

## Seasonal Changes in Nutritive Value of Some Grass Species in West Sumatra, Indonesia

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**ABSTRACT :** This study was carried out to evaluate the potential nutritive value of commonly found grasses collected at native pasture in West Sumatra, Indonesia during dry and rainy seasons. Variables measured included chemical composition, *in vitro* digestibility, concentration of Ca, P and Mg, gas production and metabolizable energy (ME) content of the grasses. The results showed that species and season had significant effect on chemical composition and mineral concentration. Crude protein content in the dry season ranged from 6.5% (*B. decumbens*) to 14.4% (*P. maximum*) and increased slightly from 7.8% (*B. decumbens*) to 14.8% (*A. compressus*) in the rainy season. Data on fiber fraction showed that grass contained more NDF, ADF and ADL in dry season than in rainy season. Data on mineral concentration showed that *C. plectostachyus* and *P. maximum* in dry season had higher Ca than those of other species, while in rainy season *P. maximum* had highest Ca concentration. In dry season, the DMD varied from 50.4% (*P. purpureum*) to 59.1% (*P. purpureum*), while in rainy season ranged from 50.3% (*A. gayanus*) to 61.8% (*P. purpureum*). The potential and rate of gas production were significantly ( $p < 0.05$ ) affected by species and season. During dry season, potential of gas production ranged from 21.8 ml/200 mg (*A. compressus*) to 45.1 ml/200 mg (*C. plectostachyus*), while in rainy season it varied from 35.6 ml/200 mg (*A. gayanus*) to 47.5 ml/200 mg (*P. purpureum*). ME content of grasses varied from 6.0 to 8.3 MJ/kg in dry season and increased slightly from 6.4 to 8.6 MJ/kg in rainy season. Both in dry and rainy seasons, the highest ME content was occurred in *P. purpureum* and *C. plectostachyus*. In conclusion, nutritive value of the observed grasses in West Sumatra, Indonesia was relatively higher during rainy season compared with dry season. *Pennisetum purpureum* and *Cynodon plectostachyus* had the best nutritive value in both dry and rainy seasons. (*Asian-Aust. J. Anim. Sci.* 2004, Vol 17, No. 12 : 1663-1668)

**Key Words :** Dry Season, Wet Season, Grass Species, Nutritive Value

### INTRODUCTION

In smallholders farming systems, native forages and agriculture by products are the main feed source for ruminants in Indonesia. According to Nitis et al. (1980), the botanical composition of the forage fed during wet season consists 35% grass and 65% shrub and tree fodders, while during dry season it consists 6% grass and 94% shrub and tree fodders. The potential of any feed to support animal production depends on the quantity eaten and extent to which the feed consumed supplies energy, protein, mineral and vitamin requirements (Minson, 1990). Many tropical grasses have been studied in both laboratory and feeding practices. The nutritive value of forages is a result of the combined effects of genetic and environmental factors. The genetic factors include species, strain within species, type of growth and the response to environmental factors. Some

environmental factors are climate, weather, soil fertility, fertilizer application and management (Sullivan, 1973). Previous study showed that nutritive value of legumes assessed by nutrient digestibility and metabolizable energy content greatly varied among the species and it was higher in rainy season than that in dry season (Evitayani et al., 2004). There was no information available concerning nutritive value of grass in West Sumatra in relation to season, therefore the aim of this study was to evaluate the nutritive value through determination of chemical composition, mineral concentration, *in vitro* digestibility, *in vitro* gas production and estimation of metabolizable energy (ME) content of grasses during dry and rainy seasons.

### MATERIALS AND METHODS

#### Experimental site

This study was conducted in Padang (West Sumatra), Indonesia. The area is located in the tropical and monsoon region, and lies between 0°30' N to 3°30' S and between 98°36' to 101°53' East. There are two seasons during the year, dry season from February to September and rainy season from November to March. The temperature is nearly constant, differing only a few degrees among the dry and rainy seasons with daily temperature ranges from 22 to 32°C.

