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TECHNICAL NOTE: HEALTH STATUS AND GROWTH PERFORMANCE OF RABBITS FED DIETS WITH DIFFERENT STARCH LEVEL DURING THE POST-WEANING PERIOD

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Abstract: A total of 240 rabbits (Hyplus®), weaned at 35 days of age, were used for growth rate and health status evaluation. Rabbits were divided into two groups (group S14 and group S12), and fed diets S14 (diet Starch 14%) and S12 (diet Starch 12%) formulated according to the most recent recommendations for rabbit feeding. The study was performed on a commercial farm. The diets were similar in the level of crude protein, fibre fractions and fat, but differed in the level of starch (14.4 *vs.* 11.9% in the S14 and S12 diets, respectively) and consequently digestible energy (10.0 *vs.* 9.6 MJ/kg), as well as in the digestible protein/digestible energy ratio. Rabbits of the S14 group received diet S14 from weaning to slaughter (77 days of age). Those in the S12 group received diet S12 from weaning to 49 days of age and were then fed with the S14 diet till slaughter. No significant differences were observed in feed intake between groups. For the entire fattening period, the weight gain values observed for the rabbits of the S12 group, were lower than those observed of the S14 group, but non significant differences were recorded (39.9 *vs*. 41.3 g/d, *P*=0.10). Rabbit mortality was relatively low and no significant differences were recorded between groups, either during post-weaning or in the finishing period. However, both morbidity (*P*=0.01) and health risk index (*P*=0.03) were observed to be significantly higher in rabbits of the S12 group than in those of the S14 group. The highest number of sick rabbits in the S12 group was recorded before the change of diet. Similar morbidity was subsequently observed in both groups. It can be concluded that *i)* a lower dietary starch level did not prevent digestive troubles in weaned rabbits and *ii)* a 14% dietary starch level is suitable for both growth and good health status in the post-weaning and finishing period.

Key words: rabbit, starch, feeding, health, growth performance.

INTRODUCTION

Growing rabbits are very susceptible to digestive disorders. According to Licois (2004), the etiology of the intestinal infections is still not clear since there are often multiple causes, and symptoms are comparable. A key role in the prevention of digestive troubles is played by feeding diets with the correct supply of fibre fractions (Bennegadi *et al*., 2001; Gidenne, 2003; Gidenne *et al*., 2004a). Another important factor is to decrease the dietary level of starch, mainly in the post-weaning period (Blas *et al*., 1994; Lebas and Fortun-Lamothe, 1996).

To ensure the digestive security of growing rabbits, it is recommended to maintain dietary starch below 14% during the post-weaning period, while it is possible to increase this level to 18% during the finishing period (Perez *et al*., 2000). However, other authors did not observe a high dietary starch

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level to have a negative effect on the digestive health of kits (Gutiérrez *et al.*, 2002; Xiccato *et al.*, 2002; Gidenne *et al.*, 2005). The literature therefore provides conflicting results regarding the effect of dietary starch level on digestive ailments in growing rabbits.

The aim of this study was to verify whether a low dietary starch level in the post-weaning period is related to the prevention of digestive troubles in rabbits. Two levels of dietary starch (14 and 12%) were used for the evaluation of health status and growth performance under practical conditions on a commercial farm.

MATERIAL AND METHODS

Animals, diets and recordings

A total of 240 Hyplus® rabbits (915 ± 83 g), weaned at 35 days of age, were randomly allocated to two groups (group S14 and group S12). The experiment was performed on a commercial farm, in the autumn-winter period. The environmental conditions were controlled by an automatic heating system (a minimum temperature of 16°C). At weaning, rabbits were moved from the maternal sector to the fattening sector and put in all-wire cages (30 × 30 × 33 cm), two per cage.

Two diets (diet S14 with 14% starch and S12 with 12% starch) were formulated according to recent recommendations for rabbit feeding (Lebas, 2004) (Table 1). S12 contained a lower level of barley and a slightly higher level of oats, wheat bran and sunflower meal than S14. The diets had similar contents

Table 1: Ingredients and chemical composition of experimental diets.

