PERFORMANCE OF GROWING RABBITS FED DIETS SUPPLEMENTED WITH SANGROVIT® IN INTERACTION WITH THE FEEDING PLAN

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ABSTRACT

Fattening rabbit mortality during the 50-60d period is generally in relation with digestive troubles like diarrheas and enterocolitis. Out of the antibiotics, one of the solutions used to control this mortality is the feed restriction, which significantly decreases mortality, but simultaneously reduces growth rate. The feed additive Sangrovit®, is a natural product extracted from *Macleaya cordata*, plants belonging to the Papaveraceae family, which contains quarternary benzophenanthridine and protopine alkaloids (QBA PA) of which sanguinarine has the highest content. The QBA PA alkaloids as sanguinarine are phytoalexine substances produced by the plants to inhibit further growth of bacteria, fungi and viruses. The aim of the present study was to determine the effect of Sangrovit® on viability, growth and slaughter performance of fattening rabbit between weaning and slaughter time. A trial was carried out with an experimental design 3x2 with the dosage of Sangrovit® (0, 40 and 80 ppm) as the first factor and the feeding plan as the second factor (restricted feeding versus *ad libitum* feeding). Rabbits (1573) were distributed in 6 homogenous groups composed of 53 cages of 5 rabbits each, where they were fed from weaning to slaughtering. This work confirms that, without the additive, the feed restriction reduced mortality (11.0 *vs* 17.7%; P<0.05) and the feed conversion ratio (3.84 *vs* 4.06) but also reduced growth rate (39.6 *vs* 43.1 g/d; P<0.01). The addition of 40 ppm of Sangrovit® induced a significant reduction of mortality (P<0.05) but an unexplained late mortality erased the benefit. At the opposite, the dosage of 80 ppm of Sangrovit® decreased significantly (P < 0.05) the mortality in *ad libitum* conditions (9.4% vs 17.7%). Whatever the dosage, Sangrovit® has no average effect on growth rate, feed efficiency or slaughter rate, but the lower mortality reduced the economical feed conversion ratio. This publication shows that the dosage of an additive is different according to the feeding plan. In conditions of feed restriction, the recommended dosage is 40 ppm. In *ad libitum* conditions, 80 ppm of Sangrovit® has the same effects on mortality than the restriction feeding, keeping the positive effects on the growth of feeding *ad libitum*. Consequently, the profit of rabbits fed *ad libitum* with 80 ppm of Sangrovit® is higher than the one of rabbits feed restricted without Sangrovit®.

Key words: Fattening rabbits, Sangrovit®, digestive troubles, feed restriction.

INTRODUCTION

Fattening rabbit mortality during the 50-60d period is generally related to digestive troubles like diarrhea and enterocolitis (Fortun-Lamothe and Gidenne, 2006). During the past years antibiotics were often used to solve these difficulties. At the same time, alternative solutions were studied to replace antibiotics (Maertens *et al.*, 2006). One of these solutions is the feed restriction, *i.e.* the daily distribution of a limited quantity of feed per rabbit according to its age. It allows a significant decrease of mortality, but simultaneously reduces growth rate (Boisot *et al*., 2005; Foubert *et al.*, 2008; Martignon *et al.*, 2009). The feed additive Sangrovit®, produced and patented by the German company Phytobiotics Feed Additive GmbH, is a natural product extracted from *Macleaya cordata* plants, belonging to the Papaveraceae family, which contains quarternary

benzophenanthridine and protopine alkaloids (QBA PA) of which sanguinarine has the highest content (1.5% according to Vieira *et al.*, 2008). The QBA PA alkaloids are substances produced by the plants to inhibit further growth of bacteria, fungi and viruses (Schmeller et al., 1997). The *Arctomecon humilis* plant, that also contains sanguinarine, is eaten by rabbit in its natural habitat without causing mortality (Raynie et al., 1991). Consequently, the Sangrovit® can have a positive effect on the rabbit viability, because of its anti-inflammatory effect (Lenfeld et al., 1981), its antimicrobial effects (Lenfeld et al., 1981; Dzink and Socransky, 1985; Dvorak and Simanek, 2007) and its antioxidant effects (Chaturvedi et al., 1997). The aim of the present study was to determine the effect of Sangrovit® on the viability, growth and slaughter performance of growing-fattening rabbits in interaction with the feeding plan.

