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Effect of Harvesting Time on the Chemical Composition of *Pennisetum clandestinum*

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ABSTRACT

The study of the chemical composition of Pennisetum clandestinum at various harvesting time was carried out between March 2015 and March 2016 at the University of Dschang. A completely randomized block design comparing three harvesting frequencies (30, 45 and 60 days of growth) in 8 replicates on 96 plots of 4 m 2 (2m x 2m) each one, for a total of 24 plots per block, was used for the production of P. clandestinum. Consecutive harvests at each frequency were done throughout the farming season (March-November 2015). Samples of forage at each mow were collected for chemical analysis. The results showed that, from the first to the last mow of each frequency, dry matter (DM) and organic matter (OM) contents increased; the ash, crude protein (CP) and lipid contents decreased; while the cell walls (NDF), cellulose and hemicellulose contents varied in a zigzag way (except for hemicellulose at 60 days frequency). The mean chemical composition at each frequency showed that CP content decreased ($p<0.05$), cell walls content increased ($p<0.05$) with increasing cutting age while the highest lipid content (2.78 %) was obtained at the 45 days frequency. The mean chemical composition at 45 days frequency appeared better balanced: it was comparable ($p>0.05$) to the 30 days frequency for the highest CP and lipid content, and to the 60 days frequency for the highest cell walls content. Therefore, the 45 days re growth age should constitute the suitable harvesting frequency of P. clandestinum for its best chemical composition as fodder crop.

Keywords: *Chemical composition, Cutting frequency, Harvesting time, Pennisetum clandestinum;*

INTRODUCTION

Animal feeding is one of the major factors of success in livestock raising. Not only the feed influences the animal health, but also affects the quality of the output products (Tamboura *et al*., 2005). In the majority of traditional breeding, particularly of the domestic herbivores in sub-Saharan Africa, animals are fed on natural rangeland resources (Pamo *et al.*, 2007).In time, the increase of human population leads to the extension of agricultural areas; therefore the available rangeland undergoes to reduction and overgrazing by the livestock increasing as well. With the restriction of natural rangeland to marginal zones, animal feed requirements become difficult to satisfy in such extensive breeding systems (Gurbuz and Kaplan, 2008; Pamo *et al.*, 2006).

In Mali, investigations on registration of cattle, sheep and goats showed that, on the average basis of 3 ha/UBT/year according to the natural forage resources in the rural district of Madiama, approximately11500 ha should be available to respond to the feeding needs of villager's herds only (5075 cows and 2535 sheep/goats registered) which represents 3800 UBT (Kodio *et al.*, 2001). Within 16 970 ha of that district, it is very difficult under such conditions to feed animals particularly during the farming period. One of the solutions to manage livestock and available forage resources is the transhumance extended to the neighboring districts, which unfortunately often generates many conflicts between farmers and breeders (Kodio *et al*., 2001).

Most of such problems should be solved through the intensification of livestock production using improved methods: the extensive grazing systems being gradually substituted by more intensive methods (FAO, 2003). Therefore, where there is a shortage of land, stall feeding which is an intensive breeding system, shall be encouraged even to small-scale breeders. In this system, forage is cut and carried to animals in stall feeding. It has higher labour but lower land requirements (FAO, 2003).In Cameroon for example, thanks to *Brachiaria* cultivation, transhumance by cattle breeders in the sahelian north region have been reduced since 2004. Over more, transhumance practice was totally abandoned by some breeders (Matho, 2011).In the same way; *Pennisetum clandestinum* should be helpful, within its feeding value, as an integrator between agriculture and animal husbandry in Cameroonian western highlands (Fotsing and Tchawa, 1994). In fact, compared to other tropical grasses, *Pennisetum clandestinum* surely stands as a particular grass in livestock production (Holliday, 2007).For its high dry matter yield, high nutritive value particularly the protein content and good palatability to cattle, *P. clandestinum* is a suitable grass specie in highly productive pastures for dairy cows (Fukumoto and Lee, 2003; Moore, 2016).However, the rhythm of harvest or grazing depending on the plant maturity is one of the most important factors of grasses feeding value variation (Boyer and Roberge, 1985). Therefore, *P. clandestinum* in the present study was harvested at different frequencies corresponding to 30, 45 and 60 days of re growth, throughout the annual farming season. The objective is to evaluate its feed value (especially the chemical composition) at each cutting of each frequency. The result should enable the animal breeder to provide fodder responding to the animals' nutrient requirements.

