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In vitro Indicators of *Moringa oleifera* Nutritional Value for Ruminants in the Dry Season

Redimio M. Pedraza Olivera, Susana Pérez López, Mileidys González Rodríguez, Eliane González Pérez, Marlene León González y Enrique Espinosa Sifonte

Center for Animal Production Development (CEDEPA), Faculty of Agricultural Sciences, University of Camagüey, Cuba

redimio.pedraza@reduc.edu.cu

ABSTRACT

In vitro indicators of *Moringa oleifera* nutritional value for ruminants during the dry season in Camagüey municipality, Cuba, were determined. This species is abundant in Santayana, Imán, and La Belén areas. Despite significant differences in raw protein (23,6 % and 23,0 %) and neuter-detergent fibre (17,0 % and 25,9 %), none were found for dry matter (20,0 % and 23,2 5) and ashes (7,8 5 and 10,0 %). raw protein and dry matter highest values were registered in La Belén, while the lowest ones were detected in Santayana. Neither saponins nor alkaloids were present in the three areas; however, tannins and condensed tannins had a higher prevalence in Santayana. *In vitro* gas production out of bovine feces shoed significant differences at 12; 24, and 96 hrs of incubation. *M. oleifera* nutritional value is high in these areas.

Key Words: *chemical composition*, in vitro *gas production, ruminants*

INTRODUCTION

Moringa oleifera has stood out within the non-legume trees as a promising plant for animal nutrition. Its leaves are avidly consumed by all kinds of animals: ruminants, camels, pigs, carps, tilapias and other herbivore fishes. Hence, it is considered one of the "complete" forages (very rich in protein, vitamins and minerals and high palatability) (Moroto *et al.*, 2000).

The *in vitro* indicators of nutritive values of *Moringa oleifera* foliage from three different areas were determined for ruminants in the municipality of Camagüey, during the dry season.

MATERIALS AND METHODS

Moringa oleifera leaves, stems, and petioles were chosen at random in the morning (7:00-9:00 am) with a diameter lower than five millimeters, from five plants used in hedges in three different locations in the municipality of Camagüey, Cuba: Santayana (21º 20' 15'' N and 77º 50' 55'' O), on Dark red fersialitic soil; Imán (21º 23' 25'' N and 77º 57' 30'' O) and La Belén (21º 22' 05'' N and 77º 55' 40'' O), both on brown soil without carbonate. The *M. oleifera* samples were collected in Santayana and Imán from 120 day-old plant reshoots; and 60 day-old reshoots from plants in La Belen. Sampling was carried out in February 2012.

The plants were quickly taken to the lab, sliced and homogenized; then they were dried at 66°C to achieve constant weight, for about 48 h in an electric oven with forced air circulation, then the samples were crushed through a 1 mm sieve.

The presence of antinutritive substances and analyses of dry matter (MS), ash, and gross protein (PB) were made by triplicate, according to AOAC (1995); whereas neutral detergent fiber determination (FDN) was done using the Van Soest and Robertson (1985) method.

The general procedure used for *in vitro* gas production was based on the principles set up by Menke *et al*. (1979) with the use of 100 ml glass syringes (1 ml appreciation). Bovine feces were used as inoculum (Martínez, 2008); the feces were gathered early in the morning before three hours after deposition; then they were mixed with the buffered mineral medium. All the procedure was performed with systematic injection of CO_2.

The initial volume (Vo) of each syringe was recorded and then placed in Luke-warm water bath, at 39 °C. Readings were made at 3; 6; 12; 24; 48; 72 and 96 h. Three syringes with inoculums + buffer were prepared to be used as target; other three syringes were used as guinea (*Pannicum maximum)* sample patterns. All samples were incubated by triplicate and the volume of gas was expressed as gas milliliter every 200 mg of dry samples.

The parameters for the production of *in vitro* gas were determined using the Ørskov and McDonald (1979) equation:

p = A + B * [1 - EXP (- C * t)]

Where:

t: time (h).

A: volume at 0 h.

B: gas volume (ml).

A + B: gas production potential.

C: specific speed of gas production in the exponential phase (h^{-1}).

Data normalcy was verified and descriptive statistics was performed. The composition of the chemical value and gas production in every hour of incubation were compared among the sample origins, by simple variance analysis. The differences between the means were determined by the Tukey test. Al the analysis was performed with SPSS software version 17.0.

RESULTS AND DISCUSSION

Table 1 shows the chemical composition indicators from the three areas where *M. oleifera* was collected. Dry matter and ash were observed to have no significant differences among them; contrary to PB and la FDN. Moreover, the samples from La Belen had the highest values of PB and MS; the lowest were found in Santayana. However, the samples from Santayana had the highest percents of ash and FDN compared to La Belen.

