Research Article

Nutritive Values of Whip Grass (*Hemarthria compressa*) at Different Cutting Intervals Consumed by Thai Indigenous Cattle

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Abstract

This study aimed to evaluate the effect of cutting intervals of *Hemarthria compressa* on feed intake, nutrient digestibility, and energy concentration of the grass consumed by Thai indigenous cattle. A 3 × 4 incomplete Latin Square Design was used. Treatments were 3 cutting intervals (30, 45 and 60 days) of grass fed to the bulls as green forage. Four Thai indigenous bulls were allocated into the experimental treatments. Total collection method was used. Feed intake, apparent nutrient digestibility and energy concentration of grass were subsequently assessed.

The result showed that it was a linear decline ($p<0.05$) in crude protein (CP) and ash contents as cutting intervals increased while there were linearly increased ($p<0.05$) in dry matter (DM), organic matter, neutral detergent fiber, and acid detergent lignin contents. As grass maturation increase, CP intake was decreased but not for DM intake (79.11-81.90 g/$BW^{0.75}$/d). There was no significant difference of the digestibility coefficient of any nutrient among cutting intervals except gross energy. Nevertheless, the metabolizable energy concentration of the grass were significantly decreased (linear, $p<0.05$) in accordance with increasing cutting intervals. In conclusion, harvesting the grass at 30 days of regrowth gave better nutritive values and suitable to use as livestock feed.

Key Words**:** Hemarthria compressa; Maturation; Nutritive value; Thai indigenous cattle

Introduction

Whip grass (*Hemarthria compressa*) is a perennial plant having culms decumbent to long-stoloniferous roots at the lower nodes, up to 1 m or more. As reported by Bixing and Phillips (2006), the grass is branches from base with the conspicuous, dark and glabrous nodes. Leaf sheaths are loose, compressed, keeled, glabrous and hairy along mouth. Leaf blades are linear, 2–15 x 0.2–0.5 cm, base rounded and apex sub-acute. Racemes are solitary and lightly compressed with the length of 2–10 cm. Its shape is articulation line oblique and tardily disarticulating. Sessile spikelet is slightly longer than adjacent internodes with the length of 3–5 mm. Callus are broadly triangular (with the size of 0.5–1 mm) with lower glume narrowly oblong, leathery, flat or sub-convex on back, abruptly constricted into obtuse and emarginated apex. The upper glume is adnate to rachis and thin. This grass has a wide range of habitat, including its capability to thrive in the marshes and wet land areas.

In Thailand, this grass was mostly found in the low-land area in the southern region. Insung et al. (2005) reported that *Hemarthria compressa* was the most popular grass that the farmer used to feed the fighting bulls. Waipanya et al. (2005) reported that the grass yielded about 9 to 10 tons $ha^{-1}year^{-1}$ of dry matter with a range of 8 to 10% of crude protein (CP). When the ruminal degradability of this grass was studied using the nylon bag technique, it was found that the potential degradability (PD) of the dry matter (DM) varied from 72.5–87.8% (Insung et al., 2005). Additionally, this grass was palatable to goats (Baoli and Shilin, 1997).

In term of nutrition, forage quality and utilization could be influenced not only by forage species but also by the plant maturity or growth stage of the grass (Skerman and Riveros, 1990). There are reports which showed that increasing dry matter yield, nutritive compositions and feed quality of the grass had decreased as the grass had undergone maturation (Chobtang et al., 2008; Arthington and Brown, 2005; Kamalak et al., 2005).

In term of cultural practice and pasture management, maintaining the appropriate stage of forage is a good option for improving ruminant animal productivity. Although there is a general convention that optimal nutritive values of grass suitable to feed the animals are dependent upon growth stage of the grass at harvesting, there is no scientific data on the nutritive values of whip grass in accordance with its stages of growth.

Therefore, the objective of this study aims to evaluate the relationship of nutritive values of the whip grass and its cutting intervals.

Materials and Methods

Location and climate data

The study was conducted at Suratthani Animal Nutrition Research and Development Center, Tha Chang, Thailand. The soil characteristics were loamy-skeletal, mixed, semiactive and isohyperthermic Typic Hapludults. In general, the temperature during the experiment varied between 26–34 °C, with 68% relative humidity and 1,110 mm precipitation.

Experimental plan

A 3 × 4 Incomplete Latin Square Design (LSD) was used in this experiment. Sources of variance were the cutting intervals (3 stages of cutting at 30, 45 and 60 days of regrowth), the periods of the experiment (3 periods) and the animal (4 Thai indigenous bulls). The experiment was started from July 2008 and ended on September 2008.

Animal management

Four Thai-indigenous bulls, approximately 1.5 years of age, average body weight of 202±21.89 kg, were used. All bulls were vaccinated against foot and mount disease and hemorrhagic septicemia. Vitamin A, D_3, and E were injected to ensure that the animals had sufficient vitamins and anthelmintic and ascaric druge were administered to make the bulls free of external parasite, two weeks before the experiment started. The bulls were then fed with Ruzi grass (*Brachiaria ruziziensis*) hay (9% CP) ad libitum prior to the experiment started and also at the resting period (21 days) between each experimental period. The animals were kept in an individual confinement of 2 × 2.5 m and randomly assigned to the treatments. Clean water and mineral blocks were also given to the animals during the experiment.

