Dynamic State of Nutrient Contents of Vetiver Grass

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Abstract: The dynamic state of nutrient contents of Vetiver grass was studied. Grass samples were collected and analyzed in different seasons, types of soil condition, growth stages and mowing times. The results showed that nutrient contents of Vetiver grass were correlated highly to seasons, growth stage and types of soil condition. Vetiver grass passing through winter showed lower nutritive value than those growing in other seasons. Vetiver grass growing in sand showed lower nutritive value than those growing in soil. Nutrient contents reached the highest level in the tillering stage and then decreased in the jointing stage. Vetiver grass that grew in pig farm wastes showed higher contents of crude protein, carotene and lutein, relatively lower contents of ash, Ca, Fe, Cu Mn and Zn, and contained acceptable levels of heavy metal (Pb, As and Cd), which indicated Vetiver grass which grew in pig farm waste was still a promising feed resource for ruminants.

Key words: vetiver grass, nutrient contents, ruminant

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1 INTRODUCTION

Vetiver grass, a gramineous vivacious herbage, is normally divided into two types, agamic and zoogamic. The universally used type is agamic, which has flower but produces no seeds and, therefore does not threaten farmland and other plants. Vetiver grass is deemed worldwide as an ideal plant for environment protection as it has various advantages, such as high quality and fast growth rate, easily adaptable the environment; furthermore it can bear repetitive mowing and does not encroach farmland. In addition, it is also a potential feed resource.

At present, the vast majority of studies on Vetiver grass focus on the functions of soil and water conservation, land reclamation and hillside protection, etc. There are very few studies on the application of Vetiver grass on ruminant feed. It was reported that Vetiver grass was an edible herbage of high quality for cattle and goat especially in the growing stage. This study aimed to determine the dynamic state of the nutrient contents of Vetiver grass in different plant condition, season, growth stage and mowing time, so as to provide basic data for nutrient evaluation or future application of Vetiver grass as ruminant feed.

2 MATERIALS AND METHODS

2.1 Vetiver Grass

Vetiver grass samples were collected from the Panyu Zhujiang Farm in Guangzhou (PZF), the experiment station at South China Agricultural University (EBS), the experiment station at Guangdong Institute of Animal Science (EBG), Jiufu town of Baiyun district (JBD), the Pig Breeding Center of Guangdong Academy of Agricultural Sciences (PBG), respectively. The samples were collected in

different seasons, types of soil condition, growth stages and mowing times.

2.2 Sample Collection

Vetiver grass samples were collected from 5 to 10 points with the same distance along the cater corners of the grass plot. For the samples in early jointing stage, stems were removed, and then leaves were weighted, cut, and mixed. The grass was then dried at 60_ for 12 hours and was then weighted, mixed and shattered; a hay powder sample was finally made.

Table 1 Sample descriptions

Sample name	Growing season*	Height (m)	Mowing times	Soil and nutrition State**	Growth stage	Sampling site
First	SM to AT	1.5	_	Sand, NF	Early jointing	PZF
Second	AT	1.0	_	Soil, F	Tillering	EBG
Third	SP	0.75	_	PFW	Tillering	PBG
Four	WT to SP	0.75	_	Soil, NF	Tillering	JBD
Fifth	WT to SP	1.5	_	Soil, NF	Early jointing	EBS
Second a	SP	0.75	2	Soil, NF	Tillering	EBG
Second b	SP	0.75	2	Soil, F	Tillering	EBG

* The abbreviations SP, SM, AT, WT represent spring, summer, autumn, and winter, respectively.
** F means fertilizer and "NF" means no fertilizer. PFW means pig farm waste.

2.3 Sample Analysis

Relevant methods were applied to determine the contents of dry matter (DM), crude protein (CP), ether extract (EE), crude fiber (CF), ash, calcium (Ca), and phosphorus (P) 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. Acid detergent fiber (ADF) and neutral detergent fiber (NDF) were measured using the Van Soest method while trace elements levels were recorded using the AAS method.. Amino acids were measured by HPLC and the contents of carotene and lutein were identified according to AOAC (1990). Gross energy was measured with a bomb calorimeter.

3 RESULTS AND DISCUSSION

3.1 The Effects of Soil Condition and Fertility on Nutrient Contents of Vetiver Grass

The chemical composition of vetiver grass under different growing conditions was shown in Tables 2, 3, 4 and 5. Fertility had significant effects on the nutrient content of Vetiver grass. The results showed that levels of crude protein, ether extract, lutein and carotene in Vetiver grass growing in sand were lower than those growing in red soil and in pig farm waste. Sample second 'b', to which fertilizer was applied, showed higher levels of crude protein and crude fiber and lower levels of calcium and nitrogen free extract, compared with sample second a, without fertilizer.

