Sweet potato leaves and water spinach

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On-farm trials to study intake and digestibility in growing pigs fed different levels of sweet potato leaves and water spinach as supplements to a mixture of rice bran and cassava root meal (with the permission of Livestock Research for Rural Development).

The aim of this experiment, conducted at the Livestock Research Center of the National Agriculture and Forestry Institute (NAFRI), Lao PDR, was to study intake and digestibility in growing pigs fed different levels of sweet potato leaves and water spinach as supplements to a mixture of rice bran and cassava root meal. Three local male pigs of average live weight 13.3 kg were housed in individual cages. The design was a 3*3 Latin square with periods of 10 days, the treatments being ratios of sweet potato vines and waters sponach of 100:0, 75:25 and 50:50 (DM basis). The cassava root meal and rice bran (50:50 mixture) was restricted to 2% (DM basis) of live weight, the sweet potato leaves mixed with water spinach were fed ad libitum (120% of observed intake). Fresh sweet potato leaves and water spinach were harvested everyday in the Livestock Research Center and were chopped into small pieces prior to feeding. Increasing the level of water spinach did not effect total dry matter intake of the diet, nor the coefficients of apparent digestibility of DM, organic matter, nitrogen and crude fiber, nor the retention of nitrogen. It is concluded that water spinach and sweet potato leaves appear to have the same nutritive value when used to supplement a basal diet of cassava root meal and rice bran for growing pigs.

Key words:
Digestibility, cassava root meal, intake, pigs, rice bran, sweet potato leaves, water spinach.

Introduction

Pig farming plays an important role in Laos in small farming systems as a source of protein for the family, as a valuable fertilizer for paddy and vegetable plots, and as a means of family capital accumulation. Pigs are normally raised in a free-range system supplemented by rice bran and other household waste products. Sweet potato (*Ipomoea batatas* L. (Lam)) is a common crop in Laos after rice and maize, and has high biomass yields of both tubers and vines. Traditionally, sweet potato is used as human food when rice is not sufficient, although at present it is commonly used as feed for farm livestock, especially pigs. The tubers have a high carbohydrate content while the leaves are rich in protein, and both tubers and vines can be used as animal feed (Woolfe 1992). The vines include the leaf and stem, with a crude protein content in the leaves of 260-330 g/kg DM compared with 100-140 g/kg DM in the stems (Woolfe 1992; Ishida et al 2000; Le Van An et al 2003). It has been shown that the leaves make up approximately half of the sweet potato vines biomass (Woolfe 1992; Le Van An et al 2003). Thus, if the leaves could be separated from the stems a considerable improvement with respect to the dietary protein and amino acid supply would be expected (Le Van An et al 2003).

Water spinach *(Ipomoea aquatica)* is a water plant. It is cultivated for human food and used for pigs and other animals in Laos. It does not appear to contain anti-nutritional compounds and has been used successfully for growing pigs as the only source of supplementary protein in a diet based on broken rice (Ly 2002; Chhay Ty and Preston 2005). The fresh leaves and stems of water spinach have a high crude protein content in the range of 18 to 31% in dry matter. Chhay Ty and Preston (2005) reported that fresh water spinach was more palatable than cassava leaves as reflected in higher total DM intake and the proportion of the diet (47%) provided by the leaves. The digestibility coefficients of dry matter, organic matter, crude protein and crude fiber were higher in the diet with water spinach than in the diet with cassava leaves.

The hypothesis to be tested in this experiment was that there would be improvements in intake and digestibility in growing pigs when a combination of water spinach and leaves of sweet potato were fed as supplements to a low-protein basal diet, compared with a supplement only of sweet potato leaves.

Materials and methods

Location

The experiment was carried out from 18 September to 12 October 2005 at the Livestock Research Center of the National Agriculture and Forestry Institute (NAFRI), Nam Xuang about 44 km from Vientiane city, Lao PDR.

