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EFFECTS OF DIETARY INCLUSION OF *YUCCA SCHIDIGERA* EXTRACT OR PHILLIPSITE TUFF ON DIGESTIBILITY AND PERFORMANCES OF GROWING RABBITS

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ABSTRACT : In order to evaluate the effect of *Yucca schidigera* extract or an Italian zeolitite containing phillipsite, 60 growing rabbits Grigi di Carmagnola (initial l.w. 1087 ± 129 g) were divided in three groups and fed *ad libitum* for 83 days with a diet added as follows : A) diet + De-odorase ® (120mg/kg) ; B) diet + zeolitite (30 g/kg) ; C) control diet. Besides, in order to evaluate the effects on diet digestibility twenty-four 56 days old rabbits (l.w. 1643 ± 120 g) were utilized for a digestibility *in vivo* trial by total faeces collection. The addition of zeolitite resulted in a significant (P = 0.0002) higher feed intake (+9.9 %), however performance traits showed small and not significant differences (daily weight gain, g : 23.92 A ; 25.83 B ; 24.13 C). No differences were induced by *Yucca schidigera*. Zeolitite significantly (P = 0.0054) reduced dry matter digestibility (61.02, 57.20, 60.26 % for A, B, C diet respectively). Ether extract digestibility is significantly affected by *Yucca schidigera* addition with respect to control (78.26 *vs* 84.21 %).

RÉSUMÉ : Effet de l'addition alimentaire de* Yucca schidigera *ou de zéolitite sur la digestibilité et les performances des lapins en croissance.
Dans le but d'évaluer les effets de l'addition d'un extrait de Yucca schidigera *ou d'une zéolitite contenant du phillipsite dans le régime alimentaire, 60 lapins "Grigi di Carmagnola" (poids moyen initial 1087 ± 129 g) ont été séparés en trois groupes et alimentés* ad libitum *pendant 83 jours avec les régimes suivants : A) Aliment + De-odorase ® (120mg/kg) ; B) aliment + zeolitite (30 g/kg) ; C) aliment contrôle. De plus, dans le but d'estimer les effets sur la digestibilité, 24 lapins âgés de 56 jours (poids moyen 1643 ± 120 g) ont été utilisés pour un essai de digestibilité* in vivo *par collecte totale de fèces. L'addition de zéolitite s'est traduite par une augmentation significative (P = 0.0002) de l'ingestion (+ 9.9 %) ; toutefois les résultats concernant les performances n'ont pas montré de différences significatives (gain de poids vif g/jour : 23.92 A ; 25.83 B ; 24.13 C). De même les performances zootechniques n'ont pas été affectées par l'introduction de* Yucca Schidigera *dans le régime alimentaire. La zéolitite diminue de façon significative (P = 0.0054) la digestibilité de la matière sèche (61.02 ; 57.20 ; 60.26 % respectivement pour les régimes A, B et C). L'inclusion de* Yucca Schidigera *a affecté de façon significative, par rapport à l'aliment contrôle, le digestibilité de la fraction lipidique (78.26 vs 84.21 %).*

INTRODUCTION

A number of products, presently utilized in rabbit feeding, are able to improve breeding environmental conditions through a reduction of ammonia outlet from manure (AL-BAR *et al.*, 1992). Improved environmental conditions would provide economical gain thanks to a decrease in enteritis and respiratory diseases with a subsequent fall both in mortality and incidence of unproductive animals (GROBNER *et al.*, 1982 ; SMITH, 1982 ; CHMITELIN, 1992).

Among these products, *Yucca schidigera* extract and natural zeolitites have recently turned out to be the most efficient, even though the real efficacy on performances due, respectively, to the quantity of active component (glycofraction) of the extract and to the kind and the percentage of zeolitite in zeolite bearing rock influencing the ability in cation exchange and specificity for ammonium, are still matter of debate.