MATERIALS AND METHODS

A trial has been carried out from the 6th February 2011 to the 17th March 2011. The experimental farm (EARL 3L) doesn't use antibiotics since 2003 in any form.

Animals and experimental design

At weaning (36 d of age), 1573 Hyplus PS19 x PS40 hybrid rabbits of both sexes were divided in 6 homogeneous groups according to weaning weight. The slaughtering age was 74 d. The rabbits were placed in collective cages of 5 rabbits. The fattening unit contained 6 x 57 flat-deck cages (dimensions: 39 x 90 cm). Each line corresponds to a treatment, a former methodological study having shown that this arrangement of the cages doesn't interfere with the experimental results (Revois, 2009). Mechanical ventilation was used in the unit but without heating system. The trial corresponded to an experimental design 3x2 (Table 1) with the dosage of Sangrovit® (0, 40 and 80 ppm) as the first factor and the feeding plan as the second factor (2 levels: restricted versus *ad libitum* feeding).

Table 1: Experimental diets

Diets	SANGROVIT	Feeding	Number of cages	Number of rabbits
C-R		Restricted	53	264
C-AL		*Ad Libitum*	52	260
S40-R	40 ppm	Restricted	53	265
S40-AL	40 ppm	*Ad Libitum*	53	265
S80-R	80 ppm	Restricted	53	263
S80-AL	80 ppm	*Ad Libitum*	52	256
		TOTAL	**316**	**1573**

Feeds

The basic diet formula corresponds to the control diet already used (Colin *et al.*, 2007). The feed nutritional value is: 2180 kcal of digestible energy (according to the table INRA 2002; Sauvant *et al.*, 2002), 15.1% of crude protein, 3.3% of fat, 7.7% of ash, 20.5% of crude fiber (Weende) and 8.7% of lignin (ADL).The Sangrovit® has been incorporated in substitution of the sunflower seed meal by the use of a concentrate, in order to guarantee the homogeneity of the Sangrovit® in the feed. The concentrate of Sangrovit® containing sodium chloride (30%) and wheat bran (70%) was incorporated at 0, 2 and 4 kg/T. The feed formula modification induced by these incorporations had negligible effect. The program of feed restriction is that recommended by the Hypharm Company (France) for its commercial hybrid rabbits PS19 x PS40 (Figure 1).

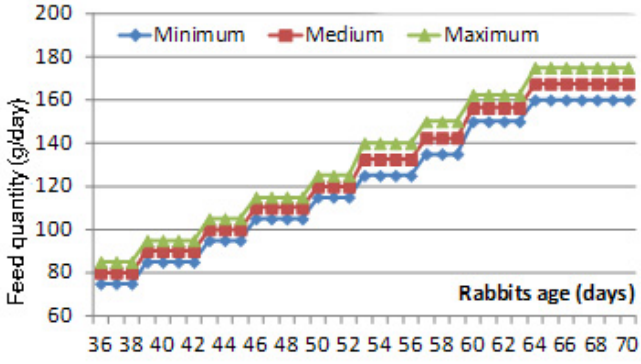

Figure 1: The feeding plan

Measured criteria

The animals were weighted collectively per cage at 36, 55 and 69 d of age and all together at 74 d. The mortalities were registered daily and apparent causes were characterized for a minimal of 90% of the dead animals and classified in 5 categories: diarrheas, caecal compaction, enterocolitis, respiratory problems, other. One dead animal can be affected to several categories. The feed intake per diet was estimated for all the growing-fattening period (weight of the distributed and remaining feed intake at the end) in order to calculate the economical and technical feed conversion ratio. For the last one, the feed intake of the dead rabbits was calculated according to the death date estimating their feed intake from the feed intake of the live rabbits. The proportion of small rabbits (number of rabbit inferior to 1 kg carcass weight in percentage of the number of slaughtered rabbits), seizure (seized weight divided by slaughtered weight) and the slaughtering yield were carried out according to the method of the slaughter company Loeul-et-Piriot in Lignol (France).

Statistical analysis

The continuous variables were studied by 2 x 3 factorial variance analysis with feeding plan (FP) and Sangrovit® (SGT) inclusion, as controlled factors, with interaction FP/SGT (Dagnelie, 1970). The mortalities were treated according to the same statistical design applied on the Boolean values 1 for dead rabbits and 0 for rabbit alive at the end of the considered period.

