EFFECTS OF ZINC BACITRACIN ON PERFORMANCE, DIGESTIBILITY AND CAECAL DEVELOPMENT OF GROWING RABBITS

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ABSTRACT

Zinc bacitracin is an antibiotic growth promoter (AGP) commonly used in rabbit production to prevent mortality provoked by epizootic rabbit enterocolitis in the growing period. In 3 trials, mixed-sex weaned rabbits were used to evaluate the effect of zinc bacitracin on 1) growth performances and mortality; 2) digestibility; 3) caecal development and concentrations of caecal bacterial populations. Two experimental treatments were applied to a common pelleted basal diet as follow: Control (no AGP); and AGP (0.1 g Zn-Bacitacin kg^{-1} diet). Experimental diets were offered *ad libitum* from the weaning (32 days of age) to the end of trial. On the growth trial 160 rabbits were controlled from day 32 to day 67. The weight of rabbits at 67 days with antibiotic and control were 2024 and 2026 g, respectively. Although not significantly (P=0.17), the AGP group showed lower mortality values (2.5%) than the control (8.8%). In the digestibility trial, 2 groups of 10 rabbits were allotted to the previous dietary treatments. Digestibility was measured from d41 to d46. The zinc bacitracin did not significantly affect the digestibility of major diet nutrients. In the third trial 8 rabbits per treatment were slaughtered at d46. No significant effects of AGP on caecal development were found. However, the AGP group showed lower levels of caecal bacterial populations as well as lower pH values (P<0.05).

Key words: rabbit, performances, caecal development, digestibility, zinc bacitracin.

INTRODUCTION

Digestive disorders are a common problem in weaning rabbits. The most common prevention of these digestive disorders is the use of antibiotics. When included at subtherapeutic concentration, as antibiotic growth promoter (AGP), they modify the gut flora, suppress bacterial catabolism and reduce bacterial fermentation. These changes lead to an improved health state and increased nutrient availability for the animal, thus increasing growth performance (VANDAELE, 1980; SZABÓ *et al*. 1988; SKRIVANOVA *et al*. 1999). Zinc bacitracin, the most used AGP in rabbit production, is commonly used to reduce mortality in growing rabbits originated by epizootic enterocolitis. In farms affected by epizootic enterocolitis the use of zinc bacitracin reduce mortality and significantly improve daily weight gain of growing rabbit after weaning (RICHARD *et al*., 2000; DUPERRAY *et al*., 2000). However, the information on the use of zinc bacitracin is limited and mainly concern to growth performances and mortality and, as far we know, no studies were done on effects of AGP on digestibility and caecal microbial population. Research in chicken broilers has shown that zinc bacitracin, decreased the growth of clostridia, anaerobic cocci, enterococci and coli-areogenic bacteria on caecal contents (HOCK *et al*., 1997). The study of these effects on rabbit will contribute; in our opinion; to a better understand of AGP action and to obtain alternatives to its use, as recently recommended by the European Union.

The objective of this experiment was to study the effects of zinc bacitracin on several parameters of the rabbit microbial fermentation and on zootechnical performances. For this purpose, effect of AGP on growth performances, total digestibility, caecal development (organ and content weight) and bacterial concentration were investigated.

MATERIAL AND METHODS

Two experimental treatments were applied to a common basal diet. A commercial antibiotic growth promoter (AGP; zinc bacitracin) was added (Table 1) at two different concentrations (Control diet; 0 $g.kg^{-1}$; AGP diet 0.1 $g.kg^{-1}$). The common basal diet met the nutritive requirements for fattening rabbits (GIDENNE, 2000).

