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NUTRITIVE VALUE AND UTILIZATION OF LEUCAENA HAYS (*Leucaena leucocephala* & *Leucaena leucocephala* cv. Cunningham) FOR GROWING RABBITS

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Abstract – Twenty-one NZW rabbits, 50 days old, were used to evaluate the digestibility of *Leucaena leucocephala* (LL) and *Leucaena leucocephala* cv Cunningham (LC) hays. Three diets were used; one reference and two tests, in which LL and LC replaced, respectively, 25.0 % of dry matter reference diet. The apparent digestibility coefficients of dry matter, crude protein and gross energy were, respectively, 21.4, 39.4 and 20.1 % for LL and 23.1, 40.9, and 18.6 % for LC. The digestible dry matter contents, digestible protein and digestible energy, based on total dry matter were, respectively, 19.1 %, 9.0% and 897 kcal/kg for LL and 20.9 %, 7.8 % and 866 kcal/kg for LC.
In the performance trial, 132 NZW rabbits where distributed following a randomized completely design. They were fed between 40 and 90 days of age diets in which the crude fibre of alfalfa hay was partially substituted (15; 30; 45; 60 or 75% by LL or LC hay. Each of these 11 diets was fed to six replicates of two animals. The inclusion of leucaena hays in the diets did not affect the rabbits performance and carcass trait. The histological analysis of kidneys showed a focal interstitial nephritis in rabbits fed with leucaena hays regardless its levels of inclusion.

INTRODUCTION

The use of *Leucaena leucocephala* in animals diets has limitations by the presence of mimosine, a nonproteic and toxic amino acid to ruminants and nonruminants (JONES, 1985). This amino acid is degraded through endogenous enzymes from own vegetal tissue or by actions of ruminal bacteria to 3-hidroxy-4(1H)-pyridone (GUPTA and ATREJA, 1998). The replacement of alfalfa with 40% of *Leucaena leucocephala* in rabbits diets reduced the digestibility of nutrients (HARRIS et al., 1981). TANGENDJAJA et al. (1990) studying the inclusion of 20, 30 and 60% of *Leucaena leucocephala* cv. Cunningham with or without hot water treatment in the diets of NZW rabbits with 60 days old, related that mimosine was amply degraded (more than 80%). The growth was depressed but there were no clinic signals of toxicity. However, ONWUDIKE (1995), showed that the use of *Leucaena leucocephala* to supply all the green feed needed by growing rabbit reduced the growth rate, feed intake and feed efficiency and caused hair loss (alopecia), reddish-brown urine and critical histological alterations in the liver and kidneys. However, the deleterius effects was not noted when leucaena constituted only 50% of the green feed or 7% of the feed dry matter. The aim of this work was to determine the nutritive value of *Leucaena leucocephala* and *Leucaena leucocephala* cv. Cunningham hays by digestibility assay and to verify the effects of the inclusion of thoses hays in diets for growing rabbits.

MATERIALS AND METHODS

Experiment 1:

A digestibility experiment was conducted using 21 male NZW rabbits, housed at 50 days old in individual cages to determine the nutritive value of *Leucaena leucocephala* (LL) and *Leucaena leucocephala* cv. Cunningham (LC) hays. Animals were given, *ad libitum*, one

reference and two test diets where the LL and LC hays replaced, respectively, 25,0% of reference diet dry matter.

The chemical composition of reference diet, based in total dry matter, using corn, soybean meal, wheat meal, alfafa hay, minerals and vitaminic premix showed 18.2% CP, 12.4% CF, 27.6 % N.D.F., 21.2% A.D.F. and 4310 GE/kg. The chemical composition of the hays is showed in Table 1.

Table 1: Chemical composition of *Leucaena leucocephala* (LL) and *Leucaena leucocephala* cv. Cunningham (LC) hays[1]

Nutrients	LL	LC
Dry matter (%)	89.4	90.3
Crude protein (%)	20.5	17.2
Crude fiber (%)	24.6	31.0
N.D.F. (%)	54.8	56.6
A.D.F. (%)	54.4	56.0
Gross Energy (kcal/kg)	3,989	4,205
Tannins (%)	1.13	0.83

[1]Analysis carried out in Nutrition Laboratory – Universidade Estadual de Maringá

Following a seven days period of adaptation to each diet, feed intake was recorded and total faecal output collected during seven consecutive days. Faeces produced daily were stored at –20^{o} C. Faeces and diets were analyzed for dry matter, crude protein and gross energy (SILVA, 1990) to determine the digestibility of the hays, based on MATTERSON et al. (1965).

