ARC Journal of Animal and Veterinary Sciences
Volume 7, Issue 1, 2021, PP 15-27
ISSN No. (Online) 2455-2518
DOI: https://doi.org/10.20431/2455-2518.0701003
www.arcjournals.org

Effect of *Desmodium intortum* and *Arachis glabrata* on The i*n vitro* Digestibility of *Panicum maximum* Hay

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Abstract: *Study were carried out at the Teaching Application and Research Farm (FAR) and at the Animal Production and Nutrition Research Unit (LAPRONAN) of the Faculty of Agronomy and Agricultural Sciences (FASA) of the University of Dschang with the aim to evaluate effects of Desmodium intortum and Arachis glabratta on the in vitro digestibility of Panicum maximum hay. Panicum maximum, Desmodium intortum and Arachis glabrata leaves were collected from the Dschang University campus. Panicum Maximum hay was obtained within LAPRONAN. After harvesting, the leaves were dried and crushed. A 100 g sample of each of these fodder was taken and dried at 60°C in an oven till constant weight, then crushed and stored in plastic bags for bromatological analyzes and in vitro digestibility. The leaves of the legumes were mixed in the proportions of 30% and 50% with the Panicum maximum hay having the proportions of 50% and 70%. The results of this study showed that the increase in the level of incorporation of these legumes made it possible to significantly increase the CP contents (from 8.88% to 15.19% with the addition of D. intortum and 8.88% to 11.63% with addition of A. glabrata) and DM (from 92.51% to 94.33% with addition of D. intortum and from 92.51% to 93.85 with addition of A. glabrata). The in vitro digestibility of organic matter (IVDOM) and the in vitro digestibility of dry matter (IVDDM) of P. maximum hay, were significantly ($p<0.05$) higher when it was mixed at 30% and 50% A. glabrata than when mixed with D. intortum. This study shows that apart from the partitioning factor and volatile fatty acids (VFAs), all parameters of the in vitro digestibility of Panicum maximum hay were significantly ($p<0.05$) improved with the inclusion 30% and 50% of the leaves of A. glabrata and D. intortum.*

Keywords: *In vitro digestibility, Panicum maximum, Arachis glabrata, Desmodium intortum.*

1. Introduction

In Cameroon, the acute deficit of ruminants feed is felt more particularly in the dry season. During this period, the fodder found there is in fact made up essentially of perennial or annual grasses which are of good nutritional value only at the beginning of the rainy season and this value deteriorates as the season progress (Pamo et *al.*, 2007; Lemoufouet et *al.*, 2012). Among these grasses widely used during the lean season for animal feed is guinea grass (*Panicum maximum*). *Panicum maximum* is a perennial grass native to Africa, and it has been introduced to almost all tropical countries as fodder for animals. Often regarded as one of the best species for beef production (Aganga and Tschwenyane, 2004), it has the advantage of not containing any anti-nutritional factors (Bindelle et *al.*, 2007). According to Motta et *al.* (1960), *Panicum maximum* is the best grass for its protein content. Despite the ability of ruminants, and particularly sheep and goats, to add value to these poor fodder, work has shown that it is essential to provide these animals in the dry period with food supplements rich in proteins and minerals in

order to cover their maintenance and / or production needs (Pamo et *al*., 2006). Supplementing concentrates with these forages is generally used in order to increase their feed values. However, their unavailability, high cost and handling difficulties push agro-pastoralists to search for available and less expensive products such as legumes. Legumes offer the advantage of providing a forage rich in nitrogen and carotenes (Granier et *al*., 1972). Studies have shown that the addition to pastures of forage legumes of the genus *Arachis* and *Desmodium* can improve the quality of the ration and the performance of animals (Boukila et *al*., 2009).

Legumes of the genus *Desmodium* and *Arachis glabrata* have been shown to be very palatable to animals. The first occurs in nature in the wild and the second is interesting for its ease of cultivation (Kenfack et *al*., 2006). The high crude protein contents of *Desmodium intortum* and *Arachis glabrata* (10-25% TNM / kg DM) make them important protein supplements for feeding ruminants in the tropics especially during the dry season, period during which the grasses which form the basis of their diet are highly lignified and poorly digestible (Pamo et *al*., 2007). However, no studies have been performed on the effect of *Desmodium intortum* and *Arachis glabrata* on the *in vitro* digestibility of *Panicum maximum* hay in small ruminants. It is to remedy this shortcoming that the present study was initiated with the objective to evaluate the comparative effect of *Arachis glabrata* or *Desmodium intortum* on the digestibility of *Panicum maximum* hay.

2. Materials And Methods

2.1. Study Area

The present study was conducted at the Animal Production and Nutrition Laboratory (LAPRONAN) of the University of Dschang. Located at an altitude of about 1400 m and between 10° 03 'East longitude and, 05° 26' North latitude, this area receives 1500 and 2000 mm of rain per year. Temperatures vary on average between 16°C and 21°C, with a maximum of 31°C during the hottest month. The climate is Sudano-Guinean in altitude, characterized by a short dry season (mid-November to mid-March) and a long rainy season (mid-March to mid-November) corresponding to the period of crops.

2.2. Animal Equipment and Health Protection

An empty adult guinea dwarf goat, about 18 months old, was purchased in the market in Dschang town. It was used as a ruminal fluid donor in this study. The animal was housed in a digestibility cage, measuring 1.5 m in length; 0.5 m wide and 1.6 m high equipped with a feeder, a drinker. One month before the start of the study, the animal was dewormed with Ivermectin (1%), a synthetic broad-spectrum anthelmintic active on gastrointestinal and pulmonary nematodes, adults and larvae.

2.3. Plant Material

The plant material consisted of the hay of *Panicum maximum* and the leaves of *Desmodium intortum* and *Arachis glabrata*. The leaves of *Desmodium intortum* and *Arachis glabrata* were collected at the run-up stage within the Dschang University campus. *Panicum maximum* hay was obtained within LAPRONAN. After harvesting, the leaves were dried and crushed. A 100 g sample of each plant was taken, dried at 60°C in an oven to a constant weight, crushed and stored in plastic bags for evaluation of chemical composition (AOAC, 1990).