Table 1. Major ingredients and determined chemical analysis of experimental diets ($g.kg^{-1}$ DM)

Ingredients	**($g.kg^{-1}$)**	**Chemical analysis**	**($g.kg^{-1}$ DM)**
Dehydrated alfalfa	233.0	Organic matter	895.0
Sunflower meal	176.0	Crude protein	155.8
Wheat	106.0	Starch	160.2
Beet pulp	98	Neutral-detergent fibre	347.7
Molasses	60.0	Fat	33.6
Citrus pulp	60.0		
Corn destiller's grain dehydrated	50.0	Estimate digestible	
Barley	50	energy ($kcal.kg^{-1}$ feed)	2356
Wheat bran	49.0		
Grape-seed meal	37.0		
Sunflower hulls	20.0		
Animal fat	8.0		
Sunflower oil	5.0		
Minerals, vitamins and supplements	47.7		

From weaning (d32) to slaughter (d67) the diets were given *ad libitum* to 2 groups of 80 UPV rabbits housed in cages with eight animals each. Feed intake and cage live-weight were controlled between the beginning and end of fattening period. When a rabbit death occurred, the weight of remaining rabbits and feed in the cage were controlled, which permit to calculate correctly the weight gain and feed intake. Mortality, weight gain, feed consumption, feed conversion ratio (FCR; feed consumption/weight gain) per cage and rabbit average weight were determined. Total apparent digestibility was measured, according to PEREZ *et al*. (1995), in two groups of nine rabbits housed in individual cages. On a total of 8 animals sacrificed per treatment at d46 caecal development was measured and caecal content collected for evaluation of pH and bacterial concentration. The samples of caecum content were placed in sterile tubes, and weighed. For total bacteria count, coliforms and *enterococci* further decimal dilutions of the samples were prepared in 0.1% peptone solution (Merck 1.07228). Total Bacteria Count, Coliforms and Enterococci were enumerated using pour plate technique on PCA, MacA, and SLA, respectively. The plates were incubated aerobically for 24 h at 37 ºC. The counts were determined according of the method FDA (MATURIN and PEELER, 1998). Bacterial concentrations were subject to log 10 transformations prior to analysis.

Dry matter, ash, crude protein (nitrogen × 6.25) and fat contents were determined according to the procedures of the AOAC(1990). Starch content was determined by enzymatic hydrolysis of starch to glucose as described by SALOMONSSON *et al.* (1984). Neutral detergent fibre (NDF) content was determined after hydrolysis with α-amylase according to the procedures described by VAN SOEST *et al.* (1991).

Mortality was analysed with χ^2 test. Data on growth performance, digestibility coefficients and caecal development and bacterial concentration were examined by one-way analysis of variance using the GLM procedure of SYSTAT 5.0 (1992).

RESULTS AND DISCUSSION

The growth performances were not significantly increased (P>0.05) by AGP supply during the growing period (Table 2). The FCR was lowered by 12% during this period (32-76d), but the effect was not significant (P=0.18). Zn-bacitracin, was also tested in rabbits by ABU-EL-ZAHAB *et al*. (1992), and RICHARD *et al*. (2000). ABU-EL-ZAHAB *et al*. (1992), observed a significant improvement in FCR but no evident effects in weight gain. Significant increases of weight at slaughter age were observed in rabbits with zinc bacitracin (RICHARD *et al*., 2000) or other AGP (SZÁBO *et al*., 1988; SKRIVANOVA *et al*., 1999).

Table 2. Feed Intake and growth performances according to bacitracin of zinc supply, in rabbits from weaning (32d old) to slaughter (67d old), (n=10).

	Control diet	AGP diet	SEM [1]	P level
Rabbits cage weight at 32 days (g)	5296	5027	142.8	ns
Rabbits cage weight at 67 days (g)	14860	15803	543.2	ns
Rabbit weight at 32 days (g)	662	628	17.9	ns
Rabbit weight at 67 days (g)	2026	2024	40.9	ns
Total cage weight gain (32 at 67 days) (g)	9564	10777	501.5	ns
Total feed intake (32 at 67 days) (g)	29403	31139	920.1	ns
Feed conversion ratio	3.29	2.90	0.145	ns
Mortality rate	7 (8.8%)	2 (2.5%)	0.185	ns

[1]SEM: standard error of mean; ns = P>0.05.

Zinc bacitracin lowered (8.7% vs. 2.5%), but on a non-significant way (P>0.05), the rabbit mortality during the growth period (Table 2). Even in the control group, mortality was lower than average values normally observed on commercial farms. Also DUPERRAY *et* *al.* (2000) and RICHARD *et al.* (2000) observed a significant reduction in mortality with zinc bacitracin. Probably, the low mortality and satisfactory health state of the rabbits during the growing period contributed to the similar growth performances observed between the two groups.

