SOME DIGESTIVE-PHYSIOLOGICAL PARAMETERS OF EARLY-WEANED RABBITS FED NON-MEDICATED DIETS

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ABSTRACT

The effect of a non-medicated diet and of a feed additive consisting of natural ingredients on the growth of rabbits weaned early (on day 21) and on certain anatomical and physiological parameters of the digestive tract was examined. The aim of the study was to get more information on the developmental process of the digestive tract from birth to 42 days of age in order to decrease use of antibiotics and losses due to digestive disorders. New-born rabbits were examined weekly from 7 to 42 days of age. Body weight, quantity and pH of the gastric, small intestinal and caecal content, as well as the weight and length of the empty stomach, small intestine, caecum and colon were measured. Composition of the caecal microflora and volatile fatty acid production were determined. It could be established that the early weaning of rabbits can be accomplished by the use of a non-medicated diet without any decrease in production. The body weight gain of rabbits fed a non-medicated diet and a feed additive containing natural basic ingredients was higher than that achieved by rabbits fed the conventional medicated diet. Differences between groups in certain parameters (gastric pH, composition of the microflora, VFA production) were temporary and they did not lead to development of enteropathy.

Key words: rabbit, early weaning, non-medicated diet, feed additive.

INTRODUCTION

Rearing losses in broiler rabbit production are primarily due to diseases of the digestive tract and to mortality resulting from this (GIDENNE and FORTUN-LAMOTHE, 2002). Apart from the losses caused, these diseases have a major impact on the welfare of animals as well. To reduce mortality, antibiotics are still being used widely; however, this gives cause for food safety and human health concerns.

In this experiment the effect of a non-medicated diet and of a feed additive consisting of natural ingredients on the growth of rabbits weaned early (on day 21) and on certain anatomical and physiological parameters of the digestive tract was studied.

MATERIALS AND METHODS

Pannon White does and their progeny were used in the experiment. The does were housed in flat-deck cages while the growing rabbits in two-level cages (2 kids/cage), in a closed building, with 16 light hours per day. The house for breeding was not air-conditioned and, therefore, the temperature occasionally reached 28 °C. The growing rabbits were kept at a temperature of 21–23 °C on a continuous basis.

The does were randomly distributed into three groups. From the time of 3 days before kindling up to weaning at 21 days of age, the rabbits were fed one of the three diets *ad libitum.* Some of the does kindled on day 31 and the remaining does were treated with oxytocin (5 IU/doe). Eight to 9 kits were placed into each litter. A total of 515 rabbits were used in the experiment.

Eight rabbits per group were examined weekly from 7 to 42 days of age. The rabbits were euthanised by an overdose of CO_2, bled, weighed, and the weight of the kidneys, liver, heart and lungs was measured. After removing the gastrointestinal tract, the quantity and pH of the gastric, small intestinal and caecal content, as well as the weight and length of the empty stomach, small intestine, caecum and colon were measured.

The rabbits were fed a basal diet containing 9.7 MJ DE/kg, 15.0% crude protein, 2.9% ether extract and 18.3% crude fibre. The diet of group 'C' (control) was not supplemented. To the diet fed to rabbits of group 'IM', a feed additive containing natural basic ingredients (Immunovet-HBM, 1 kg/t) was added, while the diet fed to group 'M' rabbits contained the medicaments (50 mg/kg tiamulin, 500 mg/kg oxytetracycline, 1 mg/kg diclazuril).

The active ingredients of the growth promotant containing natural base materials were benzoquinones (methoxy-p-benzoquinone and 2,6-dimethoxy-p-benzoquinone, etc.) produced during the fermentation of wheat germ with yeast, as well as other, hitherto precisely not identified biologically highly active substances that have antioxidant, immunostimulating and roborant properties and affect/stimulate the formation of certain growth factors (e.g. IGF-1 and IGF-2) and cytokines (SZENDE *et al.,* 1998)

The pH values were measured with a manual automatic pH meter (OP-110, Radelkis, Hungary).

For the microbiological examinations, a dilution series was made from 1 g of chyme. The following media were used for determination of aerobe germ count and the count of Bacteroides, coliforms, Lactobacilli and Streptococci: blood, agar, Schaedler agar supplemented with esculin, neomycin and Fe-ammonium-citrate, MRS, Edward's and Chromocult, respectively. Aerobs and Streptococci were incubated aerobically at 37 °C for 48 h, Lactobacilli and coliforms anaerobically at 37 °C for 48 and 24 h, respectively. Bacteroides were incubated under sever anaerobic conditions at 37 °C for 96 h. After incubation the colonies were counted under microscope. The colony counts were expressed as log 10 values.

The volatile fatty acid concentration of the caecal content was measured using gas chromatography (Shimadzu GC 2010, Japan).

The experimental data were evaluated by one-way analysis of variance using SPSS 9.0 programme package.

