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EFFECT OF FEEDING PROGRAM BEFORE WEANING ON THE PRODUCTION OF RABBIT DOES AND THEIR KITS

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Abstract: The aim of the experiment was to analyse the effect of the feeding program between 21 days *post partum* (dpp) to weaning (35 dpp) on the production of rabbit does and their kits. The does were randomly housed in 2 rooms. In the 1st room, a continuous 16 h light period was applied (16L; n=60). In the 2nd room, an 8 h light period was used which was extended by an additional 1 h light period in the middle of the 16 h long dark period 8 d prior to insemination (8+1L; n=59). In both rooms, 2 sub-groups were formed: in the 1st sub-group, does and their kits received breeding pellet from parturition to weaning (digestible energy: 10.4 MJ digestible energy/kg, crude protein: 17.8%, crude fibre: 13.6%; BB group; n=60 does, 228 parturitions); in the 2nd sub-group, the breeding pellet was replaced by growing pellet from 21 dpp to weaning (digestible energy: 9.7 MJ digestible energy/kg, crude protein: 16.0%, crude fibre: 17.2%; BG group; n=59 does, 234 parturitions). The experiment was completed after 5 reproductive cycles. As no significant interaction was found between the lighting and feeding programmes, the 2 effects are evaluated separately. In this paper, the effect of feeding program is discussed. No significant differences were observed between the BB and BG groups for number of inseminations per parturition, body weight of the does measured at parturition and at 21 dpp or for litter size. Changing the pellet in BG group significantly affected the body weight of the does measured at 35 dpp (4610 *vs*. 4530 g, in BB and BG, respectively; P=0.016), the litter and individual body weight of the kits at 35 dpp (8160 *vs*. 7834 g and 1006 *vs*. 964 g for BB and BG, respectively; $P \leq 0.001$) and the does' condition at kindling, as measured by the TOBEC method (E-value: 1922 *vs*. 1957 for BB and BG, respectively; P=0.024). Productivity indexes, expressed as number of kits born alive, number of weaned (at 35 dpp) kits and total weight of the weaned kits per year per doe were similar in the 2 groups. Body weight of the growing rabbits was significantly higher in the BB group at the ages of 5 and 7 wk (984 and 937 g, $P<0.001$, 1651 and 1621 g, P=0.008; respectively). After this period, the body weight of the 2 groups was the same. The feeding program had no effect on the feed conversion ratio and mortality of the 2 groups. According to the results, it may be concluded that it is preferable to avoid food changes around weaning.

Key Words: feeding program, rabbit does, growing rabbits, reproduction, productive performance.

INTRODUCTION

In the rabbit farms the does and their kits receive the same pellet until weaning. The possible options are that both the does and their kits are fed by breeding pellet till weaning, or from the 21 days *post partum* (dpp) until weaning the does and kits are fed by growing pellet. However, the nutrient demands of the does and kits are different (Fortun-Lamothe and Gidenne, 2003).

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According to Lebas (2004) the energy and nutritional needs of rabbit does are the following: 11 MJ digestible energy (DE)/kg, 18-19% crude protein, >13.5% acid detergent fibre (ADF), >3% acid detergent lignin (ADL), >9% cellulose, >30% neutral detergent fibre (NDF), >8.5% hemicelluloses and <20% starch. These parameters for the 3-6 wk old rabbits are the following: 9.5 MJ DE/kg, 15-16% crude protein, >19% ADF, >5.5% ADL, >13% cellulose, >32% NDF, >12% hemicelluloses and <14% starch. Thus, feeding the does and the kits by breeding pellet does not fulfil the suckling kits' demands, while the growing pellet is not satisfactory in terms of the rabbit does.

The aim of the experiment was to compare the effects of 2 feeding programmes (breeding pellet till weaning or breeding pellet changed to growing pellet diet from the 21 dpp until weaning) on production of rabbit does and their kits.

MATERIALS AND METHODS

The experiment was conducted at the Kaposvár University with Pannon White rabbits. The origin of this breed was described by Szendrő *et al.* (1998). The design of the experiment was shown in the previous paper Gerencsér *et al.* (2011). At 11 wk of age the female rabbits were randomly placed in 2 rooms. The rooms differed only in the lighting schedule. In the 1st room, continuous 16 h lighting was applied. In the 2nd room, an 8 h long lighting period was used which was extended by an additional 1 h light in the middle of the dark period 8 d prior to insemination. In both rooms, 2 further sub-groups were formed: the does and their kits received breeding pellet

Table 1: Composition of the different pellets fed during the experiment (based on fresh matter).

