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INVESTIGATION OF *EIMERIA* OOCYSTS AND *PASSALURUS AMBIGUUS* INFESTATION IN DOMESTIC RABBITS

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1. Background and objectives of the research

1.1. Background of the research

Nowadays, the biggest challenge in large-scale rabbit farming is the management of digestive problems in rabbits. Gastrointestinal problems are common in fattening rabbits. A significant percentage of gastrointestinal diseases are caused by parasites and the most common endoparasite infection in industrial farmed rabbits is coccidiosis, in which several *Eimeria* species are involved. In fact, it is the spore-forming protozoa in the intestine that cause coccidiosis in livestock. Intestinal coccidiosis causes more or less severe disease in rabbits, depending mainly on the infective dose, the parasite species, the immune status and the age of the animals. The characteristic symptoms of intestinal coccidiosis are diarrhoea, weight loss and sometimes death, and both clinical and subclinical coccidiosis infections can cause significant economic losses. In addition to coccidiosis, a number of other parasites, including nematodes, have been detected in wild rabbits in different parts of the world. Nematode infections of domestic rabbits are relatively rare. The exception is *Passalurus ambiguus*, which is found in domestic and wild rabbits worldwide. In rabbit breeding, monitoring studies, hygiene measures and effective medication are of utmost importance in the control of *Eimeria* species and *P. ambiguus* infestations.

1.2. Objectives of the research

Based on several years of data collection, our aim was to assess the seasonal variation of *Eimeria* oocysts and *P. ambiguus* infection in industrial rabbit farms.

A further aim of our study was to determine the species composition of *Eimeria* oocysts in rabbit faeces on large-scale farms in Hungary. In addition, we wanted to investigate the species composition of *Eimeria* at different stages of the production cycle. An important objective was the simplified induction of sporulation *in vitro*.

Our aim was to examine the distribution of *Eimeria* and *P. ambiguus* infections depending on the age of the rabbits, their possible correlations and to suggest the age of preventive treatments against the parasite.

We investigated whether an extra high crude fibre content of the diet (24% crude fibre content compared to 17%) has an effect on parasitological infection, production and mortality of growing rabbits.

2. Materials and methods

2.1. Seasonal effects on the infestation of industrial rabbit farms with *Eimeria* oocysts and *Passalurus ambiguus*

Faecal samples were collected from 29 Hungarian and 2 Slovakian rabbit farms. The survey covered farms with a herd size between 200 and 6000 rabbit does. Sampling covered all stages of production. All animals were fed with a complete granulated feed mixture appropriate to age and production level. The feed of the does and that of the growing rabbits in the post-weaning and finishing phase typically did not contain any anti-worm supplementation. In cases of heavy infestation anti-parasite treatments were used on veterinary prescription and under supervision. In terms of housing, the mixed faecal samples were collected from rabbits kept in standard and welfare improved cages.

For *Eimeria* oocysts, data were collected between March 2018 and February 2022. In the present study, 5723 samples were evaluated, representing an average of 127 samples per month, not evenly distributed. For *P. ambiguus*, data collection took place between March 2018 and April 2022. Among the samples in the present study, 7612 samples were evaluated, with unequal distribution per period. The samples were collected according to a standardized method. In all cases, the samples were collected from the manure channel under the rabbits, from fresh faecal droppings after daily manure extraction. Samples were taken from the first, middle and last thirds of the manure channels of the sheds and mixed. A minimum of 2-5 g of faeces was collected per row and mixed, i.e. the sample is not an individual sample but a mixed pooled sample of individuals of the same age group in the barn.

The flotation tests were carried out in the laboratory of S&K-Lap Ltd. Samples were analysed within 48 hours of collection. The flotation test solution was a solution of 400 g of magnesium sulphate ($MgSO_4$) and 1 Litre of distilled water.

