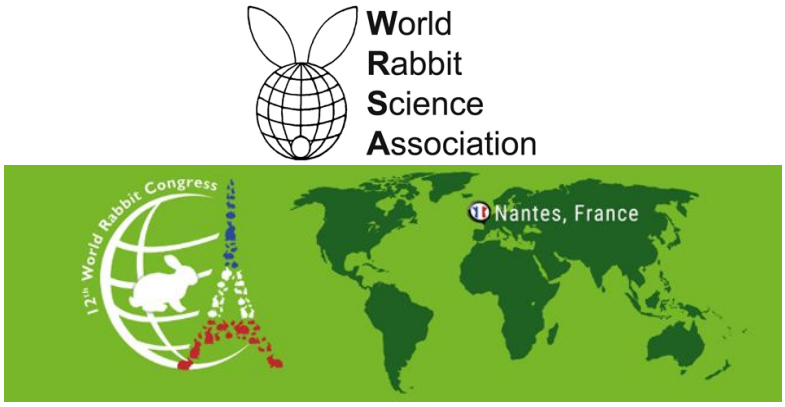

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DIGESTIBILITY IN LACTATING RABBIT DOES AND GROWING RABBIT: A COMPARATIVE STUDY

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ABSTRACT

The present study is proposed to elucidate whether nutrient digestibility differs between lactating rabbit does and growing rabbits, by using a common methodology, performing simultaneous measurements and with all animals housed in the same room. A total of 13 lactating rabbit does and 24 growing rabbits were used. Digestibility trials were conducted during four consecutive days, in two different periods: P1 (in lactating rabbit does: days 14 to 18 of lactation; in growing rabbits: days 42 to 46 of age) and P2 (in lactating rabbit does: days 21 to 25 of lactation; in growing rabbits: days 49 to 53 of age). The DM and OM digestibility of diet (190 g CP, 363 g NDF and 182 g ADF per kg DM) was higher in lactating rabbit does than in growing rabbits (64.6±0.27% *vs*. 63.5±0.23%, *P*=0.003, for DM; 64.9±0.25% *vs*. 63.8±0.22%, *P*=0.003, for OM). These differences are essentially explained by the increase in NDF digestibility (29.9±0.49% *vs*. 27.8±0.44%, *P*=0.003), linked to the increase in ADF digestibility (20.2±0.57% *vs*. 16.7±0.51%, P<0.001) since the type of animal did not affect digestibility of hemicelluloses, as well as that of CP. Discrepancies with some previous studies could have their origin in methodological differences. Consequently, it would be of interest to have a standardized reference method to evaluate the digestibility of nutrients in lactating rabbit does, similar to what already occurs in growing rabbits.

Key words: digestibility, lactating rabbit does, growing rabbits

INTRODUCTION

As a result of a collaborative work of the EGRAN group (European Group on Rabbit Nutrition), a reference method is available to test the total tract apparent digestibility (TTAD) in growing rabbits (Perez *et al*., 1995). However, there is no standardized methodology for assessing TTAD in lactating rabbit does.

Two papers recently published allow the comparison of TTAD in lactating rabbit does and growing rabbits, with contradictory results. In an experiment with only one diet, Read *et al*. (2017) observed that TTADs of nutrients (DM, OM, GE, CP, NDF, ADF and hemicelluloses) were, in comparison with those obtained in growing rabbits, widely higher in non-pregnant lactating rabbit does and even more in simultaneously lactating and pregnant rabbit does. However, in two different experiments involving a total of eight diets, Delgado *et al*. (2017, 2018, 2019a, 2019b) observed in all of them lower TTADs of all nutrients assessed (except NDF in two diets) in lactating rabbit does than in growing rabbits, although no direct comparison among both types of animal were performed.

Probably, the origin of the discrepancy could be in methodological differences between the mentioned studies and in the possibility of confounding uncontrolled environmental effects. The present study is proposed to elucidate whether nutrient digestibility differs between lactating rabbit does and growing rabbits, by using a common methodology, performing simultaneous measurements and with all animals housed in the same room.