Material and Methods

Study Site

The study was carried out between March 2015 and March 2016 at the Research and Experimental Farm (F.A.R.) and the Animal Production and Nutrition Research Unit (LAPRONAN) of the University of Dschang. Located at approximately 1420 m of altitude, between 10°03' Eastern longitude and 05°26' Northern latitude, the annual rainfall in this zone varies between 1500 and 2000 mm. Mean temperatures vary between 16 and 21°C, with a maximum of 31°C during the hottest month. Climate in the region is a Sudano-Guinean type of higher altitude, with two main seasons: the dry season which is shorter (mid-November to mid-March) and the rainy season which is longer (mid-March to mid-November) and correspond to the farming period (Pamo et *al*., 2006).

Experimental Design and Soil Analysis

A completely randomized block design comparing three harvesting frequencies (30, 45 and 60 days of growth) in 8 replicates on 4 m^2 plot (2m x 2m) each, for a total of 24 plots per block, was used. Before ploughing and plantation, soil samples were randomly collected within 0-20 cm deep through the superficial soil layer. Their analysis was carried out at the Environmental, Chemistry and Soil Analysis Laboratory (LABASCE) of the University of Dschang. Results showed that the soil was loamy, slightly acid, containing 12 % of organic matter, 7 % of carbon, 0.6 % of total nitrogen and 0.5 mg/kg of assimilable phosphorus.

Land Preparation, Plantation and Weed Control

Land preparation for crop establishment started with manual removal of shrubs, followed by a mechanized ploughing. In order to improve the soil productivity, and in accordance with the soil analysis results and the nitrogen requirement of the plant, basal manure constituted by dry droppings of goats (16.80 % N content) was applied to the soil (Roos, 1975) at a rate of 1.19 kg/m^2, equivalent to 19.992 g N/m^2 (approximately 200 kg N/ha). After blocks and plots dressing, plantation of stolon fragments was manually done. Stem cuttings of approximately 30 cm long with at least 4 nodes each one, were planted at 20 cm x 20 cm spacing and getting 2 or 3 nodes under grounded. This way, a planting rate of 121 stolon fragments per plot was achieved. Weed control was manually done each month throughout the experimental period.

Harvest

The last day of each cutting frequency (30^{th}, 45^{th} and 60^{th} day of growth), forage was harvested on 8 plots per block. Cutting was done at 10 cm above the ground level onto a useful area of 1 m^2 delimited inside each plot by a 1m x 1m metallic quadrate. At the end of the farming season, a total of 6, 4 and 3 cuts were obtained respectively at 30, 45 and 60 days of *P. clandestinum* re growth.

Chemical Composition Evaluation

At each cutting, a sample of 500 g (weighed on a digital scale of Dahongying mark, max weight 30 kg and precision 2 g) was collected on a plot per bock of the experimental design. All the samples, preserved individually in paper envelopes, were immediately carried to the Animal Production and Nutrition Laboratory and dried in a ventilated laboratory oven (of Gallenkamp mark) at 60 °C until constant weight. Dried samples were afterwards ground in a tri-hammers mill with a 1 mm mesh screen.

Powders obtained were respectively kept in plastic bags before different chemical analysis. Dry matter (DM), ash, organic matter (OM), lipid, crude protein (CP) and nitrogen contents were determined according to the methods described by AOAC (2005). Fibre components (NDF, ADF and ADL) were determined according to Van Soest et *al*.(1991) method.

Statistical Analysis

The data on the chemical composition of forage from consecutive harvests of each frequency were subjected to one way analysis of variance following the General Linear Model. Whenever differences existed between treatments, means were separated by the Duncan test at 5% significance level (Steel and Torrie, 1982).