Faecal samples were processed exclusively according to the McMaster method, as recommended by the Royal Veterinary College and the FAO. The flotation test was performed by counting the number of *Eimeria* oocysts and *P. ambiguus* eggs. The results of the *Eimeria* oocysts tests were expressed as OPG (oocysts per gram of faeces). Numerical results were categorised to facilitate analysis, so that test results could be negative (OPG = 0), low (1 ≤ OPG ≤ 358), high (359 ≤ OPG ≤ 5000) or very high (5000 < OPG) oocyst counts.

The prevalence of OPG negative and OPG positive samples in each season and the prevalence of *P. ambiguus* negative and positive samples in each season were compared by Chi-squared test using the IBM SPSS 29.0 software package.

2.2. Occurrence of different *Eimeria* species on industrial rabbit farms in Hungary

Data collection for the species composition of *Eimeria* oocysts was carried out between August 2022 and November 2022. During this period 54 faecal samples containing oocysts were analysed for species identification and a total of 1235 oocysts were evaluated.

The faecal samples were collected from 13 rabbit farms in Hungary. Housing, feeding and manure samples were collected as described in subsection 2.1. Samples were processed within 48-72 hours after collection and processed samples, separated for sporulation, were checked after 4 days. For sporulation of oocysts, the flotation solution described in subsection 2.1. was used and the filtered liquid was stored at room temperature between 20-24 °C. The sporulated oocysts were examined after 4 days and the first 20 oocysts per sample were identified by morphological characteristics.

The analyses were performed with a optical microscope and a digital microscope and software (Aenscope, AENSys Ltd., Szeged), which displays the image of the

digital camera connected to the microscope on the computer screen and facilitates the measurements with a virtual ruler function that can be calibrated to the scale of the microscope in the plane of the field of view.

The length and width dimensions of sporulated and non-sporulated oocysts of each *Eimeria* species were compared by T-test using the "R" software.

2.3. Infestation of industrial rabbit farms with *Eimeria* oocysts and *Passalurus ambiguus* depending on age

For both parasites, faecal samples were collected from 29 Hungarian and 2 Slovakian rabbit farms between 2018-2022, while between 2022-2024 sampling was limited to Hungarian farms only. For *Eimeria* oocysts 4060 samples and for *P. ambiguus* 5469 samples were evaluated, with unequal distribution per period. Animal housing, manure sample collection and flotation test were the same as described in subsection 2.1.

IBM SPSS 29.0 software package was used for statistical evaluation. Data were analysed using a predictive statistical model, including a so-called exponential smoothing model. The data were evaluated both on a per-item basis and as a percentage. The correlation between *Eimeria* oocysts and *P. ambiguus* infection rates was analysed using Pearson's correlation.

2.4. Effect of crude fibre content of feed on parasitological infection, production and mortality in growing rabbits

Two studies were conducted with Hycole rabbits at two rabbit farms of Tetrabbit Ltd. in Hungary (Study I: Vaskút; Study II: Dabas). In buildings of both farms 18-22°C ambient temperature and 8L : 16D lighting schedule were applied.

In study I (Vaskút), individual body weights of 90 rabbits per group were measured and weight gain was assessed, and mortality data and faecal samples of 1600 rabbits (800 individuals per group; housed in the same building and housing system) were analysed. Feed consumption and feed conversion were not evaluated in the first study.

In Study II, production data (individual body weight and weight gain, feed consumption per cage and feed conversion) of 90 animals per group were evaluated, and the mortality of 1050 animals per group kept under the same conditions was assessed and faecal samples were collected. Study I was conducted between 37 and 72 days of age and study II between 38 and 66 days of age.

Rabbits were housed in wire mesh cages at both sites, with 5-5 rabbits per cage (cage size: 0.38 m x 0.87 m x 0.32 m; stocking density: 15 rabbits/m^2). The rabbits in the Control group were fed a commercially available granulated feed mix (DE: 9.0 MJ/kg; crude protein: 16.0%; crude fibre: 17.5%), while the rabbits in the High fibre group were fed a special high fibre (also lower energy and crude protein) commercial feed mix (DE: 8.4 MJ/kg; crude protein: 14.3%; crude fibre: 24.0%). The diets contained medications (Robenidin 66 ppm and Valnemulin 30 ppm). The rabbits were fed *ad libitum* and could drink freely from nipple drinkers at both sites.

