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

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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 (50x70x32 cm³), 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 (35x50x32 cm³). 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)

<table>
<thead>
<tr>
<th>Lactating rabbit does</th>
<th>Growing rabbits</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>DM intake (g/d)</td>
<td></td>
<td>TA</td>
</tr>
<tr>
<td>P1 345 (10.3)</td>
<td>90 (9.1)</td>
<td>4</td>
</tr>
<tr>
<td>P2 369 (10.3)</td>
<td>108 (8.4)</td>
<td>0.515</td>
</tr>
<tr>
<td>TTAD DM 64.9 (0.34)</td>
<td>63.7 (0.32)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>P1 64.4 (0.34)</td>
<td>63.3 (0.28)</td>
<td>0.147</td>
</tr>
<tr>
<td>P2 64.6 (0.32)</td>
<td>63.6 (0.26)</td>
<td>0.907</td>
</tr>
<tr>
<td>TTAD OM 65.1 (0.32)</td>
<td>64.0 (0.31)</td>
<td>0.003</td>
</tr>
<tr>
<td>P1 64.6 (0.32)</td>
<td>63.6 (0.26)</td>
<td>0.762</td>
</tr>
<tr>
<td>P2 64.0 (0.31)</td>
<td>63.6 (0.26)</td>
<td></td>
</tr>
<tr>
<td>TTAD CP 75.1 (0.67)</td>
<td>76.8 (0.62)</td>
<td>0.086</td>
</tr>
<tr>
<td>P1 74.9 (0.67)</td>
<td>76.0 (0.55)</td>
<td>0.576</td>
</tr>
<tr>
<td>P2 76.6 (0.62)</td>
<td>77.0 (0.53)</td>
<td></td>
</tr>
<tr>
<td>TTAD NDF 30.8 (0.65)</td>
<td>27.8 (0.62)</td>
<td>0.003</td>
</tr>
<tr>
<td>P1 29.1 (0.65)</td>
<td>27.7 (0.53)</td>
<td>0.193</td>
</tr>
<tr>
<td>P2 30.0 (0.65)</td>
<td>29.9 (0.65)</td>
<td></td>
</tr>
<tr>
<td>TTAD ADF 21.2 (0.80)</td>
<td>16.4 (0.77)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>P1 19.2 (0.80)</td>
<td>17.0 (0.66)</td>
<td>0.104</td>
</tr>
<tr>
<td>P2 21.2 (0.80)</td>
<td>19.2 (0.80)</td>
<td></td>
</tr>
<tr>
<td>TTAD Hemicelluloses 40.4 (0.66)</td>
<td>39.4 (0.63)</td>
<td>0.274</td>
</tr>
<tr>
<td>P1 39.0 (0.66)</td>
<td>38.4 (0.54)</td>
<td>0.755</td>
</tr>
<tr>
<td>P2 40.4 (0.66)</td>
<td>40.3 (0.66)</td>
<td></td>
</tr>
</tbody>
</table>

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 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 animals 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) than 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.

REFERENCES


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**

- **Parturition**: May 18
- **Weaning (28 days)**: May 14
- **Lactating rabbit does**
  - Digestibility trial (P1): May 11
  - Digestibility trial (P2): May 18
- **Growing rabbits**
  - Digestibility trial (P1): April 23
  - Digestibility trial (P2): May 7

- **Digestibility trials**:
  - P1: 14th day
  - P2: 18th day
  - P1: 21st day
  - P2: 25th day

- **Trial durations**:
  - P1: 42 days
  - P2: 49 days

- **Weaning duration**: 28 days

**Timeline**:
- April 23
- May 7
- May 11
- May 14
- May 18
- May 23
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 (%)

<table>
<thead>
<tr>
<th></th>
<th>Lactating rabbit does</th>
<th>Growing rabbits</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>DM</td>
<td>64.6 ± 0.27</td>
<td>63.5 ± 0.23</td>
<td>0.003</td>
</tr>
<tr>
<td>OM</td>
<td>64.9 ± 0.25</td>
<td>63.8 ± 0.22</td>
<td>0.003</td>
</tr>
<tr>
<td>CP</td>
<td>75.0 ± 0.58</td>
<td>76.4 ± 0.50</td>
<td>0.086</td>
</tr>
<tr>
<td>NDF</td>
<td>29.9 ± 0.49</td>
<td>27.8 ± 0.44</td>
<td>0.003</td>
</tr>
<tr>
<td>ADF</td>
<td>20.2 ± 0.57</td>
<td>16.6 ± 0.51</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>
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?
Digestibility in lactating rabbit does and growing rabbits: A comparative study

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