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# Effects of diets with different fibre content on the performance of rabbit does and on parasitological infection

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## *SUMMARY*

*The effect of two diets with different fibre contents was examined on rabbit does' performance and parasitological infection. Diet P2 had 1% higher crude fibre, ADF and starch contents than that of diet P1. The performance of 12–12 does and litters per group were examined during two consecutive inseminations. In both dietary groups, according to a 49-day reproduction rhythm, the does were artificially inseminated 18 days after kindling. Most production traits were not affected by the diets (kindling rate, weight of does and their kits, feed intake, mortality; P>0.05). Significant differences were only found in litter sizes as the number of kits was lower in P1 diet fed group at all examined days of lactation. The significant "Diet x Reproduction cycle" interaction showed that the litter sizes of dietary groups did not differ at the first examined insemination, however at the subsequent reproduction cycle 6–8% lower litter sizes were counted in P1 fed does compared to group P2 (litter size at 4 day: 9.00 vs 9.58–9.92, P = 0.004; litter size at 11 day: 8.83 vs 9.58–9.92, P = 0.037 for diet P1 at the 2nd reproductive cycle compared to all the other cases, respectively). The two diets with different compositions did not affect most of the production results of the rabbit does and their kits, but the lower litter size of does consuming P1 diet at the second examined lactation suggests the adverse effect of P1 diet's long-term use. From the collected manure samples not any parasites were detected which presents a very favourable picture of farm from the point of view of hygiene and animal health.*

***Keywords:*** *rabbit; feed; reproduction; Eimeria; Passalurus*

## *INTRODUCTION*

Nowadays, Hungary is one of Europe's leading rabbit meat producers and plays a prominent role in the export of rabbit meat in the world. More than four million rabbits are slaughtered yearly, 95% of which is exported to foreign markets (Juráskó, 2022). The excellent production results can be achieved on modern large-scale farms only with completely healthy herds (Demeter et al., 2021). Currently, the biggest challenge of industrial rabbit production is the prevention and treatment of digestive disorders. The ban of AGPs (antimicrobial growth promoting agents) in the EU in 2006, has increased these problems. In gastrointestinal problems parasites can play a significant role. Coccidiosis is the most common endoparasite infection of domestic rabbits which is caused by *Eimeria* species (Vetési, 1990).

In general, one of the defining elements of production is feeding technology, the use of appropriate quality raw materials and pelleted feed. In addition to general knowledge on nutrition, the rabbit's digestive physiology, feeding behaviour and nutrient requirements must be taken into account for the modern nutrition of the domestic rabbit and the compilation of feed rations. The feed fed to rabbit does must satisfy multiple needs at the same time. In addition to maintaining the mother's life and health, we must ensure the growth of the foetus, the milk production necessary to feed the young rabbits, and the nutritional needs of the young rabbits. Depending on feeding technology of the rabbit farm, there are several solutions, depending on when they switch from a mother diet prepared based on the does' nutrient needs to feeding a weaning diet that better meets the needs of the young rabbits.

Saliu et al. (2022) examined the effect of different cellulose lignocellulose ratios on performances of does and found that the highest lignocellulose ratio increased the fee intake and body weight of does without impact on the performance of kits. Delgado et al. (2018) found that increase of soluble fibre in diet (80 vs 130 g $kg^{-1}$ DM) combined with supplementation of n-6 and n-3 fatty acids reduced the culling rate of rabbit does. According to Álvarez et al. (2017) the increase of soluble fibre level from 106 to 126 g $kg^{-1}$ DM reduced the feed intake of rabbits between the 21 and 35 days of lactation and decreased the weaning weight.

In three studies lasting longer than 1 year (Méndez et al., 1986; Barreto and De Blas, 1993; Cervera et al., 1993) the effect of feed containing 7 different acid detergent fibre (ADF) ratio (162–216 g $kg^{-1}$ ADF) on the production of rabbit does was investigated. As the fibre content increased, the feed consumption of the rabbits increased, but the feed had no effect on the reproductive performance of does. Based on the recommendation of De Blas et al. (1995), evaluating the results of several experiments, 320 g $kg^{-1}$ of neutral detergent fibre (NDF), 170 g $kg^{-1}$ of ADF and 180 g $kg^{-1}$ of starch in the diet of rabbit does may be

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recommended for maximum reproductive performance, growth of young rabbits and better feed conversion ratio.

