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A Bioassay Method for Metabolizable Energy of Feedstuffs for Peking Ducks

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Abstract: Three experiments were carried out to determine optimal feed input and excreta collection time in bioassay of feedstuff true metabolizable energy for ducks. In experiment 1, 20 drakes had been food withdrawn and were allocated to 4 groups, each of which contained 5 birds. Birds of each group were force-fed 50 g complete feed, approximately 48 h after food withdrawal. The excreta voided during the exact 56 h following feeding were collected. In experiment 2, 28 drakes were force-fed 50 g complete feed, approximately 48 h after food withdrawal. 4 birds were killed by an intravenous dose of sodium pentobarbitone 4 h, 8 h, 14 h, 24 h, 32 h, 38 h and 48 h after feeding. The residues in alimentary canal were collected and dried in an oven at 65°C. In experiment 3, 70 mature drakes were allocated to 7 groups. The treatments comprised an unfed negative control and five levels of feed input (30, 50, 70, 90, 110 and 150 g complete feed). The birds were force-fed at approximately 48 h after food withdrawal. The excreta voided during the exact 36 h following feeding were collected. The results indicated that the time prior to force-feeding and excreta collection period should be 32-36 h when evaluating feed metabolizable energy and 50-70 g feed per bird is feasible for evaluating feed metabolizable energy.

Key words: Excreta collection time, feed input, metabolizable energy, ducks

Introduction

Studies of bioavailable energy have shown significant differences in the dietary requirements and energy utilization of ducks and chickens (Muztar *et al*., 1977; Siregar and Farrell, 1980ab; Ostrowski-Meissner, 1983; Mohamed *et al*., 1984). However, duck diets are usually formulated by using ME taken from tables of chicken bioassay data because there are limited data on determinations of the available energy content of feedstuffs for ducks. There are even few reports on the bioassay method of duck feedstuffs.

Feed input and excreta collection time are tow key factors influencing the accuracy of bioassay for true metabolizable energy of chicken feedstuffs (Sibbald, 1975; Sibbald, 1976). High levels (90 g per bird) of feed input may lead to crop impaction, so the feed input have to be relatively low. On the other hand, the assay involves feeding relatively small amounts, any carry over from the previous diet or incomplete clearance of residues from the feeding stuffs being tested within the period over which collection takes place will affect the derived TME values. Fast can ensure the complete clearance of residues, but fasting is too long which may cause discomfort of the birds.

In present study, three experiments were carried out to determinate optimal feed input and excreta collection time in bioassay of feed stuff true metabolizable energy for ducks.

Materials and Methods

In all experiments, mature peking drakes, aged between 25 and 30 weeks, were used. The birds had a average body weight of 4.00±0.10 kg. The drakes were kept in individual cages with individual eating and watering facilities in a controlled environment (25°C). When not under experiment the birds had access *ad libitum* to a complete diet, the composition of which is given in Table 1. The excreta collection apparatus were prepared according to the method developed by Adeola *et al*. (1997) one week before experiment for experiment 1 and experiment 2.

Table 1: Composition of test diet

Feedstuffs	Contents	Nutrient Analysis	Nutrient Contents
Corn	60	ME MJ KG	11.92
Wheat Bran	10	Crude Protein	16.94
Leese	10	Crude fibre	3.00
Soybean Meal	16	Calcium	0.90
Premix	4	NNP	0.41

In experiment 1, 20 drakes had their food withdrawn and were each allocated to one of 4 groups, such that each group contained 5 birds. Birds of each group were force-fed 50 g complete feed, approximately 48 h after food withdrawal. The excreta voided during the exact 56 h following feeding were collected and sorted by a 4 h interval, then they were dried in an oven at 65°C.

In experiment 2, 28 drakes were force-fed 50 g complete feed, approximately 48 h after food withdrawal. The birds had access *ad libitum* to water. 4 birds were killed by an intravenous dose of sodium pentobarbitone 4 h, 8 h, 14 h, 24 h, 32 h, 38 h and 48 h after feeding. The residues in alimentary canal were collected and dried in an oven at 65°C.

