Studies on the use of acid insoluble ash as inert marker in digestibility trials with Mong Cai pigs

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Abstract

The direct method of digestibility indices estimation was compared to the indirect technique by use of the acid insoluble acid as natural inner marker in two experiments designed in a factorial arrangement 2x2 with four replications per treatment. In experiment 1, eight Mong Cai pigs of 12.5 to 15.5 kg live weight were utilized. Experiment 2 was conducted with eight Large White pigs of 15.0 and 25.0 kg live weight. In both experiments the diets were formulated with wheat bran and fish meal to contain approximately 18 % crude protein and were offered at the rate of 4.5 kg DM per 100 kg live weight.

There was no influence of live weight on digestibility values. In in Mong Cai pigs the indirect method of estimation of digestibility of nutrients appeared to predict slightly higher values than the direct method. This effect was significant only for DM and NDF digestibility. There was no significant influence of live weight or method of determination on any of the measurements conducted in Large White pigs.
It is suggested that the indirect method of digestibility determination by using acid insoluble ash as reference substance can be used for the nutritional evaluation of diets given to young pigs.

**Key words:** Mong Cai, Large White, pigs, acid insoluble ash, digestibility

### Introduction

The use of indirect methods for estimating total tract digestibility of nutrients in farm animals is not a new idea (Schurch et al 1950; Gregory and Dickerson 1952; Kimura and Miller 1957), and in the case of conventional feeds, the acid insoluble ash technique has been used extensively since the very early first reports made in Germany. Several alternatives of the basic principle of determination of the acid insoluble ash as reference substance have been studied and its influence in the calculation of digestibility has been considered (see for example McCarthy et al 1974; Van Keulen and Young 1977). In the case of non conventional feeds, the method suggested by Van Keulen and Young (1977) has been used in the evaluation of Cambodian feedstuffs for pigs (see Ly and Samkol 2001; Nguyen Thi Thuy and Ly 2002). However, there are no previous reports concerning the interrelationship between the direct method of estimation of digestibility, which implies the total collection of faeces and feed, and the indirect method, using the technique recommended by Van Keulen and Young (1977) for the estimation of nutrient digestibility in ruminants.

The aim of this investigation was to determine nutritional values of diets for local pigs in the tropical environment of Cambodia, by comparing the direct method of determination of digestibility to the acid insoluble ash procedure of Van Keulen and Young (1977).

### Materials and methods

The direct method of determining digestibility indices was compared to the indirect technique, using the acid insoluble ash as a natural, inert marker in two experiments with Mong Cai and Large White castrated male pigs.

### Experiment 1

Eight Mong Cai castrate male pigs of 12.5 to 15.5 kg live weight were used according to a factorial arrangement in which the main treatments were:

- Live weight:
  - 12.5 vs 15.5 kg mean live weight

- Digestibility method:
  - Direct (total collection) vs Indirect (acid insoluble ash)
The diet consisted of wheat bran 69.9, maize bran 19.9, fish meal 10.1 and vitamins and minerals 0.1% (DM basis). Composition of the diets was: DM 87.5% and (in dry basis) organic matter 90.9, NDF 52.1 and N 2.91%.

Experiment 2

The design was the same as in Experiment 1, but Large White castrate male pigs were used and the mean live weights were: 15.0 and 25.0 kg. were employed in this trial. The diet consisted of wheat bran 89.9, sun-dried whole fresh water fish 10.0 and vitamins and minerals 0.1% (DM basis). The chemical characteristics of the diet were DM 88.2%, and (in dry basis), organic matter 94.2, NDF 45.8 and N 3.06%.

General procedure

During the entire experimental period the animals were housed in metabolism cages built with rattan and local materials (see Chiev Phiny and Rodriguez 2001). Total collection of feed refusals, faeces and urine were made during five days following five days of adaptation to the diets. The feed was given at the rate of 45 g DM/kg live weight and was offered twice daily in equal rations. Water was freely available. Feed refusals were collected and recorded. Other details concerning the experimental procedure relating to collection of materials and manipulation of samples have been described elsewhere (Ly and Samkol 2001).

All feed and faecal samples were subjected to proximate analysis according to the methods of AOAC (1990). Dry matter content in every sample was estimated by microwave radiation until constant weight (Undersander et al 1993). NDF analyses were conducted as outlined by Van Soest et al (1991). The acid insoluble ash concentration in faeces was determined by treating the ash with a 2N HCl solution (Van Keulen and Young 1977). In addition, pH values were estimated in fresh aliquots of faeces with the aid of a glass electrode.

Data were subjected to the analysis of variance technique (Steel and Torrie 1980). The general linear model included in the Minitab statistical program (Ryan et al 1985) was used in all cases.