At the performance trial 132 NZW rabbits, males and females, were used from 40 to 90 days old, distributed in a randomized completely design. The crude fibre of alfalfa hay reference diet was partially substituted (15; 30; 45; 60 or 75% by LL or LC hay. Each of these 11 diets (Table 2) was fed to six replicates of two animals. The animals were given *ad libitum* access to feed.

At slaughter, the kidneys were collected and separated by treatment for histological analysis described by BEÇAK and PAULETE (1976).

Data from each trial were analyzed using the GLM procedure of SAS (1988) and means were compared with Tukey test ($P<0.05$).

RESULTS AND DISCUSSION

Digestibility experiment

The values of apparent digestibility coefficients of dry matter, crude fiber and gross energy of reference diet were higher ($P < 0.05$) than values of test diets with LL or LC (Table 3). TANGENDJAJA et al. (1990) also found lower values for protein and energy digestibility when diets had 60% of *Leucaena leucocephala* cv. Cunningham leaf meal replacing reference diet. They found values of 73% and 41% for CP and 65% and 53% for GE to reference and tests diets, respectively, and explain the low digestibility because of the linkage with condensed tannins.

The apparent digestibility coefficients of dry matter, crude protein and gross energy of LL and LC hays are showed in Table 4. There were no differences ($P>0.05$) in the digestibility coefficients between two varieties of leucaena hays.

Higher values of dry matter digestibility coefficients (68.0%), crude protein (69.5%) and gross energy (65.9%) from *Leucaena leucocephala* hay were found by RAHARDJO et al. (1986), using the methodology of feed pure foodstuffs for rabbits. The value 57.3% of digestibility coefficients for dry matter (ZINSLY, 1972), 54.7% of crude protein (MARTINEZ PASCUAL and FERNÁNDEZ CARMONA, 1980) and 1700 to 2830 kcal/kg DM of digestible energy (LEBAS, 1987) of alfalfa hay for rabbits are higher than the values found in this experiment for two varieties of leucaena hay.

Table 2: Chemical percentual composition and energetic value of experimental diets.

Ingredients	*Reference diet*	Levels of substitution of the crude fiber of alfalfa (%)									
		LL					LC				
		15	30	45	60	75	15	30	45	60	75
Corn	31.00	31.34	31.69	32.04	32.38	32.73	31.12	31.24	31.36	31.48	31.60
Soybean meal	11.50	11.96	12.42	12.88	13.34	13.80	11.88	12.25	12.62	13.00	13.37
Wheat meal	21.20	20.08	18.96	17.83	16.71	15.59	20.50	19.80	19.09	18.39	17.69
Alfalfa hay	32.69	27.79	22.88	17.98	13.08	8.17	27.79	22.88	17.98	13.08	8.18
LL	-	4.54	9.08	13.62	18.16	22.70	-	-	-	-	-
LC	-	-	-	-	-	-	4.46	8.93	13.40	17.86	22.33
Vegetable oil	-	0.68	1.36	2.04	2.72	3.40	0.64	1.29	1.94	2.58	3.22
Common salt	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
Dicalcium phosphate	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Limestone	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Vit. and Min. Suppl	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Zinc bacitracine	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Coccidiostat	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
DL – methionine	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
TOTAL	100	100	100	100	100	100	100	100	100	100	100
Calculated composition (on natural matter)											
Dry matter (%)	89.57	89.45	89.68	89.31	89.72	88.97	89.90	89.15	88.97	88.87	89.64
Crude protein (%)	17.06	17.21	17.36	17.51	17.66	17.80	17.07	17.07	17.07	17.08	17.08
DE (kcal/kg)	2,731	2,721	2,711	2,702	2,692	2,682	2,716	2,702	2,687	2,672	2,658
Crude fiber (%)	12.93	12.52	12.11	11.70	11.30	10.88	12.81	12.69	12.57	12.45	12.33
Phosphorus (%)	0.60	0.59	0.58	0.58	0.57	0.56	0.60	0.59	0.59	0.58	0.58
Calcium (%)	0.90	0.95	1.00	1.05	1.09	1.14	0.93	0.96	0.99	1.01	1.04
Lysine (%)	0.82	0.79	0.75	0.71	0.68	0.68	0.79	0.75	0.71	0.68	0.68
Met + cist (%)	0.64	0.62	0.60	0.60	0.60	0.60	0.62	0.61	0.60	0.60	0.60

