Effect of replacing ensiled taro foliage (*Colocasia esculenta*) with ensiled banana pseudo-stem (*Musa* spp) and soybean meal on intake, digestibility and nitrogen retention in Moo Lath pigs

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Abstract

Apparent total tract digestibility and N retention were determined in Native Moo Lath pigs fed increasing proportions of ensiled banana pseudo-stem and soybean meal replacing ensiled taro foliage. The experiment was arranged according to a 4*4 Latin Square design with diet levels (DM basis) of ensiled banana pseudo-stem of 0, 5, 10 and 15% and soybean meal (0, 2, 2 and 4%) replacing 0, 8, 12 and 20% ensiled taro foliage.

Apparent digestibility of DM and crude protein, daily N retention and N retained as percent of N digested, all declined linearly as ensiled banana pseudo-stem and soybean meal replaced ensiled taro foliage. It is apparent that the biological value of the protein in the ensiled taro foliage was superior to that in the combination of ensiled banana pseudo-stem and soybean meal.

Key words: *biological value, indigenous breeds, local resource, soybean meal*

Introduction

Smallholder pig farming contributes a source of rural food security and livelihood in many regions in Lao PDR. Local consumers prefer the pork from native pigs apparently due to its better flavor. There is also a specific demand for the meat from native pigs at traditional events (Phengsavanh et al 2011). However, the main constraint is lack of suitable feeds which creates a major challenge for rural pig keepers. Forages appear to offer most potential as these are more easily found in total areas of Laos (Phengsavanh et al 2011; Chittavong et al 2012).

The taro plant (*Colocasia esculenta*) widely distributed in many tropical and subtropical countries (Onwueme 1999). This plant is often found growing wild in the forest beside rivers and stream and in

water-logged areas. Smallholder farmers in Lao, Vietnamese and Cambodia commonly use taro foliage (leaves and petiole) as pig feed first boiling them, before mixed with other local ingredients. Taro has been shown to yield up to 250 tonnes/ha/year of foliage (Ngo Huu Toan and Preston 2008) with frequent harvests at 4 week intervals; apparently without negative effect on the corm yield (Kaensombath and Frankow-Lindberg 2012). Anti-nutritional factors in taro caused by presence of oxalate salts can be reduced by ensiling (Hang et al 2011).

Banana pseudo stem is traditionally used by farmers as feed for pigs, poultry and cattle in Laos. It has low content of DM and is high in fiber. However, it contains soluble sugars which facilitates preservation by ensiling (Dao Thi My Tien et al 2010).

This research aimed to test the effect of different proportion of ensiled banana pseudo-stem combined with ensiled taro foliage on intake, digestibility and nitrogen retention in growing native Moo Lath pigs.

Materials and Methods

Location

The experiment was conducted in the farm of the Department of Livestock and Fishery, Faculty of Agriculture, National University of Laos, Vientiane capital, Lao PDR.

Treatment and experimental design

Four castrated native Moo Lath pigs were bought from villagers in Vientiane capital. They were about 3 months old and averaged 30 kg live weight. They were housed in individual metabolism cages, designed for separate collection of urine and feces.

The experimental design was a 4x4 Latin square with 4 pigs, 4 levels of ensiled banana pseudo stem (0, 5, 10 and 15%, DM basis) replacing ensiled taro foliage. Soybean meal was added to maintain the diets isonitrogenous. Broken rice (20%) was added to all diets (Table 1).

Table 1. Experimental diets and chemical composition

	Diets, % DM basis			
	BS0	**BS5**	**BS10**	**BS15**
Ensiled banana pseudo-stem	0	5	10	15
Ensiled taro foliage	74.4	67	62	54.6
Broken rice	20	20	20	20

Soybean meal	0.0	2.0	2.0	4.0
Soybean oil	3.6	4	4.2	4.6
CaCO3	0.8	0.8	0.8	0.8
CaHPO4	0.7	0.7	0.5	0.5
NaCl	0.5	0.5	0.5	0.5
*Composition, **%** DM basis except for DM which is on air-dry basis*				
DM, %	13.4	13.1	13.1	13.2
CP	12.8	12.6	12.7	12.6
CF	13.7	14.3	16.0	17.6
Ash	1.8	1.6	1.3	2.7
OM	98.2	98.4	98.7	97.3

Experimental periods lasted ten days: five days were for adaptation to the change of diet and five days for collection of urine and feces. The diets were fed twice daily to appetite, at 7:30 am and 16:00 pm; water was freely available in automatic drinkers.

Diet preparation

Taro foliage (leaves + petioles) were harvested in the ponds where waste water was stored surrounding Vientiane city. The banana pseudo stems were obtained from farmers in the outskirts of Vientiane capital. The forages were ensiled separately following the procedure described by (Sivilai et al 2017).

Sample collection

Feeds offered and refused were weighed daily. The urine was collected in a bucket via a funnel

below the metabolism cage, with addition of 50 ml of 25% H_2SO_4 to maintain the pH below at 4). Feces were collected daily and stored at -20ÂºC. At the end of each period, the daily collections of urine and feces were mixed and representative samples stored at -20 prior to analysis.

