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EFFECT OF PARTICLE SIZE OF COAST CROSS *(Cynodon dactylon)* HAY ON CAECOTROPHY AND SOME DIGESTIVE PARAMETERS

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ABSTRACT

This study was developed to evaluate the effect of Coast cross hay's particle size on caecotrophy and digestive parameters of growing rabbits. Thirty-two crossbred rabbits (New Zealand White x Californian) of both sexes were used and distributed in a randomized design with four treatments which were the different hay's particle size (0.461; 0.635; 0.969 and 1.273 mm). Data were submitted to regression analysis. Particle size of Coast cross hay had a significative effect (P<0.01) on caecotrophes production (15.2; 17.2; 21.4 and 21.8 g/d), dry matter contribution (11.8; 13.3; 15.2 and 18.0g) and crude protein contribution (14.1; 14.7; 22.1 and 22.3g) (P<0.05). There was a significative decrease (P<0.01) in the weight of empty digestive system (172; 141; 134 and 125g), caecal tissue (40.5; 37.9; 36.6 and 30.6g), small and large intestines (102.2; 76.5; 69.7 and 70.7g) and stomach tissue (P<0.05) (29.7; 26.4; 27.5 and 24.1g) with increased hay's dietary particle size..

INTRODUCTION

Roughage of good quality can be used up to 40% of rabbits diets (CHEEKE et al, 1986), besides they provide protein and supply the necessary fiber to promote the digest transit in the rabbit's digestive system which avoid digestive disturbance (UDEN & VAN SOEST, 1982). Although caecal bacteria act on the fiber, this one has low digestibility because only the small particles can get into the caecum (CARABANO e FRAGA, 1989). For a good functioning of the digestive system, the fiber should not be grinded too fine because it could provoke mortality and diarrhea (MORRISSE, 1986). By reducing the particle size, there is an increase in caecal retention and volume and a decrease in dry matter intake (ALICATTA et al., 1988). This research was developed to evaluate the effect of Coast cross hay's particle size on caecotrophes nutritional contribution and digestive parameters.

MATERIALS AND METHODS

Diets

A diet was formulated (Table 1) having as main fiber source Coast cross hay which was previously grounded in a hammer mill, using sieves with holes of 3.0; 5.0; 7.0 and 9.0mm of diameter. The mean particle size was determinated upon HANDERSON & PERRY (1955) technique. The diets were pelleted with mean size of 4.7mm of diameter and 8.0mm in length. The resulting average particle size in the four diets was 0.461; 0.635; 0.969 and 1.273mm. The chemical composition of the diet is presented in Table 2.

Table 1: Experimental diet used for rabbits (%)

Ingredients	Percentual Composition
Corn	30.71
Soybean meal	15.29
Wheat bran	15.40
Coast-cross hay	32.00
Meat and bone meal	6.00
Salt	0.40
Vitamine Mix*	0.20

*Mineral vitamine composition (kg): Iron (180.0g); Copper (20.0g); Cobalt (4.0g); Manganese (80.0g); Zinc (140g); Iodine (4.0g); Vit. A 10,000,000 UI; Vit. D_3 100,000 UI; Vit. E 1,200mg; Vit. B_1 392mg; Vit. B_2 360mg; Pant. Ac. 2,900mg; Vit. B_{12} 0.06mcg; Vit. B_6 3,920mg.

Table 2: Chemical composition (%) of the experimental diets considering the particle size of Coast cross hay.

	Average particles size of Coast cross hay (mm)			
	D1	D2	D3	D4
NUTRIENTS	0.461	0.635	0.969	1.273
Dry matter (DM)	87.53	88.17	88.00	87.78
Crude protein (CP)	21.88	21.47	20.50	21.57
Mineral Matter (MM)	7.39	7.38	7.33	7.56
Crude fiber (CF)	11.70	12.01	12.53	11.69
Acid detergent fiber (ADF)	16.69	15.39	16.10	15.47
Neutral detergent fiber (NDF)	35.92	37.51	37.70	37.63
Organic matter (OM)	92.61	92.62	92.67	92.44
Gross energy[1] (GE)	4.42	4.30	4.34	4.38
Calcium (Ca)	1.30	1.32	1.25	1.36
Phosphorus (P)	0.95	0.92	0.92	0.99

[1] GE=Mcal/kg

Statistical Analysis

A randomized design with four diets and eight repetitions, being each animal an experimental unit, was used. The statistical analysis of the data was made according to GSAS program (Genetics and Statistical Analysis System) developed by EUCLIDES (1983) and submitted to regression analysis.