MATERIALS AND METHODS

Animals and experimental design

Thirteen lactating rabbit does and 24 growing rabbits from six other rabbit does (4 per rabbit doe) from the LP line of the Universitat Politècnica de València were used. All animals were housed simultaneously in the same room of the experimental rabbit farm of the Universitat Politècnica de València. Lactating rabbit does remained in breeding cages (50×70×32 cm^3), provided with nests. Litters were standardized at birth to 10 kits and remained matched throughout the experiment, as losses were replaced by animals of the same age and similar weight from other nursing rabbit does. Controlled lactation was performed, by opening the nests few minutes each day (at 08:00 h). Rabbit does were not inseminated during lactation. Growing rabbits were housed in metabolic cages (35×50×32 cm^3). Both breeding and metabolic cages were equipped with devices for the complete collection of faeces, minimizing contamination with urine, which was not retained in the metal mesh that retained faeces. Throughout the experiment, the animals had free access to water and feed (Cunilactal, Nanta; 190 g CP, 363 g NDF and 182 g ADF per kg DM).

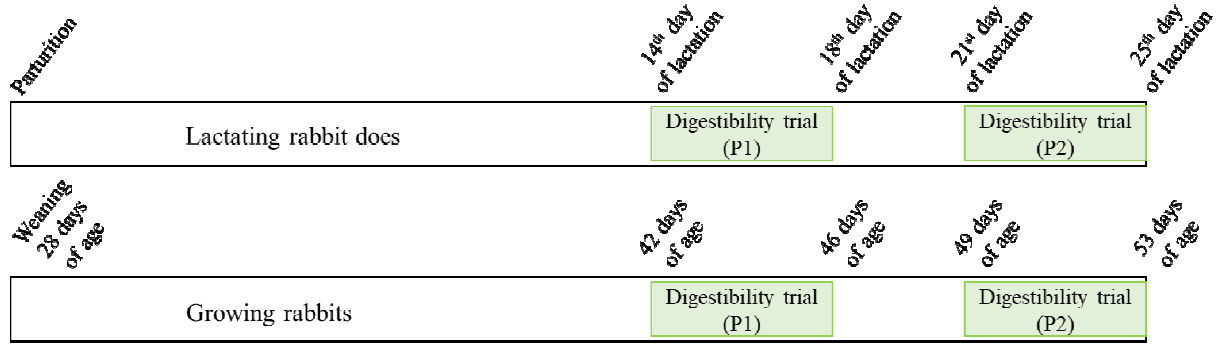

Figure 1: Temporary scheme of the experimental design

Digestibility trials were performed in two different periods (Figure 1): from 05/07/2018 to 05/11/2018 (P1; lactating rabbit does: days 14 to 18 of lactation; growing rabbits: days 42 to 46 of age) and from 05/14/2018 to 05/18/2018 (P2; lactating rabbit does: days 21 to 25 of lactation; growing rabbits: days 49 to 53 of age). Feed samples were taken at the beginning and end of each period. Faeces were collected daily and stored at -20 °C. Periods began and ended at the same time (09:30 h), and the same order of animals was followed for controlling feed intake and faecal collection. In the case of lactating rabbit does, litters always remained in the nest and had no access to the feed. In addition, the bottom of the nest was checked daily after suckling, to recover the faeces that the rabbit does could have excreted during it, what occurred very rarely.

Chemical analyses

Feed samples were taken at the beginning and the end of each period, DM was immediately determined by oven-drying and means were calculated for each period, to be used for determining DM intake during the digestibility trials. With these samples, a pool was constituted and ground with a 0.5 mm sieve for analyses. Faeces were also oven-dried and weighed after removing pellets that they could contain (which were weighed to correct the DM intake). Then, faeces were ground as described and sampled for analyses.

The AOAC (2000) methods for DM (934.01), ashes (942.05) and CP (990.03, Dumas method, CN628 Elemental Analyzer, LECO, St. Joseph, MI, USA) were used to analyze feed and faeces. The NDF and ADF fractions were analyzed sequentially according to Mertens *et al*. (2002) and AOAC (2000, 973.18), respectively, with pre-treatment with thermostable amylase and excluding ashes, using a system of nylon filter bags (Ankom, Macedon, NY, USA). Hemicelluloses were calculated as the NDF-ADF difference.

