Influence of low dietary starch/fibre ratio around weaning on intake behaviour, performance and health status of young and rabbit does

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Original article

Influence of low dietary starch/fibre ratio around weaning on intake behaviour, performance and health status of young and rabbit does

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Abstract — The influence of a low starch/fibre ratio (S/F) diet given to rabbits and does around weaning on their performance and health status was studied. In the LS group (n = 29 litters), the rabbits were fed a low S/F (0.68) diet (LS diet: 11.7 DE MJ·kg^{-1} DM) from day 18 to day 44; then they were changed to a fattening diet (F diet: 12.5 DE MJ·kg^{-1} DM). In the HS group (n = 29 litters), the rabbits were fed a high S/F (0.98) diet (HS diet: 12.6 DE MJ·kg^{-1} DM) from days 18 to 32 (weaning), and after weaning they received the F diet. From day 18 to weaning, the females and litters were fed the same diet. From day 18 to day 21, after the feed change, the LS females' feed intake dropped (–6%). As a consequence, they lost weight (–4%), and produced less milk from days 21 to 24 than the HS females (–17%; $P < 0.05$). Moreover, a high mortality was registered for the LS females (7/29 vs. 0/29, in LS vs. HS respectively; $P = 0.01$). From day 25 to weaning, the feed intake of the litters was lower in the LS group than in the HS group (–13%; $P < 0.05$). Consequently, at weaning, the live weight of the LS rabbits was lower (–6%; $P < 0.01$). From days 18 to 32, mortality was higher in the LS group (5.2 vs. 0.8%; $P < 0.01$). After weaning, feed intake tended to be higher in the LS group, and on day 44, live weight did not differ between the groups. From days 32 to 44, morbidity tended ($P = 0.06$) to be lower for the LS rabbits. In conclusion, young rabbits would not regulate their feed intake according to the dietary DE level. Moreover, a feed change for females, at the lactation peak, reduced their intake level, leading to a lower milk production. This also induced a lower health status both in the females and in the liters.

rabbit / feed intake / milk intake / does / starch/fibre ratio / sanitary status

Résumé — **Influence d'un faible ratio amidon /fibres dans l'aliment péri sevrage sur le comportement alimentaire, les performances et l'état sanitaire des lapereaux et des lapines**. Cette étude mesure les effets d'un faible ratio amidon /fibres (A/F) dans l'aliment péri sevrage, sur les performances et l'état sanitaire des lapereaux et des femelles avant et après sevrage. Dans le groupe LS (n = 29 portées), les lapereaux reçoivent à volonté un aliment (LS : 11,7 ED MJ·kg^{-1} MS) de faible ratio A/F

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(0,68) de 18 à 44 jours d'âge puis un aliment de croissance (F : 12,5 ED MJ·kg^{-1} MS) jusqu'à j70. Dans le groupe HS, de j18 au sevrage (j32), les lapereaux reçoivent à volonté un aliment (HS : 12,6 ED MJ·kg^{-1} MS) de ratio A/F élevé (0,98) puis l'aliment F jusqu'à j70. De j18 à j32, les femelles reçoivent le même aliment que leur portée. De j18 à j21, après le changement d'aliment, la consommation d'aliment des femelles LS baisse de 6 %, leur poids est réduit de 4 % et leur production laitière est plus faible que pour les femelles HS (–17 % ; $P < 0{,}05$). De plus on enregistre une mortalité élevée des femelles LS (7/29 vs. 0/29, LS vs. HS respectivement ; $P = 0{,}001$). De j25 au sevrage, la consommation d'aliment des lapereaux LS est inférieure à celle des lapereaux HS (–13 % ; $P < 0{,}05$). En conséquence le poids vif au sevrage des lapereaux LS est plus faible (–6 % ; $P < 0{,}01$). De j18 à j32, la mortalité dans le groupe LS est plus forte (5,2 vs. 0,8 % ; $P < 0{,}01$). Après sevrage, la consommation d'aliment des lapereaux LS a tendance à être plus élevée, et à j44, on enregistre aucune différence de poids entre les groupes. De j32 à j44, la morbidité des lapereaux LS a tendance à être plus faible ($P = 0{,}06$). En conclusion, les lapereaux ne semblent pas réguler leur niveau d'ingestion en fonction de la teneur en énergie digestible de l'aliment. Par ailleurs, un changement d'aliment au moment du pic de lactation, pourrait réduire le niveau d'ingestion des femelles, induisant une plus faible production de lait, et affectant ainsi l'état sanitaire des femelles et de leur portée.

