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EARLY WEANING OF RABBITS: EFFECT OF AGE AND DIET ON WEANING AND POST-WEANING PERFORMANCE

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ABSTRACT

The aim of the study was to evaluate the effect of an early weaning on performance of litters and rabbits during weaning and post-weaning, respectively, comparing four weaning age (21, 25, 28 and 32 d). The effect of the weaning diet was also evaluated. One hundred-fifty litters of pluriparous does in a commercial rabbitry were used. At 21, 25, and 28 d of age, 20 representative litters were transferred to the experimental house where rabbits were put in cages in group of nine kits, forming treatments W21, W25 and W28. Half litters were fed the diet P (CP: 15.3%; CF: 17.0%; DE: 10.53 MJ/kg), half the diet S (CP: 16.1%; CF: 17.1%; DE: 10.17 MJ/kg). At 32 d, 20 rabbits per group (W21, W25 and W28) and 20 rabbits weaned at 32 d of age were put into individual cages and fed the same diet (CP: 15.0%, CF: 15.4%; DE: 10.13 MJ/kg) from 32 d to 56 d.
At 32 d, the weight of W21 litters fed diet S was significantly lower (-6%) than W28-P and W32. Rabbits performance from 32 to 56 d did not show any difference among weaning groups with similar final weights. No mortality was recorded during the weaning and post-weaning period. The weaning diet significantly ($P<0.01$) affected litters performance during the weaning period, with higher weight gain (327 vs 305 g/d) and better feed conversion (1.34 vs 1.53) for rabbits fed diet P compared to diet S, while no residual effects was recorded on rabbit performance in the post-weaning period.

INTRODUCTION

Litters weaning usually occurs at 30 to 35 d of age with the separation of the kits from their mother. Since a negative correlation between weight at weaning and post-weaning mortality was showed (MORISSE, 1985), various studies dealt with how to increase weight at weaning by increasing milk (MCNITT and MOODY, 1990; GYARMATI *et al.*, 2000) or feed intake (MAERTENS and DE GROOTE, 1990) or by delaying weaning age (LEBAS, 1993).
Young rabbits begin to eat solid feed at about 20 d of age (MAERTENS and DE GROOTE, 1990; SCAPINELLO *et al.*, 1999). The ingestion of solid feed is accompanied by the establishment of caecal microflora and a progressive change in the fermentation patterns (PIATTONI *et al.*, 1995; GIDENNE, 1996). During this period, young rabbits are more susceptible to digestive problems (MAERTENS, 1992) and specific diets are required for rabbits at weaning (LEBAS and MAITRE, 1989; XICCATO *et al.*, 1998).
The early weaning of rabbits would permit possible advantages for both litters and does: the reduction of the contact between litters and their mothers would reduce the possibility of transmitting pathogens (SCHLOLAUT, 1988); the shorter lactation could reduce the energy deficit of the does (XICCATO, 1996). The early weaning would imply new breeding and feeding systems whose efficiency and profit need to be evaluated.
The aim of the present study was to evaluate the effect of early weaning at different age on *in vivo* performance of litters during weaning and post-weaning periods. The administration of a pre-starter diet, specific for early weaning, was also evaluated in order to better match kit requirements, favour a praecox feed intake and avoid the digestive disorders during weaning.

