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Effect of levels of sun-dried cassava foliage on growth performance of cattle fed rice straw

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Abstract

An on-farm trial experiment was carried out in Treang district, Takeo province from June to September 2006. Twenty female cattle were allocated to five levels of sun-dried cassava foliage (0, 0.25, 0.5, 0.75 and 1 % of body weight in DM basis) to evaluate the growth response when fed a basal diet of untreated rice straw plus a rumen supplement. The heifers were tethered alongside the feed trough in each household, where they had free access to the experimental diet and water. The heifers were provided rumen supplement (mainly urea, sulphur and other minerals) at 0.25% body weight and *ad libitum* rice straw. The design was a completely randomized design (CRD) with four replications of each treatment.

The intake of the leaf component of the cassava was 90% of the offer but only 45% of the offer level of petiole was consumed. The total intake of DM and crude protein intake increased according to the intake of cassava foliage. Daily weight gain increased from 201 to 402 g/day and feed conversion was better with increasing levels of protein from sun-dried cassava foliage in the diet. The responses were linear over the range of cassava crude protein intakes from 0 to 1.6 g/kg live weight.

It is concluded that supplementation with sun dried cassava foliage stimulated the growth performance of cattle and that the response was linear over the range from 0 to 1.6g cassava crude protein/kg live weight.

Key words: *On-farm trial, Sun-dried cassava foliage, rumen supplement, rice straw, growth response cattle, intake*

Introduction

Similar with other developing countries in the region, large ruminants in Cambodia depend on natural pasture and crop residues, mainly rice straw. These are of low digestibility and usually imbalanced in essential nutrients which contribute to low feed intake (Schiere and Ibrahim 1989). Supplements are required to improve rumen microbial fermentation and therefore the performance of the host animals (Dixon and Egan 1987). Inadequate nutrition in cattle has often caused economic loss to the farmers because their animals loose weight and body condition, resulting in reduced reproductive capacity and increased susceptibility to diseases and parasites (Leng 1997).

Early work with fresh cassava leaves showed that it could be the sole source of supplementary protein and roughage in diets for fattening cattle based on liquid molasses-urea

(Ffoulkes and Preston 1978). When used as a supplement to untreated rice straw the growth rates in 'local "yellow" cattle were increased threefold by supplementing them with fresh cassava foliage (Seng Mom et al 2001). Ho Quang Do et al (2002) reported a curvilinear increase in N retention in goats when fresh cassava leaves replaced grass as the supplement to ammoniated rice straw.

In Cambodia, cassava (*Manihot esculenta*) is usually planted by the farmers with the main purpose of root harvesting and the leaves are left in the field. It has been shown that this residue can be a valuable source of protein for feeding to many kinds of animals (Preston 2001). When farmers harvest cassava root, the leaves are still a good quality protein feed for cattle particularly in the dry season. This situation can give an opportunity for farmers to get more benefit by collecting the cassava leaves for cattle feeding. Therefore, it is important to promote ways of maximizing the use of this valuable crop. Wanapat et al (1997) have drawn attention to the potential of cassava foliage made into hay, which combined leaves, stems and petiole, as a feed for ruminants. Added to this, cassava foliage contains condensed tannins (Wanapat et al 1997), which when fed to buffaloes in form of sun dried hay (Netpana et al 2001; Granum et al 2002) and goats (Seng sokerya and Preston 2003) in fresh form has been reported to reduce nematode egg counts.

In view of the potential of cassava foliage as a supplement for ruminant animals, there is a need to promote research with this feed for cattle in the Cambodia situation.

Objectives

- To study effect of levels of sun dried cassava foliage on growth performance of cattle fed rice straw
- To study effect of sun dried cassava foliage on faecal nematode egg counts
- To introduce to farmers the idea of using cassava foliage for their animals

Materials and Methods

Location and duration

The experiment was carried out in villages in Treang district, Takeo province which is about 80 km south of Phnom Penh city. The experiment was conducted for 3 months from June to September, 2006 excluding adaptation and organizing period.