RESULTS AND DISCUSSION

Mortality

The average mortality of the treatments in feed restriction (11%) corresponds to the usual values at this farm (Teillet *et al.*, 2011). The results confirm that the feed restriction without Sangrovit® decreased significantly the mortality during all the growing-fattening period ($P < 0.05$) particularly the mortality by enterocolitis between 50 and 60 d of age (Table 2) as obtained Boisot *et al.*, 2005; Foubert *et al.*, 2008;

Table 2: Mortality results

Treatments		**C-R**	**C-AL**	**S40-R**	**S40-AL**	**S80-R**	**S80-AL**	**Total or average**	**Stand. Deviat**	**Probability**		
Sangrovit®		0 ppm	0 ppm	40 ppm	40 ppm	80 ppm	80 ppm			FP	SGT	Interact°
Feeding		Restrict.	*Ad lib.*	Restrict.	*Ad lib.*	Restrict.	*Ad lib.*					
Number of rabbits		264	260	265	265	263	256	1573	-	-	-	-
Mortality (%)	36-55 d	3.4 ab	6.2 b	2.3 a	4.9 ab	4.6 ab	5.5 ab	4.5	0.206	0.044	0.486	0.711
	55-74 d	7.8 ab	12.3 b	6.6 a	8.7 b	7.2 ab	4.1 a	7.8	0.224	0.335	0.478	0.011
	36-74 d	11.0 a	17.7 b	8.7 a	13.2 ab	11.4 ab	9.4 a	11.9	0.296	0.033	0.576	0.021
Mortality by diarrhea (%)	36-55 d	2.3 a	3.1 a	2.3 a	1.1 a	3.8 a	2.0 a	2.4	0.158	0.217	0.310	0.397
	55-74 d	2.7 ab	4.1 b	0.8 a	4.4 b	2.0 ab	1.2 a	2.5	0.145	0.075	0.288	0.102
	36-74 d	4.9 ab	6.9 b	3.0 a	5.3 ab	5.7 ab	3.1 ab	4.8	0.212	0.765	0.535	0.151
Mortality by enterocolitis (%)	36-55 d	0.8 a	3.1 b	0.0 a	3.0 b	0.8 a	3.5 b	1.8	0.145	0.002	0.551	0.758
	55-74 d	3.9 b	2.0 ab	2.3 b	4.4 b	4.8 b	1.2 a	3.1	0.153	0.539	0.837	0.003
	36-74 d	4.5 ab	5.0 b	2.3 a	7.2 b	5.3 b	4.7 b	4.8	0.209	0.080	0.943	0.032
Mortality caecal compact. (%)		0.4 ab	1.9 b	0.8 ab	1.1 ab	0.0 a	0.8 ab	0.8	0.091	0.049	0.375	0.576

Martignon *et al.*, 2009. The incorporation of Sangrovit® in the feed had different effects according to the dosage in interaction with the feeding plan. Indeed, at the dosage of 40 ppm, the Sangrovit® overall had no effect on mortality (Table 2). But if the last 2 days are not considered (the increase of mortality during these 2 days was not explicable), the Sangrovit® decreased significantly ($P < 0.05$) the mortality in condition of feed restriction, whereas there was no effect in conditions of *ad libitum* feeding. At the opposite, the dosage of 80 ppm Sangrovit® decreased significantly ($P < 0.05$) the mortality in *ad libitum* feeding, particularly the mortality by diarrhea at the beginning of the growing-fattening period (Table 2). Consequently, the total mortality of the rabbits fed *ad libitum* with the feed containing 80 ppm of Sangrovit® (9.4%) was not significantly different of the control diet restricted.

Growth and feed efficiency

The feed restriction decreased significantly the weight of rabbits and the growth during all the growing-fattening period (Table 3) in agreement with the literature (Boisot *et al.*, 2005; Foubert *et al.*, 2008; Martignon *et al.*, 2009). Whatever the dosage of Sangrovit® and the feeding plan, the Sangrovit® had no effect on the live weight neither the daily growth (Table 3). This result is in opposite to the literature in poultry and pig production, where the Sangrovit® increases the growth rate due to an improvement of the amino acids availability (Vieira *et al.*, 2008; Tschirner, 2008; Ilsley, 2004).