MATERIAL AND METHODS

Weaning period. One hundred-fifty litters (standardised to nine kits) of pluriparous does in a commercial rabbitry were used. From 18 d *post-partum*, litters and does received *ad libitum* the diet S, whose formulation and characteristics were consistent with the commercial diets used for the normal weaning of rabbits. An experimental group of 110 litters was used to select 60 litters to be weaned at different ages, excluding those with health problems or not homogeneous. The remaining 40 litters, to be weaned at 32 d of age, were used for daily data recordings from 21 to 32 d *post-partum*: 20 litters (group W32) were maintained with their mothers and feed intake (litter+mother) and litters weight were measured daily; the other 20 litters (group W32L) were separated from their mothers and submitted to controlled lactation in order to measure milk production, litters feed intake, does feed intake, and litter weight (PARIGI BINI *et al.*, 1992). At 21, 25 and 28 d, the experimental litters were weighed and 20 representative ones were transferred to the experimental facilities of the Department, forming the groups W21, W25 and W28. At their arrival, the rabbits of each group were located in 20 cages for reproducing does (9 kits per cage), regardless from the maternal origin. Ten litters per weaning age were fed *ad libitum* the diet P, an experimental pre-starter diet specific for early weaning, and 10 litters were fed the diet S. Litter weight and feed intake were recorded daily until 32 d. The cages were equipped to measure feed spoilage and the nipple drinkers were placed at a low height to favour drinking.

Post-weaning period. At 32 d, one representative rabbit per litter was selected from the W32 litters at the commercial rabbitry, moved to the experimental house and put into individual cages. At the same time, also 20 representative rabbits (2 per litter) were selected from the 6 groups of weaned litters (3 weaning ages x 2 diets) and put into individual cages. During the post-weaning (32 d to 56 d of age), the 140 rabbits were fed *ad libitum* a unique commercial diet (CP: 15.0%, CF: 15.4%; DE: 10.13 MJ/kg). Individual live weight and feed intake were recorded twice a week. The digestibility and nutritive value of diets P and S were determined *in vivo* on a distinct group of 20 rabbits, following the European standardized method (PEREZ *et al.*, 1995). Diets and faeces were analysed as detailed by PARIGI BINI *et al.* (1992).

Along the whole experiment, no mortality or health problems were recorded in any groups.

Statistical analysis. The litter weights of the experimental groups at 32 d of age were compared by using the *t* test. The performance of W21, W25 and W28 litters from their weaning until 32 d were submitted to analysis of variance using a bi-factorial model (3 weaning age x 2 diets) with interaction. The same model without interaction was used to compare the performance of W21, W25, W28 and W32 rabbits in the post-weaning period.

RESULTS AND DISCUSSION

Chemical composition and nutritive value of diets. The diet P was formulated taking into account the requirements of the kits at very early stages of growth. The low level of barley limited the supply of starch to kits whose digestive enzymatic activity was not yet fully developed (GIDENNE, 1996). A higher energy supply was assured by the inclusion of animal fat and sugar beet pulp, whose fibre fractions are highly digestible in rabbits (GIDENNE *et al.*, 1998). An adequate fibre level was guaranteed by 30% of alfalfa meal. As usual in starter feeds (PRUD'HON and BEL, 1968; MCNITT and MOODY, 1992), skimmed milk was included in the diet. The formulation of the diet S considered the requirements of young rabbits and also those of their mothers in the last 10 days of lactation and overlapping pregnancy (LEBAS, 1989; MAERTENS, 1992; XICCATO, 1996), by increasing both alfalfa meal and barley.

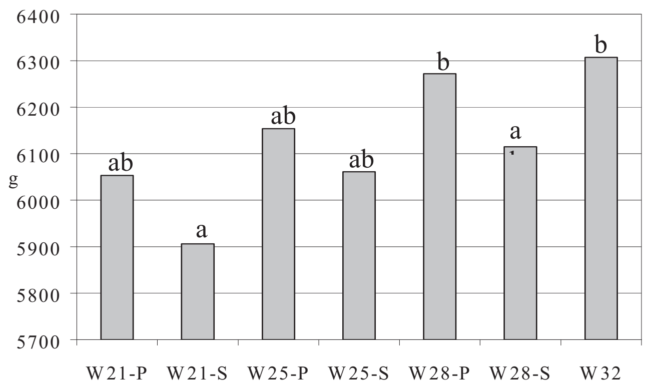
Table 1 reports the chemical composition and nutritive value of the diets. According with formulation, crude protein and ether extract concentrations accounted for the main differences between the two diets, while the DM digestibility was similar. The inclusion of sugar beet pulp was the reason for the higher crude fibre digestibility of diet P and the presence of fat for the higher DE concentration. The DP/DE ratio of the diet P better matched the nutritional recommendations for growing rabbits, while that of the diet S was more suitable for reproducing does (MAERTENS, 1992; XICCATO, 1996).

