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Digestibility of ensiled and fresh Golden Apple Snails (*Pomacea spp)* by growing pigs

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Abstract

A digestibility trial on Golden Apple Snails (GAS) (*Pomacea spp)* was carried out to determine the apparent nutrient digestibility by growing pigs of diets containing ensiled (EGAS) and fresh Golden Apple Snails (FGAS). The EGAS and FGAS replaced 30% of the dry matter (DM) of a basal diet (B) to give diets ES30 and FS30, respectively. Six castrated male F1 crossbred (Mong Cai x Large White) pigs with a mean initial live weight of 35 kg were used in a double 3*3 Latin square design. The chopped flesh (FGAS) was made into silage by mixing, on a fresh basis, 2 kg of FGAS with 1 kg of an additive consisting of a mixture of molasses (10%) and rice bran (90%). The silage was stored for 21 days in sealed plastic bags. The FGAS and EGAS had DM contents of 181 and 453 g/kg, respectively, and crude protein (CP) contents of 621 and 368 g/kg (DM basis), respectively. The apparent digestibility of DM was 813, 745 and 735 g/kg ($P<0.05$), and of organic matter 828, 764 and 762 g/kg DM ($P<0.05$), for diets B, ES30 and FS30, respectively. CP and NDF digestibility were not different among treatments ($P>0.05$). Apparent digestibility of DM and CP in EGAS and FGAS was 586 and 551, and 828 and 809 g/kg, respectively ($P>0.05$).

Key words: Apparent digestibility; ensiled Golden Apple Snail (EGAS); fresh Golden Apple Snail (FGAS); F1 (Mong Cai x Large White) pigs

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1. Introduction

The Golden Apple Snail (GAS) (*Pomacea spp)* is the major pest in the rice fields of Laos. However, because of its high growth rate (Delacruz *et al.*, 2000), high protein content and large body size it has considerable potential for use as animal feed. Uncooked fresh GAS meal in swine diets can be used at levels of up to 15% (Catalma *et al.,* 1991). Ensiling is a technique for preserving and improving the nutritive value of raw materials with high moisture and protein contents. However, this is difficult if the basic material has a low soluble carbohydrate content, in which case materials high in fermentable carbohydrates are added (McDonald, 1981). This inhibits the growth of bacteria, and hence enables long-term storage of the raw material, such as fish and its by-products (FAO, 1998).

The aim of the present study was to determine the dry matter and nutrient digestibility of diets containing ensiled (EGAS) and fresh (FGAS) Golden Apple Snails using F1 (Mong Cai x Large White) growing pigs.

2. Materials and methods

2.1. Location and climate

The experiment was carried out in the ecological farm of the Faculty of Agriculture, National University of Laos (NUOL), located in Saythany district, near Vientiane City, Laos. The mean ambient temperature was 33 ºC in the middle of the day during the trial, which started in July 2004.

2.2 Experimental animals and design

Six castrated male F1 crossbred (Mong Cai x Large White) pigs with a mean initial live weight of 35 kg were used in a double 3*3 Latin square design with three treatments. The pigs were housed in individual metabolism cages made from wood, including feeders. The experiment consisted of three periods of 10 days each. Five days in each period were for adaptation to the diets, followed by another five days for collection of faeces and feed refusals.

2.3. Experimental feeds and feeding

Golden apple snails (GAS) were purchased from local farmers. The shell and cover of the fresh GAS were removed, the flesh (FGAS) cleaned, chopped into small pieces, and made into silage (EGAS) by mixing 2 kg of FGAS with 1 kg (fresh basis) of an additive consisting of a mixture of molasses (10%) and rice bran (90%) (Table 1). This was found to be the most suitable ratio of FGAS to additive in Experiment 1 (Paper I). The silage was stored for 21 days in sealed plastic bags to ensure complete fermentation.