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Received November 13, 2003; Accepted June 4, 2004

Table 1. Organic matter (OM), crude protein (CP) and ether extract (EE) content of grass species

Species	OM		Se <sup>a</sup>	CP		Se <sup>a</sup>	EE		Se <sup>a</sup>
	Dry	Rainy		Dry	Rainy		Dry	Rainy	
<i>A. gayanus</i>	86.8 <sup>a</sup>	90.0 <sup>bc</sup>	*	8.5 <sup>ab</sup>	11.1 <sup>b</sup>	NS	1.8	2.9 <sup>ab</sup>	*
<i>A. compressus</i>	88.1 <sup>ab</sup>	86.6 <sup>a</sup>	NS	12.7 <sup>cd</sup>	14.8 <sup>c</sup>	*	1.6	2.6 <sup>ab</sup>	*
<i>B. decumbens</i>	90.4 <sup>b</sup>	93.3 <sup>c</sup>	*	6.5 <sup>a</sup>	7.8 <sup>a</sup>	NS	1.5	2.3 <sup>a</sup>	NS
<i>C. plectostachyus</i>	86.2 <sup>a</sup>	88.5 <sup>ab</sup>	NS	13.8 <sup>d</sup>	12.7 <sup>bc</sup>	NS	2.3	3.1 <sup>ab</sup>	NS
<i>P. maximum</i>	89.9 <sup>ab</sup>	88.7 <sup>ab</sup>	NS	14.4 <sup>d</sup>	12.9 <sup>bc</sup>	*	1.7	3.7 <sup>b</sup>	*
<i>P. purpuphoides</i>	86.2 <sup>a</sup>	88.0 <sup>ab</sup>	NS	9.5 <sup>b</sup>	12.6 <sup>bc</sup>	*	2.3	2.8 <sup>ab</sup>	NS
<i>P. purpureum</i>	92.2 <sup>b</sup>	90.0 <sup>bc</sup>	NS	12.4 <sup>cd</sup>	13.7 <sup>bc</sup>	NS	2.7	3.1 <sup>ab</sup>	NS
Mean	88.5	88.9		11.1	11.7		2.0	2.5	

<sup>a</sup>Se: Effect of season in the same species of grass. \* p<0.05, NS: Not significant.

<sup>a, b, c, d</sup> Values in the same column with different superscripts differ significantly (p<0.05).

with humidity about 86%. The means of monthly rainfall in dry and wet seasons are 192.2 and 298.4 mm, respectively.

### Collection of grass samples

The forage evaluated consisted of seven grasses species (*Andropogon gavanus*, *Axonopus compressus*, *Brachiaria decumbens*, *Cynodon plectostachyus*, *Panicum maximum*, *Pennisetum purpuphoides* and *Pennisetum purpureum*) representing common grass fed to ruminants in West Sumatra. The forages were collected from native pasture during dry and rainy seasons. The samples were dried at 60°C for 48 h and then coarsely milled to pass a 1 mm screen for further analysis. Chemical composition of the forages were analyzed by the standard method of the Association of Official Analytical Chemist (AOAC, 1984); while NDF, ADF and acid detergent lignin (ADL) contents were determined according to the procedures of Goering and Van Soest (1970). Concentration of Ca, P and Mg were analyzed by Inductively Coupled Plasma Emission Spectrometer (ICPS-2000, Shimadzu, Japan) after hydrochloric acid digestion.

### Determination of *in vitro* digestibility, gas production and metabolizable energy content

*In vitro* digestibility of dry matter (DMD), organic matter (OMD) and crude protein (CPD) of the foragesamples were determined by the method of Tilley and Terry (1963) and Goering and Van Soest (1973). The rumen fluid for measurement of *in vitro* digestibility and gas production was taken from healthy mature Japanese *Corriedale* sheep fitted with permanent rumen cannulae (Ø=70 mm). One part of the rumen fluid was mixed with two parts of the medium consisting of *in vitro* rumen buffer solution, macro and micro mineral solutions, resazurine and reduction solution. One gram of each sample was incubated in the rumen fluid-buffer medium mixture through at 39±0.1°C for 96 h. After the *in vitro* degradation trials, all the incubated materials were filtered and then dried at 60°C for 96 h to determine DMD. The residues were analyzed for crude protein (CP) and organic matter (OM) to determine OMD and CPD.