2.4. Conduct of The Test

2.4.1. Collection of Forage Samples and Formulation of Rations

After harvesting the plant material a sample of 500 g of each forage was taken, chopped manually using cutlass to a size of 2-5 cm and dried at 60°C to constant weight in a Gallemkamp ventilated oven. After drying, the samples were ground using a hammer mill fitted with a 1 mm mesh screen, then stored in plastic bags. Five rations were used in this study:

Ration 1: PM100 = 100% of *Panicum maximum* hay

Ration 2: PM50 + AG50 = 50% of *Panicum maximum* hay + 50% of *Arachis glabrata* leaves

Ration 3: PM70 + AG30 = 70% of *Panicum maximum* hay + 30% of *Arachis glabrata* leaves

Ration 4: PM50 + ID50 = 50% of *Panicum maximum* hay + 50% of *Desmodium intortum* leaves

Ration 5: PM70 + DI30 = 70% of *Panicum maximum* hay + 30% of *Desmodium intortum* leaves

2.5. Analysis of The Chemical Composition of The Different Rations

The determination of the dry matter (DM), organic matter (OM), crude fiber (CF), lipids and total nitrogenous matter (TNM) contents of the various rations were carried out according to the methods described by AOAC (2002). The cell

wall content (NDF) was determined according to the method proposed by Van Soest et *al*. (1991).

2.6. In Vitro Digestibility

2.6.1.Animal Adaptation

The adaptation phase of the *in vitro* digestibility assessment lasted for 10 days. During this phase, the animal was housed in a digestibility cage, measuring 1.5 m long; 0.5 m wide and 1.6 m high equipped with a feeder and a drinker. Animal received 800 g of rations consisting of *Panicum maximum* hay combined with the leaves of *Desmodium intortum* and *Arachis glabrata*. Water was distributed *ad libitum*.

2.6.2.Preparation of Samples and Stock Solution

For each ration, 500 mg of samples were weighed in triplicate, using a KERN 770 brand electric balance, with a capacity of 210 g and a sensitivity of 0.001 g, then placed at the bottom of the syringes, the whole covered by the plunger of the syringe previously embalmed with petroleum jelly to facilitate its movement. The stock solution (Table 1) was prepared according to the method and procedure described by Menke et *al*. (1979).

Table1. *Reagents used in the formulation of the stock solution and their volume*

Reagents	**Volumes (ml)**
Phosphate bouffer	333
Macro minéral	333
Micro minéral	0,333
Rezasurin 0.4%	0,417
Distill water	732

2.6.3.Conditioning and Incubation of Samples and Stock Solution

On the eve of the test, the samples and the freshly prepared stock solution according to the procedure described above were placed in a Memmert brand incubator at 39°C overnight. Likewise, the water bath was started and the temperature was controlled by two LAUDA E300 brand thermostats set at 39°C. In the morning before ruminal fluid collection, the solution was placed in the water bath set at 39°C. In this solution a continuous flow of C02 came from a gas cylinder, the pressure of which was set at 4 bar. Sodium sulfide (417 mg) and 6N NaOH (0.444 ml) were added to the stock solution.

2.6.4.Ruminal Fluid Collection and Incubation

Ruminal fluid was collected immediately after slaughtering the goat at the laboratory. Collected directly from the rumen, this liquid was immediately filtered under a stream of CO_2 that came continuously from a gas cylinder. For the preparation of 2100 ml of inoculum, 700 ml of this liquid were taken and introduced into the stock solution, still under the flow of CO_2. This mixture (inoculum) was homogenized for 10 min using a magnetic rod. 40 ml of this inoculum was taken and injected into each syringe using a Fortuna Optifix brand precision dispenser, then the whole was placed in the water bath for incubation.

The incubation lasted 24 hours and the gas volumes produced were recorded at 0, 3, 6, 9, 12, 18 and 24h. Gas production was calculated and corrected using the following formula proposed by Menke and Steingass (1988):

$$GP\ \ (ml/200mg\ MS) = \frac{(V_{24} - V_o - GP_o) \times 200mg \times GP_h}{m \times MS}$$

With:

V_{24} = Volume of gas read after 24 hours of incubation;

V_0 = Volume of inoculum in the syringe at the start of incubation;

GP0 = Volume of gas produced by the blank after 24 hours of incubation;

GP_h = Volume of gas produced by the standard after 24 hours of incubation.

2.6.5.Assessment Of In Vitro Digestibility of Dry Matter (IVDDM)

At the end of the incubation, the contents of the syringes were emptied into 600 ml beakers. These syringes were rinsed twice with two 15 ml portions of Neutral Detergent Dual Solution (NDS) and emptied into these beakers. The samples were brought to a boil over low heat for one hour and filtered in pre-tared filter crucibles. These crucibles were dried at 103°C overnight and then weighed.

This operation made it possible to remove more or less undegraded substrates and

microorganisms which, when dead, are generally reused in the digestive tract of ruminants. IVDDM was obtained by the difference between the weight of the incubated substrate and the weight of the undegraded residue after the NDS treatment at the end of the incubation from the following formula (Van Soest and Robertson, 1985):

IVDDM (%) $=\frac{Pe-R}{Pe} \times 100$, where: Pe = weight of the incubated sample;

R = weight of the sample after incubation.

2.6.6. Assessment Of In Vitro Digestibility of Organic Matter (IVDOM) And Metabolizable Energy (ME)

After 24 hours of incubation, the gases produced and corrected by the gases from the control tubes were used to calculate the *in vitro* digestibility of organic matter (IVDOM) using the regression equation of Menke and Steingass (1988). As for the metabolizable energy (ME), it was calculated according to the equation proposed by Makkar (2002).

IVDOM (%) = 14.88 + 0.889 GP + 0.0651 C

ME (MJ / Kg DM) = 2.20 + 0.136 GP + 0.057 CP, with:

GP = Quantity of gas produced after 24 hours of incubation;

CP = Crude Protein;

C = Ash.

2.6.7. Determination of partitioning factor, microbial mass and volatile fatty acids

The partition factor (PF) is the amount of organic matter fermented to produce 1 ml of gas. It was obtained by calculation from the following formula (Makkar, 2002):

FC (mg/ml)$= \frac{DOM}{GP}$, where: DOM (mg) = Degraded Organic Matter

GP (ml) = Quantity of gases produced after 24 hours of incubation

The microbial mass was calculated from the following formula (Makkar, 2002):

MM (mg) = DOM - (GP × FS), with:

DOM (mg) = Degraded Organic Matter;

GP (ml) = Quantity of Gas Product after 24 hours of incubation;

FS = Stoichiometric factor (2.20 for forages).

