# THE USE OF CASSAVA LEAF SILAGE FOR FEEDING GROWING PIGS AND SOWS IN CENTRAL VIETNAM

*Nguyen Thi Hoa Ly[1], Nguyen Thi Loc[1], Du Thanh Hang[1] and Le Van An[1]*

**ABSTRACT**

This study aimed at using cassava leaves, ensiled with rice bran, sugar molasses and cassava root meal (at 5 and 10% levels), as a protein source for growing pigs and pregnant Mong Cai sows. The added ingredients contributed to producing good quality silage (pH 3.8 or less; HCN 90-120 mg/kg fresh silage) which could be stored for up to five months.

Digestibility and nitrogen balance trials were conducted to evaluate the substitution of fish meal by ensiled cassava leaves (ECL) at the levels of 0, 50, 75 and 100 g/day of protein in diets based on ensiled cassava roots (ECR). There was an indication (P = 0.08) that apparent digestibility of the dry matter (DM) decreased with increasing levels of ECL. The decrease in crude protein (CP) digestibility, from 86.6 to 79.6 for 100 g/day substitution, was highly significant (P = 0.001). Nitrogen retention also decreased from 14.5 to 9.0 g/day when ECL was used at the level of 100 g/day of protein.

The inclusion of 10% ensiled cassava leaves as replacement for sweetpotato vines and partial replacement for fishmeal in growing Mong Cai gilt had no effect on reproductive performance. However, at the 20% level, the live weight gain of gilts was decreased, age at first mating was increased from 170 to 196 days, and live weight increased from 40.2 to 43.8 kg.

Twenty-four crossbred pigs (Mong Cai x Large White) were allocated (4 pigs/household) among two groups of families to compare the effect of supplementing the traditional diet with ensiled cassava leaves. The overall difference was not significant and no effect on the growth of pigs was observed.

In another 16 households, feeding of 15% ensiled cassava leaves to Mong Cai sows during pregnancy, as replacement for sweetpotato vines and partial replacement of fishmeal, had no effect on reproductive traits.

## INTRODUCTION

In Central Vietnam, the ingredients used by farmers in pig feeds are generally low in protein, as they consist mainly of cassava root meal and rice by-products. Conventional protein sources such as fishmeal, soybean, fermented fish and groundnut meal, are expensive and rarely available. So, it is very important to identify local sources of protein, particularly those that can be produced by small-scale farmers.

Cassava is considered the third most important food crop after rice and sweet-potato. About 702,000 tonnes of fresh roots are produced annually in Central Vietnam, which are used both as human food and animal feed. At harvest, the fresh leaves are a potentially valuable by-product (about 10% of the weight of the fresh roots) but are rarely used for animal feed. Cassava leaves are high in protein and thus have good potential as an animal feed. Limitations to its use for monogastric animals are due to its high fibre content and low protein digestibility (Abdelsanie and Tanggend, 1981). Buitrago (1990) mentioned that the greatest limitation to the use of cassava as animal feed is its high content of potentially toxic cyanogenic glycosides. Sun-drying, artificial dehydration and ensiling have been used as means of conserving the leaves and reducing the cyanide content. Sun

[1] Hue University of Agriculture and Forestry, 24 Phung Hung, Hue city, Vietnam.

drying is difficult in Central Vietnam because harvesting coincides with the rainy season. Ensiling is thus the preferred technology.

The objective of these experiments was to identify appropriate preservation methods of cassava leaves by ensiling with different additions of sugar molasses, rice bran and cassava root meal, and to evaluate the use of ensiled cassava leaves for feeding pigs under farm conditions in Central Vietnam.

## EXPERIMENTAL RESULTS

### Experiment 1. The effect of additives on the quality of ensiled cassava leaves

Fresh leaves of cassava were collected at time of root harvest and these were ensiled together with either sugar molasses, rice bran or cassava root meal at inclusion levels of 0, 5 or 10% (fresh basis). The leaves were separated from the stems and petioles, chopped into small pieces (2-3 cm), mixed with salt (0.5%) and one of the additives (no additive in the control treatment), and then put in plastic bags, taking care to eliminate the air by packing the contents tightly. There were 7 bags for each additive level so that sampling could take place at 0, 7, 14, 21, 28 and 56 days as well as at 6 months after ensiling. After sampling the rest of the contents was discarded.