Farmer selection

In Treang district, Takeo provice, CelAgrid has been implementing a cattle project financed by Heifer International Cambodia. The aims of the implementation are to improve cattle management and feeding. Twenty farmers (including women householders) were selected for the study to evaluate the response to sun-dried cassava foliage. Beside these farmers, seven other farmers joined in the study to serve as controls using the traditional system of un-supplemented free grazing treatment. The selection of the farmers was based on:

- Having Heifers of 1.5 to 2 years of age
- Availability of land for growing cassava foliage

- Willingness to participate in the research and strong commitment to the idea
- Willingness to share technologies with neighbors

Experimental design

The experimental design was a "production function" to evaluate the growth response of cattle to increasing levels of sun-dried cassava foliage when fed untreated rice straw plus a "rumen supplement". One female animal per household (n=20) was allocated to one of 5 levels of sun dried cassava foliage (0, 0.25, 0.5, 0.75 and 1 % of body weight in DM basis). The design was a completely randomized design (CRD) with 4 replications of each treatment.

The individual treatments were

- **RC0:** Rice straw + rumen supplement at 0.25% body weight

- RC0.25: Rice straw + rumen supplement 0.25% body weight + sun dried cassava foliage 0.25% body weight (in DM)

- RC0.50: Rice straw + rumen supplement 0.25% body weight + sun dried cassava foliage 0.50% body weight (in DM)

- RC0.75: Rice straw + rumen supplement 0.25% body weight + sun dried cassava foliage 0.75% body weight (in DM)

- RC1: Rice straw + rumen supplement 0.25% body weight + sun dried cassava foliage 1% body weight (in DM)

Animals and management

The heifers were vaccinated against Foot and Mouth Disease before starting the experiment. They were from 1.5 to 2 years of age with an average live weight of 174 kg live weight. Twenty heifers were tethered alongside the feed trough (Photo 1) in each household, where they had free access to the experimental diet. The sun-died cassava foliage was fed first at about 7.00 am. The rumen supplement and rice straw were fed 2 times per day in the morning (8:00h) and afternoon (16:00h). Water was available the whole day. The seven "control" heifers were kept under traditional farmer management of free grazing and no supplementation.

Photo 1: Individual animals tethered to the feed trough in each household

Experimental Feeding

The cassava foliage was bought from farm households situated along the riverside in Kandal province, at the time of harvesting the roots. It was taken to CelAgrid for drying. The cassava leaves plus petioles were separated from the hard stem and sun dried by spreading on a plastic sheet placed on the ground. The duration of sun drying was 3 to 5 days until the leaves become crisp (>85%DM). After sun drying, the foliages were stored in bags and transported to the study site in Takeo province.

The ingredients for the rumen supplement (Table 1) were bought at the local market and mixed by the farmers participating in the study (Photo 2). After mixing, it was kept by each farm household and fed to the cattle at the rate of 0.25% of body weight per day. Rice straw was bought from farmers in the study area. It was from rice grown under rain-fed conditions.

Table 1: Composition of the rumen supplement

Ingredient	**% (fresh basis)**
Sugar palm syrup	27
Water	13
Rice bran	33.5
Urea	13
Diammonium phosphate	3
Salt	5
Lime	5
Sulfur	0.5

Photo 2: Farmers preparing the rumen supplement

Data collection

Feeds offered and refused were recorded daily and weighed to measure daily feed intake. Representative samples of feeds offered and refused were collected for chemical analysis. The live weight was taken at the beginning of the study and then every 2 weeks until the end of the trial (Photo 3). Faecal samples were collected directly from the rectum of each animal once at the beginning of the experiment and after every 2 week interval to check the nematode egg count.

Photo 3: the method of weighing the cattle

Chemical analyses

The feeds offered and refused were analyzed for DM using microwave radiation (Undersander et al 1993) and N following the Kjeldahl procedure as outlined by AOAC (1990). For faecal egg counts, 4 g of representative samples of faeces were ground and mixed with 56 ml of floatation fluid (a saturated salt solution in water). A sub sample was transferred to both compartments of a McMaster counting chamber and allowed to stand for

5 minutes. All helminth eggs were counted under a microscope at 10x10 magnification and multiplied by 50 to yield the eggs per gram of faeces (Hansen and Perry 1994).