lapin / consommation d'aliment / ingestion de lait / lapines reproductrices / ratio amidon/fibre / état sanitaire

1. INTRODUCTION

Around 18 days of age, when rabbits begin to eat solid feed, their digestive system is not mature: intestinal enzymatic activities are low and the cæcal flora is not established. Few studies have described the development of the young rabbit's digestive system [6, 9, 18, 22, 30], and little is known about the nutritional needs and feed intake regulation of rabbits before weaning [28, 30]. Moreover, digestive troubles observed after weaning could be a consequence of a disturbance in the digestive system development, due to an inadapted composition of the diet ingested before weaning [13]. Boriello and Carman [3] showed that the degradation of a high quantity of starch in the caecum favoured pathogenic flora. Moreover, feeding rabbits a high starch diet before weaning altered their viability after weaning [19]. In addition, Morisse [23] showed a positive effect of a high fibre diet before weaning on the rabbit sanitary status after weaning. In rearing conditions, before weaning, rabbits are fed the same diet as their mother, which has a high digestible energy content. Thus the high energetic requirements of reproducing females are respected to the detriment of the nutritional needs of the young rabbits. Consequently, the nutritional needs of rabbits before weaning must be studied in interaction with those of the females.

In this work, we studied the influence of a low starch/fibre ratio (S/F) diet given before and after weaning on feed intake, performance and health status of young rabbits and on the reproductive performance of the females.

2. MATERIALS AND METHODS

2.1. Animals and feeding strategy (Fig. 1)

Fifty-eight litters from primiparous hybrid females (INRA strain A2066 × A1077) were equalised at birth (day 0) to nine young. They were allocated into two groups (group LS and group HS, 29 litters per group), according to their live weight and the size of litter at birth before equalisation. Does and pups were submitted to a feeding program with either three or two diets, according to the group. The ingredients and chemical composition of the feeds are

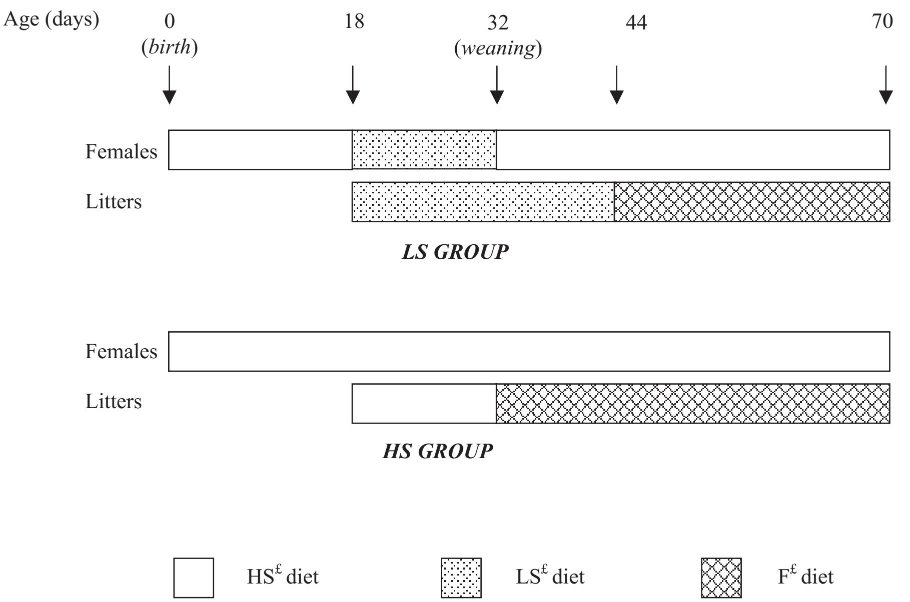

Figure 1. The feeding pattern of young rabbits and does according to the experimental group. £: HS: high starch diet, LS: low starch diet, F: fattening diet

