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World Rabbit Science

World Rabbit Sci. 2012, 20: 209 - 213
doi:10.4995/wrs.2012.1230

NUTRITIVE VALUE OF SUN-DRIED *PUERARIA PHASEOLOIDES* FOR RABBITS UNDER TROPICAL CONDITIONS

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Abstract: The nutritive value of *Pueraria phaseoloides* (whole plant, full fruit stage, sun-dried) for the growing rabbit was studied by comparing diets containing an increasing incorporation of *Pueraria* (0 to 40%) in substitution to a basal mixture. The crude protein (CP) concentration of *Pueraria* was 17.6 % dry matter (DM), while neutral detergent fibre (NDF) and acid detergent fibre were 51 and 39%, respectively. A basal diet was formulated (51.1% NDF and 19.9% CP, on DM basis) and pelleted. Another 2 diets were obtained through substitution of 20 and 40% of basal diet by *Pueraria*. Faecal digestibility was measured between 42 and 46 d of age on 12 young rabbits per diet, fed *ad libitum* since weaning (35 d, 754±108 g). The substitution of 40% of basal diet by *Pueraria* reduced the digestibility of organic matter, crude protein and NDF from 69 to 55%, 80 to 68%, and 56 to 43%, (P<0.01), respectively. The digestible energy obtained by regression for sun-dried *Pueraria* was 3.81±0.38 MJ/kg DM, and the digestible protein content of *Pueraria* was 41.7±6.7 g/kg DM.

Key Words: *Pueraria*, nutritive value, growing rabbit, digestion.

INTRODUCTION

Since the rabbit is a monogastric and herbivorous animal (Gidenne and Lebas, 2006), it is relevant to use plants or vegetable sources in rabbit rearing, especially forage not used for human feeding. However, one main restriction to the use of plants is the need to store them in good conditions, especially in dried form. Precariousness and rural depopulation are growing in many African countries. This trend can be limited if populations are able to exploit profitable and sustainable systems. Farming methods based on a system of crop-livestock integration as areas of sustainable development should be explored (Tian *et al.,* 2001). *Pueraria phaseoloides* is a leguminous plant that appears naturally throughout the humid tropics. It is used as part of a mixture or a sole cover crop to prevent soil erosion and enrich the soil of tree crops such as coconuts, oil-palm and rubber. In Côte d'Ivoire, many studies showed that in the first stage the growth rate of *Pueraria* was not fast, and did not disturb maize or others cereal growth. In others phases, the growth rate of *Pueraria* was fast and the most important role of *Pueraria* cover crop was the beneficial contribution to the parent tree crops through the deposition of leaf litter and nitrogen fixation in

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http://dx.doi.org/10.4995/wrs.2012.1230

the soil. So, *Pueraria* will help improve the nutrition and economy of smallholder families, both as animal forage and a source of extra income. In addition, the use of leguminous cover crops has the capacity to restore and maintain soil fertility without disrupting the traditional cropping system. These legumes constitute a feed resource for herbivorous animals such as the rabbit and avoid the need to import similar fibre sources like alfalfa meal (Guemour *et al*., 2010; Kadi *et al*., 2011). On the other hand, hay production in tropical climates is limited in the rain season. One way to collect and transform *Pueraria* in good conditions may be at the onset of the dry season, where small farmers have low activity. The *Pueraria* studied conforms to the plant that can currently be collected by the small farmers around Allada (South Benin). Therefore, the aim of this work was to determine the nutritive value of whole *Pueraria*, freshly collected from the farm, sun-dried and incorporated at increasing levels in pelleted feeds for growing rabbits.

MATERIALS AND METHODS

Feeding, animals and experimental design

Whole *Pueraria* was collected in fresh form (full fruit stage) from one location (area of Allada, Bénin), and immediately sun-dried for 4 d. The *Pueraria* was then ground up before mixing with other ingredients and pelleting.