Statistical analysis

Data for feed intake, growth and feed conversion were analyzed by analysis of variance (ANOVA) using the General Linear Model procedure of MINITAB software (Version 13.31 2000). Sources of variation were levels of sun dried cassava foliage and error. Regression analysis was used to relate the independent variable (levels sun dried cassava foliage) with the dependent variables (live weight gain, feed intake and feed conversion).

Results and discussion

Animal health

There were no signs or symptoms of disease or toxicity in the animals during the experiment. Animals were in good healthy and it was observed that the skin became brighter in colour towards the end of the experiment, especially in the treatments with highest offer levels of cassava foliage. The changing appearance of the skin observed in this study may have been due to the effect of the protein supplementation enhancing the expression of immunity against internal and external parasite (Leng R A. personal communication).

Chemical composition of diet

The chemical composition of the components of the sun-dried cassava foliage, and of the rumen supplement, are shown in tables 2 and 3. The crude protein level in the cassava leaves was almost three times higher in the leaves than in the petioles. It was lower than in the studies of Wanapat (2003) and Vongsamphanh and Wanapat (2004) where the values reported were 23.6% and 27.3% in DM. These higher values could be because these authors harvested the foliage 3 months after planting, whereas the sun-dried cassava foliage in this study was collected at root harvesting. The nutritive value of cassava foliage has been shown to be affected by variety, location, soil type and other environmental conditions as well as the method of chemical analysis (Seerley 1972).

Table 2: Mean values for chemical composition of feed ingredients

	% DM	N*6.25, % in DM
Whole sun dried cassava foliage	87	18.8
Sun dried cassava leaves	88.7	23.4
Sun dried cassava petiole	86.3	9.7
Rumen supplement	70.6	39.6

The DM and crude protein of the rice straw varied slightly among the different households (Table 3). The mean overall values were 87.1% DM and 5.41% crude protein.

Table 3: Mean values for chemical composition of rice straw in the different house-holds

Family name	% DM	N*6.25, % (in DM)
Mr. Banh Keo	85.6	5.8
Mr. Chham Kosal	85.5	4.9

Mrs. Eth Sarom	87.5	5.1
Mr. Im Ean	88.0	5.1
Mr. Khat Youn	88.3	4.9
Mr. Kim Cho	86.3	5.7
Mr. Kong Thol	87.5	4.9
Mr. Moa Khon	88.4	5.7
Mrs. Moa Yat	85.7	5.8
Mr. Ngan Thy	85.8	5.7
Mrs. Nhem That	86.3	5.7
Mrs. Nhem Theoun	87.3	5.7
Mr. Ni Chivo	87.5	4.9
Mrs. Oam Rani	86.6	4.9
Mrs. Om Yen	88.0	5.1
Mrs. Sok Chanthy	88.0	5.8
Mrs. Sok Mali	88.3	5.1
Mrs. Sok Min	85.9	5.8
Mrs. Thou Ka	86.8	5.8
Mrs. Yong Thuch	87.8	5.7
Mean±SD	**87.1±1.01**	**5.41±0.39**

Feed intake

The actual intake of the supplements was lower than the planned offer levels (Table 4; Figure 1). The heifers selected the cassava leaves in preference to the petioles, such that intakes of the former were 90% of the offer levels while for the latter it was less than 45% of offer levels. The low acceptability of the sun-dried petioles may be due to the effect of drying (rather hard in texture) or the lower protein content. In this study, leaves and petioles were sun-dried without chopping. In contrast, when feeding fresh cassava foliage managed by repeated harvesting there was no selection (personal observation) against the petioles. The cattle consumed petioles, leaves and soft stems but refused the hard stems.