Treatments and design

The three treatments were:

- WS0: mixture of rice bran and cassava root meal supplemented with sweet potato leaves
- WS25: mixture of rice bran and cassava root meal supplemented with water spinach and sweet potato leaves (25:75 DM basis).
- WS50: mixture of rice bran and cassava root meal supplemented with water spinach and sweet potato leaves (50:50 DM basis).

The experiment was done according to a 3*3 Latin Square arrangement of the 3 dietary treatments with 3 local male pigs of average live weight 13.3 kg. The animals were housed in metabolism cages (80 x 80cm) made from wood and bamboo (Photo 1). Each experimental period consisted of 10 days; 5 days to adapt to the diets followed by another 5 days for collection of faeces and urine, and recording of feed offered and feed refusals. The arrangement of the treatments is in Table 1.

Table 1.
Experimental layout

Periods/pigs	1	2	3

1	WSO	WS25	WS50
2	WS25	WS50	WS0
3	WS50	WS0	WS25

Diets and feeding

The chemical characteristics of the ingredients in the diets are shown in Table 2.

Table 2
. Chemical characteristics of the ingredients of the diets

Dry matter, %	18.2	8.49	87.3	88.0
As % of DM				
Ash	9.73	13.6	10.4	2.58
N	4.49	3.35	0.54	0.61
CP (N*6.25)	28.1	20.0	3.37	3.81
Crude fiber	5.50	13.6	28.6	5.60

The cassava root meal and rice bran (50:50 mixture) were restricted to 2% (DM basis) of live weight, the sweet potato leaves mixed with water spinach were fed ad libitum (120% of observed intake). Fresh sweet potato leaves and water spinach foliage (leaves and stems) were harvested everyday in the Livestock Research Centre and chopped into small pieces before feeding separately from the mixed cassava root meal and rice bran. The feeds were offered in 3 meals daily (7.30, 11.30 and 16.30h). Water was permanently supplied through drinking nipples.

Data collection

Feed offered, feed refusals, faeces and urine were collected every day during the last 5 days of each period. Sub-samples of 10% were taken as a representative sample and frozen in plastic bags until analysis. The samples from every treatment at the end of each period (feed offered, feed refusals, and faeces) were thawed, mixed thoroughly by hand and then homogenized in a coffee grinder, prior to taking representative samples that were analyzed for DM, N, water soluble DM and N. Urine was collected in a plastic bucket to which sulphuric acid was added to maintain the pH below 4.0. The volume of urine was measured every day and a 10% sample kept in the refrigerator until the end of each period; the samples then bulked and analyzed for N. The animals were weighed at the beginning of each period.

Chemical analyses

Nitrogen and ash in feed ingredients, faeces and urine were analysed following the methods of AOAC (1990). The DM content was determined using the microwave method of Undersander et al (1993).

Statistical analyses

The data were subjected to analysis of variance according to the general linear model of the Minitab software (Minitab release 13.31, 2000). Sources of variation were pigs, periods, treatments and error.

Results and discussion

Feed intake

All the rice bran and cassava root meal were consumed. Total intake of DM (Table 3) and of crude protein, crude fiber and organic matter (Table 4), were not influenced by the level of water spinach. This contrasts with the data of Chhay Ty and Preston (2005) where replacement of cassava leaves by water spinach in a basal diet of broken rice led to increases in intake of the total diet DM and crude protein.

