Performance of Suckling Rabbits Fed a Low Fibre Concentrate

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ABSTRACT : The aim of this study was to evaluate the effect of two diets different in crude fibre content and ingredients on performance and on caecal characteristics of rabbits around weaning. Thirty litters from thirty New Zealand White does were divided at Day 18 in two groups fed, respectively, a low fibre concentrate (LFC, consisting mainly of soybean meal, delactated whey, barley) from Day 18-28 followed by a creep feed (CF, consisting mainly in alfalfa meal, barley and wheat bran) from Day 29-32, and a CF from Day 18-32. After weaning (32 days) both groups were fed the CF *ad libitum* for two weeks. During the pre-weaning period, mortality, milk intake and solid feed intake (from Day 20) were recorded daily, while the live weight of kits was recorded twice, at 18 and 32 days. At day 28, one rabbit/litter was slaughtered in order to obtain data on caecal content characteristics. After weaning, the rabbits were located in collective cages, feeding *ad libitum* CF; feed intake, live weight and mortality were recorded weekly for two weeks. During the pre-weaning period, there were no differences between the groups in milk and solid feed intake and, by consequence, in live weight at weaning; instead, the mortality was higher (12.5 vs 4.5%) for the group (A) that changed diet at 28 days. Group A showed also a higher caecal pH (6.12 vs. 5.72), propionate to butyrate ratio (0.73 vs. 0.46), ammonia content (9.3 vs. 7.1 mmol/l), but a lower total volatile fatty acid content (66.8 vs. 82.1 mmol/l) than B Group, probably due to the dried milk whey in the concentrate. After weaning, there were no significant differences between the two groups. The authors concluded that the use of a low fibre concentrate for suckling rabbits is not recommended. ***(Asian-Aust. J. Anim. Sci. 2005. Vol 18, No. 10 : 1421-1424)***

Key Words : Low Fibre Concentrate, Solid Feed Intake, Weaning Rabbit

INTRODUCTION

The live weight at weaning in rabbits is strongly related to milk intake, in fact, kits from smaller litters, generally, show a higher weight at weaning than the kits from larger litters (Poigner et al., 2000) due to the higher milk availability (Mc Nitt and Lukefahr, 1990; Sabater et al., 1993). However, rabbits are able to ingest more milk than produced by mothers. In fact, Gyarmati et al. (2000) showed that kits suckling milk twice a day from two does, increased milk intake by 89% and consequently, body weight at 21 days by 70% in comparison with kits suckling once a day from their mother.

During suckling, rabbits' solid feed intake (that generally starts around 20 days of age), is low and increases more slowly when milk availability is higher (Pascual et al., 2001). Some authors (Scapinello et al., 1999; Di Meo et al., 2003) recorded a high solid feed intake in larger litter sizes (that intake less milk) than in rabbits from smaller litters. Also the physiological condition of does (pregnant or non pregnant), affecting the milk production, induce a different solid feed intake (Nizza et al., 2002). A higher pre-weaning solid feed intake may well accelerate the maturation of the digestive process and facilitate the transition to exclusively solid feed. Little research has so far been undertaken in this direction, and no definitive conclusions are currently available.

Thus, considering that suckling rabbits have a high milk intake capacity but a low voluntary intake of solid feed, the aim of the present paper was to stimulate the solid feed intake of litters during suckling by the administration of a low fibre concentrate (LFC) containing milk serum in order to improve the concentrate palatability and, consequently, its voluntary intake. Moreover, the administration of a CF four days before weaning could decrease the risk of digestive troubles in kits.

MATERIALS AND METHODS

Thirty litters, from thirty New Zealand White does, (since birth, caged separately from their mothers) were standardised at partum at 8 kits, and weaned at 32 days of age. Dead kits were replaced until 18th day of age by kits with the same age. The litters were divided into two groups: Group A (16 litters, 128 rabbits) fed a low fibre concentrate (LFC) constituted mainly by soybean meal, delactated whey and barley from Day 18-28 and creep feed (CF) consisting mainly of alfalfa meal, barley and wheat bran from Day 29-32; Group B (14 litters, 112 rabbits) fed a CF from Day 18-32. Daily milk yield of does was recorded by weighing does before and after milking. Does were put with their litters to suckle for a short period (about 10 minutes) once daily in the morning. Body weight of kits was recorded twice, at days 18 and 32. Solid feed intake of litters from Day 21 to 32 was also recorded. Chemical analysis of diets (Table 1)