In the present study, the reproductive performance of rabbit does was compared which were fed with two diets of different nutritional contents during the entire lactation period.

## *MATERIALS AND METHODS*

The study was carried out at the rabbit farm of Tetrabbit Ltd. in Dabas with multiparous Hycole rabbit does. In the building 18–25 °C ambient temperature and 16L:8D lighting schedule was applied. The does (at the 3rd and 4th parity) and their litters were housed in commercial wire-mesh flat-deck cages (86 x 38 x 30 cm; with a removable plastic nesting part 28.5 x 38 cm).

Rabbit does were divided into two groups, taking into account the parity order and reproductive stage (lactating or non-lactating). The performance of 12–12 does and litters per group were examined during two consecutive inseminations. In both groups, according to a 49-day reproduction rhythm, the does were artificially inseminated 18 days after kindling, hormonal oestrus synchronization was not used. The first examined lactation occurred from May 16 to June 16, 2022, and the second examined lactation from July 4 to August 4. After kindling cross-fostering was applied within group (9–10 kits/litter). Controlled (once-a-day) nursing was allowed until the 17th day of lactation later on the does could nurse the kits freely.

The two experimental groups consumed completed, single-phase, granulated diets manufactured by Cargill Takarmány Zrt., with two different nutrient contents (*Table 1*). Both diets were free of coccidiostats and antibiotics, the ingredients used for the recipes were the same: alfalfa, olive cake, grape seed pellets, Arbocel, sugar beet pellets, sunflower groats, oats, barley, wheat bran, DDGS, CGF, corn germ, molasses, soybean oil, salt, Ca carbonate.

*Table 1:* **Nutritional content of diets P1 and P2**

| | P1 | P2 |
|---|---|---|
| Dry matter, % | 88.2 | 88.5 |
| DE rabbit, MJ kg$^{-1}$ | 9.9 | 9.8 |
| DE rabbit, kcal kg$^{-1}$ | 2368 | 2343 |
| Crude fiber, % | 14.5 | 15.5 |
| Crude protein, % | 17.5 | 17.5 |
| Crude fat, % | 3.7 | 3.8 |
| ASH, % | 7.8 | 7.6 |
| NDF | 32.2 | 32.9 |
| ADF | 17.8 | 18.9 |
| Lysine | 0.9 | 0.9 |
| Methionine | 0.3 | 0.3 |
| Threonine | 0.6 | 0.6 |
| Tryptophan | 0.2 | 0.2 |
| Met + Cyst | 0.6 | 0.6 |
| Adj. total starch | 13.4 | 14.1 |

Between 4th and 31st days of lactation, the body weight of rabbit does, the litter weight and feed consumption were measured on a weekly basis. The mortality of suckling kits was daily checked. When comparing the kindling rates, we took into account the results of a larger number of does kept under the same conditions (n = 172 rabbit does).

Faecal samples were weekly collected according to a standardized method. A minimum of 2–5 g of manure per group was collected under the cages and were mixed, i.e. the samples were not individual samples, but mixed samples of the individuals per group.

The flotation tests were carried out in the laboratory of S&K-Lap Ltd. The samples were examined within 48 hours after collection. The applied solution was a mixture of magnesium sulphate ($MgSO_4$) and water. The processing of faecal samples and the examination of *Eimeria* oocysts and *Passalurus ambiguus* eggs were performed according to the McMaster method based on the recommendation of the Royal Veterinary College and the FAO (URL1).

The statistical analysis of the production data was carried out with GLM-test (fix effects: Diet and Reproductive cycle). In case of significant ($P<0.05$) „Diet" x „Reproductive cycle" interactions were found; the results of the four subgroups were compared with One-way ANOVA. Kindling rate and mortality of groups were compared with Chi-square test, using the SPSS 10.0 software package.

## *RESULTS AND DISCUSSION*

The calculated kindling rate ranged between 73.5% and 81.5% and was not influenced by the type of the diet (*Table 2*).

The feed consumption of rabbits during the two lactations differed in all examined periods, however, we did not find any difference between the feed consumption of groups fed with different diets considering the different periods or the whole lactation (*Table 3*). The lower feed intake at the second examined lactation may have been due to the late summer period when there was a heat wave.