	Breeding pellet	Growing pellet	Finishing pellet
Digestible energy, MJ/kg	10.4	9.7	10.5
Crude protein, %	17.8	16.0	16.0
Crude fat, %	4.6	3.1	4.5
Crude fibre, %	13.6	17.2	14.6
Starch, %	18.5	15.1	18.6
Lysine, %	0.85	0.75	0.70
Methionine, %	0.29	0.24	0.25
Met+Cys, %	0.61	0.51	0.54
Ca, %	1.17	0.90	0.77
P, %	0.68	0.58	0.63
Na, %	0.20	0.20	0.20
Cu, mg	20	20	18
A-vitamin, IU/kg	15000	15000	13500
D3-vitamin, IU/kg	1250	1250	1130
E-vitamin, mg/kg	100	50	45
Medication:			
Pulmotil 200, %	0.025	-	-
Thiamutin 10, %	-	0.050	-
Cycostat 6.6, %	-	0.100	-
Tetravet 50, %	-	0.100	-

Nutrient values were calculated by the feed company.

from parturition to weaning at 35 dpp (BB group; n=60, 228 parturitions), or the breeding pellet was replaced by growing pellet from the 21st d of lactation until weaning (BG group; n=59, 234 parturitions). From 5 to 9 wk of age both groups were fed by medicated growing pellet, while finishing pellet was used between the ages of 9 and 11 wk (non-medicated). The compositions and medication of the different pellets are summarised in Table 1. Pellet and water were available *ad libitum*.

The basic breeding cage area was 860×385 mm, including the nest box (260×385 mm). In both rooms the maximum temperature could be as high as 28°C during summer, while in winter the minimum temperature was 16°C.

The rabbits were 1st inseminated at the age of 16.5 wk, thereafter using a 42-d long reproduction rhythm. No hormonal (PMSG/eCG) treatment was applied to stimulate the receptivity at the time of artificial insemination (AI). All does were inseminated at the same time (each 42 d) using a batch system. AI occurred 11 d after kindling using diluted semen from single buck. Does received an intramuscular injection of GnRH analogue (1.5 μg/rabbit; Ovurelin, Reanal). After birth, cross-fostering was applied. Litters were equalised according to the average number of live born kits in each group (maximum 8 and 10 kits for primiparous and multiparous does, respectively). After 2 unsuccessful AI, sick does and does with weak condition were culled. Dead and culled rabbits were not replaced with young females. The experiment was finished after 5 reproductive cycles.

During the experiment, litter size (total born, live born, at 21 and at 35 dpp), body weight of the does and litter weight at parturition, at 21st and 35th d of lactation were recorded. The conditions of randomly selected rabbit does (n=30) from every group were assessed by total body electrical conductivity (TOBEC) measurements (E-value) (EM-SCAN Model SA-3203 type). The method was described by Fortun-Lamothe *et al.* (2002). These does were locked out from the nest boxes (at the day before the measurement) and allowed nurse their kits immediately prior to the TOBEC measurements, so the milk within the mammary gland could not influence the results. TOBEC measurements of the non-lactating does took place on the same day. At the time of TOBEC measurement the rabbit does were also weighed. Feed consumption was measured during 1st gestation then between kindling and 21 d of lactation and between 21 d and d 35 of lactation. In the latter case, the total feed consumption of the doe and her litter was recorded. Rabbits were weaned at the age of 35 d.

The productivity index calculation was based on the IRRG recommendation (2005). The numerical productivity (number of born alive and weaned rabbits per inseminated doe) and overall productivity (weight of weaned rabbits per inseminated doe) were multiplied by the number of theoretical AI per year (8.69).

The 35 d old weaned rabbits were selected at random from litters originating from the 2nd and 3rd parity (n=BB: 244, BG: 244) and placed into wire net cages (2 rabbits per cage of 400×380 mm). Body weight and feed consumption was measured at 5, 7, 9 and 11 wk of age and weight gains and feed conversion values were calculated. Mortality was recorded every day. When calculating feed consumption, it was supposed that the rabbits did not consume any pellet 2 d prior to their loss.