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Table 1. Chemical composition of diets (g/kg)

Diets	LFC	CF
Dry matter	905	908
Crude protein	161	160
Crude fibre	60	150
Ether extract	25	35
Ash	75	78
Starch	147	141
Neutral detergent fibre	196	345
Acid detergent fibre	90	200
Acid detergent lignin	24	52
Digestible energy (MJ) [1]	12.20	9.92

[1] Calculated from Maertens et al. (1988).

followed the AOAC method (1990) for dry matter (DM), ash, ether extract (EE), crude protein (CP) and crude fibre (CF). Van Soest et al. (1991) procedures were used for neutral detergent fibre (NDF), with a thermostable amylase pre-treatment, acid detergent fibre (ADF) and acid detergent lignin (ADL). Digestible energy was calculated from equation of Maertens et al. (1988). On Day 28, one rabbit per litter was slaughtered after 12 h fasting. From each rabbit, the caecum was isolated by tying up the two extremities with a nylon string to prevent losses of caecal content and transported to our laboratories as soon as possible. Here, the caecal contents were diluted with 0.9% NaCl solution 1:2 (V/V) and the pH was recorded by pH-meter Orion EA 940. Thereafter, diluted caecal contents were frozen at -18° C until ammonia volatile fatty acids (VFA) determinations. In particular, ammonia (NH_3) was measured on the sulphuric extract spectrophotometrically with the Enzymatic UV method utilising a test kit (Boehringer Ingelheim GmbH, Germany), while for VFA analysis the liquid sample was centrifuged twice at 12,000 g for 10 minutes at 4°C. After centrifugation, 1 ml of supernatant was taken, to which 1 ml of oxalic acid 0.06 M was added. The volatile fatty acids (VFA) were measured by gas chromatography (ThermoQuest mod. 8,000[top], FUSED SILICA capillary column 30 m×0.25 mm×0.25 mm film thickness) including acetate, propionate, butyrate iso-butyrate, valerate and iso-valerate as standards. The area of each VFA was compared with the external standard.

After weaning the rabbits were located in collective cages, in an experimental room with artificial ventilation and a 12 h light-12 h dark schedule. The rabbits were given *ad libitum* the CF diet and weekly feed intake, live weight and mortality were controlled for two weeks.

Statistical analysis was carried out by ANOVA (GLM, SAS, 2000), following the model:

$$Y_{ij} = \mu + G_i + \varepsilon_{ij},$$

when

y = single observation;

μ = general mean;

G = group effect (i = LCF or CF);

ε = error.

Mortality was analysed by chi-square method.

RESULTS AND DISCUSSION

Pre-weaning performance

Table 2 reports kits' performance recorded in the pre-weaning period. The use of a LFC from Day 18-28 did not improve the solid feed intake. The last one, was similar for LFC and CF groups during Day 21-28 (12.8 vs. 13.1 g/d, respectively), and Day 29-32 (41.4 g/d for both groups). Our data confirmed the results of other authors (Debray et al., 2000; Gidenne and Jehl, 2000; Casado et al., 2004) that showed similar or lower feed intake in suckling rabbits fed lower fibre diets. Despite a milk constituent (delactated whey) in the low fibre concentrate, dry matter intake did not increase, as occurs, when the young rabbit ingests extra milk. In this regard, McNitt and Moody (1988) and Gyarmati et al. (2000) showed that kits can suckle twice a day from two does and achieve almost double the intake of rabbits that are suckled only by their mothers. Also milk intake, as expected, did not show differences between the groups. Consequently, the growth rate in the period 18-32 days did not show statistically significant differences (27.9 vs. 24.9 g/d/rabbit) even if LFC group showed higher growth rate (about 3 g/d/rabbit more), probably due to a

Table 2. Performances (mean±SD) of suckling rabbit (18-32 days)

		LFC	CF	SEM
			18-28 days	
Litters	n°	16	14	
Milk intake	g/d/rabbit	25.2±4.4	24.6±3.5	1.3
Feed intake (Day 21-28)	g/d/rabbit	12.8±6.4	13.1±7.3	1.8
			29-32 days	
Milk intake	g/d/rabbit	16.6±2.9	16.1±2.9	1.1
Feed intake	g/d/rabbit	41.4±18.0	41.4±20.5	1.6
Mortality (Day 18-32)	%	12.5 (16/128)	4.5 (5/112)	4.84*
Live weight at 32 days	g/rabbit	584.2±91.0	546.9±100.0	32.5
Growth rate (Day 18-32)	g/d/rabbit	27.9±7.3	24.9±5.9	1.9

* χ^2 value, $p<0.05$.

