EFFECT OF FEED RATIONING AND PARITY ORDER OF RABBIT DOES ON GROWTH PERFORMANCE AND MEAT QUALITY OF THEIR OFFSPRING

Dalle Zotte A.*, Rizzi C., Chiericato G.M.

Department of Animal Science, University of Padova, Viale dell'Università 16, 35020 Legnaro (PD), Italy
*Corresponding author: antonella.dallezotte@unipd.it

ABSTRACT

Thirty hybrid female rabbits of 15 weeks of age were randomly divided into three groups and fed with one of the three following diets: "C diet" for young females (DE=11.71 MJ/kg DM) fed *ad libitum*; "R diet" was the C diet fed at 80% of *ad libitum*, "F diet" rich in fibre (24.6% vs. 18.7% of C diet; DE=9.77 MJ/kg DM) fed *ad libitum*. The rabbits were first time inseminated at 19th weeks of age. The three diets were administered until the first parturition, afterwards all the does received the C diet *ad libitum*. The offspring received a commercial pelleted diet balanced for growing rabbits. The trial examined the offspring's performance and meat quality of two parity orders. Two newborn rabbits per litter were chosen at the first and second parturition of does and their growth performance, carcass yield and meat chemical composition were determined. For each doe, one rabbit was slaughtered at 36 days of age (weaning), the other one at 81 days of age. After weaning the remaining rabbits were caged by pairs in standard commercial cages. Maternal feed rationing did not affect offspring's performance and carcass and meat quality, with exception of a reduction in daily growth during the first 36 days of life on rabbits belonging to does rationed with diet F if compared to diet C (18.4 vs. 21.5 g/d; $P<0.10$) that elicited lower live weight at weaning (708 vs. 813 g; $P<0.10$). The feed intake of weanling rabbits of the second parity was significantly lower than that of first parity (134 vs. 150 g/d; $P<0.001$) but the live weight at 81 days was not significantly different between the two groups. Rabbits of the second parity showed higher slaughter yield at 36 and 81 days of age ($P<0.05$) and furnished leaner carcasses on the slaughter at 81 days ($P<0.05$). Also hindleg meat tended to be leaner, but only for rabbits slaughtered at 36 days of age ($P<0.10$). Parity order x maternal diet interaction was found on the protein content of hindleg meat of offspring at 81 days of age ($P<0.001$): while the protein content of rabbits that derived from mothers fed C and F diets decreased from the first to the second parity, that of rabbits of R-fed mothers showed an opposite trend.

Key words: Doe, Feed rationing, Offspring, Growth, Meat quality.

INTRODUCTION

The young rabbit does fed *ad libitum* with diets of high energy level often show parturition problems, with the subsequent reduction of the number of newborn rabbits, linked to excessive fatness (Fortun-Lamothe and Lebas, 1996). In order to avoid the excessive fatness of young rabbit does, rationed feeding is frequently applied. Research on the effect of maternal rationed feeding on the possible influence on the offspring's productive performance are scarce and limited to birth-weaning period (Pascual *et al.*, 1999; Eiben *et al.*, 2001; Szendrő, 2000). It was found that quantitative (80% of *ad libitum*) or qualitative (reduced DE content) maternal feed rationing did not modify muscle fatty acids profile of weaning or fattening rabbits (Dalle Zotte *et al.*, 2001) but oxidative metabolism of *Longissimus lumborum* muscle was significantly increased in weaning rabbits due to the maternal quantitative rationing (Dalle Zotte *et al.*, 2005).

The aim of the present work was to evaluate the effect of a moderate feed rationing (quantitative and qualitative) of nulliparous does, applied until their first parturition, on offspring's performance and meat quality, considering the first two parity orders and two offspring age (36 and 81days).