Table 1. Ingredients (%), chemical composition and nutritive value of the diets

	Diet P	Diet S
Ingredients:		
Dehydrated alfalfa meal	30.00	35.00
Barley	8.00	16.00
Wheat bran	25.00	25.00
Soybean meal, 44% CP	6.00	4.00
Sunflower meal, 30% CP	8.00	8.00
Sugar beet pulp	15.00	8.00
Animal fat	2.00	-
Skimmed milk	2.00	-
Cane molasses	2.00	2.00
Limestone	0.55	0.55
Dibasic calcium phosphate	0.42	0.42
Salt	0.45	0.45
Vitamin-mineral premix	0.30	0.30
DL-methionine	0.08	0.08
HCl-lysine	0.10	0.10
Coccidiostatic	0.10	0.10
Chemical composition:		
Crude protein (CP), %	15.3	16.1
Ether extract, %	3.7	1.8
Crude fibre (CF), %	17.0	17.1
ADL, %	5.1	6.0
Nutritive value:		
DM digestibility, %	60.8	60.3
CP digestibility, %	74.2	77.0
CF digestibility, %	24.7	20.5
GE digestibility, %	61.4	60.0
Digestible energy (DE), MJ/kg	10.53	10.17
Digestible protein/DE (DP/DE), g/MJ	10.78	12.21

Performance during weaning and post-weaning. When comparing the litter weight of all the experimental groups at 32 d (figure 1), the W21 litters fed diet S (W21-S) were lighter than the W28 litters fed diet P (W28-P) ($P<0.05$) or the W32 litters ($P<0.01$). Even if no significant difference was recorded, the S litters always weighed less than the P litters within weaning age.

Figure 1. Litters weight at 32 d of age



When looking at the effect of weaning age on litters performance from weaning to 32 d of age (table 2), we have to take in mind the different period for the three experimental groups. A lower daily gain and a worse feed conversion were observed for the W21 group compared to W25 and W28 litters. The live weight at 32 d was significantly higher for P litters compared to S litters, as well as daily gain from weaning to 32 d of age. The P litters consumed less feed and showed a better feed conversion (P<0.01) than S litters.

Table 2. Effect of diet and weaning age on litter performance during weaning

	W21	W25	W28	P	Diet P	Diet S	P	RSD
Litters, n	20	20	20		30	30		
Litter weight, g								
at weaning (W)	3127^{A}	3766^{B}	4778^{C}	<0.01	3887	3893		97
at 32 d of age	5980^{A}	6107^{B}	6193^{B}	<0.05	6160	6027	<0.05	236
Performance from W to 32 d								
weight gain, g	2853^{A}	2341^{B}	1415^{C}	<0.01	2272	2134	0.01	212
weight gain, g/d	259^{Aa}	335^{Bb}	354^{Bc}	<0.01	327	305	<0.01	30
feed intake, g	4407^{A}	3143^{B}	1958^{C}	<0.01	3099	3387	<0.01	256
feed intake, g/d	401^{A}	449^{B}	490^{C}	<0.01	435	458	0.01	37
feed conversion	1.56^{A}	1.35^{B}	1.39^{B}	<0.01	1.34	1.53	<0.01	0.15

a, b, c: P<0.05; A, B, C: P<0.01

In the post-weaning period, from 32 to 56 d of age, the performance of growing rabbits were not influenced neither by the weaning age nor the weaning diet (table 3). As already described for litters, the live weight at 32 d was significantly higher for rabbits weaned later and for rabbits fed diet P, but no significant differences among groups were found at 56 d. Thus, during post-weaning, a compensatory growth permitted W21 and S rabbits to get the same final weight of the other groups.