Table 3. Effect of diet on caecal characteristics of rabbits at 28 days of age

	Diets		SEM
	LFC	LC	
Rabbits (n°)	16	14	
pH	6.12[a]	5.72[b]	0.22
Total VFA (mmol/l)	66.8[A]	82.1[A]	1.84
Acetate (%)	74.0[B]	81.0[A]	1.13
Butyrate (%)	15.0	13.0	1.10
Propionate (%)	11.0[A]	6.0[B]	1.05
C3/C4	0.73[A]	0.46[B]	0.11
Ammonia (mmol/l)	9.3[a]	7.1[b]	0.81

[A, B] $p<0.01$; [a, b] $p<0.05$.

high ED level in the diet. The live weight at 32 days (average 565 g) was lower than that (about 700 g) reported in literature for rabbits weaned at the same age and belonging to selected breeds (Xiccato et al., 2000; Gidenne and Fortun-Lamothe, 2001). Confirming reports in the literature (Aboul-Ela et al., 2000; Soler et al., 2002), the low fibre diet (LFC) induced a mortality rate higher than the high fibre concentrate, (12.5 vs. 4.5%; $p<0.05$). Moreover, it is important to remark that a part of mortality in LFC group happened in the period 29-32 days: probably, beyond diet characteristics, also the diet change contributed to results.

Table 3 reports the caecal data recorded in the rabbits slaughtered at 28 days. Considerable differences were observed in the characteristics of the caecal content. In particular, group LFC showed a higher pH (6.12 vs. 5.72, $p<0.05$). Normally, the pH is higher in rabbits feeding more on milk and less on solid feed (Nizza et al., 2001; Di Meo et al., 2003). In our case, it is probable that the presence of dried milk serum in the concentrate induced this effect. On the other hand, the rabbits of group LFC showed a lower production of total VFA than group CF (66.8 vs. 82.1 mmol/l, $p<0.01$) testifying to less fibrolitic activity. In this respect, Piattoni and Maertens (1999) reported that as solid feed intake increased, caecum weight and volatile fatty acids production increased, while caecum pH decreased, and Gidenne and Licois (2001) observed that the diet used before weaning (21-29 days) could affect the caecal fermentative activity also after weaning. The molar proportion of Acetate is high enough in both groups and the recorded values are in line with those reported in the literature (Torturo et al., 1994; Taranto et al., 2003; Pinheiro et al., 2004) even if the animals of CF group showed the highest values (81.0 vs. 74.0%). The lower C3 to C4 ratio of group CF (0.46), compared to that of LFC (0.73), must be considered an index of better fermentative activity in the caecum. Normally in the adult rabbit, butyrate is almost three times higher than propionate (Hoover and Heitmann, 1972). Molar proportions of propionate and butyrate showed significant and opposite changes in young rabbits; initially, in rabbit kits that ingest only milk, butyrate is

Table 4. Post-weaning performance of rabbits during the period 33-46 days

		Groups		SEM
		LFC	CF	
Rabbits	n	96	93	
Initial weight	g	584.2	546.9	32.5
Daily weight gain	g/d	35.0	35.3	2.6
Feed intake	g/d	80.7	83.3	3.0
Feed conversion ratio		2.31	2.36	0.3
Mortality	%	2.08	2.15	

completely absent from day 25 onwards (Piattoni et al., 1996); but also before (from day 22), as observed by Padilha et al. (1995), butyrate exceeded propionate. Also the ammonia content (9.3 vs. 7.1 mmol/l; $p<0.05$, respectively for LFC and CF groups) was affected by diet. The values of this parameter are higher in younger rabbits and in those with a lower fibrolitic activity (Gidenne, 1996).