The silage was analyzed for pH, dry matter (DM), crude protein (CP) and HCN (AOAC, 1988) at 0, 7, 14, 21, 28 and 56 days after ensiling. The analyses were done in the University laboratories.

The inclusion of the additives (at levels of 5 and 10%) resulted in good quality silage, which had an acceptable aroma for pigs, with no mould growth and good keeping quality for at least five months. Without the additives the silage deteriorated after two months.

The effect of additives on pH at various times after ensiling is shown in **Figure 1**. The pH of both types of silage decreased quickly to 3.7-4.1 at 28 days of ensiling, but was maintained at close to that level until 56 days. With additives in the silage the pH decreased more rapidly and remained at a low level of 3.7 at 28 and 56 days; without additives the pH of silage decreased to 4.1 at 28 days and then increased to 4.3 at 56 days of ensiling.

The effect of various additives on dry matter, crude protein and HCN content of ensiled cassava leaves is shown in **Tables 1** and **2** and in **Figure 2**, respectively. **Table 1** shows that for both additive supported silage and the control silage without additive the DM content decreased slightly from 0 to 56 days of ensiling.

The crude protein content (**Table 2**) for additive supported silage decreased slightly from 0 to 56 days of ensiling; without additives, the crude protein content decreased slightly from 0 to 28 days and then decreased quickly from 28 to 56 days of ensiling.

**Figure 2** shows that the HCN content of ensiled cassava leaves decreased very quickly from 0 to 28 days and then further decreased until 56 days of ensiling. The HCN was about 8, 30 and 25% lower in additive supported silage than in the control silage without additives at 0, 28 and 56 days of ensiling, respectively.

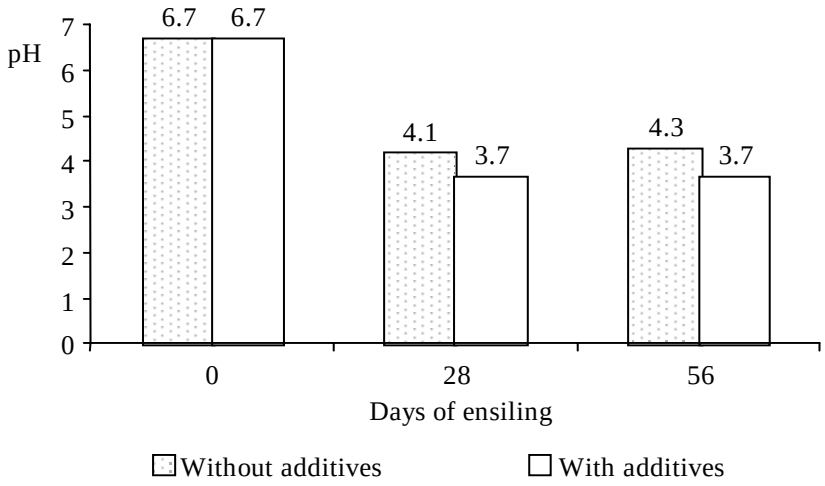


*Figure 1. Average effect of three additives and two levels of inclusion on the pH of ensiled cassava leaves at various times after ensiling.*

**Table 1. Effect of additives and time on the dry matter content of ensiled cassava leaves.**

| Treatments[1)] | 0 | 7 | 14 | 21 | 28 | 56 |
|---|---|---|---|---|---|---|
| | (Days of ensiling) | | | | | |
| | Dry matter (%) | | | | | |
| Control | 28.73 | 28.86 | 28.60 | 28.70 | 28.80 | 27.24 |
| M5 | 31.96 | 31.85 | 31.18 | 30.45 | 30.57 | 30.70 |
| M10 | 33.93 | 33.8 | 32.40 | 29.88 | 29.16 | 29.35 |
| CR5 | 31.69 | 33.19 | 32.12 | 32.10 | 32.30 | 31.14 |
| CR10 | 34.70 | 35.27 | 33.40 | 33.60 | 33.80 | 33.99 |
| RB5 | 33.75 | 33.70 | 30.90 | 30.46 | 30.76 | 30.50 |
| RB10 | 34.81 | 34.20 | 33.60 | 32.70 | 32.90 | 32.67 |

[1)]M= “A” molasses; CR= cassava root meal; RB= rice bran; 5 and 10 refer to % inclusion.