Pasture management and treatments

A 1.6-ha pasture plot was carefully chosen from a 7-ha of 2-year old stand of *Hemarthria compressa* pasture. The chosen field was cut using a drum mower machinery at 3-cm stable height for a uniformly growth, the residue was removed and the pasture was fertilized with N-P-K fertilizer (15-15-15) at 8 $kgha^{-1}$. The pasture was irrigated using sprinkle every 7 days and allowed to regrowth for 45 days.

Consequently, the pasture was divided into 4 main plots for each experimental period (green grass from one plot used for one animal); each plot was then divided into 21 subplots. Areas of the subplots were 80, 60 and 40 m^2 for 30, 45 and 60 days plot, respectively. The first subplot of 30, 45 and 60 days of regrowth age was cut at 31, 46 and 61 days, respectively before the beginning of the experiment. As a result, there were a grass with 30, 45 and 60 days of regrowth at the beginning of the experiment and other subplots would be reached the expected date at the next day of the experiment.

Intake and total tract digestion study

In this study, total collection method was used. Each experimental period, dry matter and nutrient intake, and total tract digestion of nutrient measurements were conducted for 21 days in which the first 14-day period was a preliminary period and the last 7 days were the collection period. Grass was cut in the morning, kept under shed and fed to the animal ad libitum according to the treatments twice a day, 08.30 and 16.00 h. In order to eliminate the carrying effects, the animals were initially fed with a Ruzi grass (*Brachiaria ruziziensis*) hay for 21 days prior to the beginning of the next experimental period. At the collection period, feeds, feed refusals and feces were weighed and then, 10% of feed refusals and feces were sampled for each day. Composites of feeds, feed refusals and feces were sub-sampled at approximately 1,000 g from each bull. Samples were dried at 65 °C for 72 h and ground to pass a 1 mm screen using Wiley mill. The samples were then kept at -21°C freezer for subsequent chemical analysis.

Chemical analysis

Dry matter (DM), organic matter (OM), crude protein (CP), ether extract (EE) and ash components of composited samples of feeds, feed refusals and feces from each bull and period were analyzed using method described by AOAC (1990). Cell wall components (neutral detergent fiber (NDF) and acid detergent fiber (ADF) and acid detergent lignin (ADL)) were analyzed using method described by Van Soest et al. (1991). Gross energy of all samples was determined using adiabatic bomb calorimeter. Metabolizable energy (ME) content of feeds was estimated using the equation of ME = 0.82*DE as proposed by NRC (1996).

Statistical analysis

The nutritive values and chemical composition of the grass at different cutting intervals, and intake and apparent nutrient digestibility of grass consumed by Thai indigenous bulls were analyzed as a 3 × 4 Incomplete Latin Square Design. Pre-planned orthogonal polynomial (linear and quadratic) was then statistically tested (Muller and Fetterman, 2003).

Results and Discussion

Chemical composition of grass

Chemical compositions of the grass are presented in Table 1. There was a linear increase ($p<0.05$) in DM, OM, NDF, and ADL concentrations, with increasing maturity of grass. However, the concentrations of CP, ash and P were decreased linearly ($p<0.05$), with increasing maturity. Crude protein content decreased 17.11 and 33.69% when cutting intervals increases from 30 days to 45 and to 60 days, respectively. This result was similar to the report of Arthington and Brown (2005) who found that crude protein of tropical grass was reduced 37.80% when regrowth age was extended from 28 to 70 days. Even though CP content of the grass in this study was linearly declined throughout the period of regrowth, the final concentration was not lower than the lowest level which affected the ruminal microbial activity (Minson and Wilson, 1980).

Table 1 Least square means of chemical compositions (dry matter basis) of *Hemarthria compressa*.

Chemical composition	Cutting intervals (days)			SEM	Contrast	
	30	45	60		linear	quadratic
DM (%)	14.05	15.78	17.37	0.53	**	NS
OM	90.78	92.33	92.89	0.35	**	NS
CP	13.21	10.95	8.76	0.63	***	NS
EE	1.60	1.46	1.36	0.12	NS	NS
Ash	9.22	7.67	7.11	0.35	**	NS
NDF	69.90	72.46	72.38	0.41	**	NS
ADF	35.50	36.56	37.14	0.50	NS	NS
ADL	4.57	5.07	5.70	0.16	***	NS
GE ($kcalkg^{-1}DM$)	4,618	4,507	4,403	37	*	NS

-$p<0.01$, *-$p<0.0001$, NS-non significant difference ($p>0.05$).