The mixed faecal samples (n = 3 pooled samples per group in each test week) were analysed by flotation tests in the laboratory of S&K-Lap Ltd. as described in subsection 2.1.

Comparisons of body weight, weight gain, feed consumption and feed conversion of the two groups were carried out using a two-sample T-test with the R software package. Chi-square test was used to evaluate the mortality.

3. Results

3.1. Seasonal effects on the infestation of industrial rabbit farms with *Eimeria* oocysts and *Passalurus ambiguus*

Of the 5723 samples tested, 3889 samples were negative (68.0%), 404 samples had low OPG values (7.1%), 775 samples had high OPG values (13.5%), and 655 samples had very high OPG values (11.4%).

The results of the first year, which showed a relatively high OPG burden, were followed by serious prevention work. Treatments to control the disease, new agents and disinfection procedures, and coccidiostat have improved the *Eimeria* infection rate. However, in the last period, the trend has been deteriorating again and the proportion of samples with high or very high OPG levels have been increasing. However, with regard to the rising OPG load, it should also be taken into account that from January 2022 the scope of medicines that can be mixed in feed and used in drinking water has changed. This change may have caused a change in the health status of the herds and in the microflora on the farm.

Considering the data for the whole studied period, the highest proportion of oocyst-containing samples occurred in summer and autumn ($P<0.05$). In these two seasons, slightly more than one third of the samples contained oocysts. A more favourable picture was observed in winter, when a significantly higher proportion of OPG negative samples were found. The most favourable results were observed in spring, when three quarters of the samples were free of oocysts.

Nearly 96% of the 7612 samples tested were free from *P. ambiguus*. Of the positive samples, 143 samples (1.9% of all samples tested) contained only the larval form of the worm, 270 samples (3.5%) contained only eggs, and 65 samples contained both developmental forms (0.9%).

In terms of *P. ambiguus* infestation in samples, the results for each year (2018: 3.43%; 2019: 4.61%; 2020: 3.45%; 2021: 5.58%) and the trends within years are not always the same. The peaks in prevalence occur at different periods in each year. Considering the data for the whole studied period, the lowest proportion of *P. ambiguus* positive samples occurred in summer ($P<0.05$). Infection rates in autumn and winter were completely similar and did not differ statistically from the spring infection rates ($P=0.06$).

3.2. Occurrence of different *Eimeria* species on industrial rabbit farms in Hungary

Eight *Eimeria* species (*E. media, E. coecicola, E. magna, E. perforans, E. irresidua, E. flavescens, E. intestinalis, E. piriformis*) were identified from faecal samples from industrial rabbit farms. In 83.3% of the samples, we observed several *Eimeria* species (between 2-7 species) simultaneously, but we did not find any samples in which all the 8 species we identified were detected simultaneously. A single species was found in 16.7% of the samples and two or three species in 20.4%. The highest proportion, four species, was present in 24.1% of samples. In smaller proportions of samples were identified 5 (13.0%), 6 (3.7%) and 7 (1.9%) different species.

E. media, E. magna and *E. perforans* species were detected in the majority of samples. *E. irresidua, E coecicola* and *E. flavescens* were also present in significant proportions. *E. intestinalis* and *E. piriformis* were found in only a few percent of positive samples.

Based on literature data, sporulation of oocysts is carried out in 2.5% aqueous potassium dichromate solution ($K_2Cr_2O_7$) in Petri dishes, typically at 29°C. However, potassium dichromate is a very dangerous substance. In our own studies, we succeeded in sporulating oocysts in the flotation liquid ($MgSO_4$).

Approximately 2/3 of the oocysts sporulated in the flotation liquid at room temperature (24°C).