Chemical analysis

Feed offered and refused and feces were analyzed for dry matter (DM), crude protein (CP) crude fiber (CF) and ash, and urine was analysed for N, according to AOAC (1990) methods.

Statistical analysis

The data were analyzed using the general linear model in the ANOVA program of the MINITAB software version 16 (Minitab 2016). Sources of variation were treatments, pigs, periods and error. The model was:

$Y_{ij\ (k)} = m + C_i + R_j + T_k + e_{ij\ (k)}$

Where:

$Y_{ij\ (k)}$: Experimental observation value of column i, row j and treatment k

Âµ: Overall mean

C_i: Effect of column i: where i = 1, 2, 3, 4

R_j: Eeffect of row j: where j = 1, 2, 3, 4

T_k: Effect of treatment k: where k = 1, 2, 3, 4

e_{ij}: Experimental error (random error)

Results

Chemical composition of diet ingredients

The data on composition of diet ingredients (Table 2) revealed no major differences from average values reported in the literature (http://www.feedipedia.org).

Table 2. Composition of the ingredients in the diets

	% DM	As % in DM				
		CP	CF	Ash	OM	
Ensiled banana pseudo-stem	7.1	3.1	31.3	1.8	98.2	

Ensiled taro foliage	7.2	14.8	27.2	2.3	97.7
Broken rice	87.0	7.5	3.8	2.7	97.3
Soybean meal	82.1	48.2	6.5	7.5	92.5
Minerals*	94.7	-	-	86.6	-

**Mixture of 40% CaCO3,30% CaHPO4,40% NaCl*

Apparent digestibility

Coefficients of apparent digestibility declined linearly as the proportion of ensiled banana pseudo-stem in the diet was increased (Table 3; Figures 1-3) with the trend being more pronounced in the case of crude fiber.

Table 3. Mean values for apparent digestibility of diets with increasing proportions of ensiled banana pseudo-stem replacing ensiled taro foliage

	BS0	**BS5**	**BS10**	**BS15**	**SEM**	***p***
DM intake, g/d	921	918	915	910	11.2	0.913
Apparent digestibility, %						
DM	88.5^{a}	84.9^{ab}	83.6^{b}	83.6^{b}	1.06	0.004
CP	84.9^{a}	80.7^{ab}	80.3^{ab}	77.2^{b}	1.38	0.002
CF	81.6^{a}	74.9^{ab}	71.6^{b}	68.6^{b}	2.00	<0.00
OM	88.9^{a}	85.6^{ab}	84.1^{b}	83.6^{b}	1.04	0.002

^{ab} *Means without common superscript differ at p=0.05*

Figure 1. Effect of increasing level of ensiled banana pseudo stem replacing taro foliage on apparent DM digestibility in Moo Lath pigs

Figure 2. Effect of increasing pseudo stem replacing e on CP digestibility in

Nitrogen retention

Daily N retention, and N retention as proportion of N digested, declined with linear trends as ensiled banana pseudo-stem replaced ensiled taro foliage (Table 4; Figures 4 and 5)

Table 4. Effect of ensiled banana pseudo-stem and taro foliage on N balance and retention in Moo Lath pigs

	BS0	BS5	BS10	BS15	SEM	*p*
N balance, g/d						
Intake	25.3^{a}	24.1^{ab}	23.9^{b}	24.7^{b}	0.31	0.013
Feces	3.8^{b}	4.8^{ab}	5.4^{ab}	4.8^{a}	0.32	0.008
Urine	5.5^{c}	7.9^{bc}	8.8^{ab}	6.9^{a}	0.39	<0.001
N retention						
g/d	16.0^{a}	13.0^{b}	11.5^{bc}	9.7^{c}	0.65	<0.001
% of N intake	63.1^{a}	52.7^{b}	47.4^{bc}	40.6^{c}	2.28	<0.001
% of digested N	74.0^{a}	65.4^{ab}	59.2^{bc}	51.7^{c}	2.39	<0.001

^{abc} *Means without common superscript differ at p=0.05*

Figure 4. Effect of ensiled banana pseudo stem replacing ensiled taro foliage on N retention in Moo Lath pigs

Figure 5. Effect of en on N retaine

Discussion

The depression in DM digestibility with increasing replacement of ensiled taro foliage by ensiled banana pseudo-stem can be attributed in part to the increase in dietary fiber content as taro foliage replaced banana pseudo-stem. However, a more important factor would appear to be the effect of the protein component. The data on N retention show clearly that the protein provided by ensiled taro foliage was of superior biological value compared with the combination of banana pseudo-stem and soybean meal that it replaced.

Conclusion

- Apparent digestibility of DM and crude protein, daily N retention and N retained as percent of N digested, all declined linearly as ensiled banana pseudo-stem and soybean meal replaced ensiled taro foliage.

- It is apparent that the biological value of the protein in the ensiled taro foliage is superior to that in the combination of ensiled banana pseudo-stem and soybean meal

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