*In vitro* gas production was measured with syringes according to the method described by Menke and Steingass (1988). The produced gas was read at a series of incubation times, i.e. 3, 6, 12, 24, 48, 72 and 96 h. The exponential equation proposed by Ørskov and McDonald (1979) was used to determine characteristics of gas production using Neway-Exel computer program (Macaulay Institute, Aberdeen, UK). The equation was:  $Y=a+b(1-e^{-ct})$ , where: Y=the volume of the gas produced with time (t); a=the intercept of the gas production curve; b=the asymptote and c=the rate of gas production (ml/h). The value of (a+b) represented the potential extent of *in vitro* gas production. The metabolizable energy (ME) content of the forages was estimated according to the following equation (Menke and Steingass, 1988):  $ME(MJ/kg DM)=2.2+0.136(GP_{24h})+0.0057(CP)+0.00029(EE)^2$ . Where: ME=metabolizable energy; GP=gas production at 24 h incubation time; CP=crude protein content of the forage (g/kg) and EE=ether extract (crude fat) content of the forage (g/kg).

### Statistical analysis

Results of the chemical composition, macro mineral, *in vitro* degradability, *in vitro* gas production and metabolizable energy were analyzed using General Linear Model (GLM) procedure for computations of means and standard errors, according to SAS/Start View<sup>®</sup> (1999). The mean comparisons between the species of grasses and seasons were compared using probability of differences. The following statistical model was used in the analysis:  $Y_{ijk}=\mu+S_i+F_k+e_{ijk}$ . Where:  $Y_{ijk}$ =dependent variable (general observation);  $\mu$ =the overall mean;  $S_i$ =effect of the  $i^{th}$  season (i=dry and rainy season);  $F_k$ =effect of  $k^{th}$  species (k=1,2...,7);  $e_{ijk}$ =error term.

## RESULTS AND DISCUSSION

### Chemical composition

Chemical composition of the grasses was significantly (p<0.05) different among species and seasons (Table 1). Crude protein content in dry season ranged from 6.5 % (*B. decumbens*) to 14.4% (*P. maximum*) and increased slightly

**Table 2.** Neutral detergent fiber (NDF), acid detergent fiber (ADF) and acid detergent lignin (ADL) content of grass in dry and rainy seasons (% dry matter)

Species	NDF		Se <sup>a</sup>	ADF		Se <sup>a</sup>	ADL		Se <sup>a</sup>
	Dry	Rainy		Dry	Rainy		Dry	Rainy	
<i>A. gayanus</i>	69.7 <sup>b</sup>	70.8 <sup>c</sup>	NS	31.2 <sup>b</sup>	36.9 <sup>b</sup>	*	7.3 <sup>c</sup>	3.9 <sup>a</sup>	**
<i>A. compressus</i>	69.3 <sup>b</sup>	62.0 <sup>b</sup>	*	31.6 <sup>b</sup>	28.3 <sup>a</sup>	NS	6.5 <sup>bc</sup>	4.8 <sup>ab</sup>	*
<i>B. decumbens</i>	69.3 <sup>b</sup>	59.8 <sup>ab</sup>	**	26.5 <sup>a</sup>	35.7 <sup>b</sup>	**	6.7 <sup>bc</sup>	7.8 <sup>c</sup>	NS
<i>C. plectostachyus</i>	58.0 <sup>a</sup>	57.3 <sup>a</sup>	NS	35.7 <sup>c</sup>	36.2 <sup>b</sup>	NS	4.4 <sup>a</sup>	3.7 <sup>a</sup>	NS
<i>P. maximum</i>	62.9 <sup>a</sup>	60.3 <sup>ab</sup>	NS	44.6 <sup>d</sup>	44.1 <sup>c</sup>	NS	6.9 <sup>bc</sup>	6.3 <sup>bc</sup>	NS
<i>P. purpuphoides</i>	64.6 <sup>b</sup>	58.6 <sup>ab</sup>	*	33.7 <sup>bc</sup>	29.4 <sup>a</sup>	*	5.0 <sup>a</sup>	4.7 <sup>ab</sup>	NS
<i>P. purpureum</i>	58.7	62.9	*	38.7	28.5	**	6.0	3.7	*
Mean	64.3	63.0		34.6	34.2		6.1	5.5	

<sup>a</sup>Se: Effect of season in the same species of grass. \* p<0.05. \*\*p<0.01. NS: Not significant.