Table 1. Ratio of DM of fresh Golden Apple Snails (FGAS) to additive mixture, as fed and on DM basis

	Ratio *	DM, g/kg	Ratio (a) to (b) DM basis
FGAS (a)	2	181	0.4
Additive mixture (b)			
Rice bran	0.9	916	0.8
Molasses	0.1	713	0.1

* Wet weight, kg

Three diets were compared: A basal diet (B) consisting of broken rice, rice bran, maize meal, salt and a mineral-vitamin premix. The analyzed chemical composition of the feed ingredients is shown in Table 2. The other two experimental diets were: FS30, the basal diet with an inclusion of 30% FGAS (DM basis) and ES30, the basal diet with a 30% inclusion of EGAS.

Table 2. Analyzed chemical composition of the feed ingredients (g/kg DM basis)

Ingredients	Parameter		
	DM	CP	Ash

Broken rice	852	77	11
Maize meal	862	94	59
Rice bran	879	130	53
EGAS	453	368	149
FGAS	181	621	
Fish meal	901	620	
Salt	941		
Premix	970		

FGAS = Fresh golden apple snail flesh;
EGAS = Ensiled Golden Apple Snail flesh

The pigs were fed twice daily with equal rations at 09:00h and 17:00h. The feed offer was calculated each week at 4 % DM of bodyweight. Clean water was supplied *ad-libitum* through nipple drinkers. The animals were weighed at the beginning of the experiment and every ten days thereafter.

2.4. Measurements

During the collection period, the weights of feed offered and refused and faeces were recorded daily. The refusals were weighed before every feeding in the morning. The faeces were collected twice daily and weighed immediately. Samples of 10% of faeces were taken from each pig at each collection and were kept in sealed plastic bags and stored in a freezer at 4 ºC until analysis.

After each five day collection period, the samples of feed offered and refused, and faeces from each pig, were mixed together and representative samples were taken for analysis.

Samples of feed offered and refused and faeces were analysed for DM, N and OM to determine digestibility. Based on the digestibility of the basal diet, the digestibility of EGAS and FGAS was calculated using the formula below:

$$A = \frac{C - 0.7*B}{0.3}$$

Where A: Digestibility of EGAS (and FGAS) (g/kg DM)
B: Digestibility of basal diet (g/kg DM)
C: Digestibility of ES30 (and FS30) (g/kg DM)

2.5. Chemical analysis

Samples were analysed in the Feed Analysis Laboratory of the Department of Livestock and Fisheries of the Ministry of Agriculture and Forestry of Laos for DM, Ash and N by standard AOAC procedures (AOAC, 1990).

2.6. Statistical analyses

The data were analysed using the General Linear model option of MINITAB (version 13.31) ANOVA software (2000). Tukey's pair-wise comparison was used to determine the difference among treatments with confidence level 95.0 %.

3. Results

3.1. Experimental diets

The chemical composition of the FGAS and EGAS is shown in Table 2. The FGAS and EGAS had DM contents of 181 and 453 g/kg, respectively, and crude protein (CP) contents of 621 and 368 g/kg (DM basis), respectively. The ingredient and chemical composition of experimental diets are shown in Table 3. The basal (B), ES30 and FS30 diets, had DM and CP contents of 854, 601 and 384 g/kg and 103, 182 and 258 g/kg DM, respectively. Ash content was higher in the diets containing GAS than in the basal diet.

Table 3. Ingredient and chemical composition of diets (g/kg DM)

Feedstuff	Dietary treatment *		
	B	ES30	FS30
Broken rice	222		
Maize meal	379		
Rice bran	389		
EGAS		300	
FGAS			300
Salt	5	5	5
Premix	5	5	5
Basal diet		690	690
Total	1000	1000	1000
Chemical composition**			
DM	854	601	384
CP	103	182	258
Ash	46	74	86

** B, basal diet; ES30, basal diet with 30 % EGAS (DM basis); FS30, basal diet with 30 % FGAS (DM basis)*
*** Analysed values*

3.2. Apparent digestibility of ensiled (EGAS) and fresh Golden Apple Snail (FGAS)

The apparent digestibility in growing pigs when part of the basal diet was replaced by EGAS and FGAS was significantly different among treatments for dry matter (DM) and organic matter (OM). DM and OM digestibility values were 813, 745 and 735 g/kg DM and 828, 764 and 762 g/kg DM, for the basal diet, ES30 and FS30, respectively ($P<0.05$). There was no differences ($P>0.05$) for CP digestibility among treatments (Table 4).