Not sporulated forms of *E. flavescens* were found in the samples. The low elemental counts of *E. intestinalis* and *E. piriformis* did not allow the evaluation and comparison of sizes. In *E. media* and *E. magna*, there were differences in both width and length between sporulated and non-sporulated oocysts. While sporulated oocysts of *E. media* were on average 10% longer and wider ($P<0.01$), sporulated oocysts of *E. magna* were 6-11% shorter and less wide compared to non-sporulated oocysts ($P<0.05$). For the other identified *Eimeria* species, there was no statistically verifiable difference between the size of sporulated and non-sporulated oocysts.

Over the whole studied period, *Eimeria* species with predominantly low pathogenicity were present in domestic rabbit populations. A quarter of the oocysts examined were moderately pathogenic, while only *E. flavescens* was present among the highly pathogenic species, with a proportion below 4%. A more nuanced picture emerges from the analysis of species composition by production stage. In the lactation period, the weakly pathogenic species were predominant, while the moderately and strongly pathogenic species were present in a proportion of less than 10%. In the present study, in the post-weaning period (6-9 weeks of age), the proportion of oocysts of species classified as moderately pathogenic increased, but it is interesting that no highly pathogenic species were detected in this period. In the final phase of fattening (10-13 weeks of age), the proportion of mildly pathogenic species was again higher, the proportion of moderately pathogenic species decreased, and we detected highly pathogenic *Eimeria* species (*E. flavescens*).

3.3. Infestation of industrial rabbit farms with *Eimeria* oocysts and *Passalurus ambiguus* depending on age

The proportion of positive samples for *Eimeria* oocysts was still low during the lactating period. In the first week (with one exception), the percentage of positive samples was between 2-8%. From days 9-10 onwards the trend was upwards, with 12-15% and in two cases over 30%. From days 20-30, values between 0-16% were observed. Between days 32-35 a big change occurred, as in 2 cases oocysts were found in all samples tested, and on the other days the percentage of positive samples was above 10%. In the week following weaning (days 35-42), the percentage of positive samples varied between 10-60%. From day 42 onwards, the percentage of positive samples was consistently high, sometimes above 60%, until the age of slaughter (70-77 days).

In the period from kindling to weaning, there was only one case where the average OPG count was above 5000. In the post-weaning period, there is a steep rise, with the critical period starting at 42 days of age, when the average OPG count reached the order of 10 000 in several cases. However, the high oocyst count does not disappear at the end of the fattening period and high average oocyst counts have often been observed at ages over 80 days.

The exponential smoothing model estimates a significant increase in infection by day 38 based on the OPG count in the faeces and by day 40 based on the percentage data.

The proportion of faecal samples containing *P. ambiguus* eggs was already high in the lactation period. Already in the first week a 50% infection rate was observed, followed by relatively high peaks in the proportion of positive samples in the next 3 weeks of lactation (the highest positive sample rates were 20%, 25% and 33% in the 2nd, 3rd and 4th week of lactation, respectively). From day 29 to slaughter age (up to 79 days of age), a relatively low infection rate was observed, with no positive sample ratio reaching 10%. However, from day 80 to the end of

the study period, high infection peaks of *P. ambiguus* were again observed, with positive samples reaching up to 66%.
In the case of *P. ambiguus*, the model estimated the increase in infection for both the number of positive samples and the percentages by day 7 after kindling.

The estimated increase in the prevalence of oocyst infection is from day 38 to 40, while *P. ambiguus* infection increases as early as day 7. Similar infection rates were observed for *Eimeria* oocysts and *P. ambiguus* eggs in the lactation period and in the finishing period of growing, but with a significant increase in oocyst presence in the intermediate period, while the proportion of *P. ambiguus* positive samples remains low. When the oocyst infestation flares up, the *P. ambiguus* infestation level drops. Pearson's correlation shows a significant (P=0.004) weak negative relationship (r=-0.278) between the percentage of positive samples of *Eimeria* oocysts and *P. ambiguus.*

3.4. Effect of crude fibre content of feed on parasitological infection, production and mortality in growing rabbits

In this chapter, the results of two identical studies are discussed separately.