given in Table I. The HS (high starch) diet was characterised by a high S/F ratio and the LS (low starch) diet by a low S/F ratio. In the LS diet, starch was substituted for fibre so that the digestible energy (DE) level was lower than in the HS diet (11.7 vs. 12.6 MJ DE·kg^{-1} DM). The HS diet and F (fattening) diet meet recent nutritional recommendation for reproducing does [33] and for growing rabbits respectively [7]. From 18 days of age to weaning (day 32 of age), the rabbits of the HS group were fed the HS diet ad libitum, and from days 32 to 70, they received the F diet. In the LS group, the rabbits were fed the LS diet ad libitum from days 18 to 44, and received the F diet on day 44. The diets were given as pellets of 3 mm diameter and 6–12 mm long. At weaning, the rabbits of each litter were allocated either to individual (n = 227 rabbits) or to collective cages (n = 250 rabbits; 5 per cage).

The females of the HS group were fed the HS diet throughout the experiment, while those of the LS group, received the LS diet from day 18 to day 32 after the first parturition, and the HS diet the rest of the time. The females were remated 11 days after parturition.

2.2. Controls

To measure the solid feed intake of the litters before weaning (day 32), without separating the young from their mothers, the cages were adapted according to Fortun-Lamothe et al. [10]. Briefly, this system consisted in carrying out several modifications on traditional wire cages. Firstly, the female's feeder was modified to prevent the ingestion of pellets by the suckling rabbits. Secondly, the young had access to a specific feeder. Lastly, a wire mesh partition

Table I. Ingredients and chemical composition of feeds given to the females and litters or to the growing rabbits.

Diets	HS£	LS£	F£
Ingredients (%)			
Wheat bran	30.00	16.80	20.00
Sunflower	21.00	12.00	15.00
Beet pulp	11.43	16.00	10.00
Wheat	7.90	7.00	11.00
Alfalfa	7.43	25.00	20.00
Extruded soybean	6.65	11.00	
Peas	6.00		
Can molasses	6.00		
Barley		6.00	11.00
Wheat straw		5.00	
Beet molasses			5.00
Soybean cake			6.50
Calcium carbonate	1.83		0.40
Bicalcium phosphate	0.13		
Talc	0.38		
CL 47L$		0.50	0.50
CL 27#	0.50		
Lysine	0.04		
Threonine	0.07		
Methionine	0.04¥	0.10¤	0.05¤
Salt	0.60	0.60	0.55
Chemical composition (%DM)			
Organic matter	90.2	91.8	91.6
NDF	33.8	38.0	34.3
ADF	17.2	20.5	17.0
ADL	4.2	4.6	4.0
Crude protein	19.6	18.8	19.0
Starch	16.9	13.9	20.2
Fat	3.1	3.2	2.2
Digestible energy ($MJ \cdot kg^{-1}$ DM)	12.4	11.6	12.5
Starch/ADF ratio	0.98	0.68	1.19

£: HS: high starch/fibre diet, LS: low starch/fibre diet, F: fattening diet.
$: Vitamin A: 1 800 000 $UI \cdot kg^{-1}$; D_3: 200 000 $UI \cdot kg^{-1}$; B_1: 300 $mg \cdot kg^{-1}$; E: 6000 $mg \cdot kg^{-1}$. Oligo elements: Cu^{2+}: 4000 $mg \cdot kg^{-1}$; Fe^{2+}: 14 000 $mg \cdot kg^{-1}$; Zn^{2+}: 20 000 $mg \cdot kg^{-1}$; Mn^{2+}: 7000 $mg \cdot kg^{-1}$.
#: Vitamin A: 9000 $UI \cdot kg^{-1}$; D_3: 1000 $UI \cdot kg^{-1}$; B_1: 0.15 $ppm \cdot kg^{-1}$; E: 30 $ppm \cdot kg^{-1}$. Oligo elements: Cu^{2+}: 20 $ppm \cdot kg^{-1}$; Fe^{2+}: 70 $ppm \cdot kg^{-1}$; Zn^{2+}: 10 $ppm \cdot kg^{-1}$; Mn^{2+}: 10 $ppm \cdot kg^{-1}$.
¥: MHA: methionine hydroxy-analogue. ¤: DL: methionine (40%).

divided the cage into two areas, to avoid the doe's access to the young's feeder. A little door in the wire mesh separation permitted to isolate the young rabbits from their mother to measure milk production.

