backyard by rural households and integrated into the existing crop production system to provide low-cost animal protein and an additional source of augmented income. Nevertheless, semi-commercial production operations are also found in different parts of the country.

There is no established and available nutritional recommendation for mallard ducks in the Philippines, and the requirements are mostly based on chicken requirements. The nutrition requirement of the Philippine mallard ducks must be reviewed to consider the cost of metabolic activity, cost of egg development, and cost of egg-laying intensity. Of which, they found that all deviation in profit per egg is due to feed function. On the other hand, duck feed producers in the country based their formulations on the published nutrient requirements which were derived from different breeds of ducks usually the fast-growing strains abroad. Some are using the nutrient requirements of chicken as the basis.

In the determination of the optimum nutrient requirements, there is a need to establish first the data on the nutrient values of feedstuffs specific for mallard ducks; particularly it is energy components since they comprise the bulk of the diet. Corn and rice bran are the most common ingredients used as a source of energy in the diets of poultry including ducks. Rice bran utilization particularly for chicken is limited due to its high fibre content. Different energy systems for poultry have been evaluated and tested however; the metabolizable energy system is still widely used when formulating diets. The other systems such as classical and corrected nitrogen total metabolizable energy and net energy (NE) have been tested and established in numerous researches however, it is seldom used as the basis for feed formulation. This study was conducted to determine the metabolizable energy of corn and rice bran specifically for Philippine Mallard duck

MATERIALS AND METHODS

Experimental Design and Feeding of Birds

Eight females growing 11week Philippine mallard ducks, with body weights ranging from 893±165 grams were used in the energy assay using the total collection method. There were two treatments, comprised of two dietary groups, corn and rice bran (D2). Each bird served as an experimental unit and there were four birds per treatment. The birds were kept in an improvised digestibility cage made with light plastic materials throughout the experimental period.

The experimental feedstuffs particularly the corn was ground through a 0.5-mm screen. Thirty grams of the test feedstuffs were diluted with 80 mL water in 200 ml glass beakers to make the homogenous wet mash. The wet mash was force-fed to the birds through a 30-cm-long, 8-mm diameter tygon tube connected to a 60-mL syringe. Specifically, the tygon tube was carefully inserted into the oesophagus of each duck. The wet mash was poured slowly into the syringe barrel and a plastic rod was used to gently force the mash through the syringe into the oesophagi of the ducks. Afterwards, the remaining 20 mL of distilled water was used to wash the particle of feedstuff that adhered to the tube and syringe barrel into the bird’s oesophagus (King *et. al.,* 1997). The crude protein and energy contents of the corn and rice bran (D2) were 6.51 and 6.66 % and 4018 ad 4046 cal/g, respectively.

Excreta Collection Equipment and Methodology

A modified basin method was used in the experiment. Each bird was kept secured in a dish basket (40 x 30 cm) with a cover and suspended into an old fruit crate lined with a clear plastic sheet which was used to collect the excreta (Figure 1). Before force-feeding, clear plastic sheets were lined to the bottom of the fruit crates. The plastic sheets were changed every time the excreta were collected based on the time stated in the experiment protocol.

Figure 1. The experimental birds in their individual improvised digestibility cage made with light plastic materials

Experimental Procedures

Before the experiment, the birds were checked thoroughly and adhering dirt to their plumage and feet web was removed. A three-day adaptation periods (Mustafa *et al*., 2004) were followed by placing the birds into the digestibility cages and feeds and water were made available during this period. The modified feeding methodology followed was based from Ragland *et al*. (1997) and Adeola *et al.* (1997). Forty-eight hours before feeding, feeds were withdrawn from all ducks. At 8 and 32 hours after feed withdrawal, all ducks were tube-fed with 15 g of dextrose in 100 mL of distilled water and allowed to purge their gastrointestinal tracts. At 48 and 54 hours after feed withdrawal, all ducks were tube-fed with 30 grams of their assigned test ingredient. The time allotted for excreta collection was based on King *et al.* (1997). The excreta collected from the plastic sheets were placed in a specimen plastic cup, contaminants were carefully removed, and the excreta was weighed, labelled and frozen immediately at -18 ^{o}C. The summary of the digestibility trial protocol followed is presented in Table 1.