MATERIALS AND METHODS

One-hundred and forty hybrid (Hyplus) female rabbits of 15 weeks of age were at random divided into 3 groups and fed to one of the 3 following diets: "C" diet for young females (DE = 11.71 MJ/kg DM; CP = 18.5% DM; EE = 3.1% DM) fed *ad libitum*; "R" diet, was the C diet fed at 80% of *ad libitum*, "F" diet rich in fiber (24.6% vs. 18.7% for the C diet; DE = 9.77 MJ/kg DM; CP = 16.9% DM; EE = 2.6% DM) fed *ad libitum*. The 80% of rationing of R diet was weekly determined by measuring the *ad libitum* feed intake of the young does of the C group. The animals were first time artificially inseminated at 19 weeks of age. The 3 diets were administered until the first parturition, afterwards all the does received the C diet *ad libitum*. The second and third insemination occurred eleven days after each parturition. The trial examined the offspring's performance and meat quality of the first two parity orders of 30 rabbit does (10 per experimental diet). Part of the lactating does were empty: 10 of the first lactation (2, 3 and 5 does for C, F and R diets, respectively) and 2 of the second lactation (for C and R diets). At each birth, the litter size was equalized to eight. After weaning at 36 days of age the rabbits were pair-caged and weekly weighed. Also feed consumption was weekly determined. After weaning all the offspring received, *ad libitum*, the same commercial pelleted diet balanced for growing-fattening rabbits. Two newborn rabbits per litter were selected at the first and at the second parturition of does, chosen with liveweight corresponding to the average liveweight of the whole litter. One selected rabbit per litter was slaughtered at 36 d of age (weaning; n=60) while the other at 81 d of age (n=58). The last slaughter occurred in July but in the hottest month the environmental temperature of the rabbitry was constantly monitored and averaged 24.6°C. The trial examined the growth performance, the milk intake (by weighing the doe immediately before and after controlled suckling), and the meat quality of the selected offspring of the two parity orders. After slaughter, the yields, the carcass meatiness and fatness were analysed, according to the WRSA Commission recommendations (Blasco and Ouhayoun, 1996). Chemical composition (moisture, fat, ash, and protein content) was assessed on hindleg meat.

Statistical analysis

Variance analysis was performed using the GLM procedure of the SAS program (SAS Institute, 1990) by including maternal diet (C, F, R) and parity order (first, second) as fixed effects, and their interactions.

RESULTS AND DISCUSSION

The feed rationing applied on nulliparous does for 8 weeks prior to their first kindling did not affect offspring's performance and carcass and meat quality, except a tendency of lower daily growth during the first 36 days of life on rabbits belonging to does rationed with diet F if compared to diet C (18.4 vs. 21.5 g/d; $P<0.10$) and slightly lower live weight at weaning (708 vs. 813 g; $P<0.10$; Table 1). Quantitative feed restriction (R diet) unaffected the weight of weaned rabbits, supporting the results of Bonanno *et al*. (2004). The feed intake of weanling rabbits of second parity order was significantly lower than that of first parity (134 vs. 150 g/d; $P<0.001$) but the live weight at 81 days wasn't significantly different between the two groups (Table 2). The lower feed intake could be explained by the negative correlation with milk intake (Szendrő, 2000), but also with the higher environmental temperature at which fattening rabbits of second parity order were exposed.

Rabbits of second parity showed higher slaughter yield ($P<0.05$) at 36 and 81 days of age (Tables 3 and 4) and furnished leaner carcasses on the slaughter at 81 days ($P<0.05$; Table 4).

Table 1: Growth performance of offspring from birth to 36 days of age

	Parity Order (P)		Maternal Diet (D)			Probability[1]		RSD
	1	2	C	F	R	P	D	
Animals (n.)	60	60	40	40	40			
Live weight (g):								
- d 1	60.7	62.4	60.1	64.2	60.5			7.3
- d 36	762	749	813[b]	708[a]	746[ab]		†	127
Milk intake (g/d)[2]:								
- d 3-19	219	239	231	235	221			25
Daily growth (g/d):								
- d 1-36	20.0	19.6	21.5[b]	18.4[a]	19.6[ab]		†	3.6

[1] †: P<0.10; [2]Litter milk intake

Table 2: Growth performance of offspring slaughtered at 81 days of age

	Parity Order (P)		Maternal Diet (D)			Probability[1]		RSD
	1	2	C	F	R	P	D	
Animals (n.)	29	29	19	19	20			
Live weight (g):								
- d 1	59.6	60.2	58.7	61.4	59.6			7.7
- d 36	761	794	821	723	790			110
- d 81	2168	2119	2161	2073	2195			184
Feed intake (g/d):								
-d 37-81[2]	150[b]	134[a]	141	142	143	***		5.7
Daily growth (g/d):								
- d 0-36	20.1	21.0	21.8	18.9	20.9			3.1
- d 37-81	31.2	29.4	29.8	30.0	31.2			3.8
- d 1-81	26.4	25.7	26.3	25.1	26.7			2.3
Feed conversion index:								
- d 37-81[2]	4.85	4.78	4.89	4.78	4.77			0.39

