Study on Digestibility of Nutrient Content of Vetiver Grass

Pingxiang Liu [2], Chuntian Zheng [2], Yincai Lin [2], Fuhe Luo [1], Xiaoliang Lu [3], Deqian Yu [2]

[1]Guangdong Academy of Agricultural Sciences, Guangzhou 510640, China
[2]Institute of Animal Science, Guangdong Academy of Agricultural Sciences, Guangzhou 510640, China
[3]South China Herbage Research Center , South China Agricultural University, Guangzhou 510642, China

Abstract: Digestibility of the nutrient contents in Vetiver grass (*Vetiveria zizanioides*) in Dongshan goat were measured using the typical method of total-faeces-collection. The results showed that digestibilities of gross energy, dry matter, crude protein, ether extract, crude fiber, calcium, phophorus and nitrogen free extract in Vetiver grass hay were 29.65%, 46.09%, 23.15%, 28.79%, 46.44%, 61.00%, 66.60% and 36.25% respectively. One kilogram dry matter of Vetiver grass hay could provide 1.47 Mcal digestible energy, 13.4 gram digestible crude protein and 4.17 gram ether extract, which indicated that Vetiver grass is a promising feed resource for goats.

Key words: Vetiver grass, digestibility, goat

Email contact: Chuntian Zheng <zhengcht@hotmail.com>

1 INTRODUCTION

For several centuries vetiver grass (*Vetiveria zizanioides*) has been commercially cultivated for the scented oil that can be distilled from its roots. This is a treasured ingredient in some of the world's best-known perfumes and soaps and largely because of its potential as an export commodity, vetiver grass can be found in at least 70 nations (National Research Council, 1993). In recent years Vetiver grass has been widely known for its effectiveness in erosion, and sediment control, and has also been found to be highly tolerant to extreme soil conditions (Truong and Baker, 1998). Vetiver grass may also be a promising feed resource because it has various advantages such as high quality, fast growth rate and easy adaptation to the environment and can bear repetitive mowing without occupying farming land. Previous research has shown that Vetiver grass is an edible herbage of high quality for cattle and goat especially in the growth stages (Liu and cheng, 2002). However, so far, there are very few studies on the application of Vetiver grass for ruminant feed. The aim of this study was to determine the digestibilities of the nutrient content of Vetiver grass so as to provide theoretical support for future applications of Vetiver grass for goat feed.

2 MATERIALS AND METHODS

2.1 Experimental animals and Vetiver grass

Four healthy Dongshan goat weaners with an average body weight of 12 kilograms and four month old were castrated for a digestive experiment.

Vetiver grass, 1.5 meters high, growing through winter in red soil, was collected in the jointing stage from the Vetiver grass experimental station at the South China Agricultural University. The grass was fan oven dried with temperatures from 50 to 60 ºC, then crushed to make hay powder.

2.2 Experimental procedures

The digestion trial was carried out using the typical method of total-faeces-collection. The goats were fed individually in a metabolism cage with free access to water. Two phases (phase I and phase II) were employed to determine the digestibility of the nutrient contents in vetiver grass. Each phase lasted 7 days and there was a 7-day transition period between the two phases. Before the formal experiment was initiated, the goats had 7 days adaptation in the metabolism cage with the basal diet. In phase I the goats were fed the basal diet, which consisted of 87.5% concentrate and 12.5% vetiver grass hay. The ingredients and nutrient composition of the concentrate are shown in table 1. In phase II the goats were fed the test diet, which consisted of 68.5% basal diet and 31.5% vetiver grass hay, i.e. 60% concentrates and 40% vetiver grass hay. During the adaptation period or transition period, goats were fed *ad libitum* and feed intake of each goat was recorded. In phase I, each goat was supplied daily an equal amount of diet in three meals according to their average *ad libitum* feed intake during the adaptation period. In phase II, each goat was also supplied a daily equal amount of diet in three meals however based on their average *ad libitum* feed intake during the transition period. The residue of feed was collected daily to analyze the contents of dry matter (DM), crude protein (CP), ether extract (EE), crude fiber (CF), Ash, Calcium (Ca), phosphorus (P) nitrogen free extract (NFE) and gross energy.