Table 4: Actual intake of sun dried cassava foliage compared with planned levels

Planned, % of body weight (DM)	**0**	**0.25**	**0.5**	**0.75**	**1**
Actual intake,% body weight (DM)	0	0.18	0.34	0.55	0.73
Intake as % amount offered					
Cassava leaf	0	96.7	95.7	94.9	96.0
Cassava petiole	0	40.1	30.3	44.2	39.4
Cassava crude protein, g/g total CP in diet	0	0.16	0.26	0.38	0.43

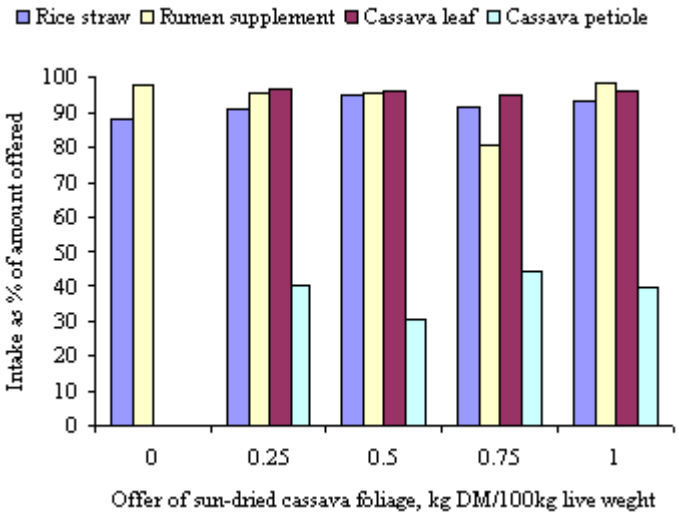

Figure 1: Mean values for intake of diet ingredients as % of amount offered according to the offer level of sun-dried cassava foliage

There were no significant effects of cassava foliage intake on DM and crude protein intake of rice straw and rumen supplement (Table 5). However, total intake of DM and crude protein intake increased according to the intake of cassava foliage (Figures 2 and 3). The total DM increased by 30% and the crude protein by 65% at the highest level of cassava foliage. The proportion of dietary crude protein from sun dried cassava foliage was 40% of the total crude protein intake at the highest level of supplementation (Figure 4). The effect of the sun-dried cassava foliage in increasing the total DM intake in this study is in agreement with reports by Vongsamphanh and Wanapat (2004), who supplemented rice straw with cassava hay in a study with cattle, and by by Ho Quang Do et al (2002) who supplemented fresh cassava foliage to goats fed ammoniated rice straw. The positive linear trend in total DM intake in response to the supplementary cassava foliage protein (Figure 5) is in accordance with the thesis outlined by Leng and Preston (1976) and by IAEA (2002) that the selected protein supplement should not reduce intake and utilization of the basal diet but instead have potential to enhance them.

Table 5: Mean values for feed intake and crude protein intake of heifers fed rice straw with levels of sun dried cassava foliage

	Planned levels of cassava, % of live weight (DM basis)						
	0	**0.25**	**0.5**	**0.75**	**1**	**SEM**	**P**
DM intake, g/day							
Rice straw	4295	4156	4538	3967	4336	224	0.49
Rumen supplement	315	293	303	258	309	18.5	0.26
Cassava	0	323	621	994	1305		
Total	4609^{c}	4772^{c}	5462^{bc}	5219^{bc}	5950^{ab}	234	0.001
DMI, g/kg LW	25.6	27.0	30.1	29.2	32.8	1.97	0.14
CP intake, g/day							
Rice straw	245	223	243	213	224	16.7	0.62
Rumen supplement	125	116	120	102	122	7.32	0.26
Cassava	0	64.7	127	196	261		
Total	369^{d}	404^{cd}	490^{bc}	511^{b}	608^{a}	20.8	0.001