Chemical composition variations in pastures and forages are well known to be associated with several different factors related to soil, the weather and plant handling. In this case, the differences among the origins may be influenced by a combination of factors where soil humidity and fertility are significant. Handling factors are mainly related to the time and kind of trimming. The samples from La Belen were observed to reshoot in fewer days, which has been associated to higher concentrations of PB and lower of fiber (Pedraza, 2000); however, fiber composition is known to determine digestibility (Goering and Van Soest, 1970), which must be considered in future studies.

Table 2 shows the presence of nutritional factors in foliage. Tannins and condensed tannins were found in all of it, more in Santayana. No saponin or alkaloids were found in any.

The antinutritional factors are important for plants, as the only defense mechanism against natural predators (Reed, 1995). In addition, this may become a disadvantage, when the levels are relatively harmful, some of these factors may lower protein digestibility (Huisman, 1991; Makkar and Becker, 1996) and affect ruminal fermentation. (Rodríguez *et al*., 2011); others, like tannins in low concentrations, may increase protein use in rumen, or contribute with the reduction of intestinal parasites (Min and Hart, 2003).

The amount of gas produced depends on the quality, digestibility and energy value of the feed assessed (Menke *et al.,* 1979; Ammar *et al.,* 2005; Posada and Noguera, 2005).

Significant differences ($P < 0.05$) among the origins were observed only at 12, 24 and 96 h of incubation. The highest values of cumulated gas were observed in the foliage from La Belen; whereas the collections from Imán and Santayana do not differ between them for the total cumulated production, at 96 h .

Figure 1 shows the *in vitro* gas production patterns, according to the equation of Ørskov and McDonald (1979). La Belen collections had the highest production of gas in comparison with Imán and Santayana. The gas production speeds were similar.

CONCLUSIONS

El valor nutritivo del follaje de las tres procedencias de *M. oleifera* para rumiantes es alto.

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Table 1. Presence of antinutritive factors in the three collections of *M. oleifera*

Factors antinutritionals	Origins		
	Santayana	Imán	La Belén
Tannnins	+	+	+
Condensed Tannnins	++	+	+
Saponins	−	−	−
Alkaloids	−	−	−

(+) Presence
(−) Absence

Table 2. Influence of *M. oleifera* origin on *in-vitro* gas production at different incubation times

Times/incubation	Origins				
	Santayana	Imán	La Belén	ES	Sig.
3	0.9	1.1	1.2	0.29	NS
6	1.7	3.1	3.1	0.37	NS
12	3.7[ac]	5.8[b]	6.9[a]	0.57	*
24	12.2[c]	13.5[b]	16.2[a]	0.72	*
48	17.8	19.9	21.8	0.87	NS
72	23.0	23.6	27.4	0.94	NS
96	27.5[b]	27.6[b]	32.2[a]	0.93	*

NS: no significant difference
* $P < 0.05$

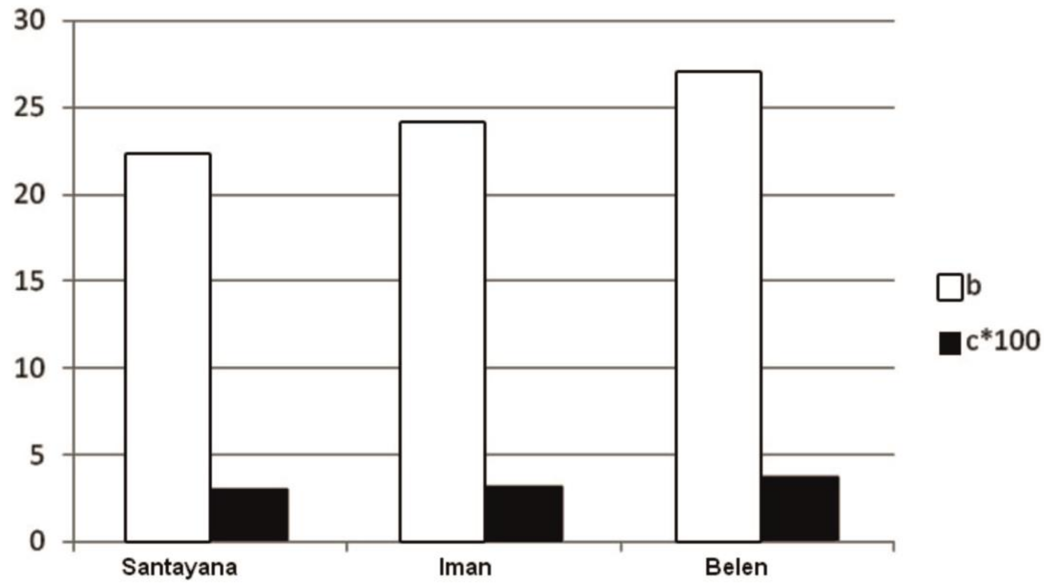

Fig. 1. ***In vitro*** **gas production parameters (ml) of the three** ***M. oleifera*** **origins**