Analysis of Excreta and Treatment of Results

The frozen excreta samples were allowed to come to equilibrium with room temperature, contaminants were further removed with aid of stereomicroscope, dried at 55 ^{o}C, weighed, and then ground through a 0.5-mm screen. Excreta and feed samples were placed in airtight containers and sent to the Animal Nutrition Analytical Service Laboratory of the University of the Philippines at Los Banos for proximate analyses. The AME values of the feedstuffs were calculated by the method cited by Ragland *et al.* (1997). The AME and AMEn were calculated as follows: AME = (EI – EO)/FI and AMEn = AME – (8.22 x ANR/FI wherein, where EI is gross energy intake (kilocalories); EO is gross energy output in the excreta (kilocalories); FI is feed intake (grams); ANR is apparent nitrogen retention (grams) calculated as the difference between nitrogen intake and nitrogen output. On the other hand, analysis of variance was performed using the STAR Statistical Software package.

Table 1. Feeding and collection schedule protocol prior to assay

Day	Hours after feed withdrawal	Operation
1	0	Feed withdrawal
1	8	Ducks fed with dextrose solution (15 g/100 g water)
2	32	Ducks fed with dextrose solution (15 g/100 g water)
3	48	Ducks weighed for initial weight
		Ducks fed (30 g/100 g water) appropriate feedstuff. Plastic sheets were placed in the fruit crates.
3	54	Excreta collected and frozen
		Ducks fed (30 g/100 g water) appropriate feedstuff. Changed plastic sheets
3	60	Excreta collected and frozen and changed plastic sheets.
4	72	Excreta collected and frozen and changed plastic sheets.
4	84	Excreta collected and frozen and changed plastic sheets.
5	96	Excreta collected and frozen and changed plastic sheets.
5	102	Excreta collected and frozen and changed plastic sheets.
		Ducks weighed for final weight and removed from the digestibility box/cage

RESULTS AND DISCUSSION

The recorded average weight loss of the birds during the 102-hour experiment was 88.25 and 79.75 grams for birds fed with rice bran (D2) and corn respectively. The dry excreta voided by the birds fed with rice bran (D2) and corns were 6.75 and 40.5 grams respectively. The high excreta output of ducks tube-fed with rice bran (D2) is attributed to the high fiber content of the feed material about 10.20% (PHILSAN, 2010). On the other hand, the apparent nitrogen retained by ducks tube fed with corn is 0.096 grams while 0.14 grams for duck's tube-fed with rice bran. The recorded apparent nitrogen retained by ducks' tube-fed with corn is similar to the findings of Ragland *et al.* (1997) and slightly higher with the data obtained by King *et al.* (1997) both using Peking ducks as experimental birds. The classical and nitrogen corrected apparent metabolizable energy of corn and rice bran (D2) is presented in Table 2.

Corn tended to have a higher($P<0.05$) metabolizable energy value for mallard duck expressed in classical and nitrogen corrected metabolizable energy at 3.63 kcal/g and 3.62 kcal/g, respectively compared to rice bran at 1.97 kcal/g and 1.95 kcal/g. In the gross energy analysis of corn and rice bran (D2), rice bran was observed to have slightly higher gross energy at 4046 cal/g compared to the 4018 cal/kg of corn however, it was found out that the energy content in corn is well utilized by the mallard ducks as manifested by the higher AME and AMEn values of the latter feedstuff. Corn is considered an excellent source of energy (PHILSAN, 2010) through its starch components; it possesses the highest starch content at 600-700 g/kg dry matter (Zhou *et al*. 2010). On the other hand, the rice bran (D2) utilized in the study is characterized as the pericarp or bran layer and germ of rice, but with a higher quantity of hull than rice bran (D1) (PHILSAN, 2010). Shaheen *et al*. (2015) shared that the major carbohydrates of rice bran are cellulose and hemicelluloses and a fraction of starch originated from the breakage of endosperm during the milling process. Rice bran contains higher fat content than the rice itself which might explain the increase of the gross energy component when subjected to direct energy analysis; however, due to its physical nature of containing high fibre, it may decrease energy utilization when consumed by animals (Zhang *et al*., 2021) which might explain the reduced metabolizable energy value for mallard ducks.