The individual live weight of the rabbits was controlled weekly from birth to day 18, twice a week from day 18 until weaning, on days 36 and 39 and then once a week until day 70. Milk production of females was determined on days 4, 8, 10, 18, 21, 25, 28 and 32 of lactation, by weighing the doe before and just after suckling. The mean daily milk intake of litters was calculated for 5 periods (4–10 days, 11–17 days, 18–20 days, 21–24 days and 25–32 days). The feed intake of the litters was measured three times a week from day 18 until weaning and weekly after weaning.

Mortality was controlled daily from birth to day 70. Controls of morbidity were made weekly until day 18, twice a week from day 18 until 7 weeks of age and once a week until day 70. The criteria used to identify a morbid animal were the detection of digestive troubles (signs of diarrhoea) and/or severe disturbance of feed intake, associated with a negative or very low daily weight gain (DWG) during one week. At each period, mean DWG – 2 × standard deviation was the threshold value under which DWG was considered to be low. The sanitary risk index was defined as the sum of morbidity and mortality for each period.

The females were weighed at the time of control of milk production and at each kindling. Feed intake was controlled on days 8, 18, 21, 28, 32 and 42 after the first parturition. The females' fertility rate was the ratio of the number of 2nd parturitions on day 42/ the number of females presented to the male. At the 2nd parturition, we registered the size and weight of the litters. Besides, milk samples (9 g per doe on average) were collected mechanically using a milking machine [15], on days 23 and 29 of lactation.

2.3. Chemical analysis

The diets were analysed for dry matter (DM) by heating at 103 °C for 24 h, ashes, organic matter (OM) after ashing for 5 h at 550 °C, and nitrogen by the Dumas procedure (autoanalyseur LECO, mod. FP428). The starch diet content was determined enzymatically, using an adaptation of the method described by Kozlowski [14]. Neutral detergent fibre (NDF) and acid detergent fibre (ADF) were determined according to the sequential procedures of Van Soest et al. [32] and with an amylolytic pre-treatment using thermostable amylase [1]. Fat diet content determination was performed using the Soxtec system H^+ [2] and gross energy was measured with an adiabatic bomb calorimeter (PARR, Moline, IL). The digestible energy of the diets was determined in a previous work [8]. Lyophilised milk samples were analysed for proteins, fat, and energy, using the methods described above. Undiluted fresh milk samples were used to measure lactose content using an enzymatic method (Boëhringer Mannheim) and DM and ashes.

2.4. Statistical analyses

The results were subjected to analysis of variance according to the general linear model procedure of the Statistical Analysis System [29]. For data concerning weight, feed intake and reproductive performance of does, and feed and milk intake of rabbits before weaning, a group effect was included in the model as the main effect. For data concerning the growth of rabbits before weaning, the group was included in the model as the main effect and the maternal origin nested within the group was declared as the random effect. Growth and feed intake of the rabbits after weaning were analysed with a model including the group, the type of housing (individual or collective cages) and an interaction between the group and the type of housing as fixed effects. There was no interaction between the group and type of housing.

The model used to analyse milk composition included the group, the day of sampling and the interaction between the group and the day of sampling. There was no interaction between the group and day of sampling. Data of fertility, morbidity and mortality were compared between the groups, using the chi^2 test.

3. RESULTS

3.1. Intake pattern and growth performance of young before and after weaning

Between days 18 and 24, young rabbits ate less than 5 g·d^{-1} per rabbit in both groups (Tab. II). From this period to the next (days 25 to 32), feed intake increased four-fold on average in both groups, but from day 25 to weaning, ingestion in the LS group was 13% lower than in the HS group ($P < 0.05$). On the contrary, after weaning (days 32–70), feed intake was higher in the LS group than in the HS group (118.9 vs. 114.8 g·d^{-1} per rabbit, $P < 0.05$).