Volatile Fatty Acids (VFAs) were obtained by calculation from the following formulas (Makkar, 2002):

VFAs (mmol / ml) = 0.0239 GP - 0.0601

Where: GP (ml) = Amount of gas produced after 24 hours of incubation.

2.7. Calculated Parameters

Incubation of the various forage samples enabled the following parameters to be calculated:

- gas production (GP);

- volatile fatty acids (VFA);

- metabolizable energy (ME);

- the partitioning factor (FC);

- the microbial mass (MM);

- the *in vitro* digestibility of organic matter (DIVMO);

- the *in vitro* digestibility of the dry matter (DIVMS).

2.8. Statistical Analyzes

The digestibility parameters of the different rations were subjected to a 1-factor analysis of variance (ration) according to the General Linear Model (MGL). The statistical model was as follows:

Xij = μ + α i + e ij

Xij = Observation of the syringe (j) having received the ration (i)

μ = Average

α i = Effect of ration (i)

e ij = Residual error observed on the digestibility of hay of *P. maximum* (j) in ration (i)

When there was a difference between the rations, the means were separated by Duncan's test at the 5% level of significance (Steel and Torrie, 1980). The statistical software used was SPSS 20.0

The comparison between the digestibility of the nutrients of *D. intortum* and *A. glabrata* was made using the student "t" test at the 5% threshold.

3. Results And Discussion

3.1. Results

3.1.1. Effect of Desmodium Intortum On the Chemical Composition and Nutrient Content of Different Rations.

The contents of dry matter (DM), organic matter (OM) and crude protein (CP) increased with the

addition of D. intortum to the rations. On the other hand, the ash contents, lipids and crude fiber (CF) decreased with the addition of D. intortum to the rations. The highest DM, OM, CP, and NDF contents were obtained with the PM50 + DI50 ration (Table 2).

Table2. *Effect of Desmodium intortum on the chemical composition of the different rations*

Chemical composition (%DM)	**Rations**		
	PM100	PM70+DI30	PM50+DI50
DM (%)	92,51	93,80	94,33
Ash content	11,87	10,98	10,43
Organic matter (OM)	88,12	89,01	89,56
Crude Protein (CP)	8,88	12,54	15,19
Lipides	2,49	1,59	1,49
Cell wall (NDF)	75,34	60,8	75,88
Crude cellulose (CC)	45,14	33,33	28,17

PM100 (control) = 100% of Panicum maximum hay; PM50+DI50= 50% of Panicum maximum hay + 50% of Desmodium intortum leaves; PM70 + DI30 = 70% of Panicum maximum hay+ 30% of Desmodium intortum leaves.

3.1.2.Effect of Arachis Glabrata On the Chemical Composition of The Different Rations.

The DM, ash and OM contents varied little with the addition of *A. glabrata*, although the highest DM and OM values were recorded with the PM50 + AG50 ration. On the other hand, the contents of CP and NDF increased with the level of addition of *A. glabrata* in the rations. In addition, the levels of CF decreased with the addition of the legume in the ration. The lipid content decreased considerably with the incorporation of 30% of *A. glabrata* in the PM70 + AG30 ration (Table 3).

Table3. *Effect of Arachis glabrata on the chemical composition of the different rations*

Chemical Composition (in %DM	Rations		
	PM100	PM70+AG30	PM50+AG50
DM	92,51	93,83	93,85
Ash content	11,87	11,44	11,39
Organic Matter (OM)	88,12	88,55	88,60
Crude Protein (CP)	8,88	10,72	11,63
Lipides	2,49	1	2,57
Cell wall (NDF)	75,34	79	85,43
Crude Cellulose (CC)	45,14	35,89	35,43

PM100 (control) = 100% of Panicum maximum hay; PM50+AG50= 50% of Panicum maximum hay+ 50% of Arachis glabrata leaves; PM70 + AG30 = 70% of Panicum maximum hay+ 30% of Arachis glabrata. leaves

3.1.3.Effect of Arachis Glabrata And Desmodium Intortum Incubated with Goat Ruminal Fluid on The Gas Production of Different Rations.

Gas production at the 18th hour was maximum, except for the control (PM100) then decreased until the 24th hour. On the other hand, the PM100 ration reached its maximum gas production after 24 hours. The PM100 and PM50AG50 rations produced amounts of gas almost similar to the 18th but which remained lower than the gas production of the other rations at this same time (Figure 1).

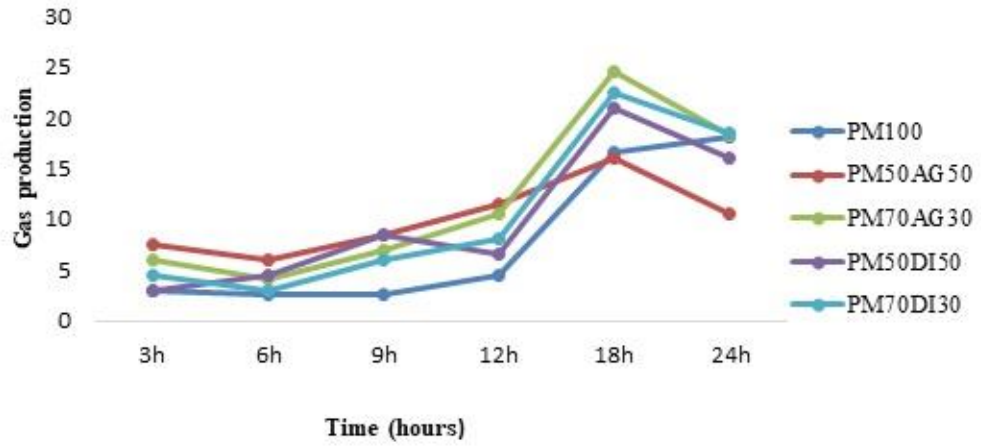

Figure1. *Evolution of the gas production of P. maximum associated or not with Arachis glabrata or with Desmodium intortum incubated with goat ruminal fluid.*

PM100 (control) = 100% of Panicum maximum hay; PM50 + AG50 = 50% of Panicum maximum hay+ 50% of Arachis glabrata leaves; PM70 + AG30 = 70% of Panicum maximum hay + 30% of Arachis glabrata leaves; PM50 + DI50 = 50% of Panicum maximum hay+ 50% of Desmodium intortum leaves ; PM70 + DI30 = 70% of Panicum maximum leaves+ 30% of Desmodium intortum leaves

3.1.4.Effect of Desmodium Intortum On The In Vitro Digestibility Parameters of Panicum Hay Maximum

The gases produced after 24 h, IVDDM, IVDOM, ME, MM and VFA significantly ($p < 0.05$) increased with the addition of *D. intortum* in the rations. The FC and MM of rations containing *D. intortum* are comparable ($p > 0.05$) and significantly ($p < 0.05$) higher than that of rations without *D. intortum*, unlike NDF-N rations which are comparable ($p > 0.05$) and significantly ($p < 0.05$) lower than that of rations without *D. intortum* (Table 4).