Post-weaning performance

During the two weeks after weaning, when the rabbits were controlled, there were no significant differences in feed intake (80.7±16.6 vs. 73.3±15.5 g/d, respectively for LFC and CF groups) and weight gain (35.0±3.7 vs. 35.3 ±4.1 g/d, respectively for LFC and CF groups). Consequently, also the feed conversion index did not show significant differences between the groups (2.31 and 2.36, respectively for LFC and CF groups). In each case, weight gain and feed conversion index values are in agreement with those reported in literature (Nizza et al., 2001; Muriu et al., 2002; Di Meo et al., 2004). Post-weaning mortality was low and similar (2%) for the two groups.

CONCLUSIONS

Our results confirmed that the use of diets with a very low fibre level did not improve the solid feed intake, not even if the diet includes raw materials normally constituting the milk as the dried milk serum used in this trial. Moreover, changing the low fibre diet to a normal fibre diet from Day 28 of suckling did not prevent the increase of digestive troubles. In conclusion, is not recommended for the suckling rabbit the use of diets low in fibre.

REFERENCES

Aboula-Ela, S., K. Abd El-Galil and F. A. Ali. 2000. Effect of dietary fiber and energy levels on performance of post-weaning rabbits. 7th World Rabbit Congress, Valencia. Vol. C. 61-67.

AOAC. 1990. Official Methods of Analysis. 15th edn. Association of Official Analytical Chemists. Arlington, Virginia.

Casado, C., M. D. Soler, S. Biglia, O. Piquer, E. Blas, C. Cervera and J. J. Pascual. 2004. Use a high digestible/low starch feed in young rabbits. In: Proceedings of the 4th Meeting of workgroup 3 and 4 COST Action 848. Cercedilla, Spain.

Debray, L., T. Gidenne, L. Fortun-Lamothe and P. Arveux. 2000. Digestive efficiency before and after weaning, according to the dietary starch/fibre ratio. 7th World Rabbit Congress, Valencia. Vol. C. 167-174.

Di Meo, C., G. Stanco, G. Piccolo, S. Taranto, M. P. Gazaneo and A. Nizza. 2003. Productive performance of rabbits according to pre-weaning solid feed and milk intake. growing rabbits. Ital. J. Anim. Sci. 2:51-58.

Di Meo, C., M. P. Gazaneo, C. Racca, F. Bovera, G. Piccolo and A. Nizza. 2004. Effect of birth weight and litter size on productive performance of rabbits. Asian-Aust. J. Anim. Sci. 17. 1158-1161.

Gidenne, T. 1996. Nutritional and ontogenic factors affecting rabbit caeco-colic digestive physiology. 6th World Rabbit Congress, Toulouse. Vol. 1:13-28.

Gidenne, T. and N. Jehl. 2000. Caecal microbial activity of the young rabbit: incidence of a fibre deficiency and of feed intake level. 7th World Rabbit Congress, Valencia. Vol. C. 233-240.

Gidenne, T. and L. Fortun-Lamothe. 2001. Early weaning: effect on performances and health. In: Proceedings of the 2nd Meeting of workgroup 3 and 4 COST Action 848. Godollo, Hungary.

Gidenne, T. and D. Licois. 2001. Interaction between nutritional status and digestive pathology of the growing rabbit: resistance to an enteropathogenic strain of Escherichia coli according to dietary fibre level and consequences on caecal fermentative activity. In: Proceedings of the 2nd Meeting of workgroup 3 and 4 COST Action 848. Godollo, Hungary.

Gyarmati, T., Zs. Szendrộ, L. Maertens, E. Biró-Nemeth, I. Radnai, G. Milisits and Zs. Matics. 2000. Effect of suckling twice a day on the performance of suckling and growing rabbits. In: Proceedings of the 7th World Rabbit Congress, Valencia. Vol. C. 283-290.

Hoover, W. H. and R. N. Heitmann. 1972. Effects of dietary fiber levels on weight gain, cecal volume and volatile fatty production in rabbits. J. Nutr. 102:375-379.

Maertens, L., R. Moermans and G. De Groote. 1988. Prediction of the apparent digestible energy (ADE) content of commercial pelleted feeds for rabbits. J. Appl. Rabbit Res. 11(2):60-67.

McNitt, J. I. and S. D. Lukefahr. 1990. Effects of breed, parity, day of lactation and number of kits on milk production of rabbits. J. Anim. Sci. 68:1505-1512.

McNitt, J. I. and J. Moody. 1988. Milk intake and growth rates of suckling rabbits. J. Appl. Rabbit Res. 11:117-119.