Statistical analysis

Data were analyzed with SAS (2002). A mixed procedure was used with a model that included the type of animal (lactating rabbit doe or growing rabbit), the period (P1 or P2) (as a factor of repeated measures) and the interaction between both as fixed effects, considering the animal as random effect.

RESULTS AND DISCUSSION

Table 2 shows the digestibility of nutrients in lactating rabbit does and growing rabbits during the two periods considered. No interactions were detected between the type of animal and the period.

Table 1: Total tract apparent digestibility (TTAD, %, standard errors between brackets) depending on the type of animal (TA) and the period (P)

	Lactating rabbit does		**Growing rabbits**		***P***		
	P1	**P2**	**P1**	**P2**	**TA**	**P**	**TA × P**
DM intake (g/d)	345 (10.3)	369 (10.3)	90 (9.1)	108 (8.4)	<0.001	<0.001	0.515
TTAD DM	64.9 (0.34)	64.4 (0.34)	63.7 (0.32)	63.3 (0.28)	0.003	0.147	0.907
TTAD OM	65.1 (0.32)	64.6 (0.32)	64.0 (0.31)	63.6 (0.26)	0.003	0.128	0.762
TTAD CP	75.1 (0.67)	74.9 (0.67)	76.8 (0.62)	76.0 (0.55)	0.086	0.291	0.576
TTAD NDF	30.8 (0.65)	29.1 (0.65)	27.8 (0.62)	27.7 (0.53)	0.003	0.109	0.193
TTAD ADF	21.2 (0.80)	19.2 (0.80)	16.4 (0.77)	17.0 (0.66)	<0.001	0.370	0.104
TTAD Hemicelluloses	40.4 (0.66)	39.0 (0.66)	39.4 (0.63)	38.4 (0.54)	0.274	0.039	0.755

Lactating rabbit does: P1, days 14 to 18 of lactation; P2, days 21 to 25 of lactation
Growing rabbits: P1, days 42 to 46 of age; P2, days 49 to 53 of age

The TTAD of DM and OM was higher in lactating rabbit does than in growing rabbits (64.6±0.27% *vs*. 63.5±0.23%, *P*=0.003, for DM; 64.9±0.25% *vs*. 63.8±0.22%, *P*=0.003, for OM). These differences are essentially explained by the increase in the TTAD of NDF (29.9±0.49% *vs*. 27.8±0.44%, *P*=0.003), linked to the increase in the digestibility of ADF (20.2±0.57% *vs*. 16.7±0.51%, *P*<0.001) since the type of animal did not affect the digestibility of hemicelluloses, nor that of the CP.

Read *et al*. (2017) also observed higher digestibility of OM, NDF and ADF in non-pregnant lactating rabbit does (days 14 to 18 of lactation) than in growing rabbits (42 to 46 days old), although the differences were markedly greater than those detected in the present study (76.5 *vs*. 68.2% for OM, 56.0 *vs*. 41.9% for NDF and 49.4 *vs*. 31.5% for ADF). In addition, contrary to what was observed in the present study, these authors showed also higher digestibility of hemicelluloses and CP in non-pregnant lactating rabbit does than in growing rabbits (65.0 *vs*. 27.8% for hemicelluloses and 78.9 *vs*. 74.1% for CP). According these authors such results would be the result of an adaptation, as animals would improve their digestive efficiency when their nutritional requirements are higher, since, in addition, i) digestibility was higher in pregnant lactating rabbit does (days 14 to 18 of lactation/days 3 to 7 of gestation) than in non-pregnant lactating rabbit does, and ii) digestibility was widely higher in non-pregnant lactating rabbit does than in non-lactating pregnant rabbit does; however, digestibility in pregnant lactating rabbit does was markedly lower in a second period (days 28 to 32 of lactation/days 17 to 21 of gestation, when feed intake was reduced to 74%,), in which values very similar to those obtained in non-lactating pregnant rabbit does were recorded, from what the authors point out that results could also be due to a bias in the balance between feed intake and faecal excretion because of an imbalance in their dynamics since they vary greatly during lactation. On the contrary, in the present study, digestibility was similar in the two periods (3rd and 4th week of lactation).