Results

Chemical Composition of Forage Consecutively Harvested at 30 Days Frequency

The chemical analysis results of forage from 6 consecutive harvests at 30 days frequency showed that dry matter (DM) and organic matter (OM) contents increased from the first to the last cutting. For each of these constituents, the content at the last cutting was higher (p<0.05) than at the first; meanwhile the content at each of the 2 last cuts of the set was higher than the average. On the other hand, the ash, crude protein (CP) and lipid contents decreased from the first to the last cutting. The content of each of these components was lower (p<0.05) at the first cutting than at the last.

In addition, the ash content at each of the 2 last cuttings and the CP content at each of the 3 last cuts of the set were lower than the corresponding average, while the lipid content at each of the 2 first cuttings was higher than the average. Lastly, cell walls (NDF), cellulose and hemicellulose contents varied in a zigzag way from the first to the last cutting. For NDF and hemicellulose, the lowest contents were observed at the 5thcutting and the highest at the 6th. The NDF content at the 2nd and the 6thcuts was higher than the average while the hemicellulose content at the 2nd, the 4th and the 5thcuts was lower than the average. The lowest cellulose content was observed at the first cutting and the highest at the 2nd; the content at the first, the 5th and the 6thcuts was lower than the average (Table 1).

Table1. *Chemical composition of forage consecutively harvested at 30 days frequency*

Components (% DM)	Consecutive cuts						*Average*	*p*
	1st	2nd	3rd	4th	5th	6th		
DM(*)	12.14 ± 1.02^{a}	15.36 ± 0.61^{b}	16.12 ± 1.19^{b}	17.16 ± 1.21^{b}	21.23 ± 2.89^{c}	27.80 ± 2.39^{d}	*18.30 ± 5.50*	*0.000*
Ash	14.43 ± 0.71^{a}	14.31 ± 0.89^{ab}	13.47 ± 0.38^{ab}	13.45 ± 0.96^{ab}	11.62 ± 0.50^{cd}	10.51 ± 1.09^{d}	*12.96 ± 1.57*	*0.000*
OM	85.57 ± 0.71^{a}	85.69 ± 0.89^{ab}	86.53 ± 0.38^{ab}	86.55 ± 0.96^{ab}	88.38 ± 0.50^{cd}	89.49 ± 1.09^{d}	*87.03 ± 1.57*	*0.000*
CP	25.56 ± 2.57^{a}	23.48 ± 1.82^{b}	22.52 ± 1.60^{bc}	20.69 ± 2.02^{bc}	19.22 ± 1.10^{cd}	17.41 ± 1.01^{d}	*21.48 ± 3.32*	*0.000*
Lipid	3.80 ± 0.28^{a}	2.93 ± 0.14^{b}	2.47 ± 0.28^{c}	2.16 ± 0.18^{cd}	1.86 ± 0.19^{de}	1.70 ± 0.58^{e}	*2.49 ± 0.80*	*0.001*
NDF	76.25 ± 2.62^{ab}	76.37 ± 1.54^{ab}	75.75 ± 3.61^{ab}	75.99 ± 0.86^{ab}	72.72 ± 3.90^{a}	80.70 ± 5.64^{b}	*76.30 ± 2.55*	*0.000*
Cellulose	24.05 ± 0.70^{a}	29.78 ± 1.24^{b}	27.81 ± 0.90^{bcd}	28.99 ± 0.53^{bc}	26.82 ± 1.74^{cd}	27.28 ± 1.88^{cd}	*27.45 ± 1.20*	*0.000*
Hemicellulose	44.70 ± 1.94^{bc}	42.32 ± 1.29^{abc}	43.96 ± 3.68^{bc}	41.25 ± 0.80^{a}	40.34 ± 2.17^{ab}	47.80 ± 4.51^{dc}	*43.39 ± 2.70*	*0.000*

DM = Dry matter; OM = Organic matter; CP = Crude protein; NDF = Neutral detergent fibre.

a, b, c, d, e : values on the same row with different superscripts differ significantly at 5% level.

(*) : % forage sample; p = Probability.