In experiment 3, 70 mature drakes were allocated to one

Table 2: Excreta energy and dry matter (DM) of different time

Time (h)	0-4	4-8	8-12	12-16	16-20	20-24	24-28
DM Excretion g	18.70±3.51^{a}	30.28±4.33^{b}	12.50±3.24^{c}	10.55±1.94^{c}	4.00±0.48^{d}	3.80±0.59^{d}	3.38±0.98^{d}
Energy Excretion kJ	-	-	-	-	47.98±4.26^{a}	46.95±4.44^{a}	48.51±5.01^{a}
Time (h)	28-32	32-36	36-40	40-44	44-48	48-52	52-56
DM Excreion g	3.38±0.90^{d}	3.00±0.24^{d}	3.28±0.71^{d}	3.25±0.47^{d}	3.05±0.55^{d}	3.10±0.48^{d}	2.98±0.90^{d}
Energy Excretion kj	45.35±3.89^{ab}	40.19±4.12^{b}	39.83±5.13^{b}	39.50±3.56^{b}	38.95±4.85^{b}	38.92±4.23^{b}	39.42±4.17^{b}

$^{a-d}$ Different superscripts within the excreta collection time and the same parameters indicate significant differences ($p < 0.01$).

Table 3: The change of residues in alimentary canal with fast time

Time (h)	4	8	14	24	32	38	48
Residues in alimentary canal (g)	23.43±3.98^{a}	11.40±0.24^{b}	8.38±0.41^{bc}	7.50±0.37^{c}	6.60±0.54^{c}	6.70±0.61^{c}	6.63±0.38^{c}

$^{a-c}$ Different superscripts within the fast time and the same parameters indicate significant differences ($p < 0.01$).

Table 4: The effect of feed input (FI) on metabolizable energy

FI g	30	50	70	90	110	150
AME kJ/kg	9965±1074^{bc}	11060±514^{a}	11324±397^{a}	11119±556^{ab}	10467±418^{a}	9585±334^{c}
TME kJ/kg	12527±782^{a}	12423±485^{a}	12122±560^{a}	11608±535^{b}	11002±489^{b}	9936±518^{c}

$^{a-c}$ Different superscripts within the feed input and the same parameters indicate significant differences ($p < 0.01$).

Table 5: The effect of feed input on endogenesis energy loose (EEL)

FI g	0	30	50	70	90	110	150
EEL kJ	58269±8201^{b}	49374±9326^{b}	54562±6520^{b}	52442±5785^{b}	44542±4401^{b}	59636±1047^{ab}	89795±21899^{a}

$^{a-b}$ Different superscripts within the feed input and the same parameters indicate significant differences ($p < 0.01$).

of 7 groups. The treatments comprised an unfed negative control and five levels of feed input (30, 50, 70, 90, 110 and 150-g complete feed). The birds were force-fed at approximately 48 h after food withdrawal. The excreta voided during the exact 36 h following feeding were collected and dried in an oven at 65°C.

The gross energy of feed and excreta were determined in a Parr-1821 bomb calorimeter. Data were analyzed by tow-way analysis of variance using ANOVA procedure of SAS software (SAS Institute, 1996). Means were compared by Duncan's multiple-range test when P-value was statistically significant ($p < 0.01$). The quadratic and linear models were analyzed using REG procedure of SAS software (SAS Institute, 1996).

Results

DM excretion increased and decreased with increase of fast time after force-feeding (Table 2). DM excretion between 4 h and 8 h after feeding is significantly more than that of other periods ($p < 0.01$). 8 h after feeding, DM excreta decreased.

Energy excretion didn't parallelize with DM excretion. Energy excretion of the periods during 16-28 h were significant more than that of the periods after 32 h ($p < 0.01$) and the energy excretion of the periods after 32 h. With the increase of fast time, the residues in alimentary canal decreased to a relative low weight and remained stable after 24 h time point. The regression of residues on fast time were calculated.

$$y = 4.21 + 72.72/x \ (r^2 = 0.97, p < 0.01)$$

It is shown on Table 4, when feed input increased from 30 g to 70 g, AME increased ($p < 0.01$) while TME decreased slightly ($p > 0.01$). The metabolizable energy decreased significantly, with the increase of feed input, when feed input was more than 70 g ($p < 0.01$). Endogenesis energy loose changed non significantly when feed input increased from 0 to 110 g, but increased significantly when the feed input reached 150 g ($p < 0.01$).