Table 1 Ingredients and nutrient composition of concentrate

Ingredients (%)		Nutrient composition	
Corn	58.5	Digestible energy (Mcal/kg)	3.40
Soybean meal	20.5	Crude protein (%)	16.66
Wheat bran	17.6	Crude fiber (%)	3.81
$CaHPO_4$	0.9	Ether extract (%)	3.08
Limestone	0.8	Calcium (%)	0.63
NaCl	0.85	Total phosphorus (%)	0.54
Vitamin-mineral premix	0.85		
Total	100		

Faeces were collected and weighed 3 times a day and stored at 4 ºC. Faeces from the 7 days were thoroughly mixed and then samples were taken and dried at 60 ºC for 12 hours. The dried samples were ground with a mortar and pestle.

The digestibility of nutrient contents in Vetiver grass were calculated using the method described by Fan and Sauer (1995). The equation was shown below.

$$D_f\,(\%) = D_b + (D_t - D_b) / f$$

Where, D_f = Digestibility of nutrient contents in the tested Vetiver grass; D_b = Digestibility of nutrient contents in the basal diet; D_t = Digestibility of nutrient contents in the basal diet supplemented Vetiver grass; f = Ratio of the nutrient contents in Vetiver grass to those in the diet of phase II.

2.3 Sample Analysis

Methods were applied to determine contents of dry matter, crude protein, ether extract, crude fiber, ash, calcium, and phosphorus according to Chinese National Standard method, GB/T 6435, GB/T 6432, GB/T 6433, GB/T 6434, GB/T6438, GB/T 6436 and GB/T 6437, respectively. Gross energy was measured with a bomb calorimeter.

3 RESULTS AND DISCUSSION

The digestibility of nutrient contents in phase I and phase II diets are showed in Tables 2 and 3, respectively. The digestibility of dry matter, gross energy, crude protein, ether extract and nitrogen free extract decreased with inclusion of vetiver grass hay in the diet, which means digestibilities of dry matter, gross energy, crude protein, ether extract and nitrogen free extract were lower than those in the concentrate. We analyzed the nutrient content of vetiver grass hay, phase I and II diets in order to calculate the digestibility of the nutrient content in vetiver grass. The results are shown in table 4. According the equation described by Fan and Sauer (1995), the digestibility of the nutrient content in vetiver grass were calculated and the results are shown in table 5.

To our knowledge, this is the first study reported to investigate the digestibility of the nutrient content of vetiver grass in goats. Zhong and Lin (2002) reported that Chinese wild rye hay, a kind of herbage commonly used in goat production in China, contained 88.3% dry matter, 3.6% crude protein, 1.47 ether extract, 36.8% crude fiber and 52.3% nitrogen free extract. One kilogram Chinese wild rye hay could provide 1.76 Mcal digestible energy and 18 gram of digestible crude protein (Zhong and Lin, 2002). In our study, one kilogram vetiver grass hay could provide 1.47 Mcal digestible energy and 13.4 grams of digestible crude protein. The nutritive value of vetiver grass hay was a little bit lower than that of Chinese wild rye hay. In another study on the dynamic state of the nutrient content in Vetiver grass, it was found that Vetiver grass passing through winter in the jointing stage showed significant lower nutritive value than those growing in other seasons. This grass was in the tillering stage under the same soil conditions, however in winter was lower especially in crude protein and ether extract contents. Vetiver grass tested in

this study had grown through winter and was collected in the jointing stage.

Even though the nutritive value of vetiver grass hay tested in this study was lower than that of Chinese wild rye hay, considering the low price, fast growth rate and strong tolerance to extreme environments, we still think Vetiver grass could be used as a source of goat feed.

Table 2 Digestibilities of nutrient contents in the diet of phase I

Items	DM (kg)	Energy (Mcal)	CP (kg)	EE (kg)	CF (kg)	Ca (kg)	TP (kg)	NFE (kg)
Nutrient intake	2.250 ±0.300	8.707 ±1.400	0.397 ±0.053	0.071 ±0.011	0.174 ±0.023	0.017 ±0.003	0.016 ±0.003	1.572 ±0.247
Nutrient in faeces	0.632 ±0.107	3.000 ±0.600	0.088 ±0.017	0.021 ±0.004	0.115 ±0.021	0.013 ±0.002	0.012 ±0.002	0.329 ±0.063
Digestibility (%)	71.9	65.54	77.9	70.0	33.9	24.6	22.4	79.1