**Table 2. Effect of additives and time on the content of crude protein of ensiled cassava leaves.**

| Treatments[1)] | 0 | 7 | 14 | 21 | 28 | 56 |
|---|---|---|---|---|---|---|
| | (Days of ensiling) | | | | | |
| | Crude protein content (%) | | | | | |
| Control | 29.65 | 29.49 | 29.23 | 29.46 | 27.40 | 23.34 |
| M5 | 28.77 | 28.68 | 26.75 | 26.05 | 26.33 | 25.78 |
| M10 | 25.91 | 23.92 | 23.52 | 23.86 | 23.32 | 24.09 |
| CR5 | 29.23 | 29.90 | 29.54 | 27.55 | 28.29 | 26.54 |
| CR10 | 26.82 | 24.92 | 24.89 | 24.47 | 24.91 | 24.21 |
| RB5 | 29.79 | 29.41 | 28.19 | 27.85 | 27.17 | 27.23 |
| RB10 | 27.88 | 26.72 | 25.98 | 25.53 | 25.84 | 25.09 |

[1)]M= "A" molasses; CR= cassava root meal; RB= rice bran; 5 and 10 refer to % inclusion.

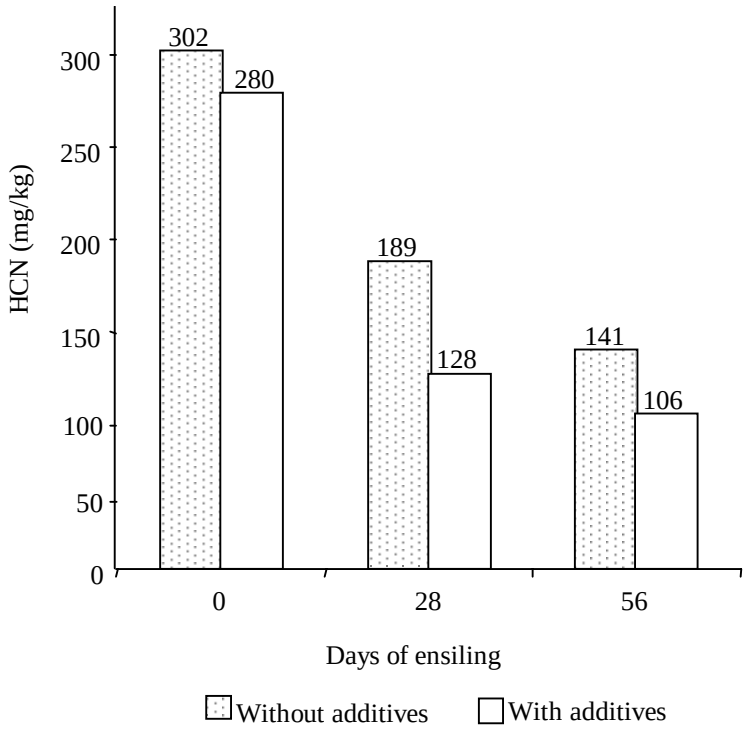


*Figure 2. Average effect of three additives and two levels of inclusion on the HCN concentration (fresh weight basis) of ensiled cassava leaves at various times after ensiling.*

**Experiment 2. Digestibility and nitrogen retention in fattening pigs fed different levels of ensiled cassava leaves (ECL)**

***Animals***

The various diets were randomly allocated to eight F1 (Mong Cai x Large White) castrated male pigs with initial weight of 48-50 kg at four months of age. The pigs were housed individually in metabolism cages that allowed the separate collection of urine and feces. The experimental periods were 10 days: 5 days for adaptation and 5 days for collection of feces and urine.