RESULTS AND DISCUSSION

The *body weight* was the highest in group IM throughout, with the exception of the day of weaning (day 21). The difference was significant on days 35–42 (Table 1). After birth the relative weight of the heart, kidneys and lungs, while subsequently that of the liver and gastrointestinal tract was higher. Significant difference between treatments was found only in gastrointestinal tract weight/body weight, which was the highest in group M at day 42.

The *weight of the gastric content* (data not shown) was the lowest in group M both prior to and after weaning. On day 21 a transient decrease could be observed in groups C and IM, which was attributable to the lack of appetite associated with weaning. The *pH of the gastric content* (Table 2) changed in conformity with the data of the literature and with our previous findings (GIDENNE and FORTUN-LAMOTHE, 2002; ZOMBORSZKY-KOVÁCS *et al*., 2002), and the pH value of <2 typical of adult rabbits developed by the second week after weaning (35 days of age). The pH of the gastric content remained significantly higher in group IM; however, this caused no change in the composition of the developing intestinal microflora (see later).

During the experiment there was no difference between the groups in the *weight of the small intestinal content*, with the exception of day 42, when it was significantly the lowest in group M (data not shown). The *pH* of the chyme increased from the initial value of around 6.0 up to day 21, then it was consistently around 7.8–8.0 in all three groups.

There were no inter-group differences in the *weight* and *pH of the caecal content* either (data not shown).

Within the composition of the intestinal microflora the *total aerobe germ count* was lower in the medicated group after weaning, but it was within the normal range in the other two groups as well (data not shown). The count of *Bacteroides*, the main constituent of the intestinal microflora, changed in conformity with the data of the literature (GOUET and FONTY, 1979; ZOMBORSZKY-KOVÁCS *et al*., 2002). The *coliform* count remained low in all cases. In group IM it transiently increased on the day of weaning (day 21), then decreased below 100/g of chyme by day 28. Larger numbers of *E. coli* were found only in group C (occasionally in the magnitude of several hundred thousand bacteria), while in groups IM and M the *E. coli* count was below 100/g of chyme. From day 14 the *Lactobacillus* and *Streptococcus* counts were below 100/g of chyme in all three groups.

The *volatile fatty acid concentration* of the caecal content reflects the intensity and character of microbial fermentation taking place in the caecum. In the present experiment the total volatile fatty acid content (*tVFA*) increased with age and from day 28 it was significantly higher in groups C and IM than in the rabbits receiving the medicated diet (Table 3).

Table 1. Body weight and relative weight of the organs (mean ± SD)

Group	Age (days)					
	7	**14**	**21**	**28**	**35**	**42**
	Body weight (g)					
C	153±23	257±55	383±55	587±101	941±92[a]	1008±137[a]
IM	180±23	290±45	431±59	657±134	987±118[a]	1117±205[a]
M	161±30	250±47	439±23	586±80	811±135[b]	768±119[b]
	Liver/body weight (%)					
C	3.1±0.3	2.7±0.3	3.6±0.7	4.4±0.8	4.8±0.8	4.3±0.6
IM	2.9±0.5	3.0±0.3	3.6±0.4	4.3±0.3	4.4±0.9	4.2±0.6
M	2.8±0.3	2.8±0.6	3.6±0.5	4.0±0.4	4.7±0.6	4.1±0.5
	Heart + kidneys + lungs/body weight (%)					
C	3.3±0.2	3.1±0.3	2.7±0.2	2.2±0.1	2.1±0.2	2.4±0.4
IM	3.5±0.3	3.0±0.2	2.8±0.2	2.4±0.3	2.0±0.4	2.2±0.4
M	3.5±0.2	3.3±0.7	2.6±0.2	2.3±0.1	2.1±0.2	2.4±0.5
	Total gastrointestinal tract/body weight (%)					
C	4.8±0.4	5.4±0.4	7.3±0.5	10.1±0.8	9.9±0.9	9.9±0.8[a]
IM	4.5±0.4	5.3±0.4	6.7±0.9	10.1±1.1	9.3±1.4	10.1±1.0[a]
M	4.5±0.3	5.6±0.4	6.9±0.6	10.7±1.5	10.7±2.2	12.0±1.3[b]

[a,b] significant difference between groups (P<0.05)

Table 2. The pH of the gastric content (mean ± SD)

Group	Age (days)					
	7	**14**	**21**	**28**	**35**	**42**
C	4.8 ± 0.3	5.7 ± 0.2	5.3 ± 0.1[a]	2.5 ± 0.8[a]	2.1 ± 0.3	1.7 ± 0.2[a]
IM	4.6 ± 0.5	5.5 ± 0.1	4.8 ± 0.4[b]	2.4 ± 0.6[a]	2.0 ± 0.5	2.0 ± 0.5[b]
M	4.2 ± 0.7	5.6 ± 0.2	5.0 ± 0.3[b]	1.7 ± 0.2[b]	1.9 ± 0.2	1.6 ± 0.1[a]

[a,b] significant difference between groups (P<0.05)