The nutritive value of *Pueraria* was studied by measuring the faecal digestibility of 3 pelleted feeds corresponding to a control diet (P0) and to 2 diets with an increasing *Pueraria* incorporation rate (Table 1). The diets containing *Pueraria* were prepared by substituting the basal mixture (without minerals and premix) with 20 or 40% of *Pueraria* (P20 and P40). Mineral and premix were added to all diets at a fixed amount of 3%. The basal mixture was formulated to reach a level of protein close to recommendations (Table 2, Gidenne, 2000; Lebas, 2004). Diets were pelleted at the Rabbit Association Corporation-The Providence established in EPAC (Benin). The pellet diameter was 4.0 mm. Cages were 76×46×30 cm (length, width and height). At weaning (weight at 35 d of age, 754±108 g), 3 groups of 12 rabbits produced at CECURI experimental unit (Benin) were assigned to the 3 pelleted diets, and placed in individual metabolism cages till 47 d of age. Animals had free access to feed and water. After a 7 d adaptation period, faeces were collected from 42 to 46 d of age, according to the standardised European procedure of the EGRAN group (European Group on Rabbit Nutrition; Perez *et al.*, 1995).

Chemical Analyses

The chemical analyses were conducted at INRA, Toulouse (UMR 1289 Tandem) on feeds and *Pueraria* studied (whole sun-dried plant) according to ISO methods and considering the recommendations proposed by the EGRAN group (EGRAN, 2001): dry matter

Table 1: Ingredients of the experimental diets (%).

Experimental diets	P0	P20	P40
Basal mixture[1]	97	77	57
Pueraria phaseoloides	0	20	40
Oyster shell	2.5	2.5	2.5
Salt	0.4	0.4	0.4
Lysine	0.1	0.1	0.1

[1] Basal mixture composition (%): wheat bran, 40; palm meal, 39.5; maize, 10; cotton meal, 5; soybean meal, 2.5.

Table 2: Chemical composition of the sun-dried *Pueraria* (whole plant) and of the experimental diets (g/kg dry matter).

	Pueraria	Experimental diets		
	(whole plant)	P0	P20	P40
Moisture	79	111	105	117
Crude ash	172	83	91	99
Crude protein (N×6.25)	176	199	179	169
Neutral detergent fibre	508	529	490	560
Acid detergent fibre	390	266	266	329
Acid detergent lignin	90	98	95	113
Gross energy (MJ/kg dry matter)	15.49	15.92	15.90	15.78

(DM; ISO 6496:1999), crude ash (ISO 5984:2002), crude protein (CP; N×6.25, Dumas method, ISO 16634-2:2009), gross energy (ISO 9831:1998), as well as for neutral detergent fibre, acid detergent fibre and acid detergent lignin (NDF, ADF and ADL) according to the sequential method of Van Soest (ISO 16472:2007 and ISO 13906:2008).

Statistical Analysis

Data were analysed as a completely randomised design with type of diet as the main source of variation by using the GLM procedure of SAS software (OnlineDoc®, SAS Inst., Cary, NC). Means comparisons were performed by Scheffe test. In addition, the effect of *Pueraria* incorporation was analysed with the REG procedure from SAS. The nutritive value of *Pueraria* was calculated according to the regression method described by Villamide *et al.* (2001).

RESULTS AND DISCUSSION

References to the use of whole sun-dried *Pueraria* in rabbit nutrition are not available in tables of ingredients (INRA, 2004) or in recent reviews (Lebas, 2004), although the chemical composition is available due to its use in ruminants (Mghen *et al.,* 1996). The CP concentration of the whole plant of *Pueraria* collected in full fruit stage and sun-dried has moderate contents of CP, 155 g/kg DM, while ADF averaged 344 g/kg DM. According to Djago *et al.* (2010) CP concentration of *Pueraria* collected at flowering, was 180 to 210 g/kg DM for whole plant of *Pueraria*. Hiep and Man (2008) showed the CP concentration of *Pueraria* leaves was 230 g/kg DM.

The digestibility coefficient for energy decreased sharply ($P<0.001$), from 64 (P0) to 49 (P40). Accordingly, the digestible energy (DE) content of the diets decreased ($P<0.001$) with *Pueraria* inclusion from 10.2 to 7.8 MJ/kg DM (Table 4). When extrapolated to 100% (using a linear regression), the predicted digestible energy content of the sun-dried *Pueraria* was 3.81±0.38 MJ DE/kg DM for a 0-40% range of incorporation rate. In comparison, the DE content of "alfalfa meal 12" is 97% higher (7.5 MJ/kg DM; Maertens *et al.*, 2002).