Table4. *Effect of D. intortum on the parameters of the digestibility of P .maximum hay*

Rations	GP (ml/200mg DM)	IVDDM (%)	IVDOM (%)	M E(MJ/kg DM)	CF(mg/ml)	MM (mg)	VFA (mmol/ml)	NDF-N
PM100	19,41b	47,50c	36,90b	5,34b	2,79ab	196,45b	0,40b	0,86a
PM50DI50	25,43ab	56,88b	45,00ab	6,52ab	2,82ab	229,04b	0,54ab	0,82a
PM70DI30	26,82ab	50,91bc	45,08ab	6,56ab	2,45b	198,65b	0,58ab	0,54b
P	0,117	0,185	0,117	0,117	0,095	0,145	0,117	0,447
ESM	1,43	1,79	1,35	0,2	0,11	8,71	0,03	0,04

a, b, c : Means with different superscripts within a row differ significantly (P < 0.05).

PM100 = 100% of Panicum maximum hay ; PM50 + DI50 = 50% of Panicum maximum + 50% of Desmodium intortum leaves ; PM70 + DI30 = 70% of Panicum maximum hay + 30% of Desmodium intortum leaves. ESM : Standard mean error; P : Probability. GP : gas produce ; M E: metabolizable energy; MM :microbial mass; FC: partitioning factor ; VFAs : volatiles Fatty acids; IVDDM :In vitro digestibility of dry matter ; IVDOM : In vitro digestibility of organic matter; N-NDF :Residual nitrogen

3.1.5.Effect of Arachis Glabrata On In Vitro Digestibility Parameters of Panicum Maximum Hay

The gases produced after 24 h, IVDDM, IVDOM, ME, MM and VFAs significantly ($p < 0.05$) increased with the addition of *Arachis glabrata* in the rations. The NDF-N of rations

containing *Arachis glabrata* are comparable (p>0.05) and significantly (p<0.05) higher for the PM50AG50 ration and significantly lower for the PM70AG30 ration than the rations without *Arachis glabrata* (Table 5).

Table5. *Effect of Arachis glabrata on the digestibility parameters of Panicum maximum hay*

Rations	GP (ml/200mg DM)	IVDDM (%)	IVDOM (%)	ME(MJ/kgDM)	CF(mg/ml)	MM (mg)	VFAs (mmol/ml)	NDF-N
PM100	19,41b	47,50c	36,90b	5,34b	2,79ab	196,45b	0,40b	0,86a
PM50AG50	25,83ab	65,36a	43,82ab	6,37ab	3,29a	270,32a	0,55ab	0,98a
PM70AG30	31,00a	56,48b	48,01a	7,02a	2,55ab	214,77b	0,68a	0,78a
P	0,117	0,185	0,117	0,117	0,095	0,145	0,117	0,447
ESM	1,43	1,79	1,35	0,2	0,11	8,71	0,03	0,04

a, b, c : a, b, Means with different superscripts within a row differ significantly (P < 0.05).

PM100 = 100% of Panicum maximum hay ; PM50 + DI50 = 50% of Panicum maximum hay + 50% of Arachis glabrata leaves ; PM70 + DI30 = 70% of Panicum maximum hay + 30% of Arachis glabrata leaves. ESM : Standard mean error; P : Probability. GP : gas produce ; M E: metabolizable energy; MM :microbial mass; C F: partitioning factor ; VFAs : volatiles Fatty acids; IVDDM :In vitro digestibility of dry matter ; IVDOM : In vitro digestibility of organic matter; N-NDF :Residual nitrogen

3.1.6. Comparative Effect of Arachis Glabrata Or Desmodium Intortum On The In Vitro Digestibility Parameters of Panicum Maximum Hay

Gas production after 24 hours of incubation was significantly (p<0.05) higher with the *P. maximum* rations supplemented with *D. intortum* and *A.glabrata*.

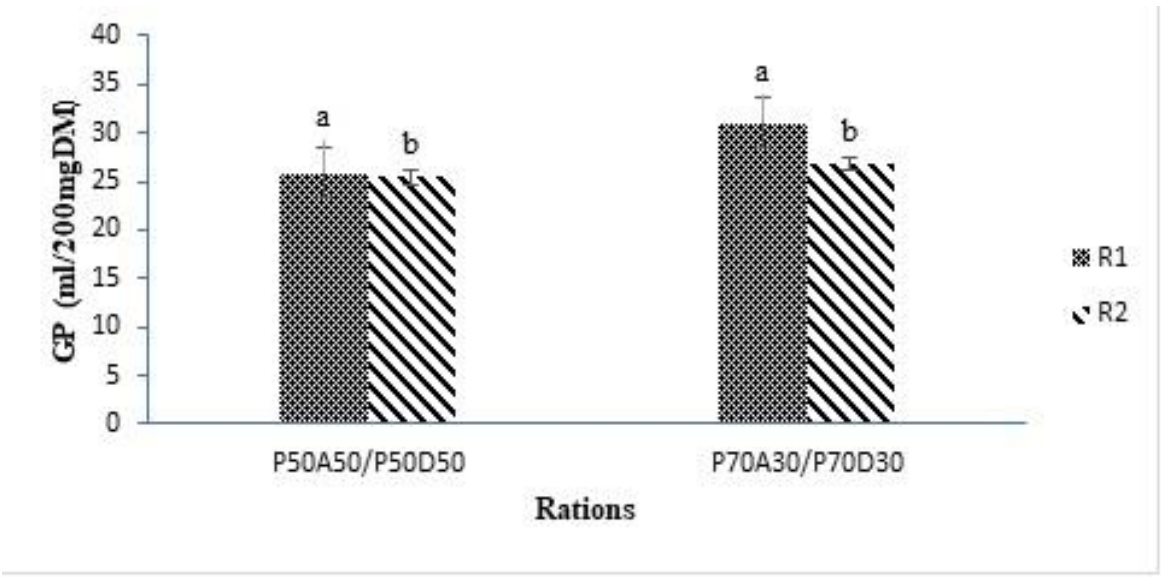

Figure2. *Comparative gas production after 24 hours of incubation according to the different rations of P. maximum*

a, b, a, b, Means with different superscripts within a row differ significantly (P < 0.05).