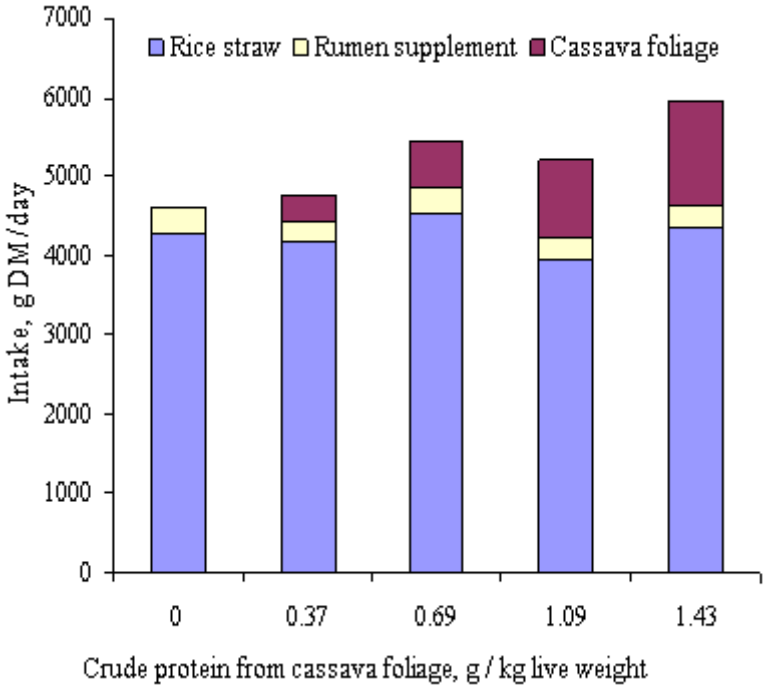

Figure 2: Mean values for intake of diet ingredients according to intake of crude protein from sun-dried cassava foliage

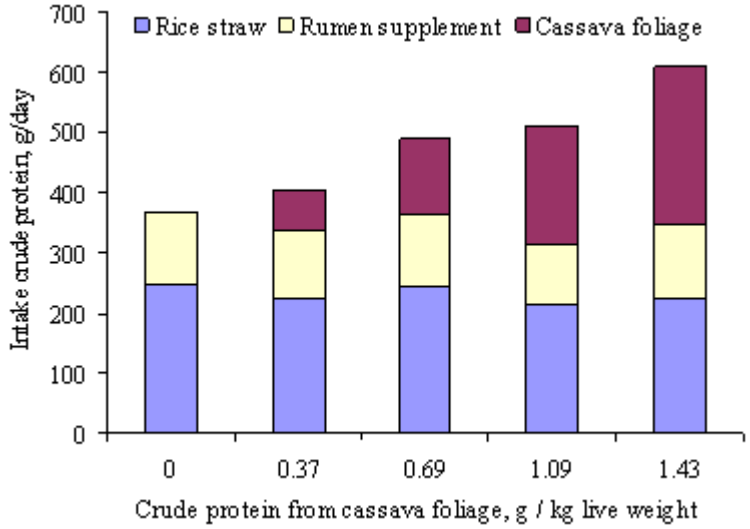

Figure 3: Mean values for intake of crude protein from the different dietary ingredients according to intake of intake of crude protein from sun-dried cassava foliage

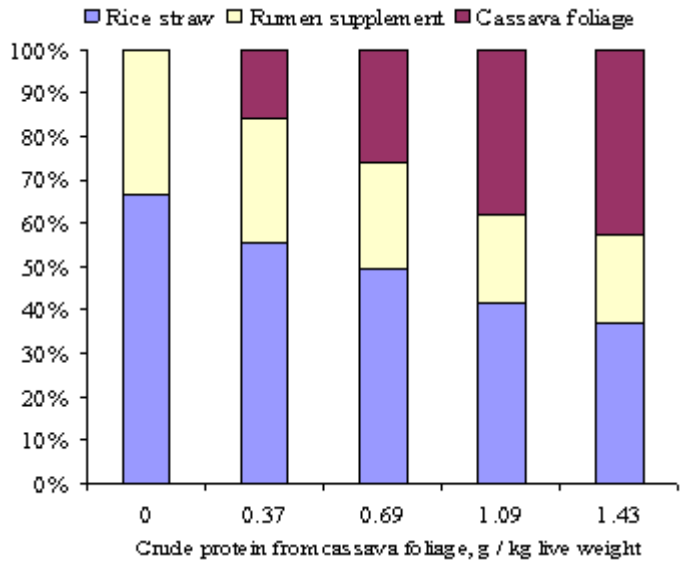

Figure 4: Mean values for percentage of dietary crude intake from the different ingredients according to intake of crude protein from sun-dried cassava foliage