Table 3 Digestibilities of nutrient contents in the diet of phase II

Items	**DM (kg)**	**Energy (Mcal)**	**CP (kg)**	**EE (kg)**	**CF (kg)**	**Ca (kg)**	**TP (kg)**	**NFE (kg)**
Nutrient intake	2.104 ±0.347	8.878 ±1.793	0.292 ±0.048	0.053 ±0.009	0.345 ±0.057	0.014 ±0.002	0.010 ±0.002	1.281 ±0.211
Nutrient in faeces	0.780 ±0.113	4.235 ±0.767	0.084 ±0.012	0.019 ±0.003	0.195 ±0.035	0.009 ±0.001	0.008 ±0.001	0.400 ±0.056
Digestibility (%)	63.0	52.2	71.3	63.0	43.6	33.8	25.5	68.6

Table 4 Nutrient contents in Vetiver grass hay, concentrate, phase I diet and phase II diet (base on DM %)

Items	**DM (%)**	**Energy Mcal/kg**	**CP (%)**	**EE (%)**	**CF (%)**	**Ca (%)**	**P (%)**	**Ash (%)**	**NFE (%)**
Hay	86.24	4.97	5.79	1.45	35.64	0.52	0.11	7.12	50.00
Concentrate	85.66	4.35	19.33	3.21	3.49	0.75	0.74	5.81	68.15
Phase I diet	85.73	3.87	17.63	2.99	7.53	0.72	0.66	5.98	65.87
Phase II diet	85.89	4.22	13.89	2.5	16.4	0.66	0.49	6.34	60.86

Table 5 Digestibility of nutrient contents in Vetiver grass (%)

Items	DM	Energy	CP	EE	CF	Ca	P	NFE
Digestibility (%)	46.09	29.65	23.15	28.79	46.44	61.00	66.60	36.25

4 CONCLUSIONS

The contents of dry matter, gross energy, crude protein, ether extract, crude fiber, calcium, phosphorus, ash and nitrogen free extract in vetiver grass hay tested in this study were 86.24%, 4.97 Mcal/kg, 5.79%, 1.45%, 35.64%, 0.52%, 0.11%, 7.12% and 50.0%, respectively. Digestibilities of dry matter, gross energy, crude protein, ether extract, crude fiber, calcium, phosphorus and nitrogen free extract in Vetiver grass hay were 46.09%, 29.65%, 23.15%, 28.79%, 46.44%, 61.00, 66.60% and 36.25%, respectively. One kilogram dry matter of Vetiver grass could provide 1.47 Mcal of digestive energy, 13.4 gram of digestible crude protein and 4.17g of digestible ether extract, which indicates that Vetiver grass would be a promising feed source for goats.

5 ACKNOWLEDGMENTS

This research was supported by Guangdong Science and Technology Program (No.2002C20810). The authors would like to express their thanks to the experimental station of Vetiver grass of South China Agricultural University. Thanks are also due to Dr. Dexun Lu, a prestigious professor of ruminant nutrition in Inner Mongolia, China for his valuable suggestion on the study.

6 REFERENCES

AOAC. 1990. Official Methods of Analysis, ^{15}th edition. Association of Official Analytical Chemists, Arlington, Virginia

Fan MZ, and Sauer WC. 1995. Determination of apparent ileal amino acid digestibility in barley and canola meal for pigs with the direct, difference, and regression methods. Journal of Animal Science, 73, 8: 2364-2374

Liu JX, and Cheng Y. 2002 Issues of utilization and protection fornative Vetiver grass. Pratacultural Science, 19, 7: 13-16

National Research Council. 1993. Vetiver Grass: A Thin Green Line Against Erosion. National Academy Press, Washington, D. C.

Truong PNV, and Baker D. 1998. Vetiver grass system for environmental protection. In: Technical Bulletin No. 1. Pacific Rim Vetiver Network, Bankok, Thailand.

Zhong S, and Lin JH (eds). 2002. Encyclopedia on Goat Production. Jiangsu Science and Technology Press. pp. 94-99

A Brief Introduction to the First Author

Dr. *Liu Pingxiang*, a nutritionist in animal science, is working at Institute of Animal Science, Guangdong Academy of Agricultural Sciences. Since 2002, he worked as an animal nutrition researcher, carrying out research and development on new feed additives such as small a peptide, anti-stress agent and meat quality controller. So far he has 5 valuable academic papers published.