Study I

During the first week of fattening, the weight gain of rabbits fed the Higher fibre diet was significantly lower than that of the Control group (-54.4%; $P<0.05$), resulting in a lower body weight of the High fibre group than the Control group at 44 days of age (-6.8%; $P<0.05$). Although there was no difference in weight gain between the two groups in the later weeks of fattening, the difference in body weight was maintained and even increased (-10.6%, -13.5% and -15.6% at 51, 58 and 65 days of age, respectively; $P<0.001$). At the end of fattening, rabbits in the High fibre group were 15.7% smaller than those in the Control group ($P<0.001$).

At 51-58 days of age, there was a significant decrease in weight gain of rabbits fed both diets. The daily weight gain calculated for the whole fattening period (37-72 days of age) was 30.5% lower in the High fibre compared to the Control group ($P<0.001$).

Based on the data collected on the larger herd (800 rabbits/group), there was no difference in the mortality of rabbits reared on different diets over the entire fattening period (Control: 5.50%; High fibre: 5.75%; $P=0.828$). In both groups, the mortality exceeded the critical mortality level of 0.2 percent mortalities per day in industrial practice on several occasions (Control group: 14 occasions; High fibre group: 10 occasions). The peaks of the mortality curve for both the Control and High fibre groups were between days 53 and 60. For the High fibre group, extremely high mortality was observed at 58 days of age, but not any mortality was observed after 60 days of age, and in the Control group, mortality was also recorded in the last 2 weeks of fattening.

The results of the weekly collected faecal samples showed that the appearance of oocysts was independent of the diet, but the OPG values in the faecal samples showed differences. Faecal samples collected at 56 and 64 days of age showed slightly lower oocyst counts in rabbits fed Higher fibre diet than in the Control group.

Study II

At 38-45, 52-59 and 59-66 days of age, rabbits fed the High fibre diet gained 21.6%, 44.7% and 17.3% less weight than the Control group. There was also a significant difference in weight gain calculated over the entire fattening period (days 38-66) between groups (-22.1%; $P<0.001$). As a result, the body weight of the High fiber group was lower than that of the Control rabbits throughout the fattening period and the difference between the two groups increased with age

(day 45: -4.43%, P<0.01; day 52: -5.24%, P<0.05; day 59: -11.05%, P<0.001; day 66: -11.95%, P<0.001).

The feed consumption of the groups differed significantly only in the first week of fattening, with the High fibre group eating less feed (days 38-45: -9.75%; P<0.05). Although no differences in feed consumption of the rabbits could be detected in the later weeks of life and over the whole fattening period, the differences in weight gain resulted in significantly worse feed conversion in the High fibre group compared to the rabbits fed the Control diet (38-45 days of age: +16.4%, P<0.05; 45-52 days of age: +60.5%, P=0.058; 52-59 days of age: +82.2%, P<0.001; 59-66 days of age: +20.0%, P<0.05). Taking into account the whole fattening period, the High fibre diet was very much worse utilized by the rabbits than the Control diet (+28.8%; P<0.001).

There was no significant difference in mortality between the two groups (1050 rabbits/group) during the whole fattening period (Control group: 13.1%, High fibre group: 10.6%; P = 0.068). When looking the days of fattening, mortality of both groups exceeded the 0.2 percent/day mortality level considered critical in large-scale farming practice on most days (Control group 23 times, High fibre group 24 times), but slightly different trends emerged. In rabbits fed the Control diet, the daily mortality rate exceeded 0.4 percent/day between 48 and 62 days of age, whereas in the High fibre group, mortality exceeded this level only at shorter period between 44 and 54 days of age and at 63 days of age. In the second study, both groups had slightly higher mortality rates than in the first study, but in neither case was there a statistically proven difference between the groups. The peak in mortality in both groups was observed almost simultaneously with the deteriorating weight gain mentioned above.

Examination of faecal samples at 40 days of age gave negative results for both groups. Thereafter, an upward trend in oocyst infection was observed from day 45 until day 59 for the Control group, with a significant decrease in oocyst count

by day 66. In contrast, the High fibre group showed a steeper upward trend for faecal samples from 45 to 52 days of age, but a significant decrease in the number of oocysts detected in faeces from 59 days of age.