Table 3. Effect of diet and weaning age on rabbit performance during post-weaning

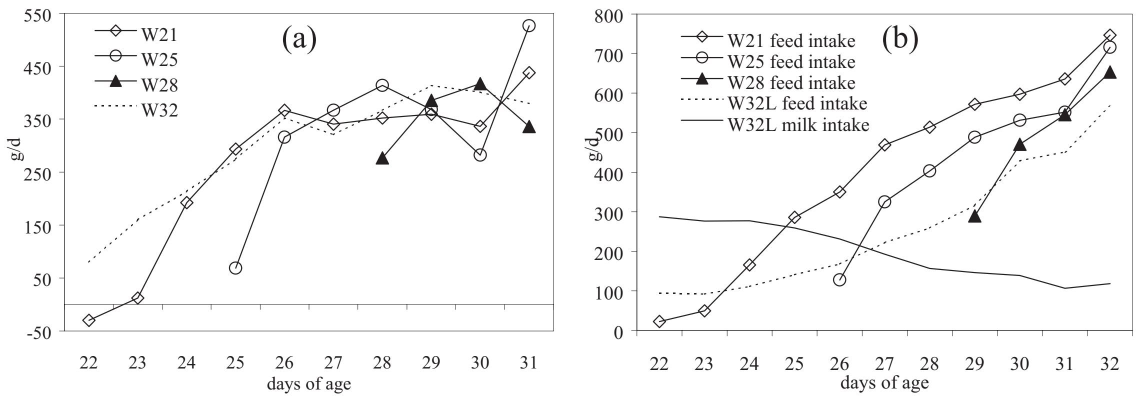
	W21	W25	W28	W32	***P***	Diet P	Diet S	***P***	*RSD*
Rabbits, n	40	40	40	20		60	80		
Live weight, g									
at 32 d of age	678^{A}	679^{A}	704^{B}	719^{B}	<0.01	706	684	0.01	46
at 56 d of age	1849	1836	1848	1863		1851	1847		131
Weight gain, g/d	48.8	48.2	47.7	47.7		47.7	48.5		4.8
Feed intake, g/d	138	136	137	134		135	138		14
Feed conversion	2.8	2.84	2.88	2.82		2.84	2.85		0.17

Effect of weaning age. The lower daily gain and the worse feed conversion of W21 litters from weaning to 32 d may be explained considering that they lost weight the two days immediately after weaning (figure 2a). As reported also for kits weaned at 18 d by PIATTONI and MAERTENS (1999), the ingestion of solid feed was very low in the first days (figure 2b). In fact, at 21 d, milk was still the unique energy source and only 24 h after the last suckling, kits became hungry and thirsty and began to look for nipple drinkers. Only after drinking, kits started to eat, confirming the relationship between feed and water intake (MAERTENS and DE GROOTE, 1990). From 24 d onwards, feed intake of W21 litters greatly increased, as also found by GYARMATI *et al.* (2000) for litters weaned at 23 d of age.

After weaning, the W25 litters recovered weight faster than W21 litters. In fact, the consumption of solid feed had been already stimulated by the decreasing milk intake (figure 2b). At their weaning, the W28 litters evidenced a little reduction in daily gain compared to W32 ones, while feed intake was little stimulated.

Daily weight gain of W32 litters appeared more constant from 21 to 32 d compared to the earlier weaned litters. However, excluding the first 1 or 2 days after weaning, the growth of litters was quite similar. The occurrence of a stress due to weaning was evidenced, less intense as weaning age increased. A little reduction of daily weight gain after weaning was also observed in the W32 rabbits.