Bibliography reports contrasting results on the improving effects of these compounds on rabbit performances (PICCOLO *et al.*, 1987 ; LAMBERTINI *et al.*, 1987 ; CASTROVILLI *et al.*, 1994 ; TEDESCO *et al.*, 1994).

The aim of the present work is to evaluate the effects of *Yucca schidigera* extract and an Italian zeolitite (Neapolitan yellow tuff), containing 58 % phillipsite and 10 % chabasite, on the productive traits and *in vivo* digestibility in growing rabbits.

MATERIALS AND METHODS

Diets

Diets were prepared at the Experimental Station of the Department of Zootechnical Science of the University of Torino, where the trial was carried out. One batch of both meals was manufactured and afterwards divided into three equal parts and added in the following way :

Table 1 : Composition of experimental diet (%)

Dehydrated alfalfa meal	35.0
Barley meal	15.0
Wheat bran	13.5
Oat meal	10.0
Maize meal	8.8
Sunflower meal	7.0
Soybean meal (44 % C.P.)	7.0
Calcium diphosphate	1.2
Ligninsulfonate	1.0
Vitamin & trace element supplement *	1.0
Sodium chloride	0.4
Coccidiostatic**	0.05
D-L Methionine	0.05

* Added per kg : Vit. A 20000 U.I. ; Vit. D_3 2000 U.I. ; Vit. E 40 U.I. ; Vit. B_1 3mg ; Vit. B_2 6mg ; Vit. PP 51.5mg ; Pantothenic acid 13mg ; Vit. B_6 4mg ; Vit. B_{12} 0.02mg ; Vit. K_3 2.6mg ; Biotine 0.5mg ; Choline 1.2mg ; Fe 200mg ; Co 4mg ; Cu 24mg ; Zn 90mg ; I 1.5mg ; Mn 40mg.
** Robenidine 66mg/kg

- Diet A : Control + *Yucca schidigera* (De-odorase ®) at 120 mg/kg feed ;
- Diet B : control + zeolitite at 30 g/kg feed ;
- Diet C : control

Yucca schidigera extract and zeolitites were added before the pelletting process. In order to avoid possible contamination, the control diet was pelleted (⌀ 3 mm) before the experimental ones. During pelleting process, temperature was lower than 70°C. Diet composition is reported in Table 1.

Chemical analysis

Analysis of diets was performed following MARTILLOTTI *et al.* (1987), for dry matter, ash, crude protein, ether extract and detergent fibres, whereas total dietary fibre (TDF) according to AOAC (1990), gross energy was determined by adiabatic bomb calorimeter. The chemical composition of the diets is reported in Table 2.

Growth trial

Growth trial was performed on 60 subjects of Grigio di Carmagnola rabbit (ZOCCARATO *et al.*, 1990). The rabbits, 35 ± 2 days old (average weight of 1087 ± 129 g) were randomly allotted to three diets and individually housed in fattening cages ; diets were offered *ad libitum* for 83 days.

At the end of the trial, mortality, live weight gains and total feed intake were recorded ; daily weight gains (DWG), daily feed intake (DFI) and feed conversion rate (FCR) were calculated. For diet B, both DFI and FCR were calculated as such by referring to control, i.e. by deducting a 3 % (due to ingestion of the added zeolite).

The data elaborated are referred to 57 rabbits reaching at the end of trial. The 3 missing rabbits (group A) were eliminated during the trial due to different causes (one subcutaneous abscess ; one "crooked teeth" ; one diarrhoea).

During the trial, air ammonia concentrations were periodically measured at 10 cm on cages level, utilizing a Gastek instrument equipped with 3LA detectors.

Digestibility trial

Apparent digestibility *in vivo* was determined on 24 different rabbits of the same breed, 56 days old, with a mean weight of 1643 ± 120 g, which were randomly allotted to the three diets A, B, C. They were housed in digestibility cages adapted for separating urines from faeces, as reported by PEREZ *et al.* (1995). Water and feed were supplied *ad libitum*.