Contrarily to Read *et al*. (2017), Xiccato *et al*. (1992) observed that the digestibility of nutrients (DM, OM, GE, CP, EE, NDF, ADF and hemicelluloses) was very similar in pregnant lactating rabbit does (days 12 to 20 of lactation/days 11 to 19 of gestation) than in non-pregnant lactating rabbit does. In the case of DM, OM, GE, CP and hemicelluloses, they also obtained very similar values in lactating rabbit does and growing rabbits (56 to 64 days old) but digestibility of EE was higher in the former (63.9 *vs*. 57.9%) while the opposite occurred in the case of NDF (18.8 *vs*. 20.8%) and ADF (15.1 *vs*. 17.6%). These results support the lack of differences between lactating rabbit does and growing rabbits in CP and hemicelluloses digestibility recorded in the present study, but contradict results referred to NDF and ADF digestibility.

De Blas *et al*. (1995) found no differences in the digestibility of nutrients (DM, GE, CP and NDF) depending on whether the rabbit does were lactating (days 12 to 16 of lactation) or not, but observed moderate and significantly higher digestibility in them than in growing rabbits (1.75 kg of average live weight) for DM (64.9 *vs*. 63.6%), GE (65.7 *vs*. 64.6%) and NDF (37.4 *vs*. 30.9%) but very similar for CP (71.7 *vs*. 72.2%), which is closely in line with the results of the present study.

Delgado *et al*. (2017, 2018, 2019a, 2019b) conducted two experiments in which digestibility of different diets in lactating rabbit does and growing rabbits was assessed, although no direct comparison among both types of animal were performed. In a first experiment (Delgado *et al*., 2017, 2019a), four diets were used and, in all of them, digestibility was lower in lactating rabbit does (days 15 to 19 of lactation) than in growing rabbits (32 to 35 days old) for DM (on av. 63.0 *vs*. 68.3%), GE (on av. 63.6 *vs*. 68.3%), CP (on av. 74.1 *vs*. 83.4%) and NDF (on av. 24.5 *vs*. 29.0%). In the second experiment (Delgado *et al*., 2018, 2019b), four other diets were used and, in all of them, digestibility was lower in lactating rabbit does (days 15 to 19 of lactation) that in growing rabbits (39 to 42 days old) for DM (on av. 62.6 *vs*. 64.4%), GE (on av. 62.3 *vs*. 65.2%), CP (on av. 67.8 vs. 76.6%), EE (on av. 72.2 *vs*. 80.3%) and soluble fibre (on av. 52.9 *vs*. 61.4%), but not for NDF (on av. 28.2 *vs*. 27.9%). The discrepancy with the results of the present study could be explained by the fact, well established, that feed intake and digestive content increase simultaneously in younger rabbits (such as those used in the mentioned studies) and thus digestibility could be overestimated.

CONCLUSION

Discrepancies detailed in this discussion could be caused by methodological differences. Consequently, it would be of interest to have a standardized reference method to evaluate the digestibility of nutrients in lactating rabbit does, similar to what already occurs in growing rabbits.

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Digestibility in lactating rabbit does and growing rabbits: A comparative study