[1]*** : P<0.001; [2]Average value referred to cage of 2 rabbits

Table 3: Slaughter yield and carcass trait of offspring at 36 days of age

	Parity Order (P)		Maternal Diet (D)			Probability[1]		RSD
	1	2	C	F	R	P	D	
Animals (n.)	30	30	20	20	20			
Slaughter weight (SW) (g)	760	771	808	721	769			150
Chilled carcass wt (CC) (g)	378	406	416	369	391			87.9
Reference carcass wt (RC) (g)	271	290	299	264	278			71.3
Slaughter yield (%SW)	49.5	52.5	51.5	51.1	50.3	*		2.7
Gastrointestinal tract (%SW)	26.5	24.8	25.0	26.1	25.9			3.1
Skin (%SW)	16.1	16.2	16.4	15.7	16.3			1.0
RC (%CC)	71.2	71.3	71.5	71.4	70.7			2.8
Dissectable fat (%RC)	2.46	1.87	2.28	2.07	2.15			0.91
Meat to bone ratio	3.09	3.42	3.39	3.07	3.30			0.57

[1]*: P<0.05

Table 4: Slaughter yield and carcass traits of offspring at 81 days of age

	Parity Order (P)		Maternal Diet (D)			Probability[1]		RSD
	1	2	C	F	R	P	D	
Animals (n.)	29	29	19	19	20			
Slaughter weight (SW) (g)	2167	2147	2166	2088	2215			183
Chilled carcass wt (CC) (g)	1230	1259	1237	1201	1294			122
Reference carcass wt (RC) (g)	998	1023	1000	977	1056			109
Slaughter yield (%SW)	56.7	58.5	57.1	57.4	58.4	*		1.96
Gastrointestinal tract (%SW)	20.5	21.9	21.3	21.5	20.8			2.2
Skin (%SW)	15.3	14.9	15.3	15.0	15.1			1.0
RC (%CC)	81.1	81.2	80.8	81.2	81.5			1.4
Dissectable fat (%RC)	2.79	1.94	2.40	2.09	2.61	*		0.79
Meat to bone ratio	5.24	5.37	5.40	5.05	5.46			0.51

[1]*: P<0.05

Also hindleg's meat seemed to be leaner, with less lipid content (1.59 vs. 1.98%; P<0.10), but limited to rabbits slaughtered at 36 days of age (Table 5). Parity order x maternal diet interaction was found on the protein content of hindleg meat of offspring at 81 days of age (P<0.001; Table 6): while the

meat protein content of rabbits that derived from mothers fed C and F diets decreased from first to second parity, that of rabbits of R-fed mothers showed an opposite trend (Figure 1).

Table 5: Chemical composition of hindleg meat of offspring at 36 days of age

	Parity Order (P)		Maternal Diet (D)			Probability[1]		RSD
	1	2	C	F	R	P	D	
Animals (n.)	30	30	20	20	20			
Water (%)	75.5	76.1	75.8	75.7	75.8			0.99
Protein (%)[2]	21.2	21.1	20.9	21.3	21.2			0.80
Lipids (%)	1.98	1.59	2.00	1.66	1.69	†		0.52
Ash (%)	1.34	1.28	1.30	1.31	1.32	†		0.07

[1]†: P<0.10; [2]Protein calculated by difference

Table 6: Chemical composition of hindleg meat of offspring at 81 days of age

	Parity Order (P)		Maternal Diet (D)			Probability[1]			RSD
	1	2	C	F	R	P	D	PxD	
Animals (n.)	29	29	19	19	20				
Water (%)	74.6	75.1	74.7	74.9	74.9				0.84
Protein (%)[2]	22.1	21.6	22.0	21.8	21.8			***	0.63
Lipids (%)	2.10	2.04	2.05	2.11	2.05				0.51
Ash (%)	1.25	1.25	1.26	1.23	1.26				0.15

[1] *** : P<0.001; [2] Protein calculated by difference

Differences in meat protein content between R group and the other 2 groups were significant in those rabbits belonging to the first parity order, being lower in the R group of rabbits (P<0.001; Figure 1). It remains to demonstrate to what extent maternal quantitative feed rationing can affect the offspring's meat protein content.