Even there was a significant change ($p<0.05$) of NDF content by grass maturity but it was narrowly varied from 69.90 to 72.46% DM**.** The ADF content was not affected ($p>0.05$) by cutting intervals and its value varied marginally from 35.50 to 37.14% DM. This finding was in agreement to the reports of Chobtang et al. (2008), Boval et al. (2007), Isuwan et al. (2007), Arthington and Brown (2005) and Achemede et al. (2000). These authors summarized that the early maturation of tropical grass was normally found. The high temperature condition and excess of sun light might be the main factors affecting this aspect (Wilson and Minson, 1980).

Table 2 Least square means of intake characteristics of Thai indigenous bulls consumed *Hemarthria compressa.*

Intake	Cutting intervals (days)			SEM	Contrast	
	30	45	60		linear	quadratic
Dry Matter						
%BW	2.12	2.08	2.05	0.05	NS	NS
Kgd^{-1}	4.73	4.70	4.53	0.12	NS	NS
$gMBW^{-1}d^{-1}$	81.90	80.61	79.11	2.03	NS	NS
Crude Protein						
Kgd^{-1}	0.64	0.54	0.43	0.04	**	NS
$gMWB^{-1}d^{-1}$	11.07	9.20	7.52	0.64	**	NS

** - $p<0.01$, NS-non significant difference ($p>0.05$).

Dry matter and crude protein intake

The values of dry matter and crude protein intake of Thai indigenous bulls fed with green *Hemarthria compressa* are shown in Table 2. There was no significant difference ($p>0.05$) in dry matter intake (DMI) among three cutting intervals (averaging of 2.08 %BW, 4.65 kgd^{-1} or 80.54 g metabolic body weight $(MBW)^{-1}d^{-1}$). Even though the bulls were ad libitum fed, the bulls had consumed green grass (DM basis) in average of 2.08% BW. This value, however, was higher when comparing to the dry matter intake of cattle receiving the other tropical grasses (Burns and Fisher, 2007). Jung and Allen (1995), Van Soest (1994) and Lippke (1980) reported that high fiber content was a major factor affecting DMI of ruminant animals.

Crude protein intake was affected by cutting intervals. It was linearly declined ($p<0.05$) as grass maturity increases. This was caused by the decline in CP content of grass with increasing maturity (Table 2).

Nutrient digestibility and energy utilization efficiency

The nutrient digestibility of the grass is presented in Table 3. There was no significant relationship ($p>0.05$) between the nutrient digestibility and cutting intervals of the grass, except the gross energy. Digestibility of gross energy decreased linearly ($p<0.05$) as cutting intervals increased. This may be caused by the increasing content of cell wall components and ADL value, and also the decreasing level of CP and GE content of grass (Table 1). Archimede et al. (2000) also reported that even harvested at 14 days of regrowth, *Digitaria decumbens* was digested at the acceptable level, leading to the availability of nutrient for the animals.

The values of energy concentration are shown in Table 4. Gross energy (GE), digestible energy (DE) and metabolizable energy (ME) concentrations of the grass decreased linearly ($p<0.05$) as the cutting intervals increased. The DE content of grass harvested at 30 days of regrowth was considered at stage of a good quality (Pond et al., 1995). At the energy values ranging from 2.53 to 2.65 $Mcalkg^{-1}DM$, the cattle can consume the grass at the level of 2.0 to 2.5% of body weight (BW). The ME of 30 days of regrowth was comparable to the temperate grass reported by NRC (1996).

Table 3 Least square means of nutrient digestibility of *Hemarthria compressa* consumed by Thai indigenous bulls.

Digestibility	Cutting intervals (days)				Contrast	
(%)	30	45	60	SEM	linear	quadratic
DM	68.41	67.16	65.69	1.38	NS	NS
OM	69.44	67.98	67.04	1.44	NS	NS
CP	69.50	69.09	64.02	2.03	NS	NS
EE	64.67	66.45	65.83	4.09	NS	NS
NDF	69.18	68.56	66.23	1.51	NS	NS
ADF	54.14	54.69	52.08	2.30	NS	NS
GE	55.20	50.88	46.22	2.28	*	NS

*-$p<0.05$, NS-non significant difference ($p>0.05$).

Table 4 Least square means of energy concentration of *Hemarthria compressa* consumed by Thai indigenous bulls.

Energy concentration	Cutting intervals (days)			SEM	Contrast	
	30	45	60		linear	quadratic
GE ($kcalkg^{-1}DM$)	4,618	4,507	4,403	37	*	NS
DE ($kcalkg^{-1}DM$)	2,591	2,311	2,047	116	*	NS
ME ($kcalkg^{-1}DM$)[1]	2,125	1,895	1,679	96	*	NS

[1]ME = 0.82*DE; *-p<0.05; NS-non significant difference (p>0.05).

Conclusion

The results of this study showed that even though whip grass (*Hemarthria compressa*) grown in tropical condition (Thailand) had declining values of nutritive composition such as organic matter and crude protein content, crude and digestible protein intake, this decline did not affect the nutritive values, such as dry matter intake and nutrient digestibility were not affected as the cutting intervals increased. However, the gross, digestible and metabolizable energy of the grass decreased as the cutting intervals increased. In conclusion, grass harvested at 30 days of regrowth had a quality which was good enough for feeding the animals.

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