Discussion

It is reported that ducks and chicks are different in the basic metabolism of energy (Siregar and Farrell, 1980ab). Also, the passage rate of chyme from duck alimentary canal is more rapid than that of chicks' (Li and Li., 1984). Residues in roosters alimentary at 24 h after feed withdrawal was much more than that at 48 h. In our experiment, DM and gross energy excretion decreased to a stable level at 20 h and 32-36 h after force-feeding, respectively. This is in agreement with the result of Han and Wu (1984). We can infer that the fast time before feeding and the excreta collection time should no less than 32 h, when the bioassay for metabolizable energy of duck feedstuffs. This is disagree with the result of Shi *et al.* (1993) for Tianfu ducks.

The apparent metabolizable energy firstly increased then declined with the increase of feed input. It decreased significantly when the feed input is more than 70 g. This was not agree with previous report (Sibbald, 1975), which indicated that apparent metabolizable energy was linear with feed intake. This may due to the difference in feed method, namely, *ad libitum* and force-feeding. When birds were force-fed, more feed input need more time for clearance of alimentary canal (Sibbald and Morse, 1982). In our experiment, the oesophageal inflated part of ducks was abnormally impacted, so the ducks were under depression. We found much

undigested feed in the excreta of the ducks received too much feed, which indicated that extra feed input may result in abnormal digestion.

The basis of TME is that, under standardized conditions, the excretion of metabolic fecal energy plus endogenous urinary energy (EEL) is constant has been explained by Guillaume and Summers (1970) and been proven in poultry (Sibbald, 1975). In present experiment, EEL was constant when feed input is no more than 90 g, which was agreed with it. But when feed input exceeded 90 g, EEL significantly increased. This owed to the undigested feed in excreta. The EEL of control group had no difference with the force-feeding groups received less than 90 g feed, which indicated

References

Adeola, O., D. Ragland and D. King, 1997. Feeding and excreta collection techniques in metabolizable energy assays for ducks. J. Poult. Sci., 76: 728-732.

Guillaume, J. and J.D. Summers, 1970. Maintenance energy requirement of rooster and influence of plane of nutrition on metabolizable energy. Canada. J. Anim. Sci., 50: 363-369.

Han, Y.W. and C.K. Wu, 1984. Metabolizable energy studies for poultry feeds: VI. empting of alimentary canal and amount of endogenous excreta by chickens and waterfowls. J. Northeast Agri. Coll., 4: 9-13.

Li, J. and L. Li, 1984. Metabolizable energy studies for poultry feeds: V. comparison of metabolizable energy of diet and wheat bran for chickens and waterfowls. J. Northeast Agri. Coll., 3: 91-95.

McNab, J.M. and J.C. Blair, 1988. Modified assay for true and apparent metabolisable energy based on tube feeding. Br. Poult. Sci., 29: 697-707.

Mohamed, K., B. Leclercq, A. Anwar, H. El-Alaily and H. Soliman, 1984. A comparative study of metabolisable energy in ducklings and domestic chicks. Food Sci. Tech., 11: 199-209.

Muztar, A.J., S.J. Slinger and J.H. Bueton, 1977. Metabolizable energy content of fresh water plants in chicken and ducks. Poult. Sci., 56: 1893-1899.

Ostrowski-Meissner, H.T., 1983. A method of simultaneous measurement of apparent (AME) and true (TME) metabolizable energy with ducks and comparisons of data obtained with drakes and cockerels. Nutr. Rep. Int., 29: 1239-1248.

SAS Institute, 1996. SAS? User's Guide: Statistics. SAS Institute Inc., Cary, NC.

Shi, Y.H., S.R. Zhang and G.W. Yue, 1993. Bioassay for metabolizable energy in ducks: I. the effect of duration of starvation and excreta collection time on the true metabolizable energy. J. Sichuan Agri. Univ., 11: 377-387.

Sibbald, I.R. and P.M. Morse, 1982. The effects of feed input and excreta collection time on estimates of metabolic plus endogenous energy losses in the bioassay for true metabolizable energy . Poult. Sci., 62: 68-76.

Sibbald, I.R., 1976. A bioassay for true metabolizable energy in feedingstuffs. Poult. Sci., 55: 303-308.

Sibbald, I.R., 1975. The effect of level of feed intake on metabolizable energy values measured with adult roosters. Poult. Sci., 54:1990-1997.

Siregar, A.P. and D.J. Farrell, 1980b. A comparison of the energy and nitrogen metabolism of fed ducklings and chickens. Br. Poult. Sci., 21: 213-227.

Siregar, A.P. and D.J. Farrell, 1980a. A comparison of the energy and nitrogen metabolism of starved ducklings and chickens. Br. Poult. Sci., 21: 203-211.