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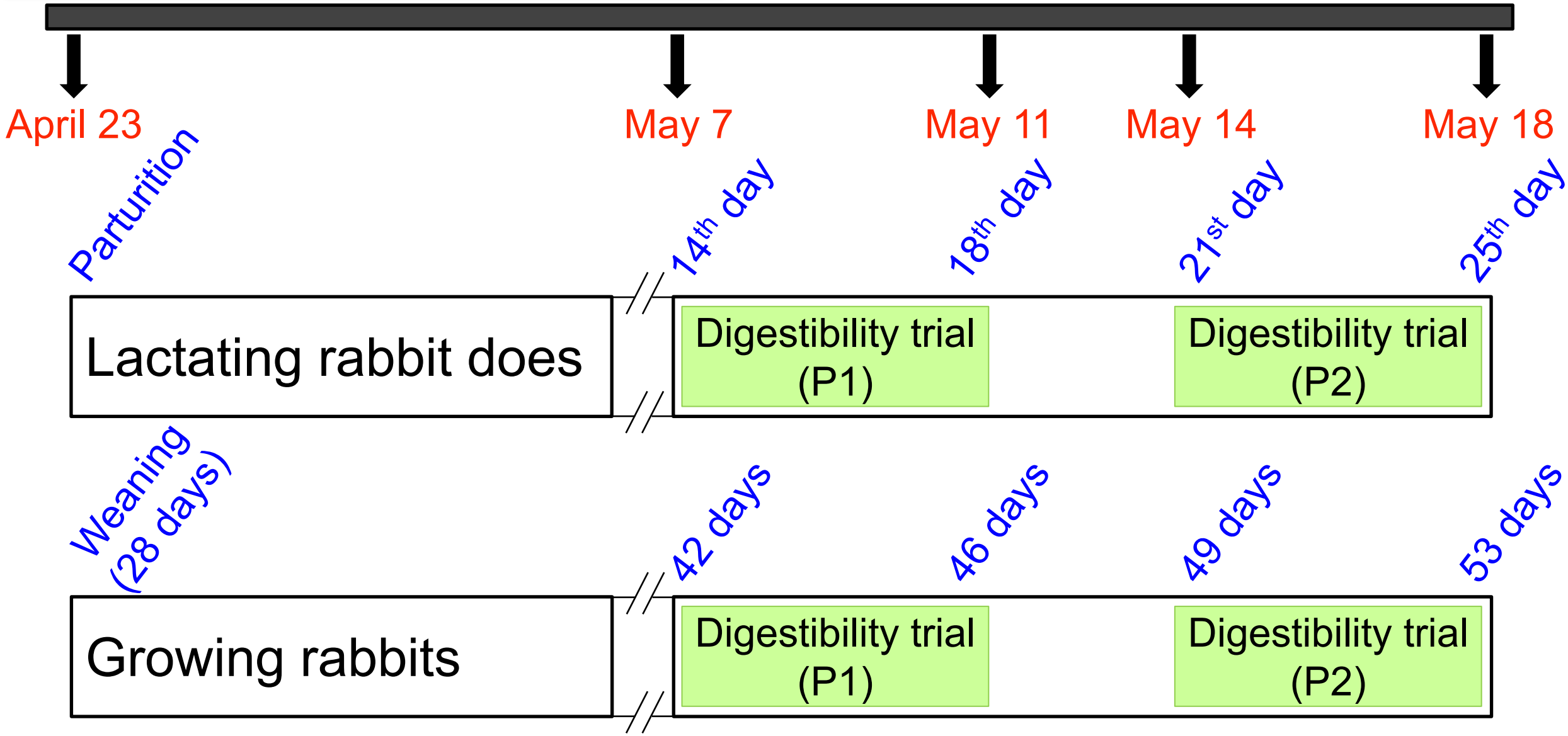
Introduction

- Bibliography shows controversial results
  - De Blas *et al*. (1995)
  - Read *et al*. (2017)
  - Delgado *et al*. (2017, 2018, 2019a, 2019b)

- Methodological differences ?

- Our objective: Comparison
  - Common methodology
  - Same room
  - Same time

Materials and Methods



Materials and Methods

- 13 lactating rabbit does
  - Litters equalized to 10 kits
  - Controlled lactation

- 24 growing rabbits

- Mixed model
  - Type of animal
  - Period
  - Type of animal * Period
  - Animal

Results

Effect of type of animal on TTAD (%)

	Lactating rabbit does	Growing rabbits	*P-value*
DM	64.6 ± 0.27	63.5 ± 0.23	0.003
OM	64.9 ± 0.25	63.8 ± 0.22	0.003
CP	75.0 ± 0.58	76.4 ± 0.50	0.086
NDF	29.9 ± 0.49	27.8 ± 0.44	0.003
ADF	20.2 ± 0.57	16.6 ± 0.51	<0.001

Conclusion

Diet digestibility measurements in growing rabbits

could slightly underestimate

the nutritive value for lactating rabbit does

… but would the same happen with other diets?

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