Table 2. The classical and nitrogen corrected metabolizable energy (AME andAMEn) content of corn and rice bran (D2) for growing Philippine mallard duck

	Corn	Rice bran (D2)	SEM[1]	CV (%)
AME (Kcal/g)	3.63^a	1.97^b	0.19	9.51
AMEn (Kcal/g)	3.62^a	1.95^b	0.18	9.37

[1]Standard error of the mean (n = 8)
[ab]Means with different superscripts are different (P<0.05)

Comparing ME values of corn and rice bran to other published literature, variations were observed which might be attributed to the procedure of energy assay, species, breeds, strains used among others. The apparent ME value both classical and nitrogen corrected of corn (3.63 kcal/g and 3.62 kcal/g) for mallard duck were higher compared with the earlier studies where obtained values were 3.207 and 3.208 kcal/kg (Ragland *et al.*, 1997), 3.16 and 3.24 kcal/kg (King *et al*., 1997), 3.28 and 3.32 kcal/kg (Adeola *et. al*., 2003); 3.62 and 3.51 kcal/kg (Hoai *et al.*, 2011) and 3.48 and 3.42 kcal/kg (Zhao *et al.*, 2014), respectively. These latter researchers used Peking and cherry valley ducks as experimental birds and different excreta collection method was used particularly the attachment of excreta collection bag to the vent of the ducks through surgical fixation except for Hoai *et al*. (2011) that utilized the basin method which is quite similar with the method used. However, the same feeding style was used particularly the controlled or tube feeding method except for Hoai *et al.* (2011) who used ad-libitum feeding. In can be deduced from the result of the experiment that in contrast with the above literatures, corn has slightly higher metabolizable energy value for mallard duck compared with other breeds particularly, the Peking and cherry valley ducks irrespective of the methods of energy assay performed. Similar observations were achieved in chickens (Tyagi *et. al*., 2008; Amerah *et al*., 2008; and Liu *et al*., 2020). It is claimed that the energy values of feedstuffs used in the formulation of duck diet based or extrapolated from chicken. On the other hand, the Philippine Society of Animal Nutritionists (PHILSAN), who based their data from National Research Council (NRC) presented that the metabolizable energy value of corn for poultry is 3300 kcal/kg which is lower than the findings of the study. The PHILSAN feed reference standards are considered the primary source data needed in the formulation of animal diets in the Philippines. This may imply that mallard ducks may have a greater capacity to metabolize corn than other breeds which were used as the basis for PHILSAN (2010) reference standards.

Rice bran is an important rice by-product but its utilization is limited particularly in diets of chickens due to its high concentration of non-starch polysaccharides. The metabolizable energy of rice bran for mallard duck (1.97 and 1.96 kcal/g) is lower than the reports of Hoai *et. al*. (2011) and Hyunh *et al*. (2013) for Pekin and cherry valley ducks. However, the latter researchers did not mention the type of rice bran used in their experiments. As previously mentioned, the study utilized rice bran (D2) with relatively higher concentration of hull which might affect the energy utilization capacity of the mallard ducks used in this experiment. Nevertheless, comparing it with PHILSAN, the book presented that the metabolizable energy value of rice bran (D2) is 1600 kcal/kg which is lower than what the experiment recorded. The mallard duck has the capacity to utilize the energy of the rice bran (D2) as manifested by the higher metabolizable energy.

CONCLUSION

Corn has a higher apparent metabolizable energy value expressed in classical and nitrogen corrected values (AME and AMEn) than rice bran. The study revealed that Philippine mallard duck utilized more efficiently the energy content of corn compared with literature using Pekin and cherry valley ducks irrespective of the methods of energy assay utilized. On the other hand, both corn and rice bran have higher energy values for mallard ducks compared to the reference standard published by PHILSAN. Therefore, the energy utilization values of these feedstuffs may contribute to the adjustment in the formulation of diets for Philippine mallard ducks which harness the actual metabolizability of the energy contents in these ingredients and produce better least cost formulations.

Similar studies are further solicited to validate the findings. Moreover, it is recommended that experimental ducks to be used in energy balance assay should be docile or must be accustomed to human contact and close environment, other methods of excreta collection must be considered and the other breeds of “Itik Pinas” should also be used to evaluate the metabolizable energy value of feedstuffs.

ACKNOWLEDGEMENT

The author greatly acknowledges the DOST-ASTHRDP for the scholarship grant, the PhD Animal Science program of the Central Luzon State University for the learning opportunity and the Mariano Marcos State University who have sent the author to full-time graduate schooling.

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