	Diet			Diet	
	S14	S12		S14	S12
Ingredients, %			*Chemical composition, %*		
Alfalfa meal	30	30	Dry matter	91.0	91.1
Sunflower meal	13	15.5	Crude protein	16.7	16.8
Soyabean meal	2	2	NDF	36.2	37.2
Wheat bran	26	27	ADF	19.3	19.9
Sugar beet pulp	4	4	ADL	6.0	6.3
Oats	6	8	Hemicelluloses (NDF-ADF)	16.9	17.3
Barley	14.5	9	Cellulose (ADF-ADL)	13.3	13.6
Rapeseed oil	1.5	1.5	ADL/cellulose ratio	0.45	0.46
Vitamin supplement[1]	1	1	Pectins (water insoluble)[2]	4.9	5.1
Dicalcium phosphate	0.5	0.5	Digestible fibre[3]/ADF ratio	1.1	1.1
Limestone	1	1	Starch	14.4	11.9
Salt	0.5	0.5	Fat	3.9	4.0
			Nutritive value[2]		
			Digestible energy, DE (MJ/kg)	10.0	9.6
			Digestible protein, DP (g/kg)	115	121
			DP/DE ratio (g/MJ)	11.5	12.5

[1] Per kg supplement: vitamin A 1 200 000 IU; vitamin D3 200 000 IU; vitamin E 5 g; vitamin K3 0.2 g; vitamin B1 0.3 g; vitamin B2 0.7 g; vitamin B6 0.4 g; niacinamide 5 g; Ca-pantothenate 2 g; folic acid 0.17 g; biotin 20 mg; vitamin B12 2 mg; choline 60 g; lysine 25 g; DL- methionine 100 g; salinomycin 2.25 g. [2] Calculated values according to Maertens *et al.* (2002). [3] Digestible fibre as hemicelluloses plus pectins.

of crude protein (CP), fibre fractions and fat, but differed in the level of starch, and consequently digestible energy (DE), as well as in the digestible protein (DP)/DE ratio (Table 1). Apart from salinomycin, the ionophore used to control coccidiosis, the diets did not contain any antimicrobials.

The rabbits of the S14 group received diet S14 from weaning to slaughter at 77 days of age. The S12 group received diet S12 from weaning to 49 days of age and were then fed diet S14 till slaughter.

Diets and water were available *ad libitum*. Consumption of feed was measured weekly per group, therefore statistical evaluation of feed intake was not possible. Feed intake (g/rabbit/day) was calculated as follows: consumption of feed was divided by both numbers of healthy rabbits within the period (e.g. rabbits without diarrhoea or severe loss of weight during week) and the number of days in the period. Animals were individually weighed every week.

Mortality was recorded every day; morbidity was recorded weekly. Health status was evaluated according to Gidenne *et al*. (2004b)and European Group on Rabbit Nutrition (Fernández-Carmona *et al*., 2005). Briefly, morbidity corresponds to sick rabbits (but still alive within a period) showing digestive troubles (diarrhoea) or severe loss of weight during a week. An animal was considered morbid only once (within period), even if diarrhoea lasted several days. The "Health Risk Index" was the sum of morbid and dead rabbits, each animal being considered only once (classed either as dead or morbid).

Analytical methods and statistical analyses

Feed samples were air-dried at 105°C to constant weight to estimate the dry matter content. CP and fat content were determined by means of Kjeltec Auto 1030 Analyser and Soxtec 1043, respectively, from Tecator AB (Sweden). Neutral detergent fibre (NDF), acid detergent fibre (ADF) and acid detergent lignin (ADL) were determined according to the procedure of Van Soest *et al*. (1991), using a Fibertec 2010 from the same company. Water insoluble pectins, DE and DP content were calculated from "EGRAN" tables (Maertens *et al*., 2002). Digestible fibre was calculated as the sum of hemicelluloses (NDF-ADF) and water insoluble pectin (Gidenne, 2003). Starch was measured polarimetrically (Ewers procedure).