Chemical Composition of Forage Consecutively Harvested at 45 Days Frequency

The different forage components of 4 consecutive harvests at the 45 days frequency diversely varied from the first to the last cutting. Dry matter (DM) and organic matter (OM) contents increased; ash, CP and lipid contents decreased while cell walls (NDF), cellulose and hemicellulose contents varied in a zigzag way. DM content at the last cutting was higher (p<0.05) than content at each of the previous cuts which were themselves comparable (p>0.05).

Only the DM content at the 4thcutting was higher than the average. CP and lipid contents at the first cutting were higher ($p<0.05$) than at the last cut of the set; the content at each of the 2 last cuttings was lower than the average. The highest content of NDF, cellulose and hemicellulose was observed respectively at the 2nd, the 3rd and the first cuttings; while the lowest was observed at the 3rdcut for NDF and at the 2ndcut for cellulose and hemicellulose.

The NDF content at the first and the 3rdcuts and the hemicellulose content at the 2nd and the 3rd were respectively lower than the average for each of these constituents. Lastly, no significant difference ($p>0.05$) was observed for the ash, OM and cellulose contents of the consecutive harvests. However, only the OM and ash contents at the 4thcutting were respectively higher and lower than their average, while the cellulose content at the 2nd and the 4thcuts was lower than the average of the set (Table 2).

Table2.*Chemical composition of forage consecutively harvested at 45 days frequency*

Components (% DM)	Consecutive cuts				*Average*	*p*
	1st	2nd	3rd	4th		
DM (*)	16.41 ± 1.38ᵃ	16.82 ± 1.28ᵃ	16.94 ± 1.58ᵃ	25.43 ± 2.26ᵇ	*18.90 ± 4.36*	*0.003*
Ash	12.37 ± 0.82ᵃ	12.33 ± 0.53ᵃ	12.28 ± 0.28ᵃ	11.75 ± 0.52ᵃ	*12.26 ± 0.36*	*0.152*
OM	87.63 ± 0.82ᵃ	87.67 ± 0.53ᵃ	87.72 ± 0.28ᵃ	88.25 ± 0.52ᵃ	*87.74 ± 0.36*	*0.152*
CP	23.66 ± 0.40ᵃ	21.89 ± 0.71ᵇ	17.05 ± 0.84ᶜ	16.89 ± 1.62ᶜ	*19.87 ± 3.43*	*0.001*
Lipid	3.14 ± 0.27ᵃ	3.02 ± 0.06ᵃ	2.63 ± 0.32ᵇ	2.35 ± 0.26ᵇ	*2.78 ± 0.37*	*0.001*
NDF	81.81 ± 1.97ᵃ	83.44 ± 5.06ᵃᵇ	80.89 ± 4.48ᵃᵇ	82.62 ± 3.91ᵃᵇ	*82.19 ± 3.11*	*0.001*
Cellulose	27.93 ± 2.37ᵃ	27.35 ± 3.53ᵃ	28.31 ± 2.15ᵃ	27.36 ± 2.90ᵃ	*27.74 ± 0.47*	*0.127*
Hemicellulose	49.95 ± 4.09ᵃ	42.19 ± 2.70ᵃᵇ	43.65 ± 2.39ᵇ	46.31 ± 3.63ᵇ	*45.52 ± 3.36*	*0.000*

DM = Dry matter; OM = Organic matter; CP = Crude protein; NDF = Neutral detergent fibre.

a, b, c : values on the same row with different superscripts differ significantly at 5% level.

(*) : % forage sample; p = Probability.

Chemical Composition of Forage Consecutively Harvested at 60 Days Frequency

The chemical analysis results of forage from 3 consecutive harvests at 60 days frequency showed that dry matter (DM) content significantly ($p<0.05$) increased from the first to the last cutting. Similar trend was observed with OM and hemicellulose contents. For each of these constituents (DM, OM and hemicellulose), only the content at the 3rd cutting was higher than the average. On the other hand, the ash, CP and lipid contents decreased from the first to the last cutting; their respective contents at the first cut were higher ($p<0.05$) than at the last.