In conformity with data of the literature (BELLIER *et al.*, 1995; PADILHA *et al*. 1995; ZOMBORSZKY-KOVÁCS *et al*., 2002), the proportion of *acetic acid* within the tVFA was around 70–80%, and there were no major inter-group differences in this respect. Unlike other farm animals, adult rabbits are characterised by a dominance of butyric fermentation over propionic fermentation. In suckling rabbits the C3/C4 ratio is >1. After

Table 3. Composition of the caecal microflora (lg germ count/g chyme)

Group	Age (days)					
	7	14	21	28	35	42
	Total aerobe germ count					
C	3.6 ± 0.7	4.4 ± 0.7	4.1 ± 0.9	4.3 ± 0.6	4.3 ± 1.0	5.2 ± 0.6
IM	4.8 ± 1.0	4.8± 0.4	5.4 ± 0.6	4.6 ± 0.8	3.7 ± 0.6	5.7 ± 0.6
M	4.6 ± 0.8	5.6 ± 0.7	5.2 ±0.5	3.1 ± 0.1	3.3 ± 0.4	4.4 ± 0.6
	Bacteroides					
C	8.2 ± 0.5	8.1 ± 0.2	9.7 ±0.6	9.1 ± 0.3	8.2 ± 0.9	8.2 ± 0.3
IM	7.8 ± 0.1	9.4 ± 0.7	10.0 ± 0.3	8.9 ± 0.7	8.6 ± 0.3	8.7 ± 0.4
M	8.3 ± 0.4	8.4 ± 0.6	10.1 ± 0.1	9.9 ± 0.6	8.5 ± 0.6	8.2 ± 0.4
	Coliforms					
C	2.0 ± 0.3	3.5 ± 0.5	3.5 ± 0.4	3.1 ± 0.6	< 2	< 2
IM	3.6 ± 0.5	3.3 ± 0.4	5.0 ± 1.3	2.0 ± 1.7	< 2	< 2
M	2.5 ± 0.4	4.0 ± 0.8	3.1 ± 0.2	< 2	< 2	< 2

Table 4: Volatile fatty acid content of the caecal chyme (mean ± SD)

Group	Age (days)					
	7	14	21	28	35	42
	tVFA (mmol/kg)					
C	12.8±4.9	13.3±5.6	45.7±9.6	93.3±19.8^{a}	91.8±9.4^{a}	104.2±16.7^{a}
IM	8.5±3.8	20.9±6.0	57.1±17.5	84.5±12.9^{a}	68.3±15.5^{b}	72.7±17.5^{b}
M	10.9±3.0	23.1±8.1	54.6±16.9	52.2±9.1^{b}	50.8±12.8^{c}	43.0±12.7^{c}
	Acetic acid (mol%)					
C	72.7±8.6	73.0±11.9	73.2±5.4	74.9±3.8	78.1±3.3	76.6±4.0
IM	75.0±11.9	76.8±9.5	72.1±4.9	78.1±1.9	77.8±3.8	76.7±4.5
M	86.8±8.1	87.6±3.5	75.6±4.8	78.8±4.5	76.9±3.6	75.1±2.1
	Propionic acid (mol%)					
C	14.6±2.3	17.0±3.6^{a}	16.0±2.2	13.7±6.5	8.0±1.1^{a}	8.3±1.3^{a}
IM	12.2±3.7	16.0±4.0^{a}	16.6±2.4	11.7±2.9	9.2±1.5^{a}	9.7±1.1^{a}
M	9.4±1.9	8.8±2.8^{b}	14.9±5.4	11.8±1.8	12.8±4.9^{b}	12.7±3.4^{b}
	Butyric acid (mol%)					
C	4.3±1.7	3.9±1.6^{a}	7.3±1.2	11.0±3.1^{a}	13.4±3.2	13.2±2.6
IM	5.2±3.5	4.6±1.5^{a}	6.1±1.5	9.6±2.4^{a}	9.5±1.7	11.9±3.5
M	3.2±1.9	1.6±0.8^{b}	5.8±1.7	7.8±1.1^{b}	9.4±1.7	10.5±3.3

^{a,b} significant difference between groups ($P<0.05$)

the change-over to the consumption of solid feed the percentage proportion (mol %) of propionic acid decreases while that of butyric acid increases, resulting in continuously decreasing C3/C4 values. In the present experiment this was found in groups C and IM, while in Group M the proportion of butyric acid was lower than that of propionic acid even on the 42nd day.

CONCLUSIONS

From the results of this study it can be established that the early weaning of rabbits can be accomplished by the use of a non-medicated diet without any decrease in production. The body weight gain of rabbits fed a non-medicated diet or a feed additive containing natural basic ingredients was higher than that achieved by rabbits fed the conventional medicated diet. From the results it appears that the studied feed additive exerts its beneficial effect by stabilising the caecal microflora (like the medicament used) and induction of more favourable fermentation process.

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