Figure 2. Daily weight gain (a), milk and feed intake (b) of litters



From 21 to 32 d, the W32 litters consumed a lower quantity of solid feed compared to the weaned litters for which feed intake was rapidly stimulated by the lack of milk. The higher feed intake of the early weaned litters permitted to limit the differences of live weight at 32 d among the groups. Also the caecal fermentation pattern measured at 32 d was influenced, showing a higher adaptation to solid feed in the earlier weaned rabbits compared to W32 rabbits (data not reported). However, at 56 d similar live weight and caecal fermentation pattern were measured.

PRUD'HON and BEL (1968) succeeded in weaning the kits at only 14 d and did not observe any differences in live weight and mortality at 9 weeks of age. On the contrary, MCNITT and MOODY (1992) found lower growth rate and higher mortality weaning rabbits at the same age. According to LEBAS (1993), a late weaning at 35 d is preferable in order to reduce mortality.
The encouraging results we obtained even with the earliest weaning could have been partially due to the parity order of the does. In fact, milk production of pluriparous does is higher and their litters are heavier at weaning compared to primiparous does. At 3 and 10 weeks of age,

GYARMATI *et al.* (2000) found higher body weight in rabbits submitted to double suckling and weaned at 23 d compared to rabbits submitted to single suckling and weaned at 32 d. Therefore, an interaction could be hypothesised between the parity order and the weaning age, with possible difficulties to wean at very praecox age the lighter litters of primiparous does.

Effect of weaning diet. The weaning of all litters was successfully completed at 32 d regardless from the diet, with no effect on the health status. The inclusion of fat, skimmed milk and beet pulp increased nutrient digestibility and DE concentration of the diet P. Feeding this diet increased litter weight at 32 d by 15% despite DE intake was lower (-5%) compared to diet S. This fact may indicate a different efficiency of DE utilisation for growth or, more likely, a not correct evaluation of nutritive value of weaning diets by using a method developed on growing rabbits.

GUTIERREZ *et al.* (2000) compared the effect of different diets on the performance of early weaned rabbits (25 d) and was able to stimulate feed intake and growth rate by the administration of diets supplemented with animal plasma. To wean rabbits at a very early age (14 d), PRUD'HON and BEL (1968) used powdered milk and pelleted feed but, in the first days, they needed to stimulate kits one by one to eat and drink. Similar findings were reported by MCNITT and MOODY (1992) using a diet supplemented with skimmed milk.

CONCLUSIONS

The early weaning of litters was proved to be possible without negative consequences on the health status both during weaning and post-weaning. Even growth performance during post weaning were unaffected, despite differences in live weight at 32 d. Weaning always reduced growth rate for one or two days and induced a rapid increase in feed intake. This stress was less intense as weaning age increased.

Feeding a pre-starter diet allowed higher weight at 32 d, being valuable to support early weaning. Further studies are needed to evaluate the real nutritive value of diets for kits and formulate diets more suitable for early weaning. Moreover, the interaction between weaning age and parity order of the does (i.e. milk intake of litters) is still worth of investigation.

REFERENCES

GIDENNE, T., 1996. Nutritional and ontogenetic factors affecting the rabbit caeco-colic digestive physiology. In: *Proc. 6th World Rabbit Congress, 9-12 Juillet, Toulouse, France,* Vol. 1, pp. 13-28.

GIDENNE, T., CARABAÑO, R., GARCÍA, J., DE BLAS, J.C., 1998. Fibre digestion. In: De Blas, J.C and Wiseman, J. (Eds.) The Nutrition of the Rabbit. *CAB International, Wallingford, UK,* 103-131.

GUTIÉRREZ, I., CACHALDORA, P., CARABAÑO, R., DE BLAS, J.C., 2000. Effect of supplementation with animal plasma and antibiotics of starter diets in rabbits. *Proc. 7th*

World Rabbit Congress, Valencia (in press).

GYARMATI, T., SZENDRÖ, ZS., MAERTENS, L., BIRÓ-NÉMETH, E., RADNAI, I., MILISITS, G., MATICS, ZS., 2000. Effect of suckling twice a day on the performance of suckling and growing rabbits. Proc. *7th World Rabbit Congress,* Valencia (in press).