The body weight of does was not affected neither by the diets fed nor by the occasion of insemination (*Table 3*). During the second examined lactation, litter weights at the age of 4 days were 14% higher ($P<0.01$) compared to the previous lactation. On the contrary, at the 11th, 24th and 31st days, the litters were already heavier in the first examined lactation with 15%, 12% and 9%, respectively ($P<0.01$; *Table 3*). The diets had no detectable effect on the litter weights, and thus presumably on the milk production of rabbit does.

The number of kits per litter was higher at the first examined lactation at all ages ($P<0.001$; *Table 3*) and the differences between the two examined lactations varied from 6.7% to 8.8%. These differences between the litter sizes and litter weights at the two lactations can also be explained by the fact that the second examined lactation occurred in the late summer period

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and there was higher ambient temperature and the rabbits ate lower amount of diet. On all examined days of lactation, we observed a higher number of litters when feeding the P2 diet (3.1–5.0% differences; P<0.05).

A significant "Insemination event x Diet" interaction was detected in the number of litters recorded on day 4th (P<0.01) and day 11th (P<0.05) of lactation (*Table 3*).

*Table 2:* **Kindling rate of rabbit does fed with the two experimental diets**

| Insemination (A.I.) | | Diet | | P-values |
|---|---|---|---|---|
| | | P1* | P2* | |
| 1 | n (kindling/A.I.) | 61 / 83 | 71 / 89 | |
| | Kindling rate, %[2] | 73.5 | 79.8 | 0.331 |
| 2 | n (kindling/A.I.) | 66 / 81 | 65 / 86 | |
| | Kindling rate, % | 81.5 | 75.6 | 0.356 |
| 1+2 | n (kindling/A.I.) | 127 / 164 | 136 / 175 | |
| | Kindling rate, % | 77.4 | 77.7 | 0.952 |

*: see the nutritional content of diets in *Table 1*

*Table 3:* **Performances of rabbit does fed with the two experimental diets**

| | Insemination (A.I.) | | Diet | | | P-values | | |
|---|---|---|---|---|---|---|---|---|
| Days of lactation | 1 | 2 | P1* | P2* | SEM | A.I. | Diet | A.I. x Diet |
| Feed intake, g day$^{-1}$ | | | | | | | | |
| n | 24 | 24 | 24 | 24 | | | | |
| 1–4 | 605 | 560 | 434 | 431 | 25.2 | <0.001 | 0.478 | 0.204 |
| 5–11 | 601 | 539 | 570 | 571 | 6.87 | <0.001 | 0.933 | 0.305 |
| 12–18 | 570 | 610 | 589 | 591 | 6.28 | 0.001 | 0.897 | 0.487 |
| 19–24 | 686 | 572 | 628 | 630 | 15.1 | <0.001 | 0.947 | 0.448 |
| 25–31 | 886 | 745 | 817 | 814 | 11.9 | <0.001 | 0.782 | 0.058 |
| 1–31 | 675 | 572 | 624 | 624 | 8.59 | <0.001 | 0.981 | 0.364 |
| Body weight of doe, g | | | | | | | | |
| 4 | 4917 | 4909 | 4989 | 4837 | 52.3 | 0.942 | 0.147 | 0.170 |
| 11 | 5108 | 5020 | 5111 | 5017 | 51.0 | 0.395 | 0.364 | 0.279 |
| 18 | 5261 | 5181 | 5270 | 5171 | 51.3 | 0.447 | 0.347 | 0.757 |
| 24 | 5115 | 5153 | 5181 | 5087 | 48.1 | 0.698 | 0.342 | 0.761 |
| 31 | 5077 | 5079 | 5111 | 5045 | 55.4 | 0.985 | 0.564 | 0.752 |
| Litter weight, g | | | | | | | | |
| 4 | 898 | 1027 | 953 | 972 | 24.5 | 0.008 | 0.682 | 0.644 |
| 11 | 2103 | 1830 | 1941 | 1992 | 44.4 | 0.002 | 0.534 | 0.964 |
| 18 | 3212 | 3040 | 3054 | 3198 | 86.2 | 0.330 | 0.413 | 0.572 |
| 24 | 4569 | 4087 | 4312 | 4343 | 88.6 | 0.006 | 0.853 | 0.721 |
| 31 | 7658 | 6998 | 7260 | 7396 | 121 | 0.006 | 0.552 | 0.640 |
| Litter size, kits | | | | | | | | |
| 4 | 9.92 | 9.29 | 9.46 | 9.75 | 0.07 | <0.001 | 0.004 | 0.004 |
| 11 | 9.83 | 9.21 | 9.29 | 9.75 | 0.09 | <0.001 | 0.002 | 0.037 |
| 18 | 9.83 | 9.08 | 9.29 | 9.63 | 0.09 | <0.001 | 0.029 | 0.265 |
| 24 | 9.79 | 9.04 | 9.21 | 9.63 | 0.10 | <0.001 | 0.010 | 0.285 |
| 31 | 9.79 | 9.00 | 9.17 | 9.63 | 0.10 | <0.001 | 0.005 | 0.190 |
| Suckling mortality, % | | | | | | | | |
| 4–31 | 1.3 | 3.1 | 3.1 | 1.3 | | 0.166 | 0.184 | |