Table 3: Estimated means and standard error of means of apparent digestibility coefficients of the reference diet and test diets with inclusion of the *Leucaena leucocephala* (LL) and *Leucaena leucocephala* cv. Cunningham (LC) hays

Nutrients	Reference Diet	Test diet (LL)	Test diet (LC)	SEM
Dry matter (%)	69.0 a	57.1 b	57.2 b	0.4
Crude protein (%)	77.2 a	67.7 b	67.9 b	0.4
Crude fiber (%)	20.4 a	12.7 b	11.2 b	0.8
N.D.F. (%)	32.7 a	17.3 b	20.7 b	2.7
A.D.F. (%)	39.1 a	31.4 b	34.4 b	0.5
Gross energy (%)	69.2 a	57.0 b	56.2 b	0.3

Means in same line followed by different letters differing ($P<0.05$) by Tukey test

Table 4: Estimated means and standard errors of means of apparent digestibility coefficients of dry matter, crude protein and gross energy of *Leucaena leucocephala* (LL) and *Leucaena leucocephala* cv. Cunningham (LC) hays

Nutrients	LL	LC	SEM
Dry matter (%)	21.4	23.1	1.2
Crude protein (%)	39.4	40.9	1.3
Gross energy (%)	20.1	18.6	1.2

Based on chemical composition of LL and LC hays and the respective apparent digestibility coefficients, the digestible dry matter, digestible protein and digestible energy, based on total dry matter, were 19.1%, 9.0% and 897 kcal/kg for LL and 20.9%, 7.8% and 866 kcal/kg for LC.

Performance experiment – The regression analysis in function of levels replacing the crude fiber of alfafa hay, only considering the treatments that use leucaena, showed that there were no differences (P> 0.05) to performance and carcass characteristics of rabbits during experimental periods. The estimated means and standard error of performance and carcass parameters according the different hays sources are showed in Table 5.

Table 5: Estimated means and standard errors of means of live weight, daily gain weight, daily feed intake and feed conversion of rabbits in the period of 40 to 90 days of age and weight and carcass yield according the different hays sources in diets

	Sources of hays in diets		
Characteristics	Alfalfa	LL	LC
Initial weight 40 days (g)	1029	1029	1029
Life weight 90 days (g)	2517 ± 83.2	2576 ± 37.2	2612 ± 37.2
Gain weight (g/d)	30,0 ± 1.7	31,0 ± 0.7	32,0 ± 0.7
Feed intake (g/d)	122 ± 6.5	122 ± 2.9	121 ± 2.9
Feed conversion	4,1 ± 0.1	3,9 ± 0.1	3,8 ± 0.1
Carcass weight (g)	1400 ± 50.4	1441 ± 22.5	1470 ± 22.6
Carcass yield (%)	55,6 ± 0.6	55,9 ± 0.3	56,3 ± 0.3

MTENGA e LASWAY (1994) did not find differences in performance and carcass yield of rabbits fed with diets containing until 30% of *Leucaena leucocephala* leaves.

The replacement of alfalfa hay, independent of level, by LL hay had a linear increase ($P < 0.05$) in the weight of kidney in agreement to equation $Y = 14.1 + 0.470X$. TANGENDJAJA et al. (1990) did not observe effects of inclusion of *Leucaena leucocephala* cv. Cunningham hay in weight of liver, kidneys and heart of rabbits.

The histopathological exams of kidneys tissue showed lesion with many degrees of tubular necrosis regardless of levels of LL and LC hays in diets. The anomalies were found in interstitio that showed infiltrations by inflammatory cells, mainly linfocits and macrophages (mononuclear cells). These infiltrations showed elongated and rounded shapes, reaching several regions of kidney like cortex, medulla and hilo characterizing a focal interstitial nephritis. GUPTA and ATREJA (1998a) found the same kind of histological anomalies using *Leucaena leucocephala* in rabbits diets.