Milk intake decreased by 50% from day 18 to weaning in both groups. From day 21 to day 24, milk intake was 17% lower in the LS rabbits than in the HS rabbits ($P < 0.05$), while it was similar in both groups from day 25 to day 32 (14 g·d^{-1} per rabbit; Tab. II).

From day 18 to day 22, the growth of the rabbits was similar in both groups (Tab. III). Then, from days 22 to 32, daily weight gain was lower in the LS group than in the HS group (–10%, $P < 0.01$). During the whole post-weaning period (days 32 to 70), growth was higher for the LS rabbits (+4%, $P < 0.001$). At weaning, live weight was 6% lower in the LS rabbits ($P < 0.01$, see Tab. III). On day 44, there was no difference in live weight between the groups, and on day 70, the rabbits' weight was 2313 g on average. During the post-weaning period (days 32–70), the feed conversion ratio was not different among the groups (2.7 ± 0.2).

Table II. Milk and feed intake before weaning (days 18–32) and feed intake between days 32 and 70, according to the group.

		LS Group	HS Group	RMSE	Statistical significance
Milk intake (g fresh·d^{-1} per rabbit)					
Number of litter		*29*	*29*		
	days 4–10	20.0	19.0	5.3	NS
	days 11–17	27.3	28.3	5.2	NS
	days 18–20	26.1	29.0	6.7	NS
	days 21–24	20.8	25.1	7.0	*
	days 25–32	13.1	14.7	5.5	NS
Feed intake (g fresh·d^{-1} per rabbit)					
Number of litter		*29*	*29*		
Before weaning:	days 18–20	1.4	1.7	0.9	NS
	days 21–24	7.5	7.2	3.6	NS
	days 25–32	27.1	31.2	7.1	*
Number of rabbit		*233*	*244*		
After weaning[£]:	days 32–44	78.0	72.7	23.5	NS
	days 45–70	134.7	132.5	16.9	NS

NS: $P > 0.10$; *: $P < 0.05$.
£: data from individual and collective fattening were pooled. There was no interaction between the group and type of fattening.
RMSE: root mean square error.

Table III. Live weight and daily weight gain of rabbits before and after weaning, according to the group.

		LS Group	HS Group	RMSE	Statistical significance
Live weight (g)†					
Number of rabbit		*261*	*261*		
	Day 18	261	262	35	NS
	Day 32 (*weaning*)	626	666	106	***
	Day 44	1141	1134	212	NS
	Day 70	2325	2302	270	NS
Daily weight gain ($g \cdot d^{-1}$ per rabbit)					
Number of rabbit		*261*	*261*		
Before weaning:	days 18–21	12.1	13.5	4.8	NS
	days 22–25	18.7	21.1	6.3	+
	days 26–32	35.9	39.9	8.1	*
Number of rabbit		*233*	*244*		
After weaning£:	days 32–44	42.1	38.0	12.7	***
	days 45–70	44.9	43.6	5.6	*

NS: $P > 0.10$; +: $P < 0.1$; *: $P < 0.05$; ***: $P < 0.001$.
£: data from individual and collective fattening were pooled. There was no interaction between the group and type of housing.
RMSE: root mean square error.

3.2. Morbidity and mortality of the young

Before day 18, mortality and morbidity were low (< 5%). From day 18 to day 32, mortality was higher in the LS group than in the HS group (5.2 vs. 0.8%, $P < 0.01$, see Tab. IV). After weaning, mortality was similar in the two groups and it evolved similarly. It reached 13% on average during the first two weeks after weaning, and 7% on average from day 44 to day 70.