Production traits (except for the rabbit does' condition) of the does were evaluated by multifactor ANOVA using the following model:

$$Y_{ijkl} = \mu + A_i + B_j + C_k + (AB)_{ij} + (AC)_{ik} + (BC)_{jk} + e_{ijkl}$$

where:

Y_{ijkl}= observation *l* in level *i* of factor A, level *j* of factor B and level *k* of factor C,
μ=the overall mean,
A_i= the fixed effect of level *i* of factor lighting schedule (*i*=1, 2),
B_j= the fixed effect of level *j* of factor feeding program (*j*=1, 2),
C_k= the random effect of level *k* of factor parity order (*k*=1, …, 5),
$(AB)_{ij}$= the effect of the interaction of level *i* of factor A with level *j* of factor B,
$(AC)_{ik}$= the effect of the interaction of level *i* of factor A with level *k* of factor C,
$(BC)_{jk}$= the effect of the interaction of level *j* of factor B with level *k* of factor C,
e_{ijkl}= random error with mean 0 and variance σ^2.

By evaluating the rabbit does' condition (TOBEC, E-value) the applied model was extended with the body weight of the rabbits, which was considered as a covariate. The production traits of the growing rabbits were evaluated by means of multifactor ANOVA, where the fixed effects of the feeding program (2 levels), repetition (2 levels) and the interaction between these effects were considered. Mortality was analysed by χ^2-test. All statistical analyses were conducted using the SPSS 10.0 software package.

No significant interaction was observed between the lighting schedule and feeding program for any trait. Thus, the 2 treatments were assessed separately. The effects of parity order on reproductive traits were shown by Gerencsér *et al.* (2011). In this paper, the effect of feeding program is discussed.

RESULTS AND DISCUSSION

Performance of does

Results related to the effects of the feeding program on rabbit doe performance are summarised in Table 2.

The rabbit does' body weight of the 2 groups was not different at kindling and at 21 dpp, but was significantly lower (*P*=0.016) at 35 dpp in the BG group. It is generally known that the increase in dietary DE content leads to decreased feed intake (Cervera *et al.,* 1993; Fraga *et al.*, 1989; Fortun-Lamothe*,* 1997), while low DE content increases the rabbits' feed consumption. In the present analysis, the feed consumption in the groups was no different during the first 3 wk of lactation until they received the same pellet, although the BG rabbits consumed slightly less feed between 21 and 35 dpp (*P*=0.069) because of the change of diet. The negative effects of the sudden pellet change during lactation was described by several authors (Debray *et al.*, 2002; Gidenne and Fortun-Lamothe, 2002) who found lowered feed consumption and as a consequence lower body weight and milk production of the does and lower body weight of the kits. This finding was also supported by our results, as lower individual and litter weights were recorded at the age of 35 dpp in the BG group (*P*<0.001) compared to the BB rabbits. It seems that the effect of changing the pellet in reducing feed intake was greater than the effect connected to the lower DE content of the diet, which should have increased feed intake. The feeding program had no effect on the number of AI/kindling, litter size (total, alive, at 21 and at 35 dpp) and suckling mortality. The lower body weight of does at weaning did not influence the reproductive and rearing performance, although BB rabbit does had better condition at parturition compared to the BG does (*P*=0.024). Debray *et al.* (2002) concluded that from the 18th d of lactation the

Table 2: Effect of the feeding program on the rabbit does' production.

	Feeding			
	BB	BG	SE	*P*-value
No. of does at the beginnings	60	59		
No. of parturitions	228	234		
AI/kindling	1.18	1.17	0.02	0.957
Body weight of does, g				
kindling	4154	4121	18	0.234
21 dpp	4735	4742	18	0.901
35 dpp	4610	4530	17	0.016
Litter size				
total	8.97	8.98	0.12	0.832
alive	8.49	8.60	0.11	0.801
stillborn	0.47	0.38	0.46	0.272
21 dpp	8.18	8.12	0.06	0.668
35 dpp	8.07	8.08	0.06	0.702
Litter weight, g				
alive	538	551	6	0.406
reared	573	574	5	0.840
21 dpp	3239	3206	29	0.186
35 dpp	8160	7834	69	0.001
Individual weight of kits, g				
alive	64.7	65.0	0.5	0.793
21 dpp	397	393	2.5	0.364
35 dpp	1006	964	5.0	<0.001
Mortality of kits, %				
0-21 dpp	3.2	4.0		0.216
21-35 dpp	1.2	0.5		0.144
Feed intake, g/d				
0-21 dpp	413	414	3	0.805
21-35 dpp	683	668	4	0.069
TOBEC, E-value				
No.	108	111		
lactating	1922	1957	24	0.024
No.	33	24		
non-lactating	2242	2216	63	0.322
Doe survival, %	73.3	84.7		0.096
Productivity index				
No. of live born kits/doe/y	60.1	63.8	1.4	0.211
No. of kits at 35 dpp/doe/y	54.9	57.9	1.3	0.244
kit's weight (kg) at 35 dpp/doe/y	55.2	55.8	1.4	0.844