<sup>a, b, c, d</sup> Values in the same column with different superscripts differ significantly (p<0.05).

**Table 3.** Concentration of Ca, P and Mg in grass during dry and rainy seasons (g/kg DM)

Species	Ca		Se <sup>a</sup>	P		Se <sup>a</sup>	Mg		Se <sup>a</sup>
	Dry	Rainy		Dry	Rainy		Dry	Rainy	
<i>A. gayanus</i>	6.6 <sup>a</sup>	8.9 <sup>c</sup>	*	4.1 <sup>b</sup>	2.4 <sup>a</sup>	*	2.8 <sup>ab</sup>	3.3 <sup>b</sup>	NS
<i>A. compressus</i>	7.1 <sup>a</sup>	7.4 <sup>b</sup>	NS	2.6 <sup>a</sup>	3.6 <sup>b</sup>	NS	4.0 <sup>c</sup>	4.4	NS
<i>B. decumbens</i>	6.8 <sup>a</sup>	7.4 <sup>b</sup>	NS	2.3 <sup>a</sup>	2.2 <sup>a</sup>	NS	3.2 <sup>bc</sup>	3.8 <sup>b</sup>	NS
<i>C. plectostachyus</i>	9.0 <sup>b</sup>	7.7 <sup>b</sup>	*	4.4 <sup>b</sup>	4.7 <sup>c</sup>	NS	3.5 <sup>bc</sup>	2.0 <sup>a</sup>	*
<i>P. maximum</i>	9.4 <sup>b</sup>	10.7 <sup>d</sup>	*	3.2 <sup>a</sup>	4.3 <sup>bc</sup>	NS	3.4 <sup>bc</sup>	3.5 <sup>b</sup>	NS
<i>P. purpuphoides</i>	6.5 <sup>a</sup>	5.3 <sup>a</sup>	NS	4.6 <sup>b</sup>	3.8 <sup>b</sup>	*	2.8 <sup>ab</sup>	2.2 <sup>a</sup>	NS
<i>P. purpureum</i>	6.1 <sup>a</sup>	6.0 <sup>a</sup>	NS	2.8 <sup>a</sup>	5.9 <sup>d</sup>	**	2.3 <sup>a</sup>	3.2 <sup>b</sup>	*
Mean	7.4	7.6		3.4	3.8		3.1	3.2	

<sup>a</sup>Se: Effect of season in the same species of grass. \* p<0.05. \*\* p<0.01. NS: Not significant.

<sup>a, b, c, d</sup> Values in the same column with different superscripts differ significantly (p<0.05).

from 7.8% (*B. decumbens*) to 14.8% (*A. compressus*) in rainy season. In general, data on fiber fraction showed that grass contained more NDF, ADF and ADL in dry season than in rainy season. The ranges of NDF, ADF and lignin content in dry seasons were from 58.0% (*C. plectostachyus*) to 69.7% (*A. gayanus*); 26.5% (*B. decumbens*) to 44.6% (*P. maximum*) and from 4.4% (*C. plectostachyus*) to 7.3% (*A. gayanus*), respectively. In the rainy season the NDF, ADF and ADL contents decreased significantly (p<0.05) with the values ranging from 57.3 (*C. plectostachyus*) to 70.8% (*A. gayanus*); 28.3% (*A. compressus*) to 44.1% (*P. maximum*) and from 3.7% (*C. plectostachyus*) to 7.8% (*B. decumbens*), respectively. *B. decumbens*, *P. purpureum* and *P. purpuphoides* had significantly lower (p<0.05) NDF and ADF in rainy season compared to those of dry season, while ADL of *A. gayanus*, *A. compressus* and *P. purpureum* was lower in rainy season than in dry season. Such seasonal changes in tropical regions are routinely noticed and are due to maturity and the age of grass species with progress of season from dry to rainy seasons. The lower content of CP in dry season than that of rainy season was in agreement with other results for the legumes in West Sumatra (Göhl, 1975; Aregheore, 2002; Evitayani et al., 2004). The wide variation in CP and fiber of the forages was consistent with previous reports (Fariani, 1996; Ammar et al., 1999; Tudsri et al., 2002; Islam et al., 2003; Manyayu et al., 2003; Nasrullah et al., 2003). Minson (1990) showed that crude protein concentrations of 560 tropical forages samples,

