

## Effect of caecectomy on true metabolizable energy and lysine availability in roosters

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True metabolizable energy, corrected for nitrogen retention ( $TME_N$ ) and true lysine availability, was determined for maize and sunflower oilcake meal, two samples of each, and in samples of fishmeal, soyabean oilcake meal and sorghum meal using intact and caecectomized roosters. The roosters were allowed *ad libitum* intake over a four day feeding period. Caecectomy had no effect on  $TME_N$  values, except in one sample of sunflower oilcake meal and one maize meal sample where lower values were found in caecectomized roosters than in intact roosters. A significantly higher lysine availability was found for intact, as opposed to caecectomized, roosters fed sorghum. No difference existed for any of the other feedstuffs.

Ware metaboliseerbare energie, gekorrigeer vir stikstofretensie ( $WME_N$ ) en ware lisienbeskikbaarheid is in mieliemeel, sonneblomoliekoekmeel (twee monsters van elk) en in sorghum,

vismeele en soja-oliekoekmeel bepaal. Normale hane en hane waarvan die sekums verwyder is, is gebruik. Die voedingsmetode het bestaan uit vrywillige inname van die proefdiëte gedurende 'n 4-dae tydperk. Seseptomie het geen invloed op  $WME_N$ -waardes gehad nie, behalwe vir een van die twee sonneblomoliekoekmeel- en een van die mieliemeelmonsters waar hoër waardes vir intakte hane as vir hane sonder sekums vasgestel is. In albei gevalle het laasgenoemde monsters heelwat laer  $WME_N$ -waardes as die ander monsters wat ontleed is, gehad. Die laer waardes kan moontlik aan 'n laer droëmateriaal-uitskeiding toegeskryf word weens fermentasie wat in die spysverteringskanaal plaasgevind het. Die beskikbaarheidswaarde van lisien in die grondstowwe is nie deur die verwydering van die sekum beïnvloed nie, behalwe in die geval van sorghum waar betekenisvol hoër waardes by intakte hane gevind is.

**Keywords:** Caecectomy, lysine availability, true metabolizable energy.

Various authors (Nesheim & Carpenter, 1967; Payne *et al.*, 1971; Hayes *et al.*, 1984) have pointed out that microbial activity in the gastrointestinal tract of the chicken may lead to an overestimation of amino acid availability values. Experiments reported by Johns *et al.* (1986), who used caecectomized roosters to eliminate the effect of fermentation of undigested protein by intestinal bacteria, indicated that the digestibility coefficients of amino acids in heat-treated meat meal were lower in caecectomized roosters than in intact roosters. On the other hand, Green *et al.* (1987) found differences in lysine digestibility between intact and caecectomized roosters for sunflower meal but not for groundnut or soyabean meal, using the precision-feeding method (tube feeding) rather than *ad libitum* feeding which is commonly employed. Furthermore, no data are available on the effect of caecectomy on metabolizable energy (ME) values of feedstuffs. The purpose of the present experiments was therefore to obtain information on the effect of caecectomy on ME and amino acid availability for a number of feedstuffs during a four day feeding period.

Adult roosters (Amber-Link, egg-laying strain), approximately 14 months of age, were housed in single cages equipped with water-nipples and special troughs to minimize feed spillage. Room temperature fluctuated between 12 and 28 °C. A 16-h light period was employed. Caecectomized roosters (Payne *et al.*, 1971) were allowed six weeks after surgery to regain lost body weight. A total of 35 caecectomized and 35 intact roosters were available for the present study.

The dual semi-quick (DSQ) method of Du Preez *et al.* (1984) was followed. This method allows the birds free access to feed and water for four days while feed intake and excreta collection were measured during the last three days of that period. Maize, supplemented with a vitamin/mineral premix (2 parts per 100), formed a basal diet to which the materials under test were mixed in a ratio of 300 g test material to 700 g basal diet. Products which were readily consumed, e.g. grains, were only supplemented with two parts of the vitamin/mineral mix and fed as such.

Excreta were dried for 48 h in a forced-draught oven at 85 °C, then allowed to equilibrate to atmospheric moisture before being weighed and sampled for energy and amino acid determinations.