LEBAS, F., 1989. Besoins nutritionnels des lapins, revue bibliographique et perspectives. *Cuni-Sciences,* **5(2)**: 1-28.

LEBAS, F., 1993. Amélioration de la viabilité des lapereaux en engraissement par un sevrage tardif. *Cuniculture,* **20 (2)**: 73-75.

LEBAS, F., MAITRE, I., 1989. Alimentation de presevrage. *Cuniculture,* **16 (3)**: 135-140.

MAERTENS, L., 1992. Rabbit nutrition and feeding: a review. *J. Appl. Rabbit Res.*, **15**: 889-913.

MAERTENS, L., DE GROOTE, G., 1990. Feed intake of rabbit kits before weaning and attempts to increase it. *J. Appl. Rabbit Res.*, **13**: 151-158.

MCNITT, J.I., MOODY, G.L., 1990. Milk intake and growth rates of suckling rabbits. *J. Appl. Rabbit Res.*, **11**: 117-120.

MCNITT, J.I., MOODY, G.L., 1992. A method for weaning rabbit kits at 14 days. *J. Appl. Rabbit Res.*, **15**: 661-665.

MORISSE, J.P., 1985. Pathologie digestive: alimentation et zootechnie. *Eleveur de lapins*, **n°9**, pp. 51-55.

PARIGI BINI, R., XICCATO, G., CINETTO, M., DALLE ZOTTE, A., 1992. Energy and protein utilisation and partition in rabbit does concurrently pregnant and lactating. *Animal Science*, **55**: 153-162.

PEREZ, J.M., LEBAS, F., GIDENNE, T., MAERTENS, L., XICCATO, G., PARIGI BINI, R., DALLE ZOTTE, A., COSSU, M.E., CARAZZOLO, A., VILLAMIDE, M.J., CARABAÑO, R., FRAGA, M.J., RAMOS, M.A., CERVERA, C., BLAS, E., FERNANDEZ, J., FALCAO E CUNHA, L., BENGALA FREIRE, J., 1995. European reference method for in vivo determination of rabbit digestibility in rabbits. *World Rabbit Sci.,* **3***:* 41-43.

PIATTONI, F., MAERTENS, L., 1999. Effect of weaning age and solid feed distribution before weaning on the caecal fermentation pattern of young rabbits. 11. *Arbeitstagung über Pelztier-, Kaninchenund Heimtierproduction und Krankenheiten, Celle, Ed. Deutsche Vet. Med. Gesellschaft e. V., Giessen*, 97-105.

PIATTONI, F., MAERTENS, L., DEMEYER, D., 1995. Age dependent variation of caecal contents composition of young rabbits. *Arch. Anim. Nutr.*, **48**: 347-355.

PRUD'HON, M., BEL, L., 1968. Le sevrage précoce des lapereaux et la reproduction des lapines. *Ann. Zootech.*, **17**: 23-30.

SCAPINELLO, C., GIDENNE, T., FORTUN-LAMOTHE, L., 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.

SCHLOLAUT, W., 1988. Present husbandry and management conditions and development trends in rabbit production. In: *Proc. 4th World Rabbit Congress, 10-14 October, Budapest, Hungary,* Vol. 1, pp. 93-112.

XICCATO, G., 1996. Nutrition of lactating does. In: *Proc. 6th World Rabbit Congress, 9-12 Juillet, Toulouse, France,* Vol. 1, pp. 29-50.

XICCATO, G., COSSU, M.E., TROCINO, A., QUEAQUE, P.I., 1998. Influence du rapport amidon/fibre et de l'addition de graisse en post-sevrage sur la digestion, les performance zootecniques et la qualité bouchère du lapin. In: *Proc. 7èmes J. Rech. Cunicole, 13-14 Mai, Lyon, France,* pp. 159-162.