Ash and CP contents at the 3rdcutting were lower than the average while the lipid content at the first was higher than the average for the set. Finally the NDF and cellulose contents varied in a zigzag way, their higher values ($p<0.05$) were observed at the 2ndcut while the first and the last were comparable ($p>0.05$). The content of each of these constituents (NDF, cellulose) at the 2ndcut was lower than the average (Table 3).

Table3.*Chemical composition of forage consecutively harvested at 60 days frequency*

Components (% DM)	Consecutive cuts			*Average*	*p*
	1st	2nd	3rd		
DM (*)	16.93 ± 0.21ᵃ	19.96 ± 1.12ᵇ	25.96 ± 1.28ᶜ	*20.95 ± 4.59*	*0.016*
Ash	11.99 ± 0.67ᵃ	11.25 ± 0.83ᵃᵇ	10.27 ± 0.99ᵇ	*11.17 ± 0.86*	*0.000*
OM	88.01 ± 0.67ᵃ	88.75 ± 0.83ᵃᵇ	89.73 ± 0.99ᵇ	*88.83 ± 0.86*	*0.002*
CP	16.08 ± 0.68ᵃ	14.57 ± 0.86ᵃᵇ	13.12 ± 1.39ᵇ	*14.59 ± 1.46*	*0.004*
Lipid	1.90 ± 0.05ᵃ	1.42 ± 0.11ᵇ	1.40 ± 0.28ᵇ	*1.57 ± 0.29*	*0.012*
NDF	84.27 ± 1.55ᵃ	82.91 ± 1.77ᵇ	85.53 ± 1.37ᵃ	*84.24 ± 1.31*	*0.000*
Cellulose	32.12 ± 0.66ᵃ	27.30 ± 1.46ᵇ	31.52 ± 1.46ᵃ	*30.31 ± 2.63*	*0.002*
Hemicellulose	43.97 ± 1.62ᵃ	44.92 ± 2.17ᵃ	47.99 ± 2.01ᵇ	*45.63 ± 2.10*	*0.001*

DM = Dry matter; OM = Organic matter; CP = Crude protein; NDF = Neutral detergent fibre.

a, b, c : values on the same row with different superscripts differ significantly at 5% level.

(*): % forage sample; p = Probability.

Comparison of Mean Chemical Composition of Forage at Different Cutting Frequencies

The mean chemical composition of forage from *P. Clandestinum* consecutively harvested at 30, 45 and 60 days of growth showed that increasing the cutting interval led to various effects from one constituent to another: DM rate as well as the OM, NDF, cellulose and hemicellulose contents increased; ash and CP contents decreased, while the lipid content varied in a zigzag way (the highest content was observed at the 45 days cutting frequency).

CP content at the 60 days frequency was lower ($p<0.05$) than at 30 and 45 days frequencies which, in addition, were comparable ($p>0.05$). Similar trend was observed with the lipid content. Cellular walls (NDF) content at the 30 days frequency was lower ($p<0.05$) than at 45 and 60 days frequencies which were themselves comparable ($p>0.05$). Lastly, no significant effect of increasing the cutting interval was observed on the DM, OM, ash, cellulose and hemicellulose contents at the different frequencies (Table 4).

Table4. *Mean chemical composition of forage at different cutting frequencies*

Components (% DM)	Cutting frequency (days)			*SEM*	*p*
	30	45	60		
DM(*)	18.30^{a}	18.90^{a}	20.95^{a}	3.54	0.47
Ash	12.96^{a}	12.26^{a}	11.17^{a}	0.84	0.06
OM	87.03^{a}	87.74^{a}	88.83^{a}	0.84	0.06
CP	21.48^{a}	19.87^{a}	14.59^{b}	2.18	0.01
Lipid	2.49^{ab}	2.78^{a}	1.57^{b}	0.46	0.03
NDF	76.30^{a}	82.19^{b}	84.24^{b}	1.80	0.00
Cellulose	27.45^{a}	27.74^{a}	30.31^{a}	1.31	0.05
Hemicellulose	43.39^{a}	45.52^{a}	45.63^{a}	1.99	0.29

DM = Dry matter; OM = Organic matter; CP = Crude protein; NDF = Neutral detergent fibre.

a, b : values on the same row with different superscripts differ significantly at 5% level.