R1 : P50A50/P50D50 ; R2 : P70A30/P70D30; P50A50 =50% of Panicum maximum hay + 50% of Arachis glabrata leaves; P70A30 = 70% Panicum maximum hay + 30% of Arachis glabrata leaves; P50D50 = 50% of Panicum maximum hay + 50% Desmodium intortum leaves ; P70D30 = 70% Panicum maximum hay + 30% Desmodium intortum leaves.

The *in vitro* digestibility of dry matter (IVDDM) of rations containing legumes (*Arachis glabrata*

and *Desmodium intortum*) was significantly ($p<0.05$) higher than those without (Figure 3).

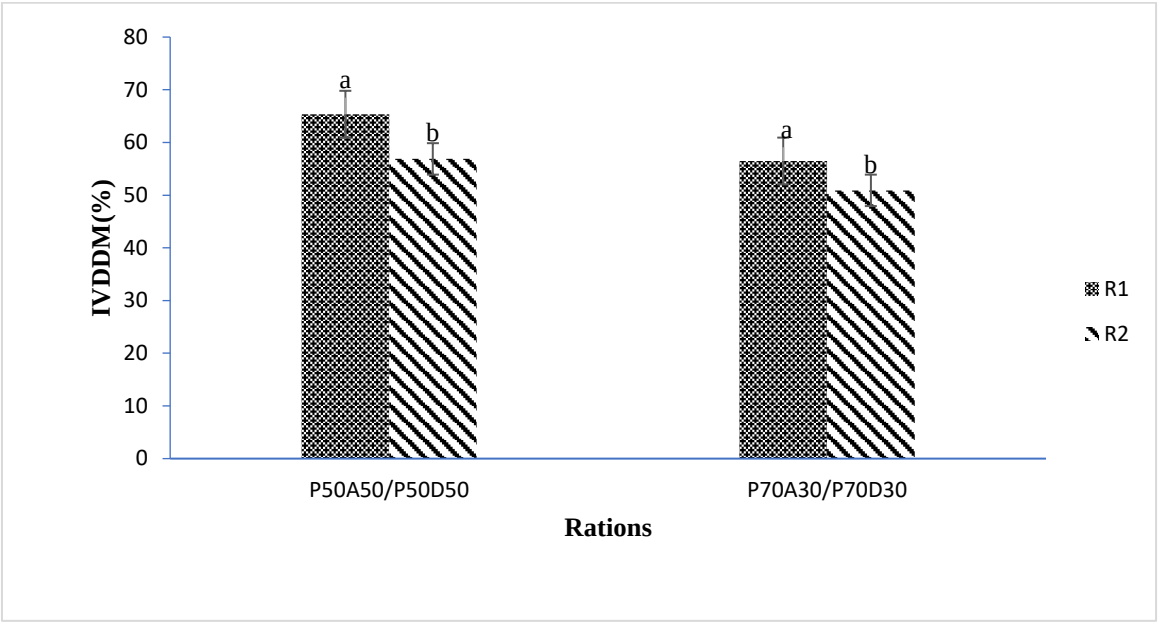

Figure3. *In vitro digestibility of the dry matter (IVDDM) of the different rations according to the addition of legumes*

a, b,c a, b, Means with different superscripts within a row differ significantly (P < 0.05).

R1 : P50A50/P50D50 ; R2 : P70A30/P70D30; P50A50 =50% of Panicum maximum hay+ 50% of Arachis glabrata leaves; P70A30 = 70% of Panicum maximum hay + 30% of Arachis glabrata leaves ; P50D50 = 50% of Panicum maximum hay + 50% of Desmodium intortum leaves; P70D30 = 70% of Panicum maximum + 30% de feuilles de Desmodium intortum.

The *in vitro* digestibility of organic matter (IVDOM) of rations containing *P. maximum* alone were significantly ($p<0.05$) lower compared to those containing *Arachis glabrata* and *Desmodium intortum* (Figure 4).

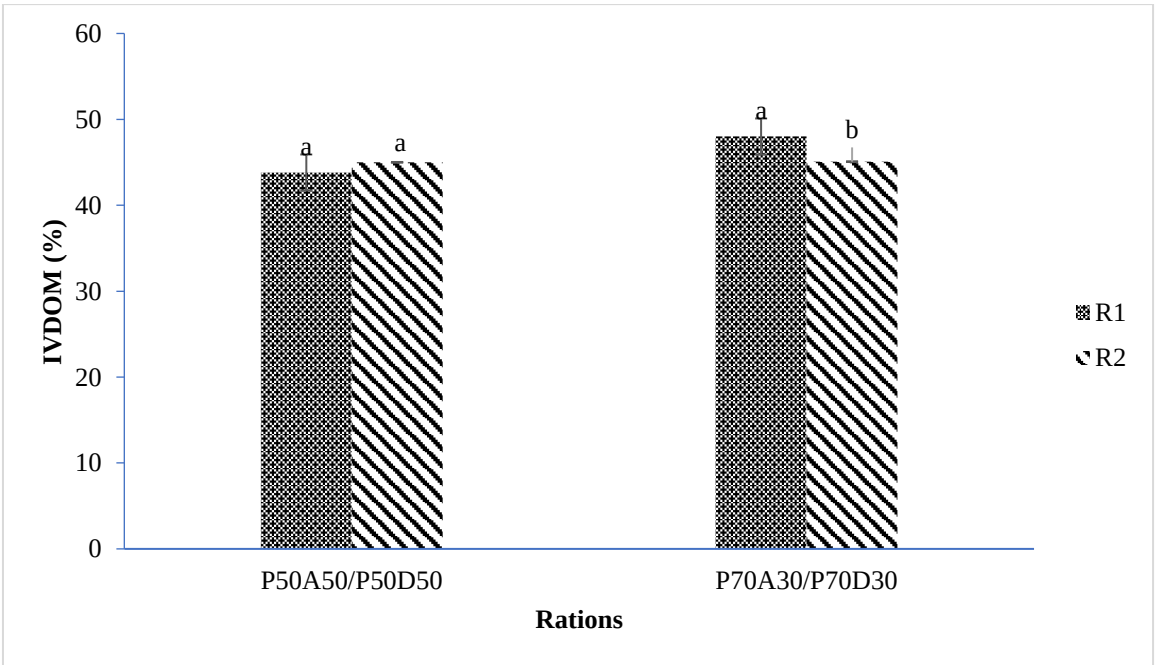

Figure4. *In vitro digestibility of organic matter (IVDOM) compared to the different rations according to the addition of legumes.*

a, b, a, b, Means with different superscripts within a row differ significantly (P < 0.05).