Supplementation of feed with AGP had no effect (P>0.05) on apparent digestibility of dry matter, crude protein, fat, starch and NDF (Table 3). A tendency (P=0.07) for higher organic matter digestibility was observed in control fed rabbits. SKRIVANOVA *et a*l. (1999), observed a decrease on crude fibre digestibility and an increase on fat digestibility with diets containing virginiamycin. Total apparent digestibilities were similar to the data published by SKRIVANOVA *et al.* (1999) and GIDENNE *et al*. (2000).

Table 3. Total apparent digestibility (%) of major nutrients, according to diet in rabbits from d42 to d46 (n=9).

	Control diet	AGP diet	SEM [1]	P level
Dry matter	70.6	69.4	0,48	ns
Organic matter	79.5	78.2	0.36	0.07
NDF	45.4	46.0	0.85	ns
Crude Protein	75.2	75.7	0.45	ns
Starch	98.3	98.3	0.08	ns
Fat	88.4	87.5	0.70	ns

[1]SEM: standard error of mean; ns = P>0.05.

Caecum is the major organ where microbial activity takes place in rabbits. Caecal microbial population secretes enzymes capable to hydrolyse the main components of the dietary fibre. In this assay, AGP did not affect caecal weight (Table 4). The data observed were similar to the data published by PINHEIRO and GIDENNE (1999). The caecal pH is lower (P<0.05) in AGP group (table 4).

Table 4. Effect of zinc bacitracin supply in caecal development of rabbits slaughtered at 46 days old (n=8)

	Control diet	AGP diet	SEM [1]	P level
Caecum weight (g/kg LW [2])				
Full	8.52	8.50	0.80	ns
empty	1.73	1.68	0.09	ns
content	6.69	6.82	0.71	ns
Length (cm/100 g LW [2])	3.78	3.27	0.16	0.06
pH	6.33	5.87	0.17	0.044
Dry matter (%)	16.34	19.86	0.84	0.012

[1]SEM: standard error of mean; ns = P>0.05. [2] LW: live weight.

The lower caecal pH resulted from an increase of caecal AGV concentration (PINHEIRO *et al*, 2004). PROHASZKA (1980) in *in vitro* studies found that high VFA concentration and a low cecal pH have a negative effect on the proliferation of *E. coli*. This was confirmed by PEETERS *et al*. (1995) who found that high VFA levels and a reduced cecal pH in rabbits create a non-favourable environment to pathogen microorganisms, having a protective effect against enteropathogentic *E. coli* infection (MORISSE *et al.*, 1985). The caecal dry matter significantly (P<0.05) increased with AGP (Table 4), which probably induced better caecal conditions for favourable microbial activity, decreasing the sanitary risk.

The concentration of different bacterial population on caecal content, decreased significantly in growing rabbits with AGP diet (Table 5). AGP reduced coliforms population in half (P<0.01) and total bacteria count in 26% (P<0.05). Enterococci were reduced to non detectable levels. Possibly, these data can result from a limitation of growth of caecal microbial population by zinc bacitracin (SKRIVANOVA *et al.,* 1999). HOCK *et al*. (1997) have shown that the use of zinc bacitracin in broilers chickens significantly decrease the growth of caecal microbial population. However, this decrease of bacterial population didn't impair the caecal fermentation activity, since the fibre digestibility was not influenced.

Table 5 - Effect of zinc bacitracin supply in concentrations of different bacterial populations (log cfu/g) on caecal content of rabbits at 46 days of age (n=8).

	Control diet	AGP diet	SEM [1]	P level
Coliforms	6.28	3.09	0.65	0.005
Enterococci	4.39	nd	-	-
Total bacteria count	5.83	4.34	0.35	0.028

[1] - SEM: standard error of mean; ns = P>0.05; nd – not detected.

CONCLUSION

In conclusion, the main effect of zinc bacitracin on the growing rabbits is the decrease of caecal bacterial population. Although, a reduction of caecal pH and increase the caecal dry matter were observed, indicating an alteration of fermentative characteristics of cecum, no evident effects were observed on total digestibility of dry matter and NDF. Zinc bacitracin could contribute to reduce mortality. In the present essay the AGP decreased mortality by 6.2 points, however this effect was not significant.

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