Based on the results above the digestible nutrients of EGAS and FGAS were calculated, and are shown in Table 5. DM, OM and CP digestibility of EGAS and FGAS were not different ($P>0.05$). CP digestibility of EGAS was 828 g/kg DM and of FGAS 809 g/kg DM.

Table 4. Effect of replacing part of a basal diet with fresh (FGAS) and ensiled Golden Apple Snail (EGAS) flesh on apparent nutrient digestibility in growing pigs g/kg (DM)

Parameter	Dietary treatment *			SE	P
	B	ES30	FS30		
DM	813[a]	745[b]	735[b]	17.95	0.005
CP	753	776	770	18.61	0.676
OM	828[a]	764[b]	762[b]	16.32	0.007

[a,b] mean values within rows with different superscript letters are significantly different (P<0.05)
* See Table 3

Table 5. Apparent nutrient digestibility* (g/kg) of ensiled (EGAS) and fresh Golden Apple Snail flesh (FGAS) in F1 growing pigs

Parameter	EGAS	FGAS	SE	P
DM	586	551	25.25	0.339
CP	828	809	20.24	0.666
OM	616	609	16.25	0.704

* Calculated from the data in Table 3 and 4

4. Discussion

In the present study, the basal diet was formulated using common ingredients and proportions typically used by rural farmers in Laos, except that a vitamin-mineral premix was included in our experiment, which would not be the case in practice. Diets for growing pigs consist mainly of cereals and their by-products, for example rice bran, maize meal and broken rice, and are often low in protein. Replacing 30% of the basal diet with EGAS and FGAS to give treatments ES30 and FS30, respectively, resulted in large differences between the chemical composition of diets B, ES30 and FS30, particularly with respect to crude protein (CP) content, which was higher in diets FS30 and ES30 than the requirement of crossbred growing pigs. The CP content of diet B was only 103 g/kg, which is very low, but fairly typical for growing pig diets in the rural areas of Laos. However, it should be emphasized that the objective of the experiment was to determine the digestibility of the fresh and ensiled snails, and so inclusion levels of the GAS in diets ES30 and FS30 were higher than would be normal under actual farm conditions.

Present results show that the DM and OM apparent digestibility was higher in the basal diet B than in diets ES30 and FS30, which was a result of the lower DM and OM digestibility of the snails (around 60%) than of the basal diet (over 80%). The molasses in the silage additive mixture would have been highly digested (McDonald *et al.,* 2002), but this would have been cancelled out by the low digestibility of the rice bran, which in Laos usually contains a high proportion of hulls.

However, the apparent digestibility of CP was not different among diets, due to the fact that the apparent CP digestibility of the FGAS and EGAS was similar to that of the basal diet, and the high CP content of the diets containing GAS, at 3.0-4.0 times maintenance, would still have had very little overall effect on digestibility (McDonald *et al.,* 2002). These values are similar to the nitrogen digestibility values reported by Phiny *et al.* (2001) of 801 - 884 g/kg DM for fresh water fish ensiled with a mixture of rice bran (65 % fresh fish and 30 % rice bran) and different ratios of sugar palm syrup. However, Ngoan *et al* (2000) reported that the apparent digestibility of the CP of shrimp by-products ensiled with molasses was only 750 g/kg DM, due to the high chitin content of shrimp by-product.

Apparent CP digestibility was high and there was no difference between the ensiled and fresh GAS. Other authors have also found that the N digestibility in fish silage is high FAO, 2005; Green *et al*., 1982); Taylor, 1976) and that processing (drying) did not affect nutrient digestibility FAO, 2005).

5. Conclusions

- The apparent digestibility of DM and OM in the ES30 and FS30 diets was lower than in the basal diet, but the digestibility of CP was similar among diets.
- The apparent digestibility of CP in EGAS and FGAS was quite high (over 80%), which suggests that Golden Apple snails can be a useful protein feed for growing pigs in Laos.

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