***Treatments and experimental design***

The four treatments were:

1. $ECL_0$: Fish meal (150 g CP/day) + ensiled cassava roots (ECR) provided *ad-libitum*.
2. $ECL_{50}$: The same as $ECL_0$ but 50 g of protein from fish meal replaced by ECL
3. $ECL_{75}$: The same as $ECL_0$ but 75 g of protein from fish meal replaced by ECL
4. $ECL_{100}$: The same as $ECL_0$ but 100 g of protein from fish meal replaced by ECL.

The experimental design was a double 4 x 4 Latin square arrangement.

The digestibility and N retention for different levels of ECL inclusion in the diets of fattening pigs is shown in **Table 3**. The data indicate that there were no statistically significant differences of DM digestibility (p=0.13), but that the N digestibility and nitrogen retention decreased markedly as levels of ECL increased.

Daily nitrogen retention decrease significantly (p=0.001) from 14.2 g/day for the $ECL_0$ diet to 9.9 g/day for $ECL_{100}$, a similar fall to that reported by Bui Huy Nhu Phuc *et al* (1996). The values were high and there were significant differences (p=0.03) in the nitrogen retained as percentage of nitrogen consumed.

**Table 3. Digestibility and N retention for different levels of ensiled cassava leaves (ECL) used for fattening pigs.**

| | $ECL_0$ | $ECL_{50}$ | $ECL_{75}$ | $ECL_{100}$ | Standard | Prob. |
|---|---|---|---|---|---|---|
| Parameters | Treatments | | | | error | |
| DM intake (g/day) | 1260 | 1226 | 1251 | 1191 | 42 | 0.62 |
| DM in feces (g) | 126 | 129 | 158 | 124 | 11.53 | 0.15 |
| DM digestibility (%) | 90 | 89.5 | 87.4 | 89.6 | 0.82 | 0.13 |
| N intake (g/day) | 24.9 | 23.7 | 24.2 | 20.3 | 1.02 | 0.02 |
| N in feces (g/day) | 3.3 | 3.6 | 4.8 | 4.1 | 0.36 | 0.04 |
| N digestion (g/day) | 21.6 | 20.1 | 19.4 | 16.2 | 0.89 | 0.002 |
| N digestibility (%) | 87 | 85 | 80 | 80 | 1.3 | 0.001 |
| N in urine (g/day) | 7.5 | 6.2 | 7.4 | 6.3 | 0.64 | 0.37 |
| N retention (g/day) | 14.2 | 13.8 | 12.0 | 9.9 | 0.72 | 0.001 |
| % N retention/N digested | 66 | 69 | 63 | 61 | 2.81 | 0.23 |
| % N retention/N intake | 57 | 58 | 50 | 48 | 2.59 | 0.03 |

**Experiment 3. Effect of ensiled cassava leaves in the diet of Mong Cai female pigs on reproductive performance**

***Animals and experimental designs***

Twelve Mong Cai female pigs (gilts) of 14 kg live weight were randomly allocated to three treatments (four gilts/ treatment) with four replicates (one pen for each pig) per treatment. **Table 4** shows the nutritional characteristics of the diets at three stages of development.

**Table 4. Diet of Mong Cai gilts at three stages of development for three treatments.**

| Diet characteristics | 10-20 | 20-30 | 30-40 |
|---|---|---|---|
| | | Live weight (kg) | |
| Dry matter (kg/day) | 0.86 | 1.04 | 1.32 |
| Crude protein (g/day) | 119 | 133 | 159 |
| Metabolizable energy (MJ/kg DM) | 8.2 | 10.5 | 13.7 |

***Diets for Mong Cai gilts***

*Control diet:* Rice bran, cassava root meal, fish meal and sweetpotato vines.
*Treatment 1*: 90% DM of control diet + 10% DM of ensiled cassava leaves.
Diet contains 25 to 50 ppm total HCN
*Treatment 2*: 80% DM of control diet + 20% DM of ensiled cassava leaves.
Diet contains 50 to 100 ppm total HCN

The effect of inclusion of ensiled cassava leaves at three levels in the diet of female Mong Cai pigs on reproductive traits is shown in **Figures 3**, **4a** and **4b** and in **Table 5**.