Table 3
. Mean values of DM in take of pigs fed different level of sweet potato leaves and water spinach as supplements to a mixture of rice bran and cassava root meal

	WSO	WS25	WS50	SEM	Prob.
Intake, g DM/day					

Sweet potato leaves	270	197	136		
Water spinach		65	136		
Mixture of RB and CVRM	270	262	273		
Total DM	541	525	546	22.8	0.80
DM, g/kg live weight	33	33	34	2.22	0.61

Table 4
. Mean values for intake (g/day) of crude protein and crude fiber in pigs fed different level of sweet potato leaves and water spinachas supplements to a mixture of rice bran and cassava root meal

	WSO	**WS25**	**WS50**	**SEM**	**Prob.**
Intake, g/day					
Crude protein	74	68	71	4.74	0.692
Crude fiber	65	62	66	1.87	0.227
Organic matter	462	439	460	20.7	0.684
As % of diet DM					
Crude protein	13.7	13.0	13.0		
Crude fiber	12.0	11.8	12.1		
Organic matter	85.4	83.6	84.2		

Nutrient digestibility and N retention

Coefficients of apparent digestibility of dry matter, organic matter, crude protein and crude fiber, and N retention, did not differ among treatments (Tables 4 and 5)). This also contrasts with the data of Chhay Ty and Preston (2005) where replacement of cassava leaves by water spinach in a basal diet of broken rice led to increases in coefficients of digestibility and N retention. The implication from this comparison is that sweet potato leaves have higher nutritive value for growing pigs than cassava leaves.

Table 5
. Mean values of nutrient digestibility in pigs fed different level of sweet potato leaves (SPL) and Water spinach (WS) as supplement to mixture of rice bran and cassava root meal

	WSO	**WS25**	**WS50**	**SEM**	**Prob.**
Digestibility, %					
Dry matter	75.7	71.8	74.7	2.01	0.371
Organic matter	77.5	73.1	76.2	2.05	0.314
Crude fiber	53.0	48.8	50.8	3.53	0.709
Crude protein	69.8	72.6	69.3	3.22	0.746

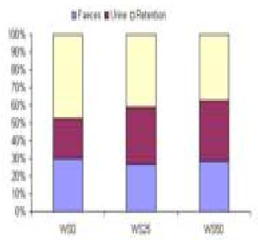
The digestibility coefficients for DM and crude protein (74.7 and 69.3%, respectively) on the 50% water spinach supplement were lower than the values (89 and 82 % for DM and crude protein, respectively) reported by Chhay Ty and Preston (2005) for a basal diet of broken rice with equal parts of water spinach and cassava leaves as protein supplement. The explanation is almost certainly the low digestibility of the rice bran which is much higher in crude fiber (29%) compared with broken rice (has close to zero level of fiber).

There were no differences in rates of excretion of N in faeces but urine N increased significantly as the proportion of water spinach in the diet increased (Table 6; Figure 1). As a result, the retention of N as a proportion of N digested also increased. An increased excretion of N in urine when water spinach replaced cassava leaves in the diet of goats was observed by Khamparn and Preston (2006), but the present report appears to be the first to demonstrate a similar tendency in pigs. The most logical explanation is of a poorer balance of essential amino acids in the water spinach compared with the leaves of sweet potato; however, an amino acid analysis of the materials as fed was not feasible in view of the lack of such analytical facilities in Laos.

Table 6
: Mean values for nitrogen balance in pigs fed increasing levels of water spinach (WS) replacing sweet potato leaves as supplement to a mixture of rice bran and cassava root meal

	WSO	WS25	WS50	SEM	Prob.
N balance, g/day					
Intake	11.9	11.0	11.5	0.65	0.61
Faeces	3.58	2.95	3.28	0.26	0.25
Urine	2.71a	3.52b	3.92b	0.22	0.001
Retention	5.62	4.52	4.31	0.63	0.29
Retention as % of					
Intake of N	47.7	43.5	38.3	4.25	0.29
Digested N	67.3a	56.6ab	52.4b	4.13	0.04
ab Mean values in same row without common letter are different at P<0.05					

Conclusions



- Water spinach foliage (leaves plus stems) appears to be slightly inferior to leaves of sweet potato a protein supplement for growing pigs fed a low-protein basal diet (50:50 mixture of cassava root meal and rice bran).
- Future experiments should compare levels of water spinach replacing sweet potato leaves over the full range of 0 to 100% in order to verify the above observations.

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