Results

Experiment 1

The voluntary feed intake was 34.8 and 38.8 g DM/kg live weight in the Mong Cai pigs of 12.5 and 15.5 kg mean live weight, respectively. Although few refusals were recorded during the conduct of the trial, it was considered that the feeding level was close to ad libitum. Average environmental temperature (January 2001) was 35 ± 2.5°C at midday (12:00 h). There was no interaction between live weight and digestibility method for any of the reported digestive...
indices. There was no influence of live weight on digestibility values (Table 1). Total tract digestibility as estimated by the indirect method appeared to predict slightly higher values than the direct method. DM digestibility was higher (P<0.05) when the acid insoluble ash was used as reference substance than the conventional method. This same trend was found for NDF digestibility (P<0.01).

Table 1. Comparison of methods of determination of digestibility indices in young Mong Cai pigs

<table>
<thead>
<tr>
<th>Method of estimation</th>
<th>Live weight, kg</th>
<th>Direct</th>
<th>Indirect</th>
<th>SEM</th>
<th>12.5</th>
<th>15.5</th>
<th>SEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>DM</td>
<td></td>
<td>81.4</td>
<td>83.9</td>
<td>1.11*</td>
<td>83.0</td>
<td>82.3</td>
<td>1.27</td>
</tr>
<tr>
<td>Organic matter</td>
<td></td>
<td>83.3</td>
<td>84.2</td>
<td>2.05</td>
<td>84.6</td>
<td>82.9</td>
<td>2.02</td>
</tr>
<tr>
<td>NDF</td>
<td></td>
<td>80.4</td>
<td>83.0</td>
<td>0.91**</td>
<td>82.4</td>
<td>81.1</td>
<td>1.09</td>
</tr>
<tr>
<td>N</td>
<td></td>
<td>78.6</td>
<td>82.8</td>
<td>2.27</td>
<td>82.1</td>
<td>79.3</td>
<td>2.40</td>
</tr>
</tbody>
</table>

* P<0.05; ** P<0.01

Experiment 2

The voluntary feed intake was 44.7 and 45.6 g DM/kg live weight in the Large White pigs of mean live weights 15.0 and 25.0 kg, respectively. It was considered that consumption was ad libitum due to the fact that some feed refusals were recorded. Average environmental temperature (August 2001) was 38 ± 3.1 °C at midday (12:00 h). The digestibility indices in the Large White pigs were not influenced by the method of estimation nor the live weight (Table 2).

Table 2. Comparison of methods of determination of digestibility indices in young Large White pigs

<table>
<thead>
<tr>
<th>Method of estimation</th>
<th>Live weight, kg</th>
<th>Direct</th>
<th>Indirect</th>
<th>SEM</th>
<th>15.0</th>
<th>25.0</th>
<th>SEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>DM</td>
<td></td>
<td>80.0</td>
<td>81.0</td>
<td>1.25</td>
<td>80.7</td>
<td>80.3</td>
<td>1.27</td>
</tr>
<tr>
<td>Organic matter</td>
<td></td>
<td>83.3</td>
<td>82.9</td>
<td>1.08</td>
<td>83.9</td>
<td>82.2</td>
<td>1.10</td>
</tr>
<tr>
<td>NDF</td>
<td></td>
<td>80.2</td>
<td>79.9</td>
<td>1.07</td>
<td>80.2</td>
<td>79.6</td>
<td>1.45</td>
</tr>
<tr>
<td>N</td>
<td></td>
<td>84.6</td>
<td>84.1</td>
<td>1.12</td>
<td>85.0</td>
<td>83.7</td>
<td>1.08</td>
</tr>
</tbody>
</table>

Discussion

Although not strictly comparable, there was a consistent difference between both genotypes tested from the point of view of voluntary feed intake, with the Mong Cai pigs having lower values compared with the Large White animals. Experimental conditions were fairly similar with feeds based predominantly on wheat bran and a high environmental temperature. In this context, it is considered that a high feed intake negatively influences total tract digestibility indices in pigs, especially when the feeding regime consists of feeds rich in cell walls (see for example, Cunningham et al 1962; Roth and Kirchgessner 1984). A similar
negative effect on pig digestibility indices has been indicated for high environmental temperature (Oude et al 1986; Jorgensen et al 1996).

The influence of breed on digestibility indices has been studied both in European pig genotypes selected for lean meat (Wilmsink 1979; Wenk and Morel 1985) and in those raised in tropical areas (Teixeira et al 1995; Le Thi Men 1999; Ly et al 2001; Nguyen Thi Thuy and Ly 2002). In this connection, it appears there is a slight trend toward a better digestion of cell walls and a decrease in the digestion of N in Mong Cai pigs, compared to improved Large White animals (Nguyen Thi Thuy and Ly 2002; this study).

For the precise evaluation of feeds, it is recommended that both age and weight of pigs from improved breeds should be considered (Lloyd et al 1957; Bayley and Summers 1975; Jorgensen et al 1978). However, in the present investigation, the weight difference between the two groups of animals in each experiment was relatively small, and this could be the cause of the absence of any significant effect due to live weight.

Conclusions

The use of acid insoluble ash as an indirect marker for estimation of digestibility, developed originally by Van Keulen and Young (1977) for studies in ruminants, appears to be equally effective when applied to the nutritional evaluation of diets given to young pigs.

References


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