EFFECT OF NUTRITIONAL STATUS OF KITS ON CARCASS TRAITS AND MEAT QUALITY (PRELIMINARY RESULTS)

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ABSTRACT

The aim of the experiment was to study the effect of nutritional supply during foetal, suckling and growing periods on carcass traits and meat quality of rabbits. New-born rabbits (n=224) were divided into three groups according to their birth weight (low/L/: 35-50 g, medium/M/: 58-62 g, high/H/: 70-88 g). Half of the litters were nursed by one doe (O), while the other half by two does (T). After weaning at 3 weeks, from the age of 4 weeks half of the rabbits were fed *ad libitum*, while the other half was reared on a restricted feeding regime corresponding to 85-90% of the *ad libitum* feed intake level. Rabbits were slaughtered at 11 weeks of age. Body weight at slaughter of L rabbits was 124 g lower than M and 255 g lower than H rabbits ($P<0.05$). L group had the highest (58.0%) while M rabbits the lowest dressing out percentage (57.3%) ($P<0.05$). Ratio of hind part was significantly ($P<0.05$) higher in H group (39.0%) than in L group (38.1%). Ratio of perirenal fat was the highest in L rabbits (2.10%) and the lowest in H group (1.64%) ($P<0.05$). Value of WHC was 1.8% lower ($P<0.05$) in H rabbits compared to L and M animals. Slaughter weight of T rabbits was 198 g higher ($P<0.001$) than that of group O. Dressing out percentage was 0.7% ($P=0.002$) lower in T rabbits. In group T the cooking loss of *m. Longissimus dorsi* was 1.6% lower ($P=0.003$) than in group O. In consequence of feed restriction the slaughter weight and dressing out percentage decreased by 141 g ($P<0.001$) and 0.8% ($P=0.001$), respectively. Feeding regime influenced all the meat quality parameters except the b* value of meat colour. Rabbits in restricted group had 0.08 ($P<0.001$) lower pH, while 1.1 ($P<0.001$) higher L* and 0.7 ($P=0.008$) lower a* values of *m. Longissimus dorsi*. The cooking loss of *m. Longissimus dorsi* of restricted rabbits was 1.2% higher ($P=0.03$). Birth weight x number of nursing does x feeding interaction had significant ($P<0.05$) influence on the lipid content of *m. Longissimus dorsi*: the highest lipid content was found in MOA rabbits (2.30%) while the lowest in HOA (1.18%) and in LOR (1.21%) groups. Birth weight x number of nursing does interaction was significant on the proportion of *m. Longissimus dorsi* to reference carcass weight ($P=0.03$) and on meat to bone ratio ($P=0.02$). Highest ratio of *m. Longissimus dorsi* was found in LO and MO groups (11.9%), while LT rabbits showed the lowest value (11.4%). Meat to bone ratio was the highest in HT rabbits; it differed significantly ($P<0.05$) from other groups except MT. These results show that the nutrient supply during foetal and suckling ages has a long term effect which could be important in terms of carcass traits and meat quality as well.

Key words: Rabbit, Birth weight, Nursing, Feeding, Production, Carcass, Meat quality.

INTRODUCTION

Maternal effect has a special importance, since fattening rabbits live more than their half life in close connection with does (4-5 weeks pregnancy, 4-5 weeks nursing, 5-7 weeks fattening). Effect of birth weight (Poigner and Szendrő, 2000), of milk supplementation (Spencer and Hull 1984; Szendrő *et al.*, 2002) and that of feed restriction after weaning (Xiccato, 1999) has been studied yet. However, in these experiments the effects of factors were analysed separately. The combined effect of the three factors has been studied scarcely (Szendrő *et al.*, 2001, 2006) and only focus on productive traits. The

aim of this experiment was to study the effect of nutrition supply during foetal, suckling and growing periods on carcass traits and meat quality of rabbits.