Caecotrophy evaluation

Thirty-two crossbred rabbits (New Zealand White x Californian) with an average weight of 2.59kg were used and housed in individual digestibility cages. An adaptation period of seven days was respected. To evaluate caecotrophy each animal weared a wooden necklace measuring 25.0 cm of diameter, with a central hole of 7.0 cm. The necklace was placed at 9 am and taken away after 24 hours. During this period pellet's intake was controlled and caecotrophes were collected each two hours, being packed, identified by diet and frozen at -10° C.

Digestive parameters

Thirty-two crossbred rabbits (New Zealand White x Californian), which were submitted to the diets of Table 2 were considered. They were slaughtered at an average weight of 2.30 kg at 2 pm. The intact digestive system was taken away, excluding appendage organs like liver and pancreas. Then, the full digestive system, full cecum, caecal tissue, caecal content, stomach tissue, small and large intestines and empty digestive system were weighted. The caecal content was mixed, taken away and centrifuged by five minutes at 2500 rpm, removing 1mL of surface liquid to the test tube. The samples to determine ammonia received the same volume of hydrogen chloride 0.2 N that acts as conserved to avoid nitrogen losses.

Diets, faeces and caecotrophes samples preparation

All frozen samples (-10°C) were left at ambient temperature and then dried in an air hothouse at 55°C by 72 hours. Following it was placed on an workbench until reach ambient temperature balance, grounded in a Willy mill (sieves of 1mm spot) and stored for chemical analysis.

Analytic Techniques

The diets, faeces and caecotophes were submitted to analysis of dry matter (DM), crude protein (CP), mineral matter (MM) and crude fiber (CF) according to the methods of A.O.A.C. (1984). Calcium was determined by permanganometry and phosphorus by colorimetry, gross energy by PARR calorimetric bomb according to HARRIS (1970). The analysis of cell wall components, acid detergent fiber (ADF) neutral detergent fiber (NDF) was made following VAN SOEST et al (1991) determinations. To determine ammonia, it was added to the samples 10mL of sodium tetra borate at 25% and then distilled. The distillate was collected in a boric acid solution at 1%, and titred with hydrogen chloride at 0.01 N (FERRERA, 1990).

RESULTS AND DISCUSSION

Caecotrophy evaluation

Caecotrophes production (CP), dry matter and crude protein contribution by caecotrophes (DMCC and CPCC) were positively affected by increased Coast cross hay’s particle size (Table 3). A percentual increase was observed of 9.5% for CP and over 50% for DMCC with the increase in particle size. The figures 1, 2 and 3 show a linear increase to CP, DMCC and CPCC according to equations $y=11.72+8.59\ x$; $y=8.44+7.32\ x$ and $y=8.49+11.76x$, respectively.

Table 3: Feed intake (g DM/day), caecotrophes production (g DM/day) and nutritive contribution by caecotrophes (%).

	Particles size of Coast cross hay (mm)				
VARIABLES	0.461	0.635	0.969	1.273	CV (%)
Dry matter intake	117.6	116.6	119.9	101.4	25.4
Crude protein intake	26.0	25.1	24.6	21.8	25.5
Caecotrophes production[1]	15.2	17.2	21.4	21.8	28.7
DM contribution by caecotrophes[2]	11.8	13.3	15.2	18.0	21.6
CP contribution by caecotrophes[2]	14.1	14.7	22.1	22.3	20.6

[1]Linear Effect ($P<0.01$). [2]Linear Effect ($P<0.05$).

Digestive parameters determination

Live weight and digestive system weight are shown in Table 4. Figures 4, 5, 6 and 7 demonstrate the linear reduction with increased Coast cross hay’s particle size in the weights of empty digestive system, caecal tissue, small and large intestines and stomach tissue. Other studies found similar results, also observing linear reductions in the weight of the digestive system and its subdivisions with the increase of particle size in the ingredients of the diets (ALICATTA et al., 1988). A linear percentual reduction was onserved of live weight, weight of empty digestive system (34.7%), caecal tissue (26.3%), small and large intestine (41.1%) and stomach tissue (21.0%) with increased Coast cross hay particles size. With regard to stomach tissue weight, CUNHA (1988) and GARCIA et al (1993) affirm that fiber type and its level have significative influence on stomach tissue weight. According to CUNHA (1988) it is possible that the higher gastric development is related with the difficult empty of this organ, due to the own nature of diet, which provokes stomach distend and permanent antral hypermotricity.