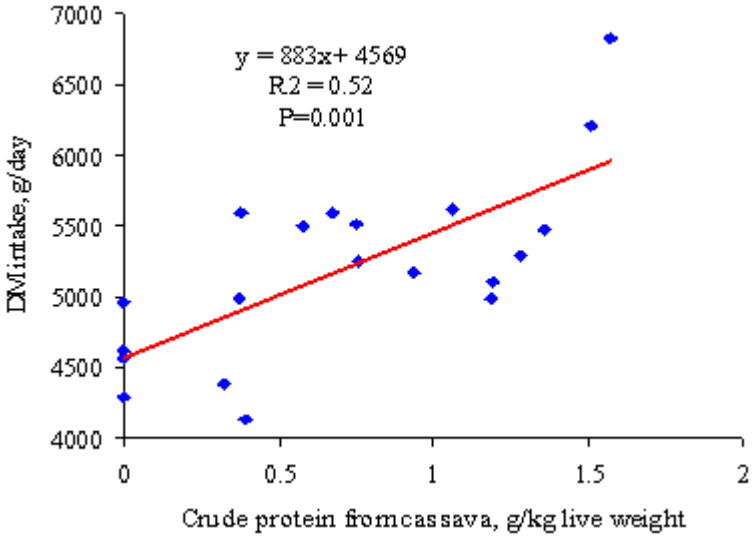

Figure 5: Relationship between sun-dried cassava foliage intake and DM intake

Growth rate

There were major differences in live weight gain between the heifers fed rice straw and rumen supplement (without cassava foliage) and those on un-supplemented free grazing (Figure 6). The rumen supplement provided nutrients for rumen microbes (ammonia, sulphur, phosphorus and other minerals) that can correct deficiencies of these nutrients in poor quality feeds such as rice straw. It cannot be concluded that the difference was due only to the rumen supplement as the grazing areas were extremely limited due to the land being used for the rice crop. The daily weight gain of the cattle fed only rumen supplement and straw in this experiment was higher than in the study of Seng Mom et al (2001); however, there were differences in the breeds which were larger and of Zebu type in our study compared with the smaller "Yellow" breed of cattle used by Seng Mom et al (2001).

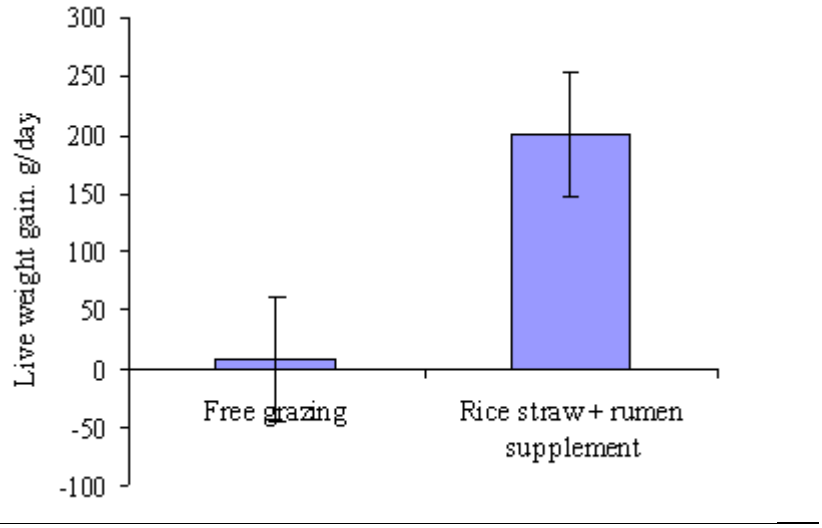

Figure 6: Comparison of rice straw + rumen supplement (without cassava) and free grazing on live weight gain