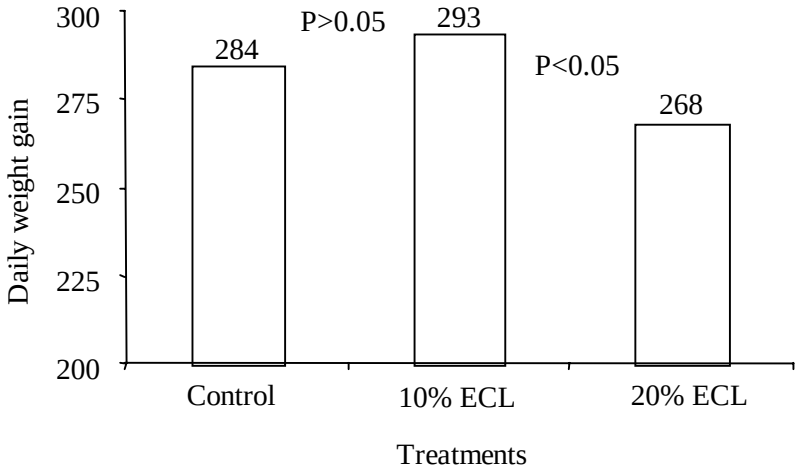


*Figure 3. Effect of three levels of inclusion of ensiled cassava leaves (ECL) in the diet on daily weight gain of Mong Cai gilts.*

