GROWTH, HEALTH STATUS AND DIGESTION OF RABBITS WEANED AT 23 OR 32 DAYS OF AGE

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ABSTRACT

Our study compared the growth performances health and digestion of young rabbits either weaned early at 23 (group W23, n=28 litters) or at 32 d (W32, n=25 litters). Litters, equalised at birth at 10 pups, were bred with their mother until weaning, in specific cages allowing to distribute separately a feed specific for young from day 16 of age, while females were fed a commercial feed. Young of both groups were fed the same diet (pellets 3.5 mm) rich in fibres (ADF=18.5%) and lipids (crude fat=5.4%) and low in starch (6.1%). At 32d of age, 5 rabbits from each litter were moved to collective fattening cages and fed a fattening diet (ADF=19.5%, DE=11.15MJ/kg, starch=13.7%) till 73d of age. From the same litters, two groups of 13 rabbits were housed from 32 till 42d old in individual metabolism cages for digestibility measurements of the fattening diet. Feed intake results, obtained from collective cages, were corrected for mortality. Two days after an early weaning (23d old) young rabbits consume about 60% more dry feed than those of W32 group; but their weight gain remained lower (17.2 *vs* 46.6 g/rab; P<0.01). For 23-32d period, the weight gain was 9.4% lower for W23 (299 *vs* 330 g/rab., P=0.024), while the feed intake was 65% higher. Rabbits of W23 group still had a 6.6% lower weight on day 52, but then they had a compensatory growth since their final weight did not differ from W32 group (meanly 2433 g at 73 days of age). Before 28d of age, no mortality was registered whatever the group, and only 5 rabbits on 280 (from 3 litters) of W23 group died from acute diarrhoea at 30 and 31d of age. Between 32 and 45d of age, the mortality and morbidity rates were twice higher in W23 than in W32 group (resp. 17.0 *vs* 9.2%, P=0.017; 27.4 *vs* 13.3%, P<0.01), while between 45 and 73d of age, the mortality rate was slightly higher in W32 group (21.1 *vs* 17.9%, P>0.20). For the whole fattening period, morbidity and mortality rates were similar among the two groups, although the health risk index tended to be higher for early weaned rabbits (60.7 *vs* 50.8%, P=0.11).

Key words: weaning, digestion, health status, rabbit, intake pattern.

INTRODUCTION

Early weaning, already assayed 35 years ago (PRUD'HON and BEL, 1968), get now an increased interest for two main reasons: 1- to feed more earlier the young with a specific diet, and thus to better meet its requirements for growth and health; 2- to reduce the lactation period and thus to improve the female body condition, as reported by XICATTO *et al.* (2004). GUTIERREZ *et al.* (2002 a, b) have explored the effect of some nutrient sources (starch, protein) on the digestion and performances of early weaned rabbits, while GIDENNE *et al.* studied the feeding behaviour according to the drinking system (2002) or pellet diameter (2003). More recently, GALLOIS *et al.* (2003) reported that an early weaning affect the digestive development of the young rabbit, and would subsequently modified its digestion. However, comparative experiments studying the impact of age at weaning on growth, digestion and particularly on digestive health is still fewly documented.

Therefore, we aimed to compare health and zootechnical performances of young rabbits either early weaned at 23 d of age, or classically weaned at 32 d of age. We also explored if the age at weaning would affect or not the food digestibility of growing rabbit.

MATERIAL AND METHODS

Animals, feeds and experimental design

A total of 53 litters, equalised at birth at 10 pups, were bred with their mother, in specific cages (FORTUN-LAMOTHE *et al.* 2000) adapted to distribute separately a specific feed to the litter from day 16 of age, while females were fed a commercial feed (without access for the litter). At 23d of age, 28 litters were weaned (group W23), while 25 litters were weaned at 32d of age (group W32). From 16 till 32d, youngs of both groups were fed an experimental diet (pellets 3.5mm) having a relatively high concentration in fibre and fat, and a low starch level (Table 1, feed W). At 32d of age, 5 rabbits from each litter were selected (using their weight ranks 2-3-5-7-8, within a litter) and moved to the same collective fattening cage, and fed a fattening diet (Table 1, feed F) till 73d old. Feeds F and W contained only a coccidiostatic, and no prophylactic treatment was applied to rabbits throughout the experiment.

Growth, health status and digestibility measurements

Litters were weighed at 23, 25, 28 and 32 d of age, then rabbits were individually weighed weekly. Feed intake was precisely controlled before and after weaning, including a control of food spillage. Health status was measured individually at 42d, 49d, 60d, and at slaughter age, through an external observation. Rabbits showing clinical signs of digestive troubles or sickness, such light or acute or finishing diarrhoea, caecal impaction, were classed as morbid. Animals without visible digestive troubles, but showing severe disturbances of growth (loss of weight during a week, or with abnormally low growth) were also classed as morbid. The morbidity rate was the expression of the number of ill rabbits on the initial number of animals, and an animal was accounted morbid only one time (within a period), even if diarrhoea lasted several days. Dead animals were only accounted in mortality rate, even when they exhibited clinical signs of diarrhoea before death. Therefore, we calculated a Health Risk index (HRi) corresponding to the sum of morbid and dead animals, knowing that each animal was accounted only once and categorised either dead or morbid.