After a preliminary adaptation period of 7 days, the collection of faeces was performed for 4 days. Faeces were dried according to PEREZ *et al.* (1995), and analyzed following the method previously reported for diets.

Statistical analysis

Statistical analysis was performed by one-way ANOVA using the STATGRAPHICS package (1992). Differences among the means were evaluated by Tukey test.

Table 2 : Proximate analysis of diets (means ± SD)

Diet		A (Yucca)	B (Zeolitite)	C (Control)
Samples	n	4	4	4
Dry matter	%	90.42 ± 0.08	91.02 ± 0.05	90.23 ± 0.03
Crude protein	% D.M.	17.94 ± 0.39	17.21 ± 0.04	17.97 ± 0.25
Ether extract	"	3.32 ± 0.03	3.09 ± 0.04	3.86 ± 0.05
Ash	"	10.00 ± 0.04	12.38 ± 0.08	9.91 ± 0.05
TDF	"	35.61 ± 0.42	34.93 ± 0.51	33.96 ± 0.49
NDF	"	29.47 ± 0.32	29.05 ± 0.46	29.39 ± 0.29
ADF	"	19.60 ± 0.17	19.44 ± 0.18	18.92 ± 0.16
DE	Mj/kg D.M.	8.92 ± 0.01	8.47 ± 0.02	8.85 ± 0.02

Table 3 : Growth performances (means ± SD).

Diet		A (Yucca)	B (Zeolitite)	C (Control)	P level
Trial length	d	83	83	83	
Rabbits	n	17	20	20	
Initial live weight	g	1092 ± 126	1081 ± 128	1088 ± 132	0.9657
Final live weight	g	3077 ± 237	3225 ± 307	3091 ± 247	0.1736
FCR		5.28 ± 0.62	5.35 ± 0.66	5.18 ± 0.59	0.6878
FCR corrected		5.28 ± 0.62	5.19 ± 0.64	5.18 ± 0.59	0.8713
Daily feed intake	g*	125.3 ± 11.2A	136.0 ± 7.9B	123.7 ± 9.2A	0.0002
Daily feed intake corrected	g*	125.3 ± 11.2ab	131.9 ± 7.7b	123.7 ± 9.2a	0.0193
Daily weight gain	g	23.92 ± 2.44	25.83 ± 3.72	24.13 ± 2.62	0.1061

Different letters on the same row split groups according to Tukey ; * as feed.

RESULTS AND DISCUSSION

Data regarding the growing trial are summarized in Table 3. No significant differences were found, except for the DFI (P = 0.0002) and corrected DFI (P = 0.0193). Feed intake appears higher in diet B than in diet A and C. Corrected DFI results significantly different only between diet B *vs* C. In practice, the mean daily intake is increased by a 9.9 % for diet B with respect to control, while the increase relative to control, by excluding zeolitite, is 6.6 %.

In spite of the lack of statistical significance for final weight (P = 0.1736) and for DWG (P = 0.1061) the mean improvement obtained with treatment B as compared to control, is worth mentioning : it accounts to 4.3 % for the former and to 7.1 % for the latter. As a trend, therefore, the increase of feed intake might have been compensated by a better growth rate, as confirmed by the homogeneity of FCR of diets.

Results of the digestibility trial are reported in Table 4. Due to the presence of the indigestible zeolitite, as expected, digestibility of dry matter decreased. Diet B dry matter digestibility results significantly lower than A and C diet, 5.1 % and 6.3 %, respectively. No apparent effects could be detected on the digestibility of organic matter, energy, crude protein and the different fibres ADF, NDF, TDF even though in the latter statistical significance is approached (P = 0.0882) for diet A with respect to control. As for lipids the difference in apparent digestibility is significant and Tukey test discriminates between diet A and control, with an overall worsening (6.6 %). Energy digestibility appears slightly decreased for diet B with respect to diet A and C.