Table 4: Live weight and digestive system weight (g)

	Particles size of Coast cross hay (mm)				
VARIABLES	0.461	0.635	0.969	1.273	CV (%)
Live weight	2336	2330	2333	2292	8.59
Full digestive system	399.3	383.0	382.5	355.8	13.1
Empty digestive system	172.4	140.8	133.8	125.4	11.5
Digestive system content	226.4	242.1	248.7	230.4	17.5
Full caecal	134.6	126.8	123.8	119.6	14.2
Caecal tissue[1]	40.5	37.9	36.6	30.6	6.7
Caecal content	94.10	88.9	87.2	89.0	18.2
Small and large intestines	102.2	76.6	69.7	70.7	15.6
Stomach tissue[2]	29.7	26.4	27.5	24.1	13.1

[1] Linear Effect (P<0,01). [2] Linear Effect (P<0,05).

Fig. 1 - Effect of particles size on caecotrophes production

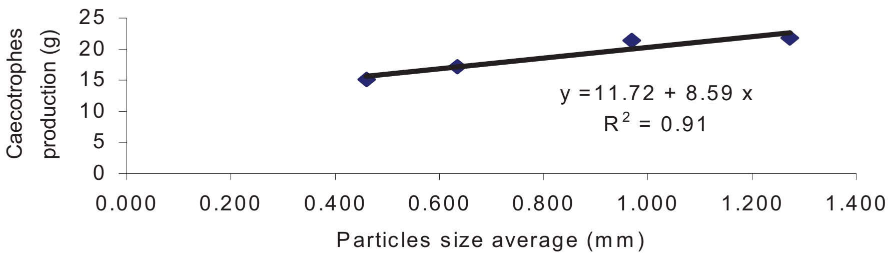


Fig. 2 - Dry matter contribution by caecotrophes

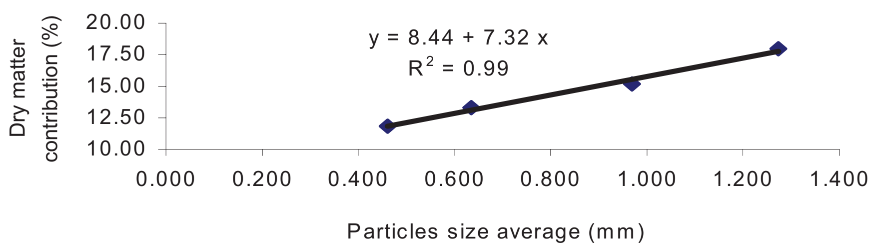


Fig. 3 - Crude protein contribution by caecotrophes

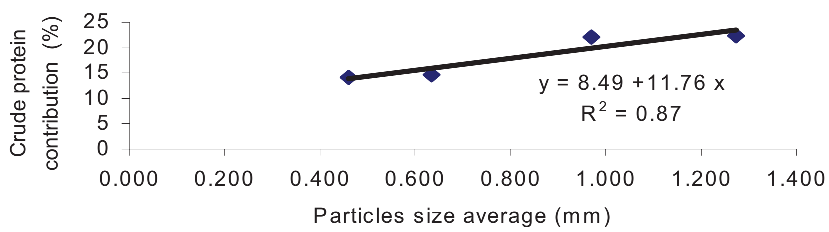


Fig. 4 - Effect of particles size on the weight of empty digestive system

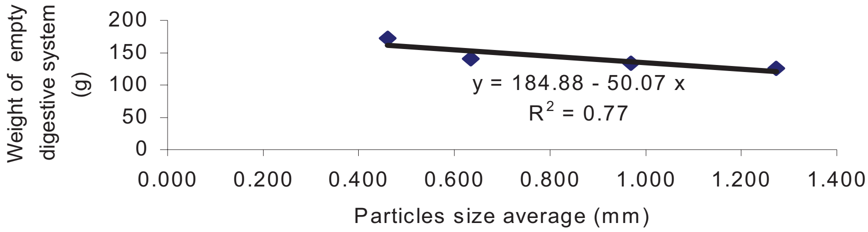


Fig. 5 - Effect of particles size on the weight of caecal tissue

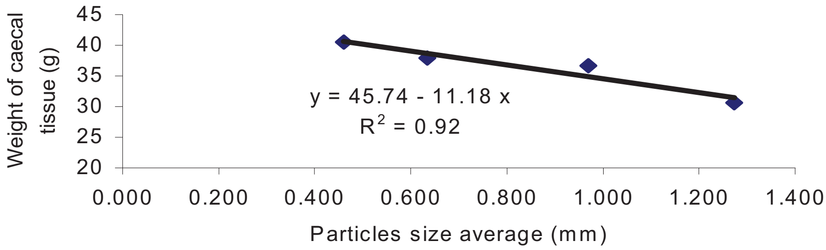


Fig. 6 - Effect of particles size on the weight of small and large intestine

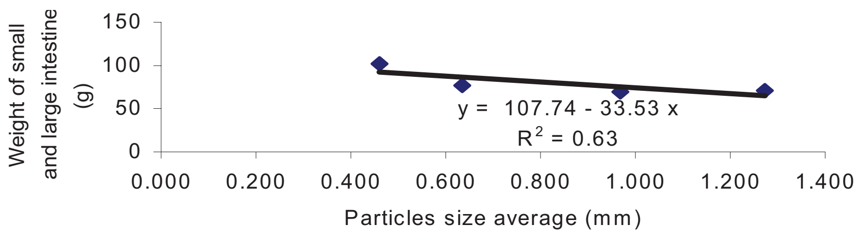
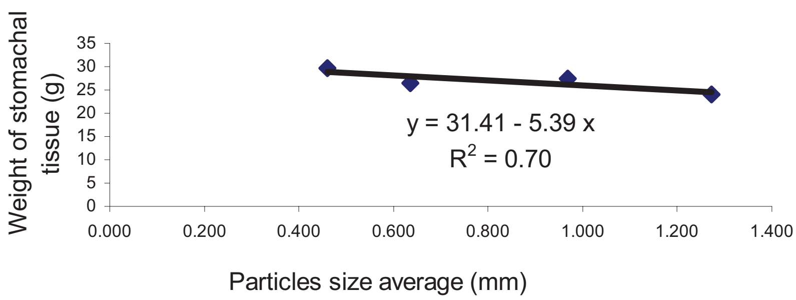


Fig. 7 - Effect of particles size on the weight of stomachal tissue



CONCLUSIONS

- There was an increase in caecotrophes production as well as in dry matter and crude protein contribution by caecotrophes with the increase in Coast cross hay's particle size.
- A decrease was observed in the weights of empty digestive system, caecal tissue, small and large intestines and stomach tissue with the increase in Coast cross hay's particle size.

REFERENCES

ALICATTA, M. L., BONANO, A., GIACCONE, P., LETO, G. 1988. Effeti del diverso grado di macinatione della farina disidratada di sulla conigli in accrescimento. *Ver. Coniglicolt*, 25:4 49-52.