From day 18 to weaning, morbidity was similar in both groups reaching 10%. During the two first weeks after weaning, it decreased in the LS group, whereas it remained high in the HS group (5.6 vs. 10.3%, $P = 0.06$). Then, from day 44 to day 70, morbidity in the HS group returned to the same level as in the LS group (4.6%). From day 18 to day 32, the sanitary risk was significantly higher for the LS rabbits than for the HS rabbits (15.9 vs. 9.9%, $P < 0.05$). Then after weaning, the sanitary risk was higher but it did not differ between the groups: 31% on average for the whole period (days 32–70).

3.3. Female performance

From parturition to day 18, female feed intake was the same in both groups (see Fig. 2). After the feed change on day 18, feed intake decreased in the LS group (–6%, see Fig. 2), and from days 18 to 20, it was lower for LS females than for HS females (–27%, $P < 0.05$). From days 21 to 27, feed intake was similar in both groups and from days 28 to 32, it tended to be lower in the LS group than in the HS group (–19%, $P = 0.07$). Therefore, total feed intake from days 18 to 32 was 14% lower in the LS group than in the HS group (273 vs.

Table IV. Mortality, morbidity and sanitary risk of rabbits before and after weaning according to the group.

	periods		
	days 18–32	days 32–44	days 44–70
Number of rabbits			
LS Group	*251*	*233*	*200*
HS Group	*253*	*244*	*216*
Mortality (%)			
LS Group	5.2	14.2	6.0
HS Group	0.8	11.5	8.8
Statistical significance	**	NS	NS
Morbidity (%)			
LS Group	10.8	5.6	4.5
HS Group	9.1	10.3	4.6
Statistical significance	NS	+	NS
Sanitary risk (%)			
LS Group	15.9	19.7	10.5
HS Group	9.9	21.7	13.4
Statistical significance	*	NS	NS

NS: $P > 0.10$; +: $P < 0.1$; *: $P < 0.05$; **: $P < 0.01$.

318 g per female, $P = 0.03$). The live weight of the females was similar in both groups all throughout the experiment. Although it was not significant, on day 21 we registered a 4% weight loss for the LS females compared to the HS females (see Fig. 3).

For all the parameters measured to evaluate the reproductive performance (pregnancy rate, interval between parturition, does and litter weights on the day of parturition and litter size), there was no difference between the groups (Tab. V).

The mortality of the LS females was relatively high. From day 18 to day 32, 6 does died and another died after weaning, while no death was registered in the HS group during the experiment.

Milk composition evolved throughout lactation (Tab. VI): between day 23 and day 29, lipid content tended to increase (+23%, $P < 0.06$), protein and ash contents increased significantly (+27%, $P < 0.001$ and +20%, $P < 0.01$, respectively), whereas lactose content decreased (–73%, $P < 0.001$). Milk composition was similar in both groups on days 23 and 29.

4. DISCUSSION

4.1. Female performance

Generally, feed intake of reproducing does increases when the dietary energy content decreases, maintaining a constant DE intake [4, 11, 17, 25]. Therefore, feed intake was expected to be higher in females offered the weaning diet, and less energetic than the maternal diet. On the contrary, females offered the low S/F diet in the middle of lactation reacted strongly to the feed change,