The seven feedstuffs used in the present study were bought on the local market and are shown in Table 1. Each feedstuff

**Table 1** Effect of caecectomy on TME<sub>N</sub> and lysine availability in roosters

Feedstuff	TME <sub>N</sub> (MJ/kg <sup>-1</sup> ) <sup>a</sup>		Lysine availability (%)	
	Intact	Caecectomized	Intact	Caecectomized
Maize A # 611	12,6* ± 0,28 <sup>b</sup>	13,4 ± ,09	85,9 ± 0,52	83,4 ± 1,99
Maize B # 650	14,0 ± 0,24	13,8 ± 0,11	92,3	
Sorghum	13,4 ± 0,26	13,6 ± 0,10	69,7* ± 6,6	83,5 ± 3,0
Sunflower oilcake # 16	8,0* ± 0,31	6,9 ± 0,30	80,4 ± 1,49	82,3 ± 1,18
Sunflower oilcake # 17	9,0 ± 0,39	8,6 ± 0,36	88,6 ± 1,79	79,4 ± 4,05
Fishmeal # 900	12,0 ± 0,58	12,6 ± 0,31	92,3 ± 1,16	93,6 ± 1,46
Soya oilcake # 31	10,2 ± 0,71	10,1 ± 0,53	86,2 ± 4,02	84,2 ± 2,60

<sup>a</sup> Kcal = 4,185 KJ.

<sup>b</sup> Average ± Standard error.

was fed to seven intact and seven caecectomized roosters and, with 35 of each type available, five feedstuffs were tested in the first week and the remaining two in the second week. The roosters were not rested between assays, but received a maintenance diet for the remaining three days of a week before experimental diets were again offered. During the second week, endogenous energy and amino acid excreted were also determined on 21 intact and 21 caecectomized roosters. This was done by tube-feeding 40 ml of a 50% dextrose solution on a daily basis for four days, starting 24 h after feed removal. Excreta were collected over the last three days of the period.

Samples were not pooled and individual values served as replicates to determine the effect of caecectomy. Significant differences between intact and caecectomized roosters were tested by Tukey's *t* test (Steel & Torrie, 1980). Standard errors for TME<sub>N</sub> values of the test materials were calculated by including the variances associated with the maize reference diet (Wolynetz, 1986).

Gross energy determinations were carried out in a Gallenkamp adiabatic bomb calorimeter. For amino acid analysis, acid hydrolysis was carried out in a sealed tube for 22 h in an oil bath at 115 °C. A ratio of 3 ml HCl (6 mol/dm<sup>3</sup>) per mg N was used and amino acid separation was done on a Beckman Model 6600 analyser.

An example to calculate the true amino acid availability of a feedstuff according to the DSQ procedure, is shown in Table 2. In order to calculate the TME<sub>N</sub> value of a test ingredient, the TME<sub>N</sub> value of the maize basal diet must be known. It must, therefore, either be done at an earlier stage, as in the present experiment, or simultaneously with the test materials. It is also important to note that the true amino acid availability of the basal maize diet has been determined separately and taken into consideration when calculating the true amino acid availability value of a feedstuff. A complicating factor in these calculations might have been large differences in moisture contents of feedstuffs. However, this was not the situation in the present experiment as values ranged from only 8,5 to 9,5%.

TME<sub>N</sub> values for the feedstuffs were largely unaffected by caecectomy (Table 1), except for the maize and the sunflower oilcake meal where one of two samples of each had significantly higher TME<sub>N</sub> values in intact roosters than in caecectomized roosters. The TME<sub>N</sub> values in both these

samples were substantially lower than the TME<sub>N</sub> values of their counterparts, probably due to a higher fibre content, which was unfortunately not determined. Microbial degradation of fibrous material in the caecum may lead to lower dry-matter excretion and thus to increases in TME<sub>N</sub> values. It was demonstrated that the addition of antibiotics to the diet, to inhibit microbial activity in the intestinal tract, depressed digestible energy values of feedstuffs in rats (Campbell *et al.*, 1982) and DM digestibility in pigs (Eggum *et al.*, 1982; 1984). It is thus possible that a similar situation may exist in roosters.