Table 3: Results of weight, average daily growth, feed conversion ratio and slaughter performance

Treatments		**C-R**	**C-AL**	**S40-R**	**S40-AL**	**S80-R**	**S80-AL**	**Total or Average**	**Stand. Deviat°**	**Probability**		
Sangrovit®		0 ppm	0 ppm	40 ppm	40 ppm	80 ppm	80 ppm			FP	SGT	Interact°
Feeding		Restrict.	*Ad lib.*	Restrict.	*Ad lib.*	Restrict.	*Ad lib.*					
Weight (g)	36 d	1070 a	1067 a	1070 a	1063 a	1073 a	1066 a	1068	78	0.508	0.972	0.976
	55 d	1889 b	1920 a	1901 a	1913 a	1854 b	1955 a	1905	142	0.014	0.959	0.060
	69 d	2417 b	2532 a	2441 b	2533 a	2410 b	2566 a	2483	165	0.001	0.958	0.385
Average Daily Gain (g/d)	36-55 d	41.0 b	42.6 ab	41.6 b	42.5 ab	39.1 c	44.4 a	41.8	5.5	0.001	0.889	0.010
	55-69 d	37.7 b	43.7 a	38.5 b	44.3 a	39.7 b	43.6 a	41.2	7.6	0.001	0.824	0.552
	36-69 d	39.6 b	43.1 a	40.3 b	43.2 a	39.3 b	44.1 a	41.6	4.0	0.001	0.895	0.236
Feed conv. ratio	Tech.	3.84	4.06	3.79	4.06	3.83	4.01	3.94	only 1 measure per treatment			
	Eco.	4.36	5.09	4.17	4.75	4.38	4.46	4.52				
Weight at 74 d (g)		2534	2621	2541	2613	2542	2628	2579				
Slaughter perform. (%)	too small	1.52 a	1.92 a	1.51 a	1.13 a	0.38 a	1.17 a	1.27	0.112	0.631	0.392	0.691
	seizure	2.17 b	0.34 a	0.54 ab	0.95 ab	0.35 a	0.42 a	0.80	0.089	0.257	0.171	0.047
	carc.%LW	58.1 ab	57.5 b	57.8 ab	58.2 a	57.3 b	58.4 a	57.9	0.023	0.018	0.502	0.000
Profit €/weaned rabbit		0.77	0.51	0.84	0.64	0.72	0.76	0.71	-	-	-	-

The feed restriction seems to reduce the technical and economical feed conversion ratio, despite the reduction of the weight at slaughter time: 3.82 *vs* 4.04 and 4.30 *vs* 4.77 on average for the technical and economical feed conversion ratios respectively. This effect was previously observed by Boisot *et al.* (2005), Foubert *et al.* (2008) or Martignon *et al.* (2009). Whatever the dosage of Sangrovit® and the feeding plan, the Sangrovit® had no effect on the technical feed conversion ratio. Like the growth, this result is in opposite to the literature in poultry and pig production (Vieira *et al.*, 2008; Tschirner, 2008; Ilsley, 2004). In the other hand, in condition of *ad libitum* feeding, the Sangrovit® seems to decrease the economical feed conversion ratio, due to the important decrease of the mortality.

Slaughter results

The proportion of small non marketable rabbits at sale was affected neither by the feeding plan nor by the Sangrovit®. The seizure's rate of the control treatment in condition of feed restriction was abnormally high in this experiment without explanation. The *ad libitum* feeding generally increases the seizure's rate in direct relation to the higher mortality. However, this effect was not observed in this experiment. The Sangrovit® did not affect it too. The feed restriction decreased significantly the carcass yield. This effect does not seem to be indicated in the literature. The Sangrovit® had no specific effect on slaughter rate.

CONCLUSIONS

This publication confirms that the feed restriction decreases mortality, growth rate, but increases the feed conversion ratio. Sangrovit® decreases mortality, in particular by enterocolitis. This work shows that the efficient dosage for an additive may be different according to the feeding plan. In condition of feed restriction, the recommended dosage approaches 40 ppm. At 80 ppm, in *ad libitum* condition, the Sangrovit® allows the same effect than the feed restriction to decrease the mortality, keeping the positive effect of the *ad libitum* feeding on growth.

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