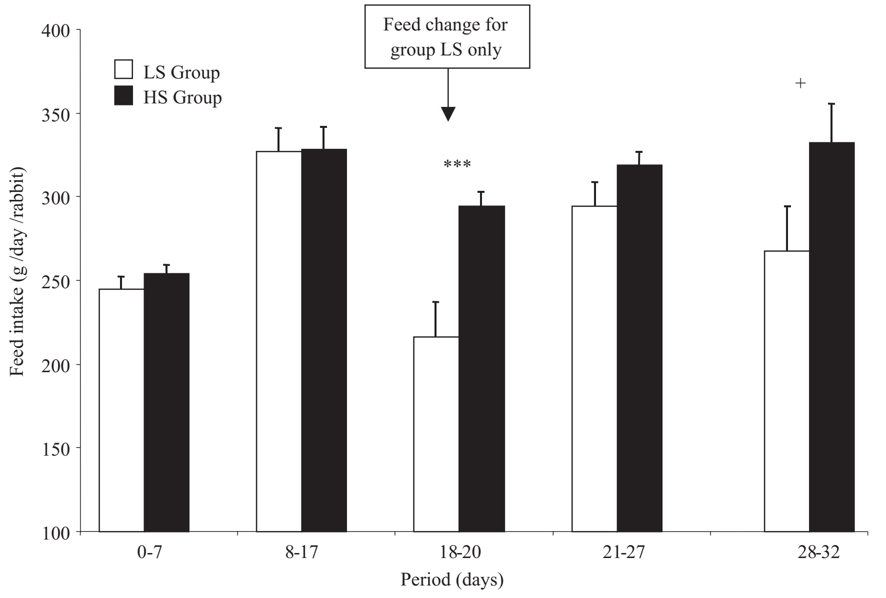

Figure 2. The change of feed intake by females during lactation according to the group. Values are means ± standard error of the mean (SEM). Within a group, the means differ at the level: +: $P < 0.1$; ***: $P < 0.001$.

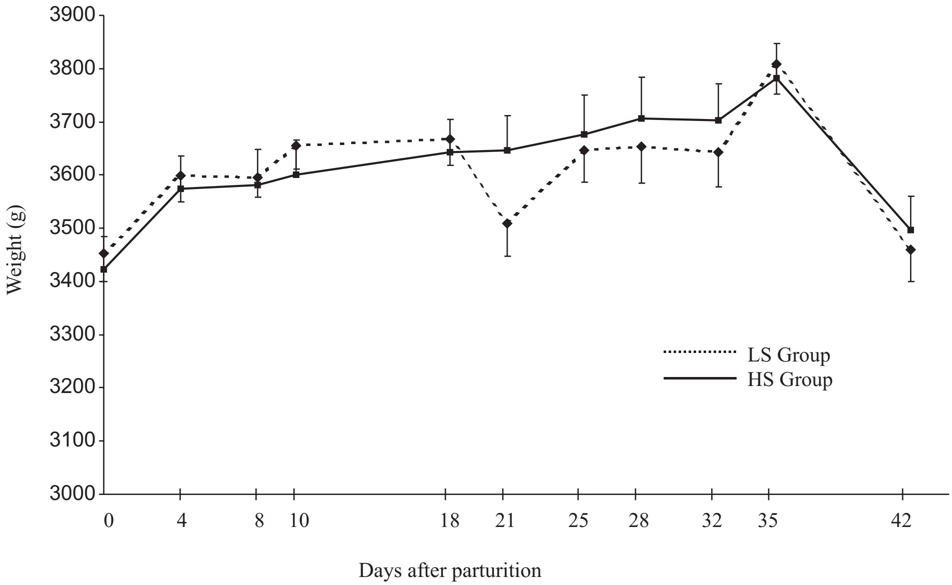

Figure 3. The live weight of females according to the group. Values are means ± standard error of the mean (SEM).

Table V. Reproductive performance of does at the 2nd parturition, according to the group.

	Group		RMSE	Statistical significance
	LS	HS		
Number of females mated 11 days after 1st parturition	*27*	27		
Pregnancy rate£ (%)	78	81		NS
Number of 2nd parturition	*19*	*28*		
Interval between parturition (days)	45	47	9	NS
Weight (g)	3509	3456	305	NS
Litter weight (g)	612	580	216	NS
Litter size	11.5	12.2	3	NS

NS: $P > 0.10$.
£: pregnancy rate was the ratio between the number of pregnant females and the number of females mated 11 days after parturition.
RMSE: root mean square error.

Table VI. Chemical milk composition, according to the day of lactation (day 23 and day 29).