grown and determined in different parts of the world, ranged from 2% to 27% of the dry matter according to growth stage and soil fertility. The differences in fiber components between season suggested that the high intensity of solar radiation and less amount of rainfall caused faster maturation during dry season and this resulted in higher cell wall contents and lower cell contents than those of rainy season. It is well known that the amount of rainfall in dry season was 192.2 mm/month while 298.4 mm/month in rainy season (Indonesia Statistical Bureau, 2001).

#### Mineral concentrations

Concentrations of mineral Ca, P and Mg of are shown in Table 3. Both season and species significantly affected Ca, P and Mg of grass (p<0.05). In dry season, *C. plectostachyus* and *P. maximum* contained higher amount of Ca than that of the other species, while in rainy season *P. maximum* contained the highest Ca concentration. Concentrations of Ca in *A. gayanus* and *P. maximum* were significantly (p<0.05) decreased with the change of season from rainy to dry season. The mean of P concentration in rainy season was higher than that in dry season without significance (3.8 vs. 3.4 g/kg). In dry season, *C. plectostachyus* and *P. purpuphoides* contained higher P concentration, while in rainy season *P. purpureum* contained the highest P concentration. In Java island, Indonesia, Ca concentration of forages in rainy season was

**Table 4.** *In vitro* digestibility of dry matter (DMD), organic matter (OMD) and crude protein (CPD) of grass in dry and rainy seasons (%)

Species	DMD		Se <sup>a</sup>	OMD		Se <sup>a</sup>	CPD		Se <sup>a</sup>
	Dry	Rainy		Dry	Rainy		Dry	Rainy	
<i>A. gayanus</i>	51.6 <sup>a</sup>	50.3 <sup>a</sup>	NS	53.5 <sup>a</sup>	53.2	NS	55.6 <sup>a</sup>	56.4 <sup>a</sup>	NS
<i>A. compressus</i>	53.7 <sup>a</sup>	55.0 <sup>bc</sup>	NS	53.1 <sup>a</sup>	59.3	*	51.8 <sup>a</sup>	59.9 <sup>ab</sup>	*
<i>B. decumbens</i>	50.9 <sup>a</sup>	49.1 <sup>a</sup>	NS	52.3 <sup>a</sup>	52.4	NS	54.7 <sup>a</sup>	56.2 <sup>a</sup>	NS
<i>C. plectostachyus</i>	52.7 <sup>a</sup>	57.7 <sup>bc</sup>	*	54.1 <sup>a</sup>	63.0	**	60.3 <sup>b</sup>	61.2 <sup>bc</sup>	NS
<i>P. maximum</i>	53.1 <sup>a</sup>	58.5 <sup>cd</sup>	*	53.9 <sup>a</sup>	59.5	*	54.3 <sup>a</sup>	59.6 <sup>ab</sup>	*
<i>P. purpuphoides</i>	50.4 <sup>a</sup>	54.8 <sup>b</sup>	*	51.9 <sup>a</sup>	57.3	*	54.2 <sup>a</sup>	60.5 <sup>bc</sup>	*
<i>P. purpureum</i>	59.1 <sup>b</sup>	61.8 <sup>d</sup>	NS	61.9 <sup>b</sup>	62.3	NS	62.3 <sup>b</sup>	63.6 <sup>c</sup>	NS
Mean	53.1	55.3		54.4	56.3		56.6	58.1	