The digestibility coefficient for CP decreased linearly and sharply from 80 (P0) to 68% with a 40% *Pueraria* incorporation ($P<0.001$; Table 4). Accordingly, the digestible protein (DP) content of the diets decreased from 159 to 114 g DP/kg DM with *Pueraria* incorporation. When extrapolated to 100% (using a linear regression), the DP content of the whole *Pueraria* was estimated to be 41.7±6.7 g/kg DM for a 0-40% range of incorporation rate. In comparison, the DP content of "alfalfa meal 12" is about 87% higher (78 g/kg DM; Maertens *et al.*, 2002). The

Table 3: Effect of *Pueraria* dietary level on feed intake and growth of rabbits during.

	Experimental diets				
Rabbit weight (g)	P0	P20	P40	RMSE[1]	Significance
No. rabbits	12	12	12		
Weight at 42 d[2] (g)	850	874	888	127	NS
Weight gain from 35-46 d (g/d)	23.8	24.7	19.8	6.6	NS
Intake from 35-46 d (g/d)	46.7	50.8	53.5	8.9	NS

[1]RMSE: Root mean square error. [2]42 d: Start of the faecal collection period.

digestibility of NDF decreased with the *Pueraria* incorporation level in the diet ($P<0.001$). This suggested that the cell wall polysaccharides contained in the whole *Pueraria* were less digestible compared to those of basal diet.

Globally, the nutritive value of the whole *Pueraria*, full fruit stage, sun dried and pelleted, is moderate for the growing rabbit, compared to other leguminous plants such as alfalfa. This is partially explained by the quality of the product studied, which was relatively poor in organic matter. Therefore, it would be convenient to obtain the whole *Pueraria* with lower mineral content, taking care during cropping as the high level of ash might be due to soil contamination. Accordingly, the crude ash level of the diets increased with *Pueraria* incorporation rate.

Hiep and Man (2008) demonstrated the maximum degree of substitution in rabbit of soybean waste by *Pueraria* foliage was around 20%, with declining performance beyond that level. Nevertheless, using cut-off intervals at 60 d (available when cultivated as cover crop in palm plantation), the whole sun-dried *Pueraria* could be introduced at a high level (20 to 40%) to replace other fibre sources.

During the trial, no mortality occurred. No effect of *Pueraria* incorporation rate was detected on growth performance (Table 3), since the period of measurement was short.

The effect of crop maturity and cutting interval on nutritive value of *Pueraria* would require further work due to their influence on *Pueraria* chemical composition (Hiep *et al,*. 2008).

Table 4: Effect of *Pueraria* dietary level on faecal digestibility coefficients (%) and nutritive value of experimental diets in growing rabbits.

	Experimental diets				
	P0	P20	P40	RMSE[1]	*P*-value
No. rabbits	12	12	12		
Intake from 42 to 46 d (g/d)	52.9^{b}	65.3^{ab}	71.2^{a}	10.6	0.009
Digestibility coefficient (%)					
Organic matter	69.1^{a}	60.7^{b}	54.8^{c}	2.3	<0.001
Crude protein	79.7^{a}	70.4^{b}	67.6^{b}	3.1	<0.001
Gross energy	63.9^{a}	54.7^{b}	49.3^{c}	3.2	<0.001
Neutral detergent fibre	55.7^{a}	42.6^{b}	42.5^{b}	3.4	<0.001
Acid detergent fibre	38.4^{a}	23.9^{b}	28.5^{b}	4.5	<0.001
Dietary nutritive value					
Digestible energy (MJ/kg DM)	10.2^{a}	8.69^{b}	7.81^{b}	0.4	<0.001
Digestible protein (g/kg DM)	159^{a}	126^{b}	114^{b}	6	<0.001

[1]RMSE: Root mean square error. ^{abc}: Means within rows with different superscripts differ at $P<0.05$.

CONCLUSION

Pueraria could be considered as a moderate source of nutrients for the growing rabbit (3.81 MJ DE/kg DM and 42 g DCP/kg DM), but as a good fibre source. Further experiments are however essential to determine the growth performances and health using a higher number of rabbits fed with balanced diets containing an increasing level of *Pueraria*.

Acknowledgements: The authors thank Viviane Batailler, Véronique Tartié and Muriel Segura for their help in biochemical analyses (INRA, UMR 1289 TANDEM).

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