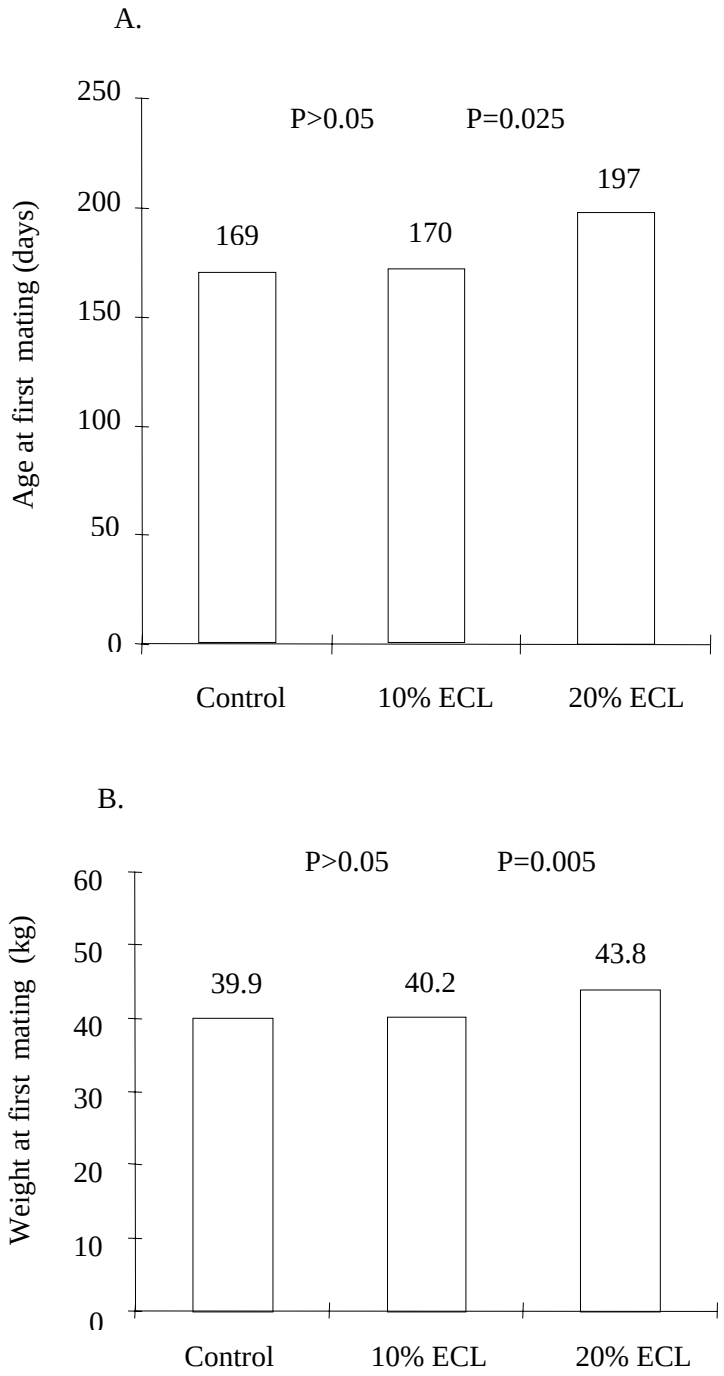


*Figure 4. Effect of three levels of inclusion of ensiled cassava leaves (ECL) on age (A) and weight (B) at first mating of Mong Cai gilts.*

**Table 5. Effect of three levels of inclusion of ensiled cassava leaves (ECL) in the gilt diet on the reproductive performance of sows.**

| | $ECL_0$ | $ECL_{10}$ | $ECL_{20}$ | Standard | Prob. |
|---|---|---|---|---|---|
| | Treatments | | | error | |
| Initial live weight (kg) | 14.2 | 14.1 | 14.9 | 0.39 | 0.321 |
| Live weight gain of gilt (g/day) | 284a | 293a | 268b | 7.90 | 0.117 |
| No. of live piglets born | 7.00 | 7.75 | 6.67 | 0.73 | 0.542 |
| Mean weight of piglets (kg) | 0.72 | 0.72 | 0.67 | 0.155 | 0.05 |
| No. of pigs weaned | 6.67 | 7.50 | 6.67 | 0.629 | 0.528 |
| Mean pig weight at weaning (kg) | 7.3 | 7.1 | 7.1 | 0.20 | 0.792 |

Note: Values followed by the same letter in the row are not statistically significant at $p = 0.05$

**Figure 3** shows that the daily gain of gilts at the level of 20% inclusion of ECL was significantly lower ($p < 0.05$) than those of the control and $ECL_{10}$ treatments. Similar findings were reported by Tewe *et al*. (1984), who also reported a significant reduction in serum thyroxin levels in growing pigs fed cassava diets containing 96 ppm total cyanide.

**Figures 4A** and **4B** indicate that the age and live weight at first mating of the $ECL_{20}$ treatment was significantly higher than those of the control and $ECL_{10}$ treatments (p=0,025 and p=0.005, respectively). There were no significant differences between treatments for these parameters at furrowing and weaning ($p > 0.05$).

**Experiment 4. The use of ensiled cassava leaves in growing pigs rations**

The experiment was carried out in six households of Thuy Xuan village, Hue provinces from June to Oct 1997. Six families raised a total of 24 pigs, all cross breeds between Mong Cai and Large White with live weights of around 23-25 kg (4 pigs/household). One group of pigs (three households) was fed the control diet: ECR + brewery by-product + rice bran + CRM + sweetpotato vines, provided *ad-libitum*. The second group of pigs was fed the experimental diet: 90% control diet + 10% ECL. The experiment lasted for 120 days.

The effect of using ensiled cassava leaves in growing pig rations is shown in **Table 6**. There were no significant differences in daily weight gain and feed conversion ratio between the pigs fed the control diet and the ECL diet. Feed cost was lower with ensiled cassava leaves supplementation. Using a 10% of DM inclusion of ensiled cassava leaves in the pigs' ration did not effect the growth rate but significantly reduced feed cost/kg gain ($p = 0.001$).

**Experiment 5. Effect of ensiled cassava leaves in the diet of pregnant sows on reproductive performance**

The experiment was carried out in 16 households of Huong Van village, Hue province, from Oct to Aug 1998. Sixteen Mong Cai sows at the third litter stage were

randomly allocated to two treatments in 16 households. The ingredients and quantity fed to the Mong Cai sows are given in **Table 7**.