For the statistical analysis of growth rate, only data from healthy rabbits were used (initial number of rabbits at weaning minus morbidity and mortality), in order to evaluate the effect of diets on growth performance corrected for the influence of sick rabbits (Gidenne *et al*., 2000). Data on growth performance were examined by one-way analysis of variance using the GLM procedure of SAS (SAS Inst. Inc., Cary, NC; SAS v.8.2). Data on mortality and morbidity were analysed using the χ^2 test.

RESULTS AND DISCUSSION

Higher average feed intake values were observed in rabbits of the S12 group before the change of diet (103.1 *vs*. 118.8 g/d in rabbits of the S14 and S12 group, respectively), according to the well-known feed intake regulation mechanism (Table 2). For the whole fattening period, no difference in the feed intake was recorded.

During the initial phase of growth (from weaning to 49 days of age), the weight gain did not significantly differ between the groups. On the other hand, the weight gain was higher both during the finishing period ($P<0.05$) and the whole fattening period ($P=0.10$) in rabbits of the S14 group than in rabbits of the S12 group (Table 2). This could be due to the adaptation of the S12 group to the S14 diet from day 49.

Table 2: Growth performance of rabbits fed diets differing in the starch level during post-weaning period.

	Group S14	Group S12	RMSE[1]	*P*-level
Rabbits, n[2]	91	79		
Live weight, g				
at weaning, 35 d	907	917	80	NS
at 49 days of age	1418	1450	193	NS
before slaughter, 77d	2640	2591	234	NS
Weight gain, g/d				
35 – 49 day of age	36.5	38.1	13.2	NS
49 – 77 day of age	43.6[a]	40.8[b]	8.2	0.03
35 – 77 day of age	41.3	39.9	5.5	0.10
Feed intake, g/d[3]				
35 – 49 day of age	103.1	118.8	-	-
49 – 77 day of age	178.5	184.2	-	-
35 – 77 day of age	164.4	171.2	-	-

[1]RMSE = Root mean square error. [2]n = initial number of rabbits at weaning (120 per group) minus mortality and morbidity. [3]Average data of groups not analysed statistically. ab values in the same row with unlike superscript differ significantly ($P<0.05$). NS – not significant.

Rabbit mortality was moderate (10.8% on average) with no significant differences being recorded between groups, either during post-weaning or during the finishing period (Table 3). However, both significantly higher morbidity and health risk index were observed in rabbits of the S12 group compared with the rabbits of the S14 group (Table 3). Morbidity was caused mainly by diarrhoea. The highest number of ill rabbits in the S12 group was recorded before the change of diet. This was apparently associated with the higher feed intake in these rabbits during the post-weaning period, in agreement

Table 3: Health status of rabbits fed diets with different starch contents during post-weaning period.

	Group S14	Group S12	*P*-level
Mortality, % (n)[1]			
35 – 49 day of age	4.2 (5)	5.0 (6)	NS
49 – 77 day of age	6.1 (7)	7.0 (8)	NS
35 – 77 day of age	10.0 (12)	11.7 (14)	NS
Morbidity, % (n)			
35 – 49 day of age	5.0 (6)	13.3 (16)	0.01
49 – 77 day of age	9.6 (11)	9.7 (11)	NS
35 – 77 day of age	14.2 (17)	22.5 (27)	0.01
Health Risk Index, % (n)			
35 – 49 day of age	9.2 (11)	18.3 (22)	0.03
49 – 77 day of age	15.7 (18)	16.7 (19)	NS
35 – 77 day of age	24.2 (29)	34.2 (41)	0.03

120 rabbits per group at the beginning of the trial.
[1]numbers of dead and sick rabbits are given in brackets.

with Gidenne *et al*. (2003), who observed that a post-weaning feed restriction reduced the incidence of diarrhoea. After the change of diet, both groups showed similar morbidity.

CONCLUSION

It can be concluded that *i)* a lower dietary starch level did not prevent digestive troubles in weaned rabbits and *ii)* 14% starch content in the diet of rabbits is suitable for both growth and good health status in the post-weaning and finishing period.

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