SE: standard error. dpp: days *post partum.*

higher or lower starch/fibre ratio of the pellet had no effect on pregnancy rate and litter size. Controversial findings were reported about the association between the energy level of the diet and reproductive performance (Maertens and De Groote, 1988; Fortun-Lamothe, 1997; Pascual *et al.*, 1999). The rabbit does in the BG group were fed by breeding pellet after weaning. This may have resulted in the fact that the condition of the BG rabbits improved until kindling. The lower energy and protein content of the BG rabbit does' diet which was used during the period from 10^{th} to 24^{th} d of gestation could not influence conception, implantation, embryonic and foetal survival, as these events had already occurred earlier. The BG tended to have a better survival rate (+11.4%; $P<0.1$).

The annual productivity indexes, such as number of kits born alive, number of weaned kits and total weight of the weaned kits per doe of the BB and BG groups were not significantly different (Table 2).

Productive traits of growing rabbits

The effects of the feeding program on the performance of growing rabbits are shown in the Table 3. Body weight of 5 and 7 wk old rabbits' was affected by the change of the diet at the age of 21 dpp, since the BB rabbits were heavier ($P<0.001$ and $P=0.008$). After weaning (between the 5th and 7th wk of age), due to the change in diet the feed consumption of the BB group was lower ($P=0.020$), which resulted in a slight difference ($P=0.077$) for the body weight gain (between the 7th and 9th wk of age) to the advantage of the BG group. No differences could be detected afterwards and the body weights at 9 and 11 wk of age were similar between the groups. Debray *et al.* (2002) reported that the change of the pellet fed at weaning (at the age of 32 d) resulted in a 7% lower daily feed intake and 10% lower body weight gain ($P<0.001$). Similar results were reported by other authors (Gidenne and Fortun-Lamothe, 2002; Feugier *et al.*, 2005).

Table 3: Effect of the feeding program on the growing rabbits' production.

Age	Feeding		SE	*P*-value
	BB	BG		
No.	244	244		
Body weight, g				
5 wk	984	937	5	<0.001
7 wk	1651	1621	7	0.008
9 wk	2120	2128	10	0.235
11 wk	2544	2554	14	0.304
Weight gain, g/d				
5-7 wk	47.6	48.9	0.3	0.499
7-9 wk	33.5	36.2	0.4	0.077
9-11 wk	30.8	30.4	0.6	0.523
5-11 wk	37.6	38.9	0.3	0.445
Feed intake, g/d				
5-7 wk	109	112	1	0.020
7-9 wk	132	136	1	0.705
9-11 wk	132	138	1	0.197
5-11 wk	124	129	1	0.122
Feed conversion ratio				
5-7 wk	2.31	2.30	0.01	0.180
7-9 wk	4.05	3.84	0.04	0.080
9-11 wk	5.29	5.25	0.18	0.923
5-11 wk	3.84	3.70	0.07	0.686
Mortality, %				
5-7 wk	0.8	0.0		0.157
7-9 wk	0.0	0.0		-
9-11 wk	5.2	5.2		0.984
5-11 wk	6.1	5.2		0.687

SE: standard error.

No significant differences were obtained for the feed conversion ratio and mortality between the groups. Mortality was almost exclusively recorded between the ages of 9 and 11 wk following termination of the medicated pellet's use. Similar results were reported by Vasquez *et al.* (1999) and Debray *et al.* (2002).

The differences measured between the groups at weaning disappeared until the end of the growing period and no significant differences were found for any trait between the BB and BG groups for the whole rearing period.

CONCLUSIONS

Comparing the 2 feeding programs, feeding both the rabbit does and the suckling kits by breeding pellet until weaning is more advantageous than feeding them by growing pellet from 21 d to weaning.

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