Table 2 Nutrient content of Vetiver grass under different growing conditions (based on DM)

Sample	CP (%)	EE (%)	CF (%)	Ca (%)	P (%)	Ash (%)	NFE (%)	ADF (%)	NDF (%)	Lutein (ppm)	Carotene (ppm)
First	5.41	1.20	33.08	0.38	0.21	9.35	50.96	45.56	81.78	6.48	3.57
Second	11.48	2.23	28.95	0.42	0.16	7.15	50.19	37.66	77.24	31.61	19.03
Third	15.08	2.05	32.40	0.27	0.21	5.41	45.06	41.86	79.67	87.40	41.58
Fourth	6.49	1.49	33.89	0.48	0.13	6.51	51.63	44.30	81.79	36.21	16.42
Fifth	5.79	1.45	35.64	0.52	0.11	7.12	50.00	---	---	---	---
Second a	13.68	2.57	31.21	0.30	0.19	8.03	44.51	---	---	---	---
Second b	13.71	2.57	32.05	0.26	0.19	8.07	43.59	---	---	---	---

Table 3 Amino acid content of Vetiver grass under different growing conditions (%, based on DM)

Sample	Glu	Ser	His	Gly	Thr	Ala	Arg	Tyr	Val	Met	Ile	Phe	Leu	Lys
First	0.49	0.21	0.09	0.78	0.27	0.45	0.44	0.16	0.25	0.07	0.26	0.19	0.42	0.17
Second	1.07	0.41	0.15	1.02	0.56	1.25	0.78	0.32	0.51	0.13	0.54	0.42	0.87	0.35
Third	1.08	0.42	0.16	0.99	0.54	1.14	0.79	0.29	0.48	0.11	0.57	0.40	0.80	0.38
Fourth	0.69	0.25	0.10	0.78	0.30	0.62	0.35	0.17	0.29	0.06	0.35	0.23	0.48	0.24

Table 4 Nutrient contents of Vetiver grass in different growing conditions (ppm, based on DM)

Sample	Fe	Cu	Mn	Zn	Se	Co
First	415.03	61.27	45.72	64.82	0.09	0.12
Second	782.29	7.71	145.00	87.38	0.08	0.11
Third	158.52	3.33	53.85	28.98	0.12	0.19
Fourth	90.07	2.14	465.04	27.61	0.12	0.08

Table 5 Heavy metal levels of Vetiver grass in different growing conditions (ppm, based on DM)

Sample	As	Cd	Pb
Third (mg/kg)	0.56	0.09	4.45
Pig farm waste (□g/L)	1.41	0.08	1.25
Maximum allowable draining (GB, mg/L)	0.5	0.1	1.0

3.2 The Effects of Seasons on Nutrient Contents of Vetiver Grass

Samples growing through winter such as samples fourth and fifth had lower levels of crude protein, ether extracts and a higher content of crude fiber, compared with samples growing in spring (samples second ‘a’, second ‘b’, third) or autumn (sample second). In general, the nutritive value of vetiver grass was highest in spring, lower in autumn and lowest in winter.

3.3 The Effects of Mowing Times on Nutrient Contents of Vetiver Grass

Results showed that samples of first mowing such as sample second ‘a’ had lower contents of crude protein, ether extract and crude fiber, compared with those samples from mowing second such as sample second ‘b’. Liu *et al.* (1997) found that the contents of crude protein and ether extract increased and the content of crude fiber decreased in saccharum sinense R oxb, a high quality herbage as the mowing times increased. The results of our study were not in accordance with the results reported above, which may be due to different seasons, but needs further study.

3.4 The Effects of Growth Stage on Nutrient Contents of Vetiver Grass

Comparing sample fourth and sample fifth, we found that Vetiver grass collected at the end of the tillering stage had higher contents of crude protein and ether extract, lower contents of crude fiber than those of Vetiver grass collected in the jointing stage. Those samples collected in tillering stage such as samples second ‘a’, second ‘b’ had a higher content of crude protein and ether extract, a lower content of crude fiber than those of samples collected in the end of tillering stage or jointing stage. These results were in accordance with the universal law of the dynamic variations of herbage.

3.5 The Variations of Nutrient Contents of Vetiver Grass Growing in the Pig Farm Waste

Vetiver grass grew well in the pig farm waste. The Vetiver grass showed higher contents of crude protein, lutein, carotene, Se and Co, relatively lower contents of ash Ca, Fe, Cu, Mn, Zn, and similar levels of crude fiber, ether extract, phosphorus, nitrogen free ether extract and amino acids, compared with Vetiver grass growing in other soil conditions. For toxic trace elements, the allowable drainage

values for As, Cd, and Pb were 0.5 mg/L, 0.1 mg/L, 1.0 mg/L, respectively according to the China National Standard. The concentrations of As, Cd, and Pb in the pig farm waste were significantly lower than the corresponding values in the China National Standard. The results shown in table 4 demonstrated that Vetiver grass could absorb heavy metals in pig farm waste, however, the contents of heavy metals in Vetiver grass were in acceptable range, which indicated that Vetiver grass growing in the pig farm waste could still be used as a feed source for ruminants.

4 CONCLUSIONS

The nutrient contents of Vetiver grass were affected significantly by seasons, growth stage and plot nutrient quality. Vetiver grass growing through winter showed lower nutritive value to that of Vetiver grass growing in other seasons. Vetiver grass growing in sand showed lower nutritive value than of Vetiver grass growing in soil. Nutrient contents reached the highest levelin the tillering stage and then reduced in the jointing stage. Vetiver grass growing in pig farm waste showed a higher content of crude protein, carotene and lutein, relatively lower contents of ash, Ca, Fe, Cu, Mn, and Zn, and contained acceptable levels of heavy metal (Pb, As, and Cd), which indicated that Vetiver grass growing in pig farm waste was still a promising feed source for ruminants.

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References

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

Liu ZS, Zhao MK, and Luo SW. 1997. Dynamic state of nutrient contents of Sacch Arum Sinense, a high quality herbage. Guizhou Agricultural Sciences, 25, 5: 38-41

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 has worked as an animal nutrition researcher, carrying out research and development on new feed additives such as a small peptide, anti-stress agent and meat quality controller. So far he has 5 valuable academic papers published.