R1 : P50A50/P50D50 ; R2 : P70A30/P70D30; P50A50 =50% of Panicum maximum hay + 50%

of Arachis glabrata leaves; P70A30 = 70% of Panicum maximum hay + 30% Arachis glabrata leaves ; P50D50 = 50% of Panicum maximum hay+ 50% of Desmodium intortum leaves; P70D30 = 70% of Panicum maximum hay + 30% Desmodium intortum leaves

Rations containing legumes (*Arachis glabrata* and *Desmodium intortum*) obtained significantly ($p < 0.05$) higher metabolizable energy than those without (Figure 4).

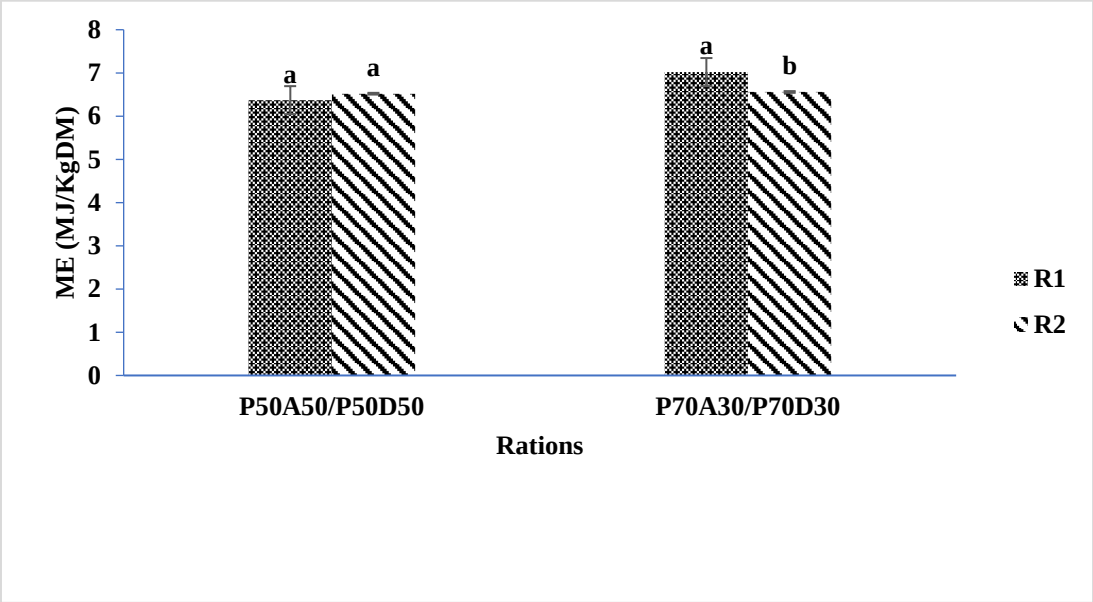

Figure4. *Comparative metabolizable energy obtained after incubation of the different rations according to the addition of legumes*

a, b, Means with different superscripts within a row differ significantly (P < 0.05).

R1 : P50A50/P50D50 ; R2 : P70A30/P70D30; P50A50 =50% of Panicum maximum hay+ 50% of Arachis glabrata leaves; P70A30 = 70% of Panicum maximum hay+ 30% of Arachis glabrata leaves; P50D50 = 50% of Panicum maximum hay + 50% of Desmodium intortum leaves; P70D30 = 70% of Panicum maximum hay+ 30% of Desmodium intortum leaves.

The partitioning factor obtained was significantly ($p < 0.05$) comparable except for the P50A50 ration which was significantly ($p < 0.05$) higher than the other rations (Figure 5).

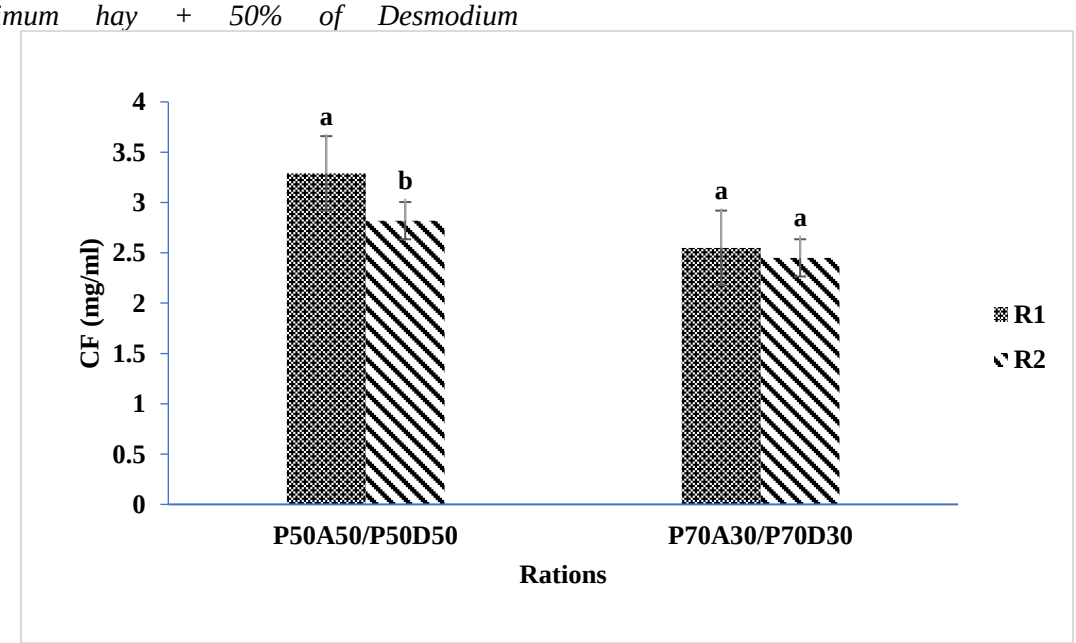

Figure5. *Comparative partitioning factor obtained after incubation of the different rations of Panicum maximum*

a, b, Means with different superscripts within a row differ significantly (P < 0.05).