Muriu, J. I., E. N. Njoka-Njiru, J. K. Tuitoek and J. N. Nanua. 2002. Evaluation of sorghum (*sorghum bicolor*) as replacement for maize in the diet of growing rabbits (*Oryctolagus cuniculus*). Asian-Aust. J. Anim. Sci. 15:565-569.

Nizza, A., C. Di Meo, G. Stanco and M. I. Cutrignelli. 2001. Influence of solid feed intake and age at weaning on caecal content characteristics and post-weaning performance. World Rabbit Sci. 9:149-153.

Nizza, A., G. Stanco, C. Di Meo, M. L. Marongiu, S. Taranto, M. I. Cutrignelli and L. Juliano. 2002. Effect of pre-weaning solid feed and milk intake on caecal content characteristics and performance of rabbits around weaning. Ital. J. Anim. Sci. 2:95-101.

Padilha, M. T. S., D. Licois, T. Gidenne, B. Carre and G. Fonty. 1995. Relationships between microflora and caecal fermentation in rabbit before and after weaning. Repr. Nutr. Develop. 35:375-386.

Pascual, J. J., C. Cervera and J. Fernandez-Carmona. 2001. Effect of solid feed intake before weaning on the performance of growing rabbits. In: Proceedings of the 2nd Meeting of workgroup 3 and 4 COST Action 848. Godollo, Hungary.

Piattoni, F., D. Demeyer and L. Maertens. 1996. *In vitro* study of the age dependant caecal fermentation pattern and methanogenesis in young rabbits. Repr. Nutr. Develop. 36:253-261.

Piattoni, F. and L. Maertens. 1999. Effect of weaning age and solid feed distribution before weaning on the caecal fermentation pattern of young rabbits. 11. Arbeitstagung über Haltung und Krankheiten der kaninchen, Pelztiere undHeimtiere, Celle, Ed. Deutsche Vet. Med. Gesellschaft e, V., Giessen. 97-105.

Pinheiro, V., A. Alves, J. L. Mourão, C. M. Guedes, L. Pinto, P. Spring and A. Kocher. 2004. Effect of mannan oligosaccharides on the ileal morphometry and cecal fermentation of growing rabbits. In: Proceedings of the 8th World Rabbit Congress, Puebla. 936-941.

Poigner, J., Zs. Szendrộ, A. Lèvai, I. Radnai and E. Biró-Nemeth. 2000. Effect of birth weight and litter size at suckling age on reproductive performance in does as adults. World Rabbit Sci. 8:103-109.

Sabater, C., C. Tolosa and C. Cervera. 1993. Factores de variacion de la curva de lactacion de la coneja. Arch. Zootec. 42:105-114.

Scapinello, C., T. Gidenne and L. Fortun-Lamothe. 1999. Digestive capacity of the rabbit during the post-weaning period, according to the milk/solid feed intake pattern before weaning. Reprod. Nutr. Dev. 39:423-432.

SAS Institute Inc. 2000. SAS/STAT User's Guide: Version 8.1, edn. SAS Institute, Inc., Cary, North Carolina.

Soler, M. D., E. Blas, J. J. Pascual and C. Cervera. 2002. An attempt of using a very digestible feed in rabbits around weaning. Meeting of workgroup 3 and 4 COST Action 848. Ispra, Varese, Italy.

Taranto, S., C. Di Meo, G. Stanco, G. Piccolo, M. P. Gazaneo and A. Nizza. 2003. Influence of age at weaning on caecal content characteristics and post-weaning performance and health of rabbits. Asian-Aust. J. Anim. Sci. 16:1540-1544.

Tortuero, F., J. Rioperez, C. Cosin, J. Barrera and M. L. Rodriguez. 1994. Effects of dietary fiber sources on volatile fatty acid production, intestinal microflora and mineral bilance in rabbits. Anim. Feed Technol. 48:1-14.

Van Soest, P. J., J. B. Robertson and B. A. Lewis. 1991. Methods for dietary fiber, neutral detergent fiber and non starch polysaccharides in relation to animal nutrition. J. Dairy Sci. 74:3583-3597.

Xiccato, G., A. Trocino, A. Sartori and P. I. Queaque. 2000. Early weaning of rabbits: effect of age and diet on weaning and post-weaning performance. 7th World Rabbit Congress, Valencia. Vol. C. 483-490.