GNAWING BLOCKS AS CAGE ENRICHMENT AND DIETARY SUPPLEMENT FOR DOES: PERFORMANCE, INTAKE,AND BEHAVIOUR

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ABSTRACT

One hundred and five pregnant rabbit does housed in conventional wire cages received during one complete reproductive cycle no enrichment (controls) or one of three different gnawing blocks hanged up with a wire at the wall of the cage. The three different blocks had the same basal components but additionally wood mash (WM), wood mash + chicory pulp (CP) or wood mash and inulin syrup (I) were respectively incorporated. Weight development during the lactation was comparable except in does that received the WM blocks. These females had a significant lower weight ($P<0.05$) at different time points compared to controls. Litter weight or kit weight was not significantly different at any of the time points measured but again the treatment with WM blocks had the lowest weight. The consumption of blocks during the whole reproduction cycle (42 days) was 11.0; 6.8 and 4.4 g/day/cage for WM, CP or I enriched blocks, respectively. A very large variability in consumption of blocks was observed between females. This varied between 1 and 5 (I or CP group) or even 1 and 9 blocks (WM group) per reproductive cycle. In each group 5 females were observed for 1 hour 3 days before the expected parturition and at 2 time points during the lactation. Although the presence of a block did not significantly increase the total number of behavioural transitions, locomotion and intake behaviour were significantly ($P<0.05$) increased when a gnawing block was available. The period of observation influenced the frequency of many behavioural transitions and was before parturition significantly higher than post parturition, respectively 56.1 *vs.* 13.7 (Week 1, $P<0.01$) and 25.1 (Week 2, $P<0.01$). Based on the consumption pattern, the hardness and behaviour this gnawing blocks could be considered as cage enrichment and those with the chicory pulp fitted best with the objective.

Key words: Gnawing blocks, does, performance, intake, behaviour.

INTRODUCTION

In current rabbit farming systems, rabbits are housed in barren cages. The lack of cage enrichment is often mentioned as a welfare problem (EFSA, 2005;Verga *et al.*, 2007). Cage enrichment is defined as providing stimuli meeting the animals' species-specific needs. There exist a lot of possibilities to enrich the environment, however, most efforts have been done with gnawing material (see review of Jordan *et al.*, 2006) or with the use of an elevated platform (Lang and Hoy, 2011). The results of these studies have shown some beneficial trends in terms of welfare and even production. Because of hygienic reasons, enrichment material should be preferentially hanging from the cage ceiling (Trocino and Xiccato, 2006).

Apart from providing stimuli, gnawing material could have a second function, namely as nutrient supply. Because rabbits have special dietary fibre needs for optimal gut health (Gidenne, 2003) and by consequence to reduce the risk of enteric diseases, we were looking for gnawing materials with a supplementary feeding value. Wood or wood products with their very high content of ADL could contribute to the dietary requirement of low digestible fibre fractions. Besides also digestible fibres or soluble fibre play a key role in the digestive health (Gidenne, 2003; Goméz-Conde *et al*., 2007). Such a source of fermentable fibre is chicory pulp that contains over 30% of pectins and has a high content of inulin (Bailoni *et al.*, 2004).
The purpose of our trial was to incorporate the 3 aforementioned products (wood, chicory pulp and inulin) in mineral blocks and to evaluate them as possible cage enrichment with additional nutrient value in does.

MATERIALS AND METHODS

Enrichment material and diets

The design of different blocks was of cutted cones with a diameter at the basis of 4 cm and a height of 7 cm (Figure 1). The weight was between 200 and 250 gram. A central hole in the block allowed to hang up the block with a galvanised wire at the wall of the cage at a height of approximately 15 cm.
The 3 experimental blocks contained the same basis of wheat, molasses and oligo-elements. They contained the following amount of test material:
a) Wood mash blocks: 10% of wood mash (WM)
b) Chicory pulp blocks: 10% wood mash and 15% chicory pulp (CP)
c) Inulin blocks: 10% of wood mash and 15% Inulin (I) syrup (Raftifeed, Orafti, Belgium)

Figure 1. The tested gnawing blocks: inulin based (left), wood mash based (middle) and pulp of chicory based (right)

During the experiments, each cage was