With regard to true lysine availability, caecectomy resulted in a lower value only for sorghum (Table 1). For the other feedstuffs, however, no differences between intact and caecectomized roosters existed. A number of workers have reported lower amino acid availability values as a result of caecectomy in roosters (Nesheim & Carpenter, 1967; Payne *et al.*, 1968; Raharjo & Farrell, 1984; Parsons, 1985; Johns *et al.*, 1986, Green *et al.*, 1987). Inspection of these data, however, reveals that not all amino acids were affected to the same extent by the removal of the caecum. Parsons (1985) found lower values in caecectomized roosters than in intact birds for most of the amino acids tested. Raharjo & Farrell (1984), however, could not demonstrate any effect of caecectomy on lysine availability in samples of meat meal, fishmeal, maize, soybean or cottonseed meal. Threonine, on the other hand, was significantly affected in maize, soybean meal and cottonseed meal. Green *et al.* (1987) found a higher lysine digestibility in sunflower meal, a less pronounced effect for groundnut meal, and no difference for soybean meal in caecectomized birds. These investigators pointed out that the endogenous excretion of amino acids, especially lysine, can be positively influenced by the caeca due to bacterial synthesis. This in turn can have a significant effect on digestibility values, not only between amino acids for the same feedstuff, but also among feedstuffs. Owing to the excretion of products such as carbohydrates, more favourable conditions for bacterial fermentation may occur with certain feedstuffs than with others.

The amount of endogenous lysine excreted by intact roosters during dextrose feeding in the present study amounted to 16,8 mg/rooster/24 h and 31,1 mg for caecectomized roosters. Although these values correspond fairly closely to the values of 23,6 for intact and 28,3 mg for

**Table 2** Calculation of TME<sub>N</sub> and amino acid availability values of fishmeal according to the DSQ method

DSQ method	Feed intake (g)	Gross energy (KJ)*		Lysine (g)		Nitrogen (g)		TME (MJ/kg)	TME <sub>N</sub> (MJ/kg)	Lysine availability (%)
		Ingested	Excreted	Ingested	Excreted	Ingested	Excreted			
Dextrose 40 g/d, 3 d			102	0	0,118	0	1,43			
Basal maize diet	332	5368	1008	0,7636	0,2085	4,88	3,54	13,43	13,13	88,15
Basal + fishmeal 70/30 mixture, 3d	327	5644	1206		0,4716	14,17	11,84	13,88	13,46	

\* 1 Kcal = 4,185 KJ.

$$\text{TME}_N \text{ for maize basal} = (5368 - 1008 + 102) / 332 - [36,5(4,88 - 3,54) - 36,5(-1,43)] / 332 = 13,13$$

$$\text{TME}_N \text{ for maize / fishmeal} = (5644 - 1206 + 102) / 327 - [36,5(14,17 - 11,84) - 36,5(-1,43)] / 327 = 13,46$$

$$\text{TME}_n \text{ for fishmeal only} = (13,46 - 0,7 \times 13,13) / 0,3 = 14,23$$

$$\text{True lysine availability} = \left(1 - \frac{\text{TLE} - \text{ULM} - \text{LEN}}{\text{LTM}}\right) \times 100$$

where

TLE = lysine excreted on the basal/fishmeal mix (= 0,4716 g)

ULM = unavailable lysine originating from the maize portion in the 70/30 mix  
 $= 0,7(1 - a)(A \times b) / 100$  g  
 $= 0,7(1 - 0,8815)(327 \times 0,23) / 100$  g  
 $= 0,0624$  g

where a = true lysine availability, g/g, in the maize basal diet

A = feed intake on the 70/30 mix

b = lysine in maize basal (g/100 g)

LEN = endogenous lysine excreted by the dextrose group (= 0,118 g)

LTM = lysine intake, total amount consumed as fishmeal  
 $= 0,3(B)(C) / 100$   
 $= 0,3(327)(4,11) / 100$   
 $= 4,03$

where B = feed intake on the basal / fishmeal mix

C = % lysine in the fishmeal

$$\text{Therefore, the lysine availability in fishmeal is as follows: } \left(1 - \frac{0,4716 - 0,0624 - 0,118}{4,03}\right) \times 100 = 92,7\%$$

caecotomized roosters during a 24-h fast as reported by Kessler *et al.* (1981), the difference in these values is probably large enough to reduce differences in lysine digestibility between intact and caecotomized roosters. The importance of accurate estimates of endogenous amino acid excretion was pointed out by Green *et al.* (1987). They found that differences between intact and caecotomized roosters were substantially reduced when true digestibility values were calculated as opposed to apparent digestibility values.

Although further research is needed to establish, with certainty, the effect of the caeca on true metabolizable energy and lysine availability in roosters, it appears that intact roosters can be used in the evaluation of TME<sub>N</sub> and lysine availability of the normal, undamaged feedstuffs.

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