R1 : P50A50/P50D50 ; R2 : P70A30/P70D30; P50A50 =50% of Panicum maximum hay+ 50% of Arachis glabrata leaves; P70A30 = 70% of Panicum maximum hay + 30% of Arachis glabrata leaves; P50D50 = 50% of Panicum maximum hay+ 50% of Desmodium intortum leaves; P70D30 = 70% of Panicum maximum hay + 30% of Desmodium intortum leaves .

The microbial mass were significantly ($p<0.05$) higher for rations containing legumes (*Arachis glabrata* and *Desmodium intortum*) than those without legumes (Figure 6).

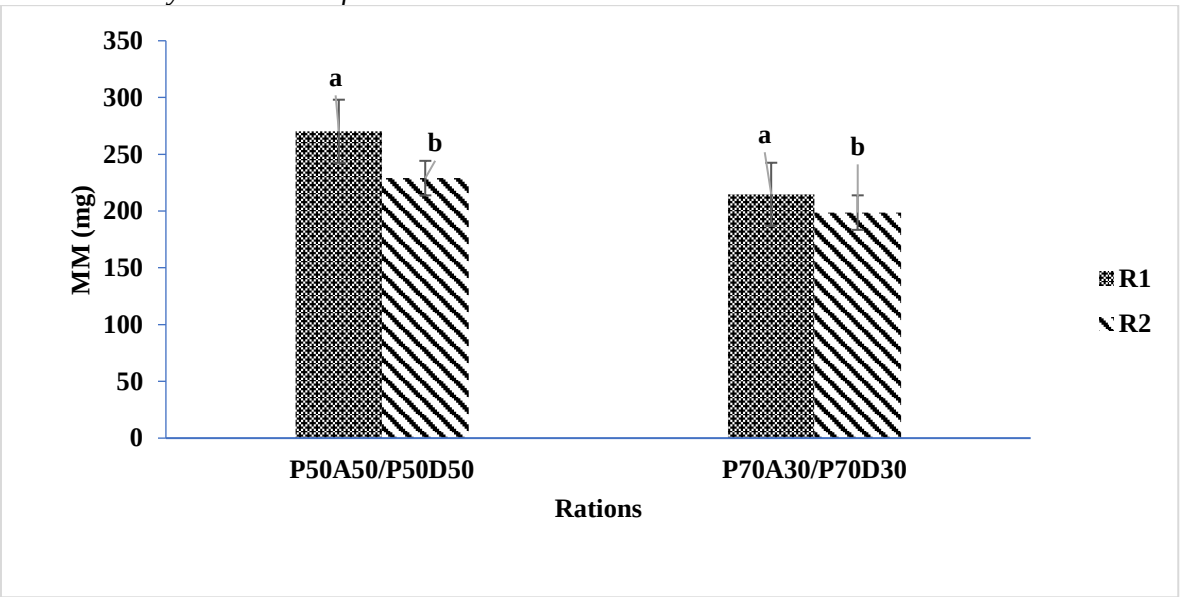

Figure6. *Comparative microbial mass obtained after incubation of the different rations of Panicum maximum*

a, b, Means with different superscripts within a row differ significantly (P < 0.05).

R1 : P50A50/P50D50 ; R2 : P70A30/P70D30; P50A50 =50% of Panicum maximum hay + 50% of Arachis glabrata leaves; P70A30 = 70% of Panicum maximum hay + 30% of Arachis glabrata hay ; P50D50 = 50% of Panicum maximum hay + 50% of Desmodium intortum leaves; P70D30 = 70% of Panicum maximum hay+ 30% Desmodium intortum leaves.

The production of volatile fatty acids (VFA) of the different rations were significantly ($p<0.05$) comparable except for the P70A50 ration which was significantly ($p<0.05$) higher than the other rations (Figure 7).

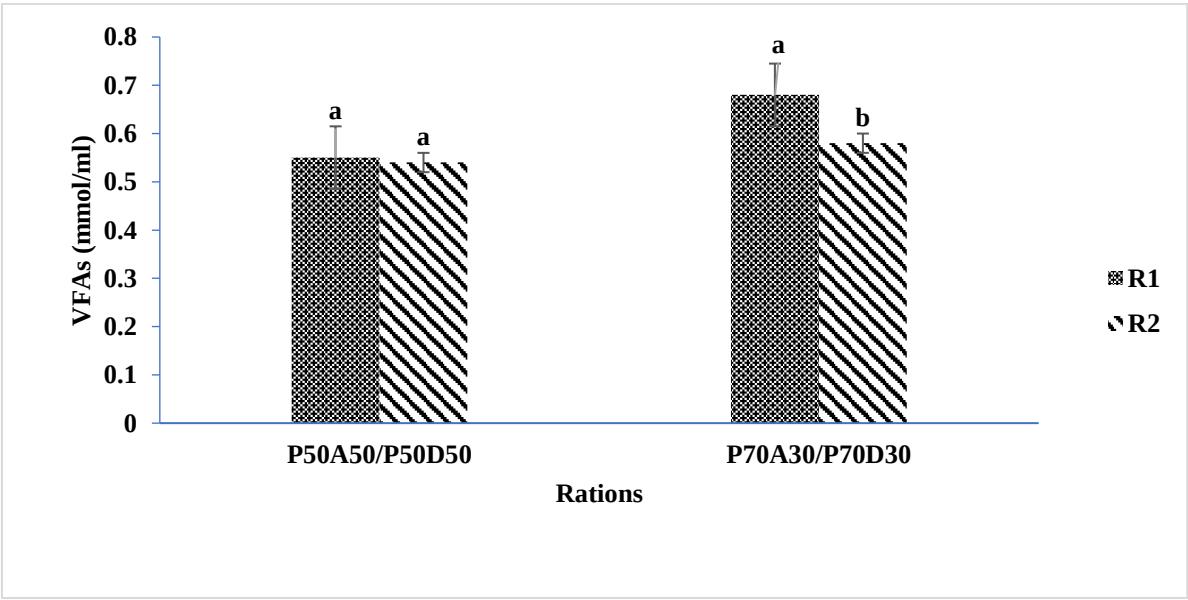

Figure7. *Production of volatile fatty acids (VFA) of the different rations*

a, b, Means with different superscripts within a row differ significantly (P < 0.05).

R1 : P50A50/P50D50 ; R2 : P70A30/P70D30; P50A50 =50% of Panicum maximum hay + 50% of Arachis glabrata leaves ; P70A30 = 70% of Panicum maximum hay + 30% of Arachis glabrata leaves ; P50D50 = 50% of Panicum maximum hay+ 50% of Desmodium intortum leaves; P70D30 = 70% of Panicum maximum hay + 30% of Desmodium intortum leaves.