A.O.A.C. ASSOCIATION OF OFFICIAL ANALYTICAL CHEMISTRY, 1984. Official methods of analysis, 14ed, Washington. 1141p.

CARABAÑO, R., FRAGA, M. J. 1989. Coprofagia. *In: DE BLAS, J. C. Alimentacíon del conejo. Ediciones Mundi-Prensa,* Madrid, 175 p.

CHEEKE, P. R., GROBNER, M.A. PATTON, N. M. 1986. Fiber digestion and utilization in rabbits. *J. Appl. Rabbit Res.*, 9 (1): 25-30.

CUNHA, L. A. L. F. 1988. Os constituintes da parede celular no processo digestivo do coelho. Tese de Doutorado. ISAUTL, Lisboa, Portugal. 359 p.

DE BLAS, J. C., SANTOMA, G., CARABAÑO, R., FRAGA, M. J. 1986. Fiber and starch levels in fattemirg rabbit diets. *J. Anim. Sci.* 63 (3): 1897-1904

EUCLIDES, R. F. 1983. *Manual de utilização do programa SAEG* (Sistema para análises Estatísticas e Genéticas). Viçosa, UFV, MG, Brasil. 59 p.

FERREIRA, W. M. 1990. Efecto de la substituicion parcial de heno de alfafa por orujo de uva o pulpa de remolachas sobre utilizacion de la dieta y los rendimentos productivos en conejo en crecimiento. *Tese de Doutorado. Universidad Politecnica de Madrid.* España. 251 p.

GARCIA, G., GALVEZ, J. F., DE BLAS, J. C. 1993. Effect of substitution of sugarbeet pulp in diets for finishing rabbits on growth performance and on energy and nitrogen efficency. *J. Anim. Sci.* 71: 1823-1830.

HANDERSON, S. M., PERRY, R. L. 1955. Agricultural process engineering. J. Wiley el. New York.

HARRIS, L. E. 1970. Os métodos químicos e bioquímicos empregados na análise de alimentos. *Universisdade da Flórida,* Gainsville, EUA.

MORRISE, J. P. 1986. Size of feed particles utilized by rabbits. The nutrition-digestive pathology hypotesis. *Nutr. Abstr. Ver.* (série b) 56 (7): 470.

UDEN, P., VAN SOEST, P.J. 1982. Comparative digestion timothy (Phleum pratense) fibre by ruminants, equines and rabbits. *Br. J. Nutr.* 47 (2): 267-272.

VAN SOEST, P. J., ROBERTSON, J. B., LEWIS, B. A. 1991. Method for dietary fiber, neutral detergent fiber and non starch polysaccharides in relation to animal nutrition. *J. Dairy Sci.* 74 (10): 3583-3597.