As for performances, our results agree with those of CHMITELIN (1992), who did not find any productive improvement due to the utilization of *Yucca* at the dose of 120 mg/kg. AL-BAR *et al.* (1992) on the other hand, found better feed conversion rates and daily weight gains by utilizing the same product at both 125 and 250 mg/kg doses. The same improvements were obtained, during the same trial, in one case after utilizing the product directly on the manure : this might have resulted both in better environmental conditions and direct growth promoter effect ; however our trial being carried out in good environmental conditions (6 ppm of ammonia at cages level during the trial) do not confirm these data. TEDESCO *et al.* (1994) point out that the dietary inclusion, at the dose of 600 mg/kg, of

Table 4 : Apparent digestibility coefficients (%) (means ± SD).

Diets	A (Yucca)	B (Zeolitite)	C (Control)	P level
Rabbits, n	8	8	8	
Dry matter	61.02 ± 2.31B	57.20 ± 1.68A	60.26 ± 1.26B	0.0054
Organic matter	62.48 ± 2.12	60.54 ± 1.61	61.83 ± 1.21	0.1630
Energy	60.74 ± 2.30	58.64 ± 1.39	60.34 ± 1.49	0.1286
Crude protein	68.69 ± 3.08	66.46 ± 1.46	67.89 ± 1.89	0.2528
Ether extract	78.66 ± 3.27A	81.93 ± 1.17AB	84.21 ± 2.17B	0.0036
TDF	27.68 ± 4.10	22.29 ± 5.37	23.27 ± 2.45	0.0882
NDF	17.04 ± 4.56	14.98 ± 4.15	17.35 ± 2.10	0.5105
ADF	15.85 ± 4.77	13.42 ± 5.02	13.53 ± 4.35	0.6119

Different letters on the same row split groups according to Tukey.

a mixture composed by *Yucca* extract (2 %) and *Saccharomyces cerevisiae* (93 %) can improve daily weight gains ; however the authors ascribe the improvement in productive traits to the effect of the probiotic yeast.

In our trial, due to the reduced energy availability, zeolitite induced a compensatory increase of feed intake level in order to achieve constant energy intake (1.01 A ; 1.04 B ; 0.98 C MJ/day) and growth rate (23.92 A ; 25.83 B ; 24.13 C g/day) that appear similar for both diets. The sodium–bentonite, a similar natural aluminosilicate differing in crystalline structure and lower cationic exchange power, utilized at the same dose, does not see to show similar effects (LAMBERTINI *et al.*, 1987).

As regard to the negative effects on lipid digestibility attributed to zeolitite, considering the low fat content in growing rabbit diets and particularly in the one utilized in our trial the reduction of apparent digestibility is in practice negligible ; our opinion is supported by the uniformity observed in energy utilization of the diet.

No statistically significant differences among apparent digestibility coefficients of fibre fractions are found. However an improved trend in fibre digestibility is evident in rabbits fed with diet A. *Yucca schidigera* could have enhanced caecal fibre degradation. Anyway this hypothesis must be supported by further experimental data. No positive effects on fibre utilization by phillipsite bearing zeolitite are detected.

PICCOLO *et al.* (1987) had tested, at 30 g and 50 g/kg diet, a zeolitite similar to the one used in our trial ; they reported worse digestibility coefficients for dry matter and fibre fractions : our results confirm this trend.

As for digestibility, CASTROVILLI *et al.* (1994), by utilizing a mixture of *Yucca* extract (2 %) and *Saccharomyces cerevisiae* (93 %) at 600 mg/kg diet, do not reported any relevant effect on diet digestibility.

In conclusion, the two ammonia bindings agents utilized in the present trial did not seem to show any safe growth promoting effects on rabbits, even though these might have been minimized by the already good environmental conditions : the use of these compounds can be therefore envisaged for the improvement of inadequate environmental conditions.

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