CONCLUSIONS

The values of digestible dry matter, digestible protein and digestible energy, based on total dry matter, for growing rabbits were respectively, 19.1 %, 9.0 % and 897 kcal/kg for *Leucaena leucocephala* and 20.9 %, 7.8 % and 866 kcal/kg for *Leucaena leucocephala* cv. Cunningham .

The leucaena hays (LL e LC) replaced efficiently the alfalfa hay in the levels used in rabbits diets without affect on performance. However, more studies are necessaries to clarify the histologics renal alterations and their influence on metabolic process of rabbits.

REFERENCES

BEÇAK, W., PAULETE, J. 1976. *Técnicas de citologia e histologia*. v. II. Rio de Janeiro. Editora Livros Técnicos e Científicos, 574p.

GUPTA, H. K., ATREJA, P. P. 1998. Influence of gradual adaptation of cattle to *Leucaena leucocephala* leaf meal on biodegradation of mimosine and 3-hidroxy-4(1H)-pyridone in rumen, their levels in blood, fate and influence of absorbed DHP on thyroid hormones and liver enzymes. *Animal Feed Science and Technology*, **74**, 29-43.

GUPTA, H. K., ATREJA, P. P. 1998 a. Influence of ferric chloride treated *Leucaena leucocephala* on metabolism of mimosine and 3-hidroxy-4(1H)-pyridone in growing rabbits. *Animal Feed Science and Technology*, **74,** 29-43.

HARRIS, D. J., CHEEKE, P. R., PATTON, N. M. et al. 1981. A note on digestibility of leucaena leaf meal in rabbits. *Journal of Applied Rabbit Research*, Corvallis, **4,** 99.

JONES, R. J. Leucaena toxicity and the ruminal degradation of mimosine. In: SEAWRIGH, A. A., HEGARITY, M. P., JAMES, L. E., KELLER, R. F. 1985. *Plant toxicology*. Brisbane, Austrália: Queensland Poisonous Plants Commitee. 111-119.

LEBAS, F. 1987. La medica disidratata nell'alimentazione del coniglio. *Rivista Di Coniglicoltura*, **24**, 32-40.

MARTINEZ PASCUAL, J., FERNÁNDEZ CARMONA, J. Composicion, digestibilidad, valor nutritivo y relaciones entre ambos de diversos piensos para conejos. In: 2nd World Rabbit Congress, 1980, Barcelona. *Proceedings ...* Barcelona, 1980, 214-224.

MATTERSON, L. D., POTTER, L., SINGSEN, E. P. 1965. The metabolizable energy of feed ingredients for chickens. *Research Report* **7,** 3-11.

MTENGA, L. A., LASWAI, G. D. 1994. *Leucaena leucocephala* as feed for rabbits and pigs: detailed chemical composition and effect of level of inclusion on performance. *Forest Ecology and Management*, **64**, 249-257.

ONWUDIKE, O. C. 1995. Use of the legume tree crops *Gliricidia sepium* and *Leucaena leucocephala* as green feeds for growing rabbits. *Animal Feed Science and Technology*, **51**, 153-163.

RAHARJO, Y. C., CHEEKE, P. R. PATTON, N. M. et al. 1986. Evaluation of tropical forages and by product feeds for rabbit production. *The Journal of Applied Rabbit Research*, Corvallis, **9**, 56-66.

SAS I. I., 1988.SAS/STAT. Guide for personnal computers, version 6.03 Edition sas (Statistical Analysis System) Institute Inc., Cary, NC, 1028 p.

SILVA, D. J. 1990. *Análise de alimentos* (métodos químicos e biológicos). Viçosa, Universidade Federal de Viçosa, Imprensa Universitária. 165p.

TANGENDJAJA, B., RAHARDJO, Y. C., LOWRY, J. B. 1990. Leucaena leaf meal in the diet of growing rabbits: Evaluation and effect of a low-mimosine treatment. *Animal Feed Science and Technology*, **29**, 63-72.

ZINSLY, C. F. 1972. Eficiência do coelho comparada a do carneiro na determinação da digestibilidade de nutrientes de algumas leguminosas forrageiras. Piracicaba: ESALQ, 84p. Tese (Doutorado), Universidade de São Paulo.