(*) : % forage sample.

SEM: Standard error of mean; p: Probability.

Discussion

The chemical analysis results of forage from consecutive harvests of *P. clandestinum* showed that, independently to the cutting frequency, dry matter (DM) content increased from the first to the last cutting. Dry matter content at the first cutting was lower ($p<0.05$) than at the last; contents at the intermediate cuts were comparable ($p>0.05$).The interval variation of DM observed at 45 days frequency is in accordance with Fukumoto and Lee (2003)who reported 16.9-22.5 % DM of *P.clandestinum* var. Hosaka harvested at 8 weeks of growth. The increase of DM content from the first to the last cutting in the present study should be justified by the fact that with increasing maturity, the absorption capacity of water by the plant decreases (root oldness). Therefore, dry matter concentrates more in the plant cells. Under the DM basis, the OM forage content increased from the first to the last cut at each frequency. The variation interval of the different cutting frequencies (30, 45 and 60 days) was 85.57-89.49 %; 87.63-88.25 % and 88.01-89.73 % OM respectively, corresponding to high OM values. These high concentrations may be explained by the fact that *P. clandestinum* is a C4 plant characterized, like most tropical C4grasses, by more efficient use of water and solar energy for organic synthesis. In addition, the decrease of ash content simultaneously with the increase of DM content should lead to the increase of OM content.

The ash, crude protein (CP) and lipid contents decreased from the first to the last harvest, independently to the cutting frequency. The variation interval of ash content at the different cutting frequencies (30, 45 and 60 days) was respectively14.43-10.51 %; 12.37-11.75 % and 11.99-10.27 %. Average ash content of 10.0±1.2 % in the aerial parts of *P. clandestinum* was reported by Heuzé et *al*. (2015).This value is close to the variation interval obtained at 60 days frequency, but also to the lowest value of ranges obtained at 30 and 45 days frequencies. Decrease of ash content was observed with increasing the cutting serial number of consecutive harvests, and also with increasing the cutting interval frequency. This result may be due in one way to the continuous decrease of mineral reserves in the soil without any compensating fertilizer application, and in another way to the inadequacy between the low capacity of mineral absorption by the roots and the entire plant requirements (Kariuki, 1989). The situation is similar for the soil nitrogen content which continuous decline resulted in a CP content decrease as follows: 25.56-17.41 %; 23.66-16.89 % and 16.08-13.12 % respectively at 30, 45 and 60 days cutting frequencies. The CP content decrease at consecutive cuts should be the effect of a continuous harvest of *P. clandestinum* unsupplied with any suitable nitrogenous fertilizer. These results also show a decrease trend of CP content with the advancing plant maturity. Similar trend was reported by Fukumoto and Lee (2003) who recorded 11.0-22.9 %, 6.7-15.2 % and 6.1-11.7 % CP respectively at 4, 8 and 12 weeks of harvest of *P. clandestinum* var. Hosaka. Declining of CP average content at the different cutting frequencies should, of course, be explained by the advancement in the plant maturity, therefore the stems/leaves ratio becomes higher, the cell walls content increases while the CP content decreases (El Hassan et *al*., 2000).

Lipid content ranged from 3.80-1.70 % to 3.14-2.35 % and 1.90-1.40 % respectively at 30, 45 and 60 days cutting frequency. The lowest content was obtained at 60 days frequency, while the highest amplitude variation was observed at 30 days frequency. These variations should be due to the conjunction and interaction between many factors within lipid synthesis by the plant. Moreover, Morel *et al.*, 2006 reported that lipid content in forage normally decreases as the plant matures.