Daily weight gain increased and feed conversion was better with increasing levels of protein from sun-dried cassava foliage in the diet (Table 6). The responses (Figures 7 and 8) were linear over the range of cassava crude protein intakes recorded in the experiment (from 0 to 1.6 g crude protein/kg live weight). The improved growth rates and feed conversion in this study are in agreement with the reports of Seng Mom et al (2001) and Ho Quang Do et al (2001), who used fresh cassava foliage as a supplement for cattle fed rice straw and Moore, (1976) who gave cassava foliage to steers fed *Pennisetum purpureum* with varying levels of cassava foliage. Le Huu Khoung and Duong Nguyen Khang (2005) reported a linear increase in live weight gain in "Sindhi* Yellow" cattle fed fresh cassava foliage as a supplement to urea-treated rice straw. The maximum response of 60% was less than the 200% response in our study probably because the rate of cassava foliage supplementation was higher (1.6 g/kg live weight compared with 1.0 g/kg live weight in the study of Le Huu Khoung and Duong Nguyen Khang (2005). The response in the experiment of Seng Mom et al (2001) was 400% for cassava foliage protein at 1.3 g/kg live weight compared with the control.

The results of this study, together with the numerous reports in the literature, indicate strongly that the beneficial effect in ruminants of the protein in cassava foliage is due to its " bypass" or " escape" properties presumably because of the binding effect on the protein of the tannins present in this forage (Wanapat et al 1997). In an *in vitro* study, Promkot and Wanapat (2003) estimated that the rumen undegradable protein (assumed to be bypass protein) as percent of total protein in cassava hay was 52.7 compared with 50.4 for cottonseed meal (considered to be one of the best sources of bypass protein according to Preston and Leng 1987) and 35 for leucaena leaf meal

Table 6: Mean values for live weight and conversion of heifers fed rice straw with levels of sun dried cassava foliage

	Planned levels of cassava, % of live weight (DM basis)						
	0	**0.25**	**0.5**	**0.75**	**1**	**SEM**	**P**
Live weight, kg							
Initial	175	166	170	168	166	8.88	0.93
Final	191	189	196	192	199	9.24	0.93
Final#	185	192	195	193	202	3.50	0.058
Daily gain, g/day	201^{b}	266^{ab}	282^{ab}	278^{ab}	402^{a}	33.0	0.01
Feed DM conversion	25.1	18.4	20.	18.8	15.0	2.39	0.09

 # Adjusted for differences in initial weight

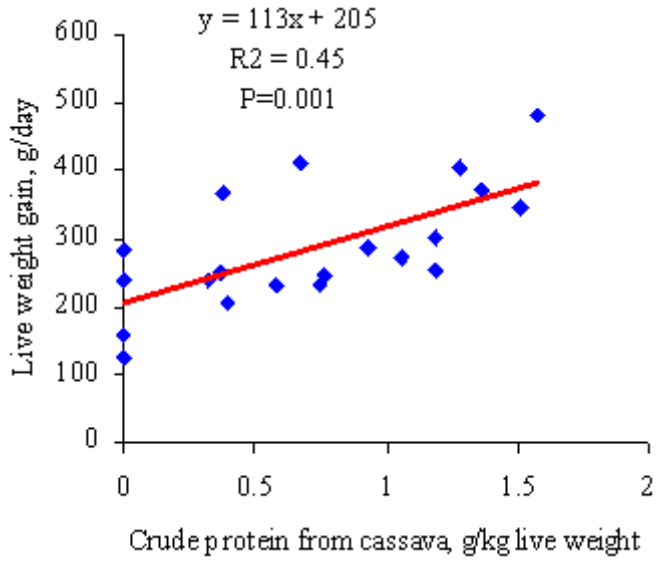

Figure 7: Relationship between protein from sun-dried cassava foliage intake (as g/kg live weight) and live weight gain