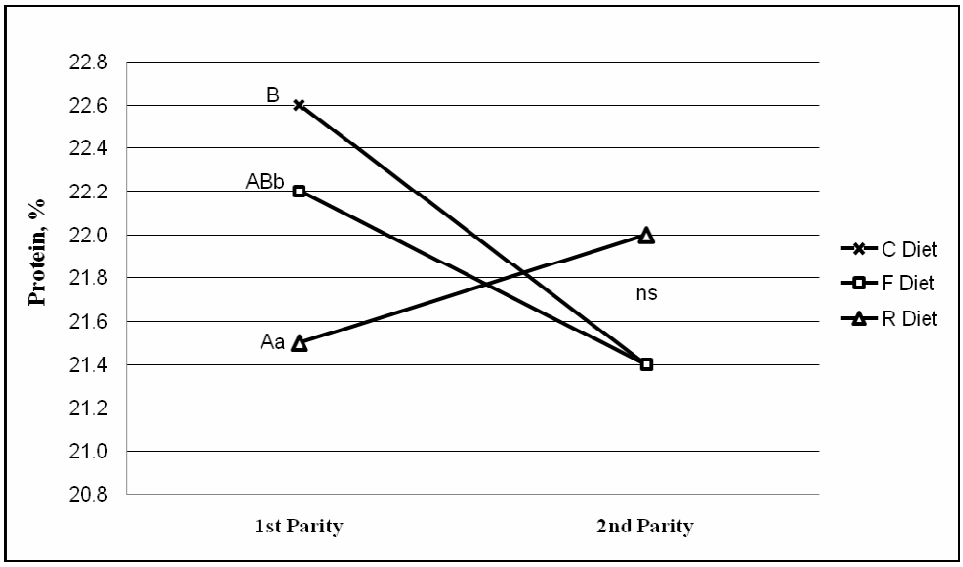

Figure 1: Interaction PxD for the protein content of hindleg meat of offspring at 81 days of age

CONCLUSIONS

Maternal feed rationing slightly influenced the live performance and the meat composition of their offspring. The negative effect of the F-rationed diet was perceived by the offspring only at their young age (weaning) while that of the R-rationed diet was evident only on those rabbits derived from the first parity order. Offspring of the second parity order weren't affected by the maternal feed rationing.

ACKNOWLEDGEMENTS

This research was supported by the Italian Ministry for University (MIUR, 1999).

REFERENCES

Blasco A., Ouhayoun J. 1996. Harmonization of criteria and terminology in rabbit meat research. Revised proposal. *World Rabbit Sci., 4, 93-99.*

Bonanno A., Mazza F., Di Grigoli A., Alicata M.L. 2004. Effects of restricted feeding during rearing, combined with a delayed first insemination, on reproductive activity of rabbit does. *In: Proc. 8th World Rabbit Congress, 2004 September, Puebla, Mexico, 224-230.*

Dalle Zotte A., Chiericato G.M., Rizzi C., Zakaria H. 2001. Effet de la restriction alimentaire de la lapine nullipare sur le profil en acides gras des lipides des muscles des lapins issus de la première mise bas. *In: Proc. 9èmes Journées de la Recherche Cunicole, Paris, France, 23-26.*

Dalle Zotte A., Rémignon H., Chiericato G.M. 2005. Influence of maternal feed rationing on metabolic and contractile properties of Longissimus lumborum muscle fibres in the rabbit offspring. *Meat Sci., 70, 573-577.*

Eiben Cs., Kustos K., Kenessey A., Virág Gy., Szendrő Zs. 2001. Effect of different feed restriction during rearing on reproduction performance in rabbit does. *World Rabbit Sci., 9, 9-14.*

Fortun-Lamothe L., Lebas F. 1996. Effects of dietary energy level and source on foetal development and energy balance in concurrently pregnant and lactating primiparous rabbit does. *Animal Sci., 62, 615-620.*

Pascual J.J., Tolosa C., Cervera C., Blas E., Fernàndez-Carmona J. 1999. Effect of diets with different digestible energy content on the performance of rabbit does. *Anim. Feed Sci. Technol., 81, 105-117.*

SAS 1990. SAS/STAT Users' Guide, Version 6. *4th ed. SAS Institute Inc., Cary, NC.*

Szendrö Zs. 2000. The nutritional status of foetuses and suckling rabbits and its effects on their subsequent productivity: a review. *In: Proc. 7th World Rabbit Congress, 2000 July, Valencia, Spain, 375-393.*