<sup>a</sup>Se: Effect of season in the same species of grass. \* p<0.05. \*\*p<0.01. NS: Not significant.<sup>a, b, c, d</sup> Values in the same column with different superscripts differ significantly (p<0.05).**Table 5.** Characteristics of *in vitro* gas production and metabolizable energy (ME) content of grass

Species	(a+b) <sup>1</sup>		Se <sup>a</sup>	c <sup>2</sup>		Se <sup>a</sup>	ME <sup>3</sup>		Se <sup>a</sup>
	Dry	Rainy		Dry	Rainy		Dry	Rainy	
<i>A. gayanus</i>	35.6 <sup>b</sup>	35.6 <sup>a</sup>	Ns	0.042 <sup>a</sup>	0.065 <sup>a</sup>	*	6.0 <sup>a</sup>	6.4 <sup>d</sup>	Ns
<i>A. compressus</i>	21.8 <sup>a</sup>	36.9 <sup>ab</sup>	**	0.067 <sup>b</sup>	0.049 <sup>a</sup>	*	6.3 <sup>a</sup>	6.7 <sup>ab</sup>	Ns
<i>B. decumbens</i>	38.0 <sup>bc</sup>	39.1 <sup>ab</sup>	Ns	0.034 <sup>a</sup>	0.044 <sup>a</sup>	*	6.3 <sup>a</sup>	6.7 <sup>ab</sup>	Ns
<i>C. plectostachyus</i>	45.1 <sup>d</sup>	45.8 <sup>c</sup>	Ns	0.088 <sup>c</sup>	0.105 <sup>b</sup>	**	8.1 <sup>d</sup>	8.6 <sup>c</sup>	*
<i>P. maximum</i>	35.1 <sup>bc</sup>	41.7 <sup>b</sup>	**	0.094 <sup>c</sup>	0.059 <sup>a</sup>	**	7.1 <sup>bc</sup>	7.5 <sup>abc</sup>	Ns
<i>P. purpuphoides</i>	39.7 <sup>c</sup>	40.3 <sup>b</sup>	Ns	0.141 <sup>d</sup>	0.136 <sup>bc</sup>	Ns	7.5 <sup>cd</sup>	7.9 <sup>bc</sup>	Ns
<i>P. purpureum</i>	44.1 <sup>d</sup>	47.5 <sup>c</sup>	*	0.164 <sup>d</sup>	0.143 <sup>c</sup>	*	8.3 <sup>d</sup>	8.6 <sup>c</sup>	Ns
Mean	37.1	41.0		0.081	0.086		7.0	7.3	

<sup>a</sup>Se: Effect of season in the same species of grass. \* p<0.05. \*\*p<0.01. NS: Not significant.<sup>a, b, c, d</sup> Values in the same column with different superscripts differ significantly (p<0.05).<sup>1</sup> Potential gas production (ml/200 mg DM). <sup>2</sup> Production rate of constant (ml/h). <sup>3</sup> MJ/kg DM.

significantly (p<0.01) higher than that of dry season. Kumagai et al. (1990). The P content in grass species also was slightly higher in rainy season than in dry season. Kumagai et al. (1990) also showed a similar trend for the P concentration in grass species, it tended to be higher in rainy season than in dry season. The Mg content in grass species were almost the same but tended to be higher in wet season than in dry season (Kumagai et al., 1990; Serra et al., 1997). According McDowell (1985), the critical level of Ca, P and Mg concentration in grass was 3.0, 2.5 and 2.0 g/kg, respectively. The present study showed there was no species of grasses deficient in Ca and Mg, and only *B. decumbens* contained P below the critical level in both dry and rainy seasons.