The residual nitrogen (NDF-N) obtained with the different rations with or without the addition of *Arachis glabrata* and *Desmodium intortum* were comparable (p> 0.05) (Figure 8).

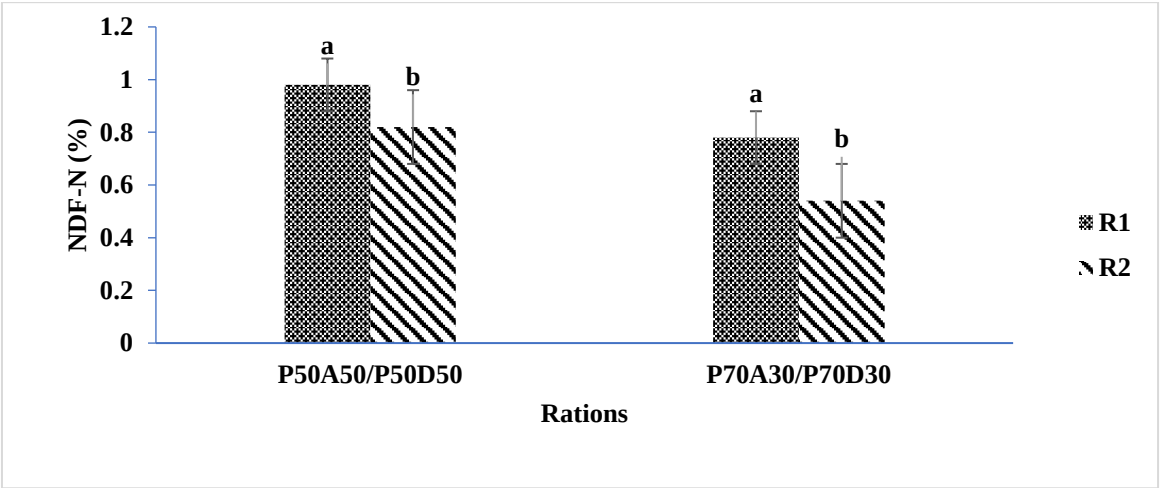

Figure8. *Comparative NDF-N of the different rations*

a, b, Means with different superscripts within a row differ significantly (P < 0.05).

R1 : P50A50/P50D50 ; R2 : P70A30/P70D30; P50A50 =50% of Panicum maximum hay + 50% of Arachis glabrata leaves; P70A30 = 70% of Panicum maximum hay + 30% of Arachis glabrata leaves; P50D50 = 50% of Panicum maximum hay+ 50% of Desmodium intortum leaves; P70D30 = 70% of Panicum maximum hay+ 30% of Desmodium intortum leaves.

3.2. Discussion

Analysis of *Panicum maximum* hay shows that it has an OM content of 88.12% which is comparable to that obtained by Miegoue (2016) 85.88% and is within the intervals of observations made by Chenost (1973), Roberge et *al*. (1976) and Minson (1971). But this value is lower than that reported by Ives et *al*. (2005). This same author obtained an NDF content (72.6%) which is lower than that obtained from our analysis, NDF (75.34%). The DM (92.51%) and lipids (2.49%) contents obtained during our analysis are comparable to those obtained by Miegoue (2016) which was 91.76% and 2.67% for DM and lipids respectively. On the other hand, the contents of PB (8.88%) and ash (11.87%) are lower than those obtained by Miegoue (2016) but being in the intervals reported by FAO (2003). We also obtained a crude fiber content of 45.14% which is higher than that obtained by Miegoue (2016) and Ives et *al*. (2005).

These differences in the chemical composition of these forages are thought to be due to the age of the plant or the season.

The amount of gas and VFAs produced was significantly (P<0.05) improved when *P.* maximum hay was supplemented with *A. glabrata* and *D. intortum*. Indeed, similar observations have been made with other grasses supplemented with forage legumes by other authors (Granier, 1972; Foster et *al*., 2014). This could be due to the high crude protein content present in these legumes ensuring that the needs of microorganisms are met and improve their efficiency. These observations have been made by many other authors (Getachew et *al*., 2000; Pamo et *al*., 2005; Boukila et *al*., 2009).

In vitro organic matter digestibility (IVDOM) and in vitro dry matter digestibility (IVDDM) of P. maximum hay were significantly (P<0.05) higher when combined with legumes *A.* glabrata and *D. intortum* only when incubated alone. This is in accordance with the work of Anifowose et *al*. (2016) which shows that the association of *P.* maximum hay with cowpea, a fodder legume, increases its digestibility. Indeed, the in vitro digestibility of organic matter (IVDOM) and in vitro digestibility of dry matter (IVDDM) were

significantly (P<0.05) higher with rations containing A. glabrata than those containing D. intortum.

The microbial mass was significantly (p<0.05) higher with the rations containing *A. glabrata* than that with *D. intortum.* Indeed, Boukila et *al*. (2009) reported high crude protein content in *A. glabrata* unlike *D. intortum*. This high protein content would provide enough energy for the activity of microorganisms because the amount of nitrogen necessary for optimal growth of microorganisms and therefore maximum digestion varies depending on the diet (Chesworth 1996).

4. Conclusion

At the end of the study on the effect of *Desmodium intortum* and *Arachis glabrata* on the *in vitro* digestibility of *Panicum maximum* hay, it appears that adding these legumes to *Panicum maximum* improves its digestibility. The CP contents, cell wall and DM increased considerably with the addition of theselegumes. Apart from residual NDF-N nitrogen, all other parameters of in vitro digestibility of *Panicum maximum* hay were significantly (P<0.05) improved with rations containing *Arachis glabrata* than those containing *Desmodium intortum*. It was observed that IVDOM had its highest value with the PM70AG30 ration and, that IVDDM had its highest value with the PM50AG50 ration. From these results we can conclude that *Arachis glabrata* improves digestibility better than *Desmodium intortum.*

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Citation: *Lemoufouet Jules*, Miégoué Emile, Mube Kuitche Herv, et.al., Effect of Desmodium intortum and A. glabrata on The in vitro Digestibility of P. maximum Hay. ARC Journal of Animal and Veterinary Sciences. 2021; 7(1): 15-27. DOI: https://doi.org/10.20431/ 2455-2518.0701003.*