Cassava leaves in pig feeding

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Effect of method of processing cassava leaves on intake, digestibility and N retention by Ba Xuyen piglets

The aim of the study was to determine the effect of method of processing cassava leaves on the intake, apparent digestibility and nitrogen retention by indigenous piglets of diets based on broken rice (with the permission of Livestock Research for Rural Development).

The experiment was conducted at An Giang University, Viet Nam where the annual temperature during the experiment ranged from 27 to 38°C. The aim of the study was to determine the effect of method of processing cassava leaves on the intake, apparent digestibility and nitrogen retention by indigenous piglets of diets based on broken rice. Four indigenous piglets of 8.3 to 9.7 kg and 3 months of age were used in the experiment. They were housed in individual bamboo cages and allocated to two treatments according to a single changeover design. The treatments were cassava leaves given ad libitum in fresh or wilted form as supplements to a basal diet of broken rice fed at the rate of 2% (DM) of live weight.

The actual intakes of cassava leaves and total DM were similar between the two treatments ($P>0.05$). Total dry matter intake was rather low in the range from 2.6 to 2.8% of body weight. The cassava leaves represented from 24 to 27.4 % of the total diet dry matter, providing about 50% of the total dietary protein. HCN levels were reduced by wilting the cassava leaves (from 269 to 42 mg/kg DM). Average values for DM, OM and N digestibility were 89.1, 89.7 and 73.9% for the diet with fresh cassava leaves, and for the diet with wilted cassava leaves, 90.9, 91.7 and 76.6%, and did not differ between treatments ($P>0.05$). There was no treatment effect ($P>0.05$) on N retention (1.93 and 2.16g/day for fresh and wilted cassava leaves). Nitrogen retention as percent of N intake and N digested were not significantly affected ($P>0.05$) by processing of cassava leaves. There was no significant difference between treatments in the feeding behaviour of the piglets ($P>0.05$).

Based on the results of this research it was concluded that fresh cassava leaves can safely be fed to growing pigs at levels up to about 25% of the diet. The HCN content in the fresh leaves did not appear to be a constraint as there was no advantage in wilting the leaves which reduced by six-fold the level of HCN.

Key words

: Ba Xuyen, broken rice, cassava leaves, HCN, digestibility, intake, nitrogen balance, pigs, wilting.

Introduction

In view of the predicted world shortage of cereal grains because of competing needs for the expanding human and livestock populations (Leng 2002), there is an urgent need for research to develop alternative feed resources especially for pigs and poultry.

Cassava (Manihot esculenta Crantz) is a widely grown crop in the tropical regions of Africa, Latin American and Asia (Calpe 1993). The leaves are high in protein (Ravindran and Ravindran 1988) and are a readily available byproduct at the time of harvesting the root. Several reports have shown that cassava leaf protein is rich in lysine but low in sulphur amino acids (Eggum 1970; Gomez and Valdivieso 1984).

In Vietnam cassava is an important food crop, and annual root production is about 2 millions tonnes (GSO 2001) the majority of which is used for animal feeding and production of starch. Cassava leaf is a rich source of protein, minerals and vitamins, with an average of 21% crude protein (range from 16.7 to 39.9%) (Eggum 1970; Allen 1984; Bui Van Chinh et al 1994).

In fresh cassava leaf there is a high content of glucosides, linamarin and lotaustralin, which are hydrolysed by the linamarase enzyme, resulting in the release of hydrocyanic acid (HCN), which is toxic to the animal (Hoang van Tien 1987). HCN is colourless, volatile and extremely poisonous. The content of HCN in cassava differs among varieties and generally ranges from 200 to 800 mg /kg DM in the fresh leaf but values as low as 80 mg/kg DM (Wood 1965) and as high as over 4000 mg/kg DM (Ravindran and Ravindran 1988) have been reported. The HCN content also depends on the nutritional status of the plant, and is increased by N fertilization (De Bruilin 1973). The glucoside concentration in cassava leaves decreases with age (Lutaladio 1984; Ravindran and Ravindran 1988). The elimination of cyanogens by heating will depend on the temperature, the stage of development of the plant, and the type of heat. Simple sun drying or oven drying has been reported to eliminate almost 90% (Oke 1994) and sun drying reduces the cyanogen content of cassava leaf more effectively than ensiling because of the stability of the linamarase at low pH values (Oke 1994). Despite its high content of HCN, documented cases of poisoning due to the ingestion of cassava leaf are rare (Ravindran 1993).

Based on this theoretical and practical background, an experiment was carried out to evaluate the effects of method of processing cassava leaves on intake, digestibility, N retention by pigs and on the HCN content in cassava leaves in the fresh and wilted form. The aims of using cassava leaves as a supplementary source of protein in animal diets is as a means of reducing the cost of feed and increasing the income for the farmer.

Materials and methods

Location

The experiments were carried out in An Giang University -An Giang province, Vietnam from 5 August, 2003 to 25 August, 2003. The annual temperature in this location is in the range of 27 to 38°C.

Treatments and design

The two treatments were:
1. FC: Cassava leaves chopped into small pieces (2-3cm) and fed immediately after chopping
2. WC: Cassava leaves chopped into small pieces (2-3cm) and wilted for 8 hours in shade and overnight before feeding.

Design

The experimental design was a single changeover arrangement (Table 1) with two periods and 4 replicates.

The experimental period was 10 days: five days for adaptation to allow the pigs to become familiarized with the new diet and a five days period for collection of faeces, urine and feed residues.

Animals and housing

Four local male pigs (Ba Xuyen breed) with live weight of 8.3 to 9.7 kg and age of 3 months were used. The pigs were housed individually in metabolism cages made from bamboos strips fixed to a wooden frame in a composite unit (1.8m length and 0.8m wide) for 2 animals per unit (Photo 1). The metabolism cages allowed the pigs to move freely. The cages were fitted with automatic water drinkers. Plastic netting was suspended below the floor to collect the faeces. The urine passed through the plastic net and was collected over a sheet of polyethylene leading to a filter placed in a funnel suspended over a plastic bucket containing sulphuric acid (10 ml of 10% sulphuric acid) so as to maintain the pH below 4.0.

Feeds and feeding system

Broken rice was fed at the rate of 2% (DM basis) of live weight. The cassava leaves were offered on a free choice basis. Drinking water was available via automatic valves.

Data collection

During the 5-day collection period, the faeces were collected every morning before feeding and kept in polyethylene bags at -20 ºC. The total volume of urine was recorded daily and 10% of the total collection retained until the end of each period, when a representative sample was taken for analysis. At the end of the collection period the faeces were thawed and mixed thoroughly to provide a representative sample for each pig. The pigs were weighed at the beginning of the experiment and at the end of each period. The feed offered and refused was weighed and recorded daily and a sample was kept for analysis.

Feeding behaviour of the pigs was recorded by direct observation every minute during 90 minutes following feeding, according to the method of Faliu and Griess (1968).

Laboratory analyses

Dry matter and nitrogen were determined in feed offered and refused and in faeces. The urine was analysed for N. The chemical analyses were done following standard procedures according to the Association of Official Analytical Chemists (AOAC 1990), except for DM which was determined by micro-wave radiation (Undersander et al 1993). Water extractable DM was assayed as outlined by Ly and Preston (1997). Total volatile fatty acids in faeces were determined by steam distillation and titration of the distillate with NaOH 0.01N.

Statistical analysis

The data for feed intake, apparent digestibility and N balance were subjected to analysis of variance according to the General linear model of the Minitab software (version 13.3). Variables in the model were: treatments, pigs and periods.

Results and discussion

Composition of feed

The composition of the feeds is shown in Table 2. The value for nitrogen content of cassava leaves indicates that the protein level is about 23% which is line with the average values in the literature of around 21% crude protein (Eggum 1970; Allen 1984; Bui Van Chinh et al 1994). The low nitrogen content of the broken rice shows that the protein content is about 8% in DM and is therefore mainly an energy source. The values for HCN in cassava leaves (41.7 mg/kg DM in wilted compared with 269 mg/kg DM in fresh leaves), shows that HCN content was considerably reduced when the leaves were wilted. These levels are considerably lower than those reported by Ravindran (1991) who quoted a range of 800 to 3,200 mg HCN/kg DM of cassava leaves.

Feed intake

The data in Table 3 show that the actual intakes of cassava leaves and total DM were similar between treatments with an indication that cassava leaf intake (P=0.080) and DM intake as percentage of body weight (P=0.087) were increased slightly by wilting. Total dry matter intake was rather low in the range of 2.6 to 2.8% body weight. With controlled offer of broken rice at 2% of body weight (DM basis) and free access to cassava leaves, the intake of the latter accounted for 24 to 27.4 % of the total diet dry matter, and provided from 44 to 48% of the total protein.

Digestibility coefficients for DM, organic matter and nitrogen were high (Table 4; Figure 1) and did not differ between treatments.

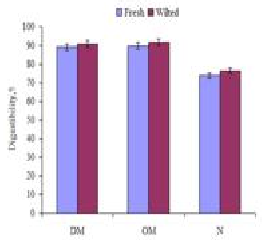

Figure 1:
 Digestibility coefficients of dry matter, organic matter and nitrogen for pigs fed broken rice and fresh or wilted cassava leaves.

There was also no treatment effect (P>0.05) on N retention (Table 5). However, N retention as percent of N intake and N digested were rather low.

N retention increased linearly as N intake increased (Figure 2), suggesting that the low DM intake was the major constraint limiting N retention.

Feeding behaviour

Feeding behaviour was observed and recorded (Table 6). There were no differences in the eating pattern of the pigs consuming the fresh or the wilted cassava leaves.

Conclusions

Fresh cassava leaves were consumed by growing pigs at levels equivalent to almost 30% of the DM intake and there appeared to be no benefit from wilting the leaves, even although this reduced six-fold the HCN concentration.

According to the results of the present experiment, the cyanogenic glucosides present in cassava leaves are not the major factor governing their utilization by growing pigs.

DM intakes expressed as percentage of body weight were less than 3%, which is below the expected norm for pigs of 10 kg body weight which should be between 4 and 5%.

Further research is needed to determine the factors that limit feed intake when the aim is to use fresh cassava leaves as the major protein supplement for growing pigs.

Acknowledgements

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