We identified 6 *Eimeria* species from faecal samples (*E. media, E. perforans, E. coecicola, E. magna, E. irresidua, E. flavescens*). In the control group, 46-46% of oocysts on day 52 were classified as slightly to moderately pathogenic and 8% were strongly pathogenic *E. flavescens*. In the Control group, at 59 days of age, 11% of the *Eimeria* oocysts were weakly pathogenic and 58% and 11% were moderately pathogenic and strongly pathogenic, respectively. In contrast, in the High fibre group, highly pathogenic *Eimeria* species were not detected, 80% of oocysts at 52 days of age were classified as slightly pathogenic and 20% as moderately pathogenic, and all oocysts identified at day 59 were from slightly pathogenic *Eimeria* species.

4. Conclusions and recommendations

In general, lower infestations of *Eimeria* oocysts and *P. ambiguus* were observed in the industrial rabbit farms studied than those reported in the literature for small-scale or backyard farms.

From the study of the influence of the seasons on oocysts, it was concluded that infection rates are lowest in spring and highest in summer and autumn, although the winter period should not be neglected. Infestation levels of *P. ambiguus* also varied between seasons but, unlike oocysts, the most favourable picture was observed in summer.

Our results suggest that the same emphasis should be placed on parasitological monitoring each month and season, as both *Eimeria* oocysts and *P. ambiguus* are present on large-scale farms throughout the year.

Oocysts of eight *Eimeria* species were identified from faecal samples from industrial rabbit farms: *E. media, E. magna, E. coecicola, E. irresidua, E. flavescens, E. piriformis, E. perforans* and *E. intestinalis*. Seventy-one percent of oocysts were from species of low pathogenicity, while oocysts of moderate pathogenicity and highly pathogenic species were detected in 25 percent and 4 percent of oocysts respectively.

We have observed that in the laboratory, sporulation of oocysts can also occur in magnesium sulphate aqueous solution at room temperature. *E. media* and *E. magna* show significant differences in the width and length of sporulated and non-sporulated oocysts.

Eimeria oocysts and *P. ambiguus* eggs can be detected in the faeces of rabbits during lactation. After weaning, oocyst infestation is very high and remains high until the end of fattening, while *P. ambiguus* infection decreases to low levels.

After 80-82 days, infection with *Eimeria* oocyst and *P. ambiguus* was detected with high frequency in the faeces of young female rabbits.

Based on the estimation model, the large increase in *Eimeria* oocyst infection is estimated to occur on days 38-40 of life, while the increase in *P. ambiguus* infection is estimated to occur 7 days after kindling.

In line with the literature, diets with higher crude fibre, lower energy, and lower crude protein content resulted in lower production levels. The diets did not affect mortality rates but caused slightly different trends in oocyst counts. While the control feed resulted in a higher proportion of moderately pathogenic *Eimeria* species oocysts in rabbit faeces, and the presence of highly pathogenic *E. flavescens* oocysts was also detected, feeding high-fibre diet resulted mainly in the presence of mildly pathogenic species, and no highly pathogenic species were detected.

The relationship between feed composition and the presence of *Eimeria* species with different pathogenicity should be investigated in further studies.

5. New scientific results

1. Faecal samples from industrial rabbit farms contained the highest proportion of *Eimeria* oocysts in summer (35.3%) and autumn (36.2%), with significantly lower oocyst infection rates in winter (29.5%) with the most favourable results observed in spring (25.1%; $P<0.05$). *Passalurus ambiguus* infection was lower in summer (3.0%; $P<0.05$) than in other seasons (spring: 5.7%; autumn: 4.4%; winter: 4.4%).

2. According to the literature, of the 12 *Eimeria* species identified in rabbits, we identified oocysts of eight *Eimeria* species on industrial rabbit farms in Hungary, with varying frequencies: *E. media* (40.3%), *E. coecicola* (22.5%*), E. magna* (18.5%), *E. perforans* (8.3%), *E. irresidua* (6.8%), *E. flavescens* (2.7%), *E. intestinalis* (0.8%), *and E. piriformis* (0.2%). In 83.3% of *Eimeria*-positive samples, oocysts of several (2-7) *Eimeria* species were present simultaneously.