*: see the nutritional content of diets in *Table 1*

As shown in *Figures 1* and *2*, the same trends were observed on days 4th and 11th of lactation. At the first examined lactation, the litter sizes of rabbits fed with the different diets did not differ. At the subsequent lactation, the values measured of the rabbits fed with the P2 diet did not differ from the previous ones, on the other hand, the litter size of the rabbits fed with the P1 diet was significantly smaller (P<0.001). It can therefore be assumed that the longer-term feeding of

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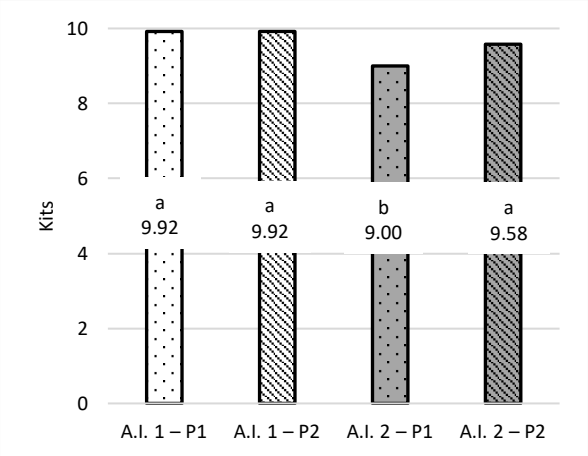
the P1 diet may have a negative effect on the number of kits.

Between the days 4–31 of lactations, there were no differences in suckling mortality, neither in the case of the lactations, nor in the case of feeding different diets (*Table 3*).

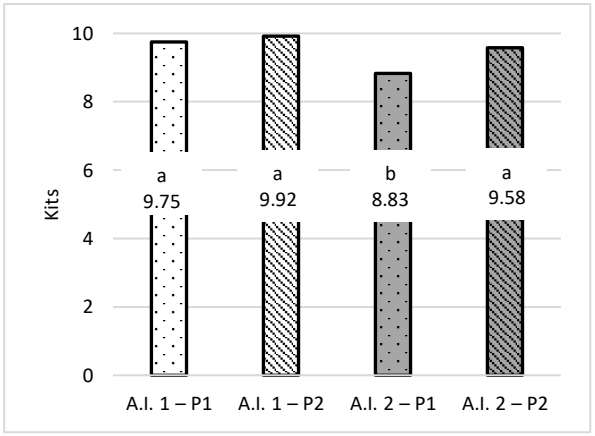
From a parasitological point of view, we got a very favourable picture of the farm and the examined rabbits, because we did not detect *Eimeria* oocysts or *Passalurus ambiguus* eggs in any of the faecal samples.

*Figure 1:* **"Diet x Reproductive cycle" interaction on litter size at 4th day of lactation**




a,b: Values with different letters differ significantly at P<0.001 level
The nutritional content of diets can be seen in *Table 1*

*Figure 2:* **"Diet x Reproductive cycle" interaction on litter size at 11th day of lactation**




a,b: Values with different letters differ significantly at P<0.001 level
The nutritional content of diets can be seen in *Table 1*

## *CONCLUSIONS*

The two diets with different compositions did not affect the production results of the rabbit does and their kits, except for the litter size, which was lower throughout the lactation when feeding the P1 diet. The litter size of does consuming P1 diet decreased during the second examined lactation, which suggests the adverse effect of its long-term use. However, further studies are needed to confirm this effect.

From a parasitological point of view, the farm and the animals showed a very favourable picture, parasites were not detected in the samples.

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