Whole tract digestibility was measured according to European procedure between 36 and 40d of age, on two groups of 13 rabbits, issued from the same litters than rabbits kept for the control of performances. Feeds and faeces were analysed for dry matter (24 h at 103°C), ash (5 h at 550°C), gross energy (adiabatic calorimeter PARR), and fibres (NDF, ADF and ADL) (EGRAN, 2001). The non-nitrogenous cellular content (NNCC), which includes starch and also the major part of pectins, was estimated by difference according to the relation: NNCC (%) = OM (%) - CP (%) - NDF (%). Starch was analysed in feeds after an enzymatic hydrolysis, and the resultant glucose was measured colorimetrically. Nitrogen was determined according to the DUMAS combustion method (Leco auto-analyser, model FP-428).

Table 1. Ingredients (%) and chemical composition of diets

Diets : Periods :	**W** (16-32d)	**F** (32-73d)
Wheat	5.00	18.00
Wheat straw	6.50	8.00
Soya bean meal	16.00	8.00
Beet pulp	17.00	18.00
Wheat bran	15.00	15.00
Sunflower meal	14.00	15.00
Alfalfa meal	16.00	16.00
Vegetable oil	4.00	0
Sugar (sucrose)	4.00	0
Minerals and vitamins	2.50	2.00
Composition *(g/kg air dry basis)*		
Dry matter	931	916
Organic matter	850	847
Neutral detergent fibre	361	378
Acid detergent fibre	185	195
Acid detergent lignin	40	40
Crude fibre	173	169
Crude fat	54	21
Crude protein (N x 6.25)	189	173
Starch	61	137
NNCC *	300	296

* NNCC = Non nitrogenous cellular content= Organic mater-NDF- crude protein.

Statistical analyses

Results of growth, intake and digestibility were analysed according to a monofactorial variance analysis (effect of age at weaning). Feed intake was corrected for cages having one or two deads, taking into account that rabbits did not consume feed during the two days before their death. Cages having more than 2 rabbits dead within a period were discarded from statistical analysis of feed intake. Data of mortality and morbidity were analysed according to the method of K Pearson (distribution of χ^2, procedure CATMOD, SAS).

RESULTS AND DISCUSSION

For the two days after early weaning (at 23d) young rabbits consume about 60% more dry feed than those of W32 group (22.9 *vs* 14.4 g/d, P<0.01), but their weight gain remained 62% lower (17.2 *vs* 46.6 g/d, P<0.01), leading to a lower weight at 25d old (408 *vs* 447 g, P<0.05). Between 23 and 25d, we found no significant correlation among the litter weight at 23d and the feed intake or the weight gain in the W23 group. Between 23 and 32 d of age, the weight gain was only 9.4% lower for W23 group, thus leading to a 5.1% lower live weight at 32d (Table 2). During the period 32-38d of age, the growth of W23 rabbits remained significantly lower than W32 rabbits (44.1 *vs* 46.5 g/d, P< 0.05), while the inverse situation was found between 45 and 73d of age (respectively 42.5 *vs* 39.6 g/d, P< 0.001). The live weight of W23 rabbits remained lower than W32 rabbits till 52 d of age (1540 *vs* 1648, P<0.01), and were similar thereafter. On the whole growth, from 23-73d of age, the weight gain did not differ among the two groups. After 32d of

Table 2. Growth and feed intake according to age at weaning*

	Age at weaning			
	23 days	**32 days**	***CVr %***	***P level***
Live weight, g				
at 23 days	390	400	*13.8*	*0.50*
at 32 days	693	730	*11.5*	*0.10*
Period 23-32 d				
Weight gain, g/day	33.2	36.6	*15.2*	*0.02*
Feed intake, g/rab.	360	219	*23.7*	*<0.01*
Live weight, g				
at 38 days	987	1041	*13.7*	*<0.01*
at 73 days	2419	2447	*9.5*	*0.42*
Weight gain, g/day				
period 32-73 days	41.3	40.9	*11.7*	*0.58*
Feed intake, g/rab.				
period 32-38 days	445	457	*13.3*	*0.50*
period 32-73 days	4914	4841	*6.2*	*0.56*

* Data obtained on healthy rabbits. CVr : residual coefficient of variation

age, as cages having more than 2 deads were discarded from the intake and feed conversion analysis, and the number of replicates was 14 and 19 cages resp. for W23 and W32 group at 45d, and respectively 11 and 13 at 73d. The feed conversion of healthy rabbits was similar among the two groups either from 32 to 45d (1.80 *vs* 1.83, P=0.65) or from 45 to 73d (2.82 *vs* 2.84, P=0.73).