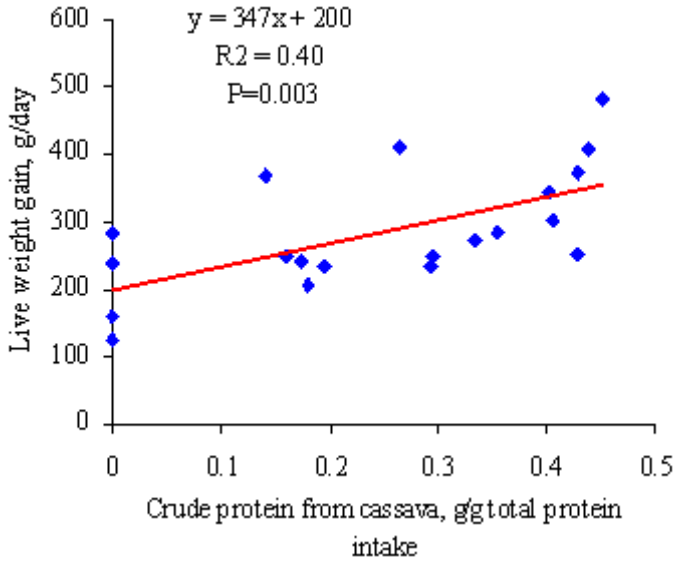

Figure 8: Relationship between protein from sun-dried cassava foliage (as proportion of total crude protein intake) and live weight gain

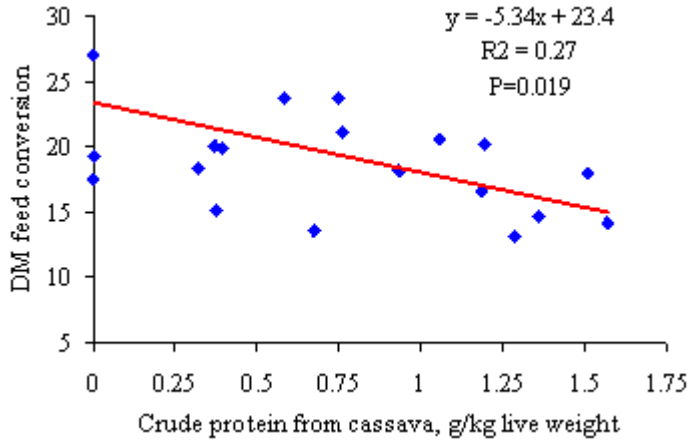

Figure 9: Relationship between intake of crude protein from sun-dried cassava foliage and DM feed conversion

Parasite egg count

The numbers of nematode eggs in the faeces were extremely low both in the supplemented cattle and those on free grazing with no obvious tendencies due to date of sampling or supplementation (Table 7).

Table 7: Nematode egg counts/g of faeces in the heifers fed rice straw and sun-dried cassava foliage or on free grazing

Sample date	Crude protein from cassava foliage, g/kg live weight					
	0	**0.37**	**0.69**	**1.09**	**1.43**	**Free grazing**
6/27/2006	275	188	238	200	425	243
7/11/2006	138	150	225	150	188	143
7/25/2006	238	250	275	375	175	193
8/8/2006	150	125	466	213	225	171
8/22/2006	213	100	325	163	288	171
9/5/2006	163	88	225	88	150	179
9/19/2006	200	75	138	100	163	229

Conclusions

Based on the results of this research it is concluded that:

- Increasing levels of sun dried cassava foliage led to significant increases in total dry matter intake and daily weight gain of cattle fed untreated rice straw and a rumen supplement
- The response to cassava foliage protein in cattle fed untreated rice straw and rumen supplement is linear over the range of 0 to 1.6 g crude protein/kg live weight.
- Sun dried cassava foliage is a good source of bypass protein source for cattle

Acknowledgements

The authors are grateful to the MEKARN project, financed by the Sida-SAREC agency and my assistants Mr. Pek Samnang and Chea Chheangly for their technical help. Thanks are also due to 27 farmers in Treang District, Takeo province, who shared their experiences and participated actively in this study.

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