MATERIALS AND METHODS

Animals and experimental design

The experiment was carried out at the rabbit farm of the Kaposvár University on Pannon White rabbits (n=224). New-born kits were divided into three groups according to their birth weight: low (L): 35-50 g, medium (M): 58-62 g, high (H): 70-88 g. Half of the litters were nursed by one doe (O), while the other half by two does (T). One of the does was allowed to the nest-box at 8 am, while the other-one (kindled on the same day) at 6 pm. On day 17 the creep-hole of the nest-box was opened and kits could move freely to their own mother (second does were removed). After weaning at 3 weeks of age rabbits were housed in fattening cages (330x500x300 mm, 2 rabbits/cage) and fed *ad libitum* (DE: 10.3 MJ/kg, crude protein: 16%, crude fibre: 15.5%). From the age of 4 weeks half of them were fed *ad libitum* (A) afterwards, while the other half was reared on a restricted feeding regime (R). In the restricted group, rabbits were allowed to feed for 11, 10, and 9 hours a day between 4-6, 6-9 and 9-11 weeks of age, respectively, thus their daily intake corresponded to 85-90% of the *ad libitum* level. The experimental design is shown in Figure 1.

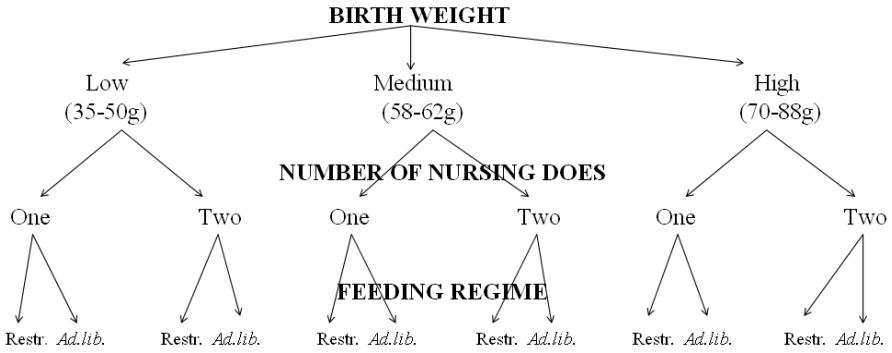

Figure 1: Experimental design

Slaughtering, dissection and meat quality analyses

At 11 weeks of age rabbits were transported to a slaughterhouse located at a distance of 200 km from the farm. They were weighed immediately before slaughter (after 24-hour fasting including the time of transport), then bled after electric stunning. Carcasses (with head, heart, lungs, liver, kidneys and fat depots) were put into a cooling room of 4°C for 24 hours then chilled carcasses were weighed again. Carcass dissection procedure was done according to the recommendation of WRSA (Blasco and Ouhayoun, 1996). Edible organs were removed, head was separated then the reference carcass was weighed, then fat depots were removed and weighed. Carcass was cut between the 7th and 8th thoracic and between the 6th and 7th lumbar vertebrae (fore-, mid- and hind part). Carcass parts were weighed; meat of the intermediate part (*m. Longissimus dorsi* – MLD) was removed and weighed. Proportion of body parts to reference carcass weight was calculated.

MLD and hind legs of 12 rabbits in each group (altogether 144 samples, chosen randomly) were transported to the University of Bologna, Cesena, Italy for meat quality analyses. Meat to bone ratio was determined on the left hind leg. The MLD was used to determine: the meat colour parameters L* (lightness), a* (redness) and b* (yellowness) according to the CIELab colour system (CIE, 1976), by using a Minolta CR-300 colorimeter (light source: C); the ultimate pH at 36 hours *post mortem* (pH_u), according to the direct probe-method by using porTable pHmeter (mod. HI98240, Hanna Inst.) equipped with a glass electrode (mod. FC230, Hanna Inst.); the lipid content determined by using an accelerated solvent extraction system (ASE 200, Dionex, Salt Lake City, U.S.A.) and a

chloroform/methanol (2:1) mixture as solvent (Toschi *et al.*, 2003). The water holding capacity (WHC) was measured according to cooking loss (Honikel, 1998), by cooking a whole dissected MLD and meat of right hind leg on a convection oven at 180°C until reaching 80°C at core sample and expressed as percentage of initial sample weight.

Statistical analysis

Experimental data were evaluated by general linear model of SPSS 10.0 (SPSS for Windows, 1999), using factors (birth weight, number of nursing does and feeding regime) as fix effects. Analysing the carcass traits, liveweight at slaughter was involved into the model as covariate. LSD-test was used to compare groups. When interactions were not significant they were taken out of the statistical model. Effect of gender was not taken into consideration in the statistical analysis.