3. Oocyst sporulation was performed in a previously undescribed manner at room temperature in an aqueous solution of magnesium sulfate (400 g MgSO4, 1000 ml distilled water). The sporulated oocysts of *E. media* were on average 10% longer and wider ($P<0.01$), while the sporulated oocysts of *E. magna* were 6-11% shorter and narrower than the non-sporulated oocysts ($P<0.05$). For the other identified *Eimeria* species, there was no statistically significant difference between the sizes of sporulated and non-sporulated oocysts.

4. Based on estimation model, it was determined that in industrial rabbit farms, the increase in *Eimeria* oocyst infection can be expected on the 38 to 40 day of life, while *Passalurus ambiguus* infection increases on the 7 day after kindling.

5. There is a weak negative correlation between the frequency of occurrence of faecal samples containing *Eimeria* oocysts and *Passalurus ambiguus* observed on certain days (r=-0.278; P=0.004).

6. In the case of feed with higher crude fibre, NDF, and ADF content and lower energy and crude protein content, mainly oocysts of mildly pathogenic *Eimeria* species were detected in the faecal samples of rabbits, while highly pathogenic species did not occur (DE: 8.4 MJ/kg; crude protein: 14.3%; crude fibre: 24.0%; NDF: 43.6%; ADF: 28.3%; ADL: 6.4% vs. DE: 9.0 MJ/kg; crude protein: 16.0%; crude fibre: 17.5%; NDF: 38.0%; ADF: 22.0%; ADL: 5.7%) In contrast, when fed Control diet, the rabbits' faeces contained higher proportions of moderately pathogenic *Eimeria* species oocysts, and highly pathogenic *E. flavescens* oocysts were also detected.

6. Scientific publications on the topic of the thesis

Peer-reviewed scientific papers published in foreign language

Demeter, Cs.; Demeter-Jeremiás, A.; Német, Z.; Sándor, M.; Mayer, A.; Gerencsér, Zs.; Matics, Zs. (2023): Effects of diets with different fibre content on the performance of rabbit does and on parasitological infection. ACTA AGRARIA DEBRECENIENSIS, 1: 41-44.

Demeter, Cs.; Matics, Zs.; Demeter-Jeremiás, A.; Sándor, F.; Gerencsér, Zs.; Német, Z. (2023): Survey of the seasonal dependency of *Eimeria* oocysts and *Passalurus ambiguus* infections in industrial rabbit farms. WORLD RABBIT SCIENCE. 31:(4) 277-283.

Demeter, Cs.; Demeter-Jeremiás, A.; Német, Z.; Sándor, M.; Mayer, A.; Gerencsér, Zs.; Juráskó, R.; Húth, B.; Matics, Zs. (2024): Effect of dietary butyrate supplementation on the production performance and parasitology of growing rabbits. BIO WEB OF CONFERENCES. 125 Paper: 02006 , 7 p. (2024)

Demeter, Cs.; Bárdos, B.; Német, Z.; Gerencsér, Zs.; Juráskó, R.; Mayer, A.; Demeter-Jeremiás, A.; Lencsés-Varga, E.; Matics, Zs. (2025): *Eimeria* oocysts and *Passalurus ambiguus* infection of farmed rabbits depending on the age. JOURNAL OF ANIMAL HEALTH AND PRODUCTION. 13(1): 178-184.

Demeter, Cs.; Matics, Zs.; Demeter-Jeremiás, A.; Mayer, A.; Bárdos, B.; Sándor, M.; Gerencsér, Zs.; Német, Z. (2025): Effect of dietary crude fibre content on the *Eimeria* oocysts excretion and production of growing rabbits. ACTA AGRONOMICA ÓVÁRIENSIS. 66(1), 23–38.

Peer-reviewed scientific papers published in Hungarian language

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