### *In vitro* digestibility

The analysis of variance for digestibility showed that both species and season had significant effect on DMD, OMD and CPD of grasses (p<0.05) (Table 4). In dry season, the DMD varied from 50.4% (*P. purpuphoides*) to 59.1% (*P. purpureum*), while in rainy season ranged from 50.3% (*A. gayanus*) to 61.8% (*P. purpureum*). Effect of season showed that DMD and OMD of *C. plectostachyus*, *P. maximum* and *P. purpuphoides* were significantly higher (p<0.05) in rainy season compared to those of dry season. The higher DMD in rainy season compared to dry season was in agreement

with the result of Nasrullah et al. (2003). The ranges of DMD in the present study were similar to those of reported by Manyay et al. (2003), Poppi et al. (1981), Fariani (1996), Tegua et al. (1999) and Ammar et al. (1999). According to Bula et al. (1977), DMD of forage during the grazing stage can vary considerably, and is related to changes in the chemical composition particularly in fiber, lignin and silica contents. Digestibility of crude protein of grasses varied from 51.8% (*A. compressus*) to 62.3% (*P. purpureum*) in dry season and slightly increased in rainy season from 56.2% (*B. decumbens*) to 63.6% (*P. purpureum*). The higher CPD in rainy season was similar with the result obtained by Göhl (1975) and the wide variation of CPD was mainly related to different content of crude protein in the grass and fiber component. Low CPD digestibility was associated with lower crude protein and higher fiber fractions (NDF, ADF and ADL) during dry season. Some differences in CPD of the forages also arise as a result of differences in species or genotype, stage of growth, environmental conditions and management practice. Generally, *B. decumbens* had relatively lower DMD, OMD and CPD than those of the other grasses. Otherwise, *P. purpureum* had higher DMD, OMD and CPD compared to the other grasses in both dry and rainy seasons. These findings were consistent with their chemical compositions as shown in Table 1, of which *P. purpureum* followed by *C.*

*plectostachyus* contained much higher crude protein but was generally lower in cell wall constituents (CWC or NDF) in both dry and rainy seasons.

### Gas production and ME contents

Characteristics of *in vitro* gas production and estimated ME content of grasses during dry and rainy seasons are presented in Table 5. In general, gas production rapidly increased with increasing incubation time interval from 3 h to 48 h and it was relatively constant from 48 h to 96 h incubation times. The potential and rate of gas production were significantly affected by species and season ( $p < 0.05$ ). During dry season, potential of gas production (a+b) ranged from 21.8 ml/200 mg (*A. compressus*) to 45.1 ml/200 mg (*C. plectostachyus*), while in rainy season it varied from 35.6 ml/200 mg (*A. gayanus*) to 47.5 ml/200 mg (*P. purpureum*). Effect of season showed that potential gas production of *A. compressus*, *P. maximum* and *P. purpureum* was higher ( $p < 0.05$ ) in rainy season than in dry season. The highest rate of gas production (c) occurred in *P. purpureum*, either in dry or rainy season (0.143 and 0.164 ml/h). Generally, *C. plectostachyus* followed by *P. purpureum* both in dry and rainy seasons had higher potential gas production. This finding indicated that the patterns of *in vitro* gas production were very similar to those of rumen DMD and OMD. As reported earlier, DMD, OMD were higher for *C. plectostachyus* and *P. purpureum* both in dry and wet seasons. This means that these grasses contained more degradable fractions than the other grasses that may have been fermented in the rumen and thus resulted in much higher volatile fatty acids (VFAs) and gas production (Fariani, 1996). The results were also in agreement with the observation of Menke et al. (1979), Krishnamoorthy et al. (1995) and Nogueira et al. (1999) that the amount of gas released when a feed is incubated *in vitro* with rumen fluid is closely related to the digestibility of the feed. As shown in Table 5, the ME content of grasses varied from 6.0 to 8.3 MJ/kg in dry season and increased slightly from 6.4 to 8.6 MJ/kg in rainy season. Both in dry and rainy seasons, the highest ME content occurred in *P. purpureum* and *C. plectostachyus*. The ME content of grasses in the present study was relatively higher compared to the ME content of several legumes in West Sumatra that varied from 6.4 to 7.8 MJ/kg in dry season and from 6.9 to 7.8 MJ/kg in rainy season (Evitayani et al., 2004).

From the above results, it could be concluded that nutritive value of the grasses grown in West Sumatra, Indonesia was relatively higher during rainy season compared with dry season. *Pennisetum purpureum* and *Cynodon plectostachyus* appeared to have better quality than other species. It suggested that proper supplementation with sources of nitrogen and energy might be required to support grazing ruminants, especially during dry season.

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