The negative effect of an early weaning, on growth between 3 and 7 weeks of age, was compensated around 8 weeks, in agreement with XICATTO *et al.* (2000). Even for a very early weaning at 14d of age, PRUD'HON and BEL (1968) also found no differences in live weight at 9 weeks of age. Besides, NIZZA *et al*. (2001) reported that rabbits weaned at 30d still have a lower weight at 10 weeks of age, compared to those weaned at 35d.

The higher intake of dry feed of early-weaned rabbit (Table 2) was insufficient to compensate the interruption of milk intake, and to ensure a growth similar to rabbits weaned 9 days later. This confirmed the difficulty for the young to increase rapidly its feed intake, or to compensate a lower milk intake by a sufficient solid food intake, as shown for young bred in large or little litters (10 *vs* 5 or 4 kits) (DI MEO *et al.* 2003, FORTUN LAMOTHE and GIDENNE, 2000).

Table 3. Health status according to age at weaning.

	Age at weaning		***P level***
	23 days	**32 days**	
Mortality between 23 and 32 d old, % (n/ni)	1.80 *(5/280)*	0.0 *(0/250)*	*0.034*
Period 32-45 d			
Mortality, % (n/ni)	17.0 *(23/135)*	9.2 *(11/120)*	*0.017*
Morbidity, % (n/ni)	27.4 *(37/135)*	13.3 *(16/120)*	*<0.01*
Health Risk Index, % (n/ni)	44.4 *(60/135)*	22.5 *(27/120)*	*<0.01*
Period 32-73 d			
Mortality, % (n/ni)	31.8 *(43/135)*	28.3 *(34/120)*	*0.54*
Morbidity, % (n/ni)	28.9 *(39/135)*	22.5 *(27/120)*	*0.27*
Health Risk Index, % (n/ni)	60.7 *(82/135)*	50.8 *(61/120)*	*0.11*

n/ni : number of cases on initial number of animals

Before 4 weeks of age, no mortality was registered whatever the group, and only 5 rabbits on 280 (from 3 litters) of W23 group died by diarrhoea at 30 and 31d of age. In return, the mortality and morbidity rates increased sharply between 32 and 45 d of age (Table 3). Autopsy of 5 recently dead animals revealed signs of inflammation on the small intestine, and a control of E. coli flora indicated high counts of E. coli of serotype

O2 in the caecum (10^7 to 10^9 CFU/g), but no entero-pathogenic E. coli such serotype O103 was detected. Between 32 and 45d of age, the mortality and morbidity rates were twice higher in W23 than in W32 group (Table 3). Reversely, between 45 and 73d of age, the mortality rate was slightly higher in W32 group (21.1 *vs* 17.9%, P>0.20). Accordingly for the whole fattening period, morbidity and mortality rates were not significantly different among the two groups, although the health risk index tended to be higher for early weaned rabbits (P=0.11). XICCATO *et al.* (2001) reported no significant effects of early weaning on mortality, but with feeds supplemented with an antibiotic. In return, LEBAS (1993) pointed out that viability of young was improved in lately-weaned rabbits. Compared to rabbits weaned at 32d, we observed an earlier sensibility of early-weaned rabbits when occurred a specific digestive pathology, and a slightly higher health risk over the whole fattening period. Thus, we cannot exclude a weaker resistance of such early-weaned animals to digestive troubles, and further studies are necessary on a larger number of rabbits to confirm our first results.

Table 4. Whole tract digestive efficiency of 5 weeks old rabbits, according to age at weaning.

	Age at weaning			
	23 days	**32 days**	***CVr %***	***P level***
Intake (g/d, from 36 to 40d old)	84.5	90.1	14.1	0.27
Digestibility coefficient (%)				
Organic matter	66.7	66.5	2.8	0.88
Crude Protein	80.7	80.9	1.7	0.65
Energy	66.3	66.3	2.7	0.94
NDF	38.8	37.8	9.3	0.48
ADF	27.1	26.3	16.7	0.66
Hemicelluloses	51.4	50.1	6.6	0.36
Non nitrogenous cellular content	93.8	92.7	1.3	0.037
Nutritive value of F diet				
Digestible energy, MJ/kg (air-dry basis)	11.15			
Digestible protein, g/kg (air-dry basis)	140			

Age at weaning did not affect significantly the whole tract digestibility of nutrients measured between 5 and 6 weeks of age (Table 4). However, the digestibility of NNCC was slightly but significantly higher in W23 group, suggesting an earlier maturation of the digestive capacity for starch, sugars and pectins. This should be confirmed by studies of enzymatic profile and of saccharides digestion.

CONCLUSION

An early weaning impairs the growth performances only before 7 weeks of age, but led to similar slaughter weights. Face to a specific pathology, an early weaning tended to increase the health risk, suggesting a specific sensibility of those animals. This effect must be confirmed in studying the interactions between the digestive health and gut maturation. The early weaning technique should thus be improved through a better knowledge on young rabbit nutrition and feeding.

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