The fibre contents (NDF, cellulose and hemicellulose) varied in a zigzag way at the consecutive harvests (except for hemicellulose at 60 days cutting frequency).The highest variation range was obtained at 60 days frequency (82.91-85.53 % for NDF; 27.30-32.12 % for cellulose and 43.97-47.99 % for hemicellulose); while the lowest was at 30 days frequency (72.72-80.70 % for NDF; 24.05-29.78 % for cellulose and 40.34-47.80 % for hemicellulose).The variation range of NDF at 30 days frequency was in accordance with Fukumoto and Lee (2003) who reported a NDF content of 68.2-79.6 % for *P. clandestinum* var. Hosaka harvested at 12 weeks. In addition, the cellulose contents observed at consecutive harvests were, independently to the cutting frequency, lower according to Jstor (2017) who reported 33.4; 32.5 and 34.5 % cellulose for *P. clandestinum* harvested at 4, 6 and 8 weeks respectively. On the other hand, the hemicellulose contents were higher than those reported by the same author, which are 30.3; 35.6 and 36.6 % hemicellulose for *P. clandestinum* harvested in the same conditions. Overall, the high fibre contents obtained in the present study should be justified by the high photosynthetic activity and yield depending on the ambient temperature and water availability. Under optimum temperature conditions, the speed growth increases and the plant elaborates more structural components. Therefore, the fluctuation of temperature and rainfall will result in a zigzag variation of the output products.

The mean chemical composition of forage showed that increasing the cutting interval had no significant effect on the DM rate as well as on the OM, ash, cellulose and hemicellulose contents. However, the CP content decreased ($p<0.05$), the NDF content increased ($p<0.05$) while the lipid content varied in a zigzag way (its highest value was obtained at 45 days frequency) with increasing the cutting interval. This result is in accordance with Ramirez et *al*. (2015) who reported 25.4 and 17.0 % CP; 4.1 and 3.2 % lipid; 53.8 and 61.6 % NDF for *P. clandestinum* harvested respectively at 30 and 60 days of growth. In addition, average obtained at different cutting frequencies is included within the ranges reported by Heuzé et *al*. (2015) which are 8.3 to 22.8 % for PB, and1.7 to 4.0 % for the lipid. The NDF contents observed at 45 and 60 days cutting frequencies were higher than the highest values (53.8 and 61.6 %) reported by Heuzé et *al*. (2015).

These results concerning the content variation of one or another constituent, as well as those of the present study, should be justified mainly by the difference in harvesting maturity. This is in accordance with Firdous et *al*. (1996) assertion indicating that the stage of maturity has a greater effect on the concentration of all components in a fodder plant. However, the CP content (14.59 %) and lipid content (1.57 %) at 60 days cutting frequency and the NDF content (76.30 %) at 30 days cutting frequency were particularly lower. This may be explained by the fact that forage harvested at 30 days is still in an early grass age, with mostly young leaves and stems, resulting in low cell walls content (NDF).On the other hand, forage harvested at 60 days seems more mature with many senescent stems and leaves. This results in a higher rate of cell walls components and lower cytoplasmic compounds (proteins, lipids) declining thus by the respiration breakdown process.

CONCLUSION

The results of the chemical analysis of forage from consecutive harvests of *P. clandestinum* at 30, 45 and 60 days cutting frequency show that:

- The effect of increasing the cutting serial number within a set (from the first to the last cutting of each frequency) was the increase of the DM and OM contents; the decrease of the ash, CP and lipid contents; and the variation in a zigzag way of the cell walls (NDF), cellulose and hemicellulose contents (except at 60 days frequency for hemicellulose).
- The effect of increasing the cutting interval (from 30, 45 to 60 days) was the increase of the DM, OM, cell walls (NDF), cellulose and hemicellulose contents; the decrease of the ash and CP contents; and the variation in a zigzag way of the lipid content.

In order to palliate the nutritional lack resulting from the low concentration in mineral and nitrogenous compounds in the fodder crops, it should be essential to apply, during *P.clandestinum* cultivation, a nitrogenized and mineral fertilizer split according to quantities of elements taken away by the harvested parts of the plant.

Lastly, the 45 days cutting frequency should be the best option for management of *P.clandestinum* during cultivation to obtain forage with more nitrogenous compounds and few components less digestible.

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