	Days of lactation				Group			
	23	29	RMSE	Statistical significance	LS	HS	RMSE	Statistical significance
Chemical composition (g·kg^{-1} of fresh milk)								
Number of females	18	13			*12*	19		
Proteins	*118.5*	*162.2*	*26.6*	***	*132.5*	*139.6*	*34.5*	NS
Fat	189.7	247.5	77.6	+	224.5	206.0	82.5	NS
Lactose	11.9	3.2	4.3	***	9.0	7.8	6.2	NS
Ash	22.9	28.6	4.9	**	24.9	25.5	5.7	NS
Gross energy£	2196	3038	603	***	2674	2470	733	NS

NS: $P > 0.10$; +: $P < 0.1$; $P < 0.01$; ***: $P < 0.001$.
£: kcal·kg^{-1} of milk.
RMSE: root mean square error.

leading to a drastic drop in feed intake for four days. Thereafter, the feed intake of these females remained low until weaning. This is in accordance with the results of Lebas and Maître [19] and Maertens and Bousselmi [20] showing a lower feed intake of females after a feed change during lactation. On the contrary, Morisse et al. [24] observed no effect of feed change during lactation on the feed intake of females and litters.

The higher mortality observed in females fed the low S/F diet was in agreement with Chmitelin et al. [5]. This could be related to the weak body condition of the does associated to their strong drop in feed intake during lactation. On the contrary, the results of Morisse et al. [24] suggested that female viability is not affected by a low energetic diet given at the end of lactation.

Milk production from day 18 of lactation, was lower when females were fed the low S/F diet, as a consequence of their drop in feed intake. Inversely, Butcher et al. [4] showed that milk production was not affected by the DE content of the diet offered during lactation. Pascual et al. [27] showed that feeding females a high starch diet leads to a lower milk yield. Pregnancy rate and the other reproductive performances (interval between parturition, weight and size of the litter at parturition) were not affected by the starch/fibre ratio of the diet given during previous lactation in accordance with Pascual et al. [27].

4.2. Performance of young rabbits

Milk intake was lower in the rabbits fed the low S/F diet as a consequence of the lower milk production of their mothers. A higher feed intake was expected in these litters, since the results of Scapinello et al. [30] and Garcia De Faria et al. [12] showed that feed intake of suckling rabbits increased when milk availability decreased. On the contrary, feed intake was lower in rabbits fed the low S/F diet, although their milk intake was lower. Two hypotheses could explain this result: palatability of the low S/F diet was poor and/or suckling rabbits did not regulate their intake level according to the dietary DE level and prefer the starch rich diet. The similar intake of the high S/F and low S/F diets by rabbits after weaning did not support the first hypothesis while the results of Butcher et al. [4] and Garcia De Faria et al. [12] supported the second hypothesis. Conversely, according to Pascual et al. [27], young rabbits fed a high starch diet had a lower feed intake and a similar DE ingestion than young rabbits fed lower energetic diets. Similarly, Pascual et al. [26] showed that at the end of lactation, pups were able to modulate their feed intake according to the energetic level of the diet, to maintain a constant DE intake. Both lower feed and milk intake could explain the lower live weight at weaning of rabbits fed the low S/F diet.

After weaning, feed intake was higher in rabbits receiving the low S/F diet, thus confirming that weaned rabbits regulate their feed intake according to the dietary DE level [16, 31]. After weaning, a compensatory growth occurred in rabbits receiving the low S/F diet around weaning, so that the pre-weaning treatment did not impair live weight at ten weeks of age. This result agrees with those of Morisse et al. [24].

Before weaning, mortality was higher in litters fed the low S/F diet. Such a result, in accordance with Chmitelin et al. [5], could be related to their low milk and feed intake and the poor body status of their mothers.

Several authors described that feeding young rabbits a fibre rich diet before weaning improved viability after weaning [21, 23]. The present results showed that morbidity tended to be lower during the two weeks after weaning when the starch/fibre ratio of the diet offered before weaning was low, although viability was not improved.

5. CONCLUSION

In conclusion, our data suggested that suckling rabbits do not regulate their feed intake according to the dietary DE level. Additionally, a brutal change of feed in the middle of lactation could perturb the intake of females, and lead to a detrimental effect on their body weight viability and performance. The negative impact of the low energetic diet on females could influence the response of young rabbits to this diet. Indeed, a low milk intake associated with a low feed intake of litters were both responsible for a weak growth and high mortality in suckling rabbits fed a low starch/fibre diet. Therefore, the effects of the dietary starch/fibre ratio on the sanitary status of rabbits around weaning should be further studied by dissociating the dietary effects in the mothers and in the young.

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