RESULTS AND DISCUSSION

Carcass traits

Birth weight had significant effect on live weight at slaughter (P<0.001), on dressing out percentage (P=0.05), on the ratio of hind part (P<0.001) and on the ratio of perirenal fat (P=0.001) to reference carcass (Table 1). Dressing out percentage was the highest in L and the lowest in M group, the 1.7% difference is significant (P<0.05). In H rabbits, the hind part ratio was higher than in L and M animals, the found differences were significant in all cases. The ratio of perirenal fat to reference carcass was the highest in L and the lowest in H group (P<0.05). Higher dressing out percentage of L animals could be caused by that rabbits of lower bodyweight consumed less pellet (103 g vs. 110 and 116 g), thus the weight of their gastrointestinal tract decreased. Contrary, the higher ratio of perirenal fat in H group shows that these rabbits consumed more pellet, thus, they built more fat into their body.

Table 1: Effect of birth weight, number of nursing does and feeding regime on carcass traits of rabbits

Traits	BW				D			F			MSE
	L	M	H	Prob.	O	T	Prob.	R	A	Prob.	
No. of rabbits	68	78	78		117	107		115	109		
LW (g)	2312a	2436b	2567c	<0.001	2339	2537	<0.001	2368	2509	<0.001	25.5
DoP (%)	58.0b	57.3a	57.7ab	0.050	58.0	57.3	0.002	57.3	58.1	0.001	0.18
Proportion to reference carcass (%)											
Fore part	27.6	27.7	27.3	0.089	27.4	27.6	0.349	27.7	27.3	0.007	0.12
Mid part	32.3	31.9	32.0	0.129	32.1	32.0	0.639	32.0	32.1	0.607	0.12
Hind part	38.1a	38.5b	39.0c	<0.001	38.5	38.6	0.693	38.4	38.7	0.094	0.11
Perirenal fat	2.10b	1.98b	1.64a	0.001	1.97	1.84	0.223	1.87	1.94	0.445	0.07

BW: birth weight; L: low birt weight; M:medium birth weight; H: high birth weight; D: number of nursing does; O: nursed by one doe; T: nursed by two does; F: feeding; R: restricted feeding; A: *ad libitum* feeding; LW: live weight; DoP: dressing out percentage; MLD: *m. Longissimus dorsi*; interactions were not significant

Rabbits nursed by two does had 198 g (P<0.001) higher live weight at slaughter. This confirms the findings of Szendrő *et al*. (2002) that rabbits nursed by two does reach slaughter weight about a week sooner compared to rabbits nursed by one doe. Dressing out percentage was 0.7% (P=0.002) lower in rabbits nursed by two does (Table 2). Milk supply had no any effect on the ratio of carcass parts to reference carcass. In the experiment of Szendrő *et al.* (2002) rabbits were nursed by one or two does until 35 days of age, contrary to our findings, no difference was found in dressing out percentage, while the mid part to carcass ratio was significantly higher in group nursed by two does.

In consequence of feed restriction the slaughter weight and dressing out percentage decreased by 141 g (P<0.001) and by 0.8% (P=0.001), respectively. Ouhayoun *et al.*, (1986) showed that carcass contains less fat and dressing out percentage decreased due to feed restriction. Xiccato (1999) – reviewed several experimental results – also found that the dressing out percentage decreased due to the feed restriction.

Birth weight x number of nursing does interaction affected the proportion of MLD to reference carcass weight (Table 2). Highest value was found in LO and MO groups (11.9%), while LT rabbits showed the lowest ratio (11.4%); the difference was significant (P<0.05). Results show that rabbits born with lower body weight and nursed by one doe had higher MLD ratio compared to rabbits nursed by two does. However, in rabbits born with high body weight the trend turned and rabbits nursed by two does had significantly higher MLD ratio.

