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Weeds forage potential for ruminant feeding: Chemical composition and kinetics of rumen degradation

Víctor Rovalino-Núñez[1], Marcos A. Barros-Rodríguez[1]*, Javier Solorio-Sánchez[2], Hernán Zurita-Vásquez[1], Carlos Sandoval-Castro[2], Geovanny Velasteguí-Espín[1], Daniela Sánchez-Gavilanes[1], Diego Cadena-Yanchapaxi[1], Jorge Vega-Chariguaman[1] and Sixto Mayorga-Paredes[1]
[1]Universidad Técnica de Ambato, Ambato, Ecuador
[2]Universidad Autónoma de Yucatán, Mérida, México
Corresponding author e-mail: ma_barrosr@yahoo.es

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Introduction

Systems of ruminant production in the Andean highlands of Ecuador are dominated by monoculture grasses, where producers do not allow association with other plants such as weeds. These systems have small areas of land and the peasants would be wasting feed resources (association) with high nutritional content and secondary compounds that may be beneficial for feeding ruminants improving the nutritional value of grassland. In this context, Castelán *et al*. (2003) mention that the use of weeds in ruminant nutrition by small producers in temperate areas of Mexico, it becomes the main natural forage resource for livestock to feed round the year, as there great availability. For farmers with limited financial resources this practice is very common, because it represents feeding efficiency with low production costs, because they use non-conventional feed resources. Weed species such as *Sicyos deppei G., Jaltomata procumbens (Cav.), Drymaria laxiflora Benth y Lopezia racemosa Cav*. contain high levels of ruminal fermentation and high crude protein content, as well as low levels of fiber (Castelán *et al*., 2003). Under this background, the objective of this research is to determine the chemical composition and *in situ* ruminal degradation of weeds with forage potential that exist in the grasslands of the Andean highlands of Ecuador.

Materials and Methods

This research was conducted at the Faculty of Agricultural Sciences at the Technical University of Ambato, located in Canton Cevallos, Tungurahua Province, Ecuador at an altitude of 2850 meters above sea level. Six sheep (male) with an average body weight of 38.6 ± 2.8 kg and fitted with rumen cannula (2 in. internal and 5 in. external diameter, Bar Diamond, Parma, Idaho, USA) were used. Sheep were fed a diet of grass *Pennisetum clandestinum* and *Medicago sativa* with water *ab libitum*. The forage of the weeds was harvested from established grassland with *Pennisetum clandestinum* with regrowth age of 40 days. The *in situ* ruminal degradation of forages was evaluated by means of the nylon bag technique. On each animal, one bags containing 3 g DM from each forage were incubated for 0, 4, 8, 12, 24, 36, 48, 72, and 96 h. At each time, bags were removed, washed under running water, and oven dried at 60 °C. Bags employed to measure washout loss (0 h) were not incubated in the rumen and only washed under running water. Data was fitted to the equation: $Y = a + b\ (1 - e^{-ct})$ (Ørskov and McDonald, 1979; Prisma 4, GraphPad Software, Inc. San Diego, CA, EE.UU.). Dry Matter, Crude Protein, Crude Fiber, Ethereal extract, Organic Matter and Ash were determined according to AOAC (1990). A completely randomised design with five treatments (T_1: *Chenopodium albus*, T_2: *Amaranthus albus*, T_3: *Sonchus oleraceus*, T_4: *Malva parviflora*, T_5: *Rumex pulcher*) and six replicate treatments was used. The parameters ruminal degradation were analyzed according to the design used in the Prisma 4, GraphPad Software, Inc. San Diego, CA, EE.UU

Results and Discussion

The highest percentage of ruminal degradation of the fraction "a" was for *Sonchus oleraceus*, *Malva parviflora* and *Amaranthus albus*. In the fraction "b" the highest percentages were observed for *Sonchus oleraceus*, *Malva parviflora* and *Chenopodium albus*, same that presented potential degradation (a + b) higher to 80%, however, was the weed *Rumex pulcher* that present the lowest parameters [a,b, (a+b) y *c*]. With regard to the degradation rate per hour "c" it was higher in *C. albus* and *M. parviflora* (0.12 and 0.09 respectively) than the other weeds (Table 1). The chemical composition of all weeds showed crude protein values between 14 and 22% and low levels of crude fiber ranging from 7 to 12%. However, the dry matter content of all forages was low (Table 1). The high percentages of ruminal degradation obtained (over 80%) may be related to the chemical composition (low fiber) (Table 1). Weeds analyzed in this study have shown equal or greater nutritional quality than *Medicago sativa* and other forage used to feed ruminants in temperate zones (Yu *et al.*, 2004). The results of this study are consistent with those reported by Martínez-Loperena *et al.*, (2011) which mention that

weeds of temperate zones, besides having high ruminal fermentation parameters can help reduce energy losses in the form of greenhouse gases, due to secondary metabolites possess.

Table 1: *In situ* rumen degradation of dry matter and chemical composition of forage weeds of temperate zones (%)

Parameters of degradation	***Chenopodium albus***	***Amaranthus albus***	***Sonchus oleraceus***	***Malva parviflora***	***Rumex pulcher***	***P value***
T_0	40.4±2.67	33.9±0.98	35.9±3.50	38.4±0.88	28.5±0.92	
a	26.3±3.20^{b}	32.9±3.16^{a}	35.3±2.18^{a}	33.1±2.90^{a}	23.1±3.32^{b}	< 0.05
b	52.5±3.87^{a}	46.1±2.93^{b}	53.7±1.99^{a}	52.8±3.12^{a}	47.7±3.04^{b}	< 0.05
c	0.12±0.012^{a}	0.07±0.009^{b}	0.06±0.008^{c}	0.09±0.018^{ab}	0.06±0.009^{c}	< 0.05
r^2	0.95	0.92	0.93	0.91	0.90	
Chemical composition						
Dry matter	16.72	6.93	14.64	15.91	13.05	
Organic matter	86.64	84.21	83.48	86.53	88.18	
Crude protein	16.42	16.80	19.96	14.77	22.08	
Crude fiber	12.19	11.80	10.23	7.42	8.03	
Ethereal extract	2.61	1.99	3.78	1.09	1.14	
Ash	13.32	15.79	16.52	13.47	11.82	

Means with different letters in the same row differ at $P < 0.05$
a, b, and *c* are equation parameters describing *in situ* rumen degradation, from: $y = a + b\ (1 - e{-}ct)$
T_0 = washout loss

Conclusion

Under the conditions of this study, it is concluded that the weeds used in this research, have a high nutritional value and could be associated with grasses of temperate zones to improve the nutritional value of grassland

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