**Table 6. Effect of inclusion of ensiled cassava leaves (ECL) on the performance of growing pigs.**

| | ECL | Control | Standard error | Prob. |
|---|---|---|---|---|
| | Treatments | | | |
| Live weight (kg) | | | | |
| - initial | 25.8 | 23.3 | 0.89 | 0.06 |
| - final | 78.1 | 74.5 | 1.02 | 0.02 |
| Daily gain (g/day) | 435 | 426 | 0.01 | 0.34 |
| DM feed conversion | 4.99 | 4.81 | 0.16 | 0.43 |
| Feed cost/kg gain (dong) | 9,357 | 11,143 | 280 | 0.001 |

**Table 7. Ingredients in the diets of pregnant sows of Mong Cai pigs (60-70 kg) and diet characteristics in Huong Van village.**

| | Control[1)] | | ECL[2)] | |
|---|---|---|---|---|
| | DM (kg/day) | % of DM | DM (kg/day) | % of DM |
| Rice bran | 0.79 | 57.9 | 0.79 | 56.8 |
| Cassava root meal | 0.23 | 16.5 | 0.23 | 16.2 |
| Fermented fish | 0.15 | 11.0 | 0.06 | 5.0 |
| Sweetpotato vines | 0.20 | 14.6 | 0.1 | 7.2 |
| Ensiled cassava leaves | 0 | 0 | 0.21 | 14.8 |
| Dry matter (kg/day) | 1.37 | 100.0 | 1.39 | 100.0 |
| Metabolizable energy (MJ/kg DM) | 14.0 | | 14.1 | |
| Crude protein (g/day) | 186 | | 186 | |

[1)]Control treatment: rice bran, cassava root meal, fermented fish, sweetpotato vines.
[2)]$ECL_{15}$ = 15% ensiled cassava leaves in the diet.

*Control treatment*: rice bran, cassava root meal, fermented fish and sweetpotato vines.
*Experimental treatment:* 85% DM of the traditional diet +15% DM of ECL. This diet contains on average 45 ppm total HCN. The composition of the diets for sows during lactation (% of DM): rice bran 28%, cassava root meal 27%, broken rice 17%, fermented fish 11%, sweetpotato vines 13%, bone meal 4%. Total DM: 2.17 kg, ME (MJ/kg): 13.5 and CP: 287 g.

The effect of using ensiled cassava leaves in the diet of pregnant sows is shown in **Table 8**. There were no significant differences between the two treatments for all the measured reproductive parameters of sows, except for the effect on mean pig weight at weaning. It is possible that this improved performance with inclusion of ensiled cassava leaves in the diet is related to the slightly lower number of piglets at weaning. These results agree with those of Tewe and Maner (1981).

**Table 8. Effect of using ensiled cassava leaves in the diet for pregnant sows on reproductive traits.**

| | Control | $ECL_{15}$ [1)] | Standard error | Prob. |
|---|---|---|---|---|
| No. of live piglets born | 11.3 | 10.3 | 1.06 | 0.535 |
| Mean weight of piglets (kg) | 0.68 | 0.70 | 0.015 | 0.209 |
| No. of pigs weaned | 9.75 | 9.14 | 0.925 | 0.632 |
| Mean pig weight at weaning (kg) | 6.9 | 7.5 | 0.11 | 0.010 |
| Total litter weight (kg) | 67.04 | 68.97 | 4.57 | 0.777 |

[1)] $ECL_{15}$ = 15% ensiled cassava leaves in the diet.

## CONCLUSIONS

1. Ensiling cassava leaves supplimented with cassava root meal, rice bran or molasses at 5 or 10% (fresh basis) produced good quality silage that could be stored for up to five months.
2. Including 10% ensiled cassava leaves (on a DM basis) as replacement for sweetpotato vines and partial replacement for fish meal in diets of growing Mong Cai gilts and fattening pigs had no effect on reproductive performance and on growth. However, at the 20% level, the live weight gain of gilts was lower, while age and live weight at first mating increased.
3. In households of 16 families, feeding of 15% ensiled cassava leaves to Mong Cai sows during pregnancy, as partial replacement of sweetpotato vines and fermented fish had no significant effect on reproductive traits at farrowing and weaning.
4. Ensiled cassava leaves can be used as a protein source for feeding pigs under village conditions.

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