Table 2: Birth weight x number of nursing does interaction on some traits of rabbits

Traits	LO	LT	MO	MT	HO	HT	MSE	Prob.
MLD (%)[+]	11.9 b	11.4 a	11.9 b	11.5 a	11.5 a	11.8b	0.14	0.027
Meat/bone ratio[†]	5.04 a	4.89 a	5.01 a	5.62 ab	5.06 a	6.04 b	0.21	0.022

LO: low birth weight nursed by one doe; LT: low birth weight nursed by two does; MO: medium birth weight nursed by one doe; MT: medium birth weight nursed by two does; HO: high birth weight nursed by one doe; HT: high birth weight nursed by two does; BW: body weight; MLD: *m. Longissimus dorsi*; a,b,c,d: P≤0.05
[+]proportion to reference carcass; [†]determined on the left hind leg

Meat to bone ratio was affected by birth weight x number of nursing does interaction (Table 2). HT rabbits had the highest meat to bone ratio which differed significantly (P<0.05) from other groups except MT. Results show that in rabbits born with medium or high body weight the meat to bone ratio is higher in case of nursing them by two does.

Meat quality

As the effect of birth weight cooking loss of MLD was 1.8% lower (P<0.05) in H rabbits compared to L and M animals, while the other quality parameters did not changed significantly (Table 3).

Nursing rabbits by two does resulted 1.6% lower (P=0.003) cooking loss in the MLD compared to group nursed by one doe (Table 3). Other quality parameters of MLD were similar.

Table 3: Effect of birth weight, number of nursing does and feeding regime on the quality of *m. Longissimus dorsi*

	BW				D			F			MSE
Traits	L	M	H	Prob.	O	T	Prob.	R	A	Prob.	
Sample No.	48	48	47		71	72		72	71		
pH	5.93	5.93	5.96	0.341	5.94	5.94	0.776	5.90	5.98	<0.001	0.02
L*	50.8	50.0	49.3	0.108	49.9	50.2	0.518	51.1	49.0	<0.001	0.43
a*	4.63	4.74	5.09	0.320	4.82	4.82	0.986	4.47	5.17	0.008	0.20
b*	3.60	3.27	3.10	0.455	3.39	3.25	0.663	3.36	3.38	0.728	0.24
Cooking loss (%)	17.8b	17.8b	16.0a	0.006	18.0	16.4	0.003	17.8	16.6	0.028	0.41

BW, D, F, L, M, H, O, T, R, A, a, b: see in Table 2; interactions were not significant

Feeding regime influenced all of the meat quality parameters except the b* value of meat colour. Rabbits in restricted group had significantly lower pH, while higher L* and lower a* values resulted lighter colour of MLD. The cooking loss of MLD in restricted rabbits was 1.2% higher (P=0.028). Xiccato (1999) published that feed restriction could be disadvantageous for the juiciness and flavour of the meat, but Larzul *et al.* (2004) did not find any disadvantageous influence on sensory traits. In our study muscle pH decreased as the effect of feed restriction while the cooking loss increased and meat became lighter. According to Gondret *et al*. (2000) feed restriction favours oxidative metabolism. However, more oxidative the metabolism of a muscle leads to lower decrease in ultimate pH of meat (Ouhayoun and Dalle Zotte, 1993). Similarly to our results Perrier and Ouhayoun (1996) found significantly lower pH in strictly restricted rabbits. In our opinion a strict restriction at early age followed by poorer restriction (such as in the study of Perrier and Ouhayoun, 1996) as well as a time restriction (as in the present study) make rabbits intensive diet consumption which could have similar effect as a diet with higher energy content; which could lead to higher amount of glycogen in muscles resulted lower ultimate pH (Gondret *et al*., 2000). Ultimate pH influences the colour and water holding capacity of meat (Ouhayoun and Dalle Zotte, 1993) thus pH changing could describe the differences in colour and cooking loss.

Studying meat quality the interaction of the three factors was significant on the lipid content of MLD The highest lipid content was found in MOA rabbits (2.30%) while the lowest in HOA (1.18%) and in LOR (1.21%) groups. In case of low birth weight nursing rabbits by two does as well as *ad libitum* feeding increased the lipid content of MLD definitely (LOR, LOA, LTR and LTA: 1.21, 1.66, 2.25 and 2.25%, respectively). However, this trend is not clear in rabbits born with medium or high weight.

CONCLUSIONS

Our results show that the different nutritional status of kits has influence on carcass traits and meat quality of rabbits. Thus, nutritional status during foetal and suckling ages has long term effects. The 10-15% feed restriction during the whole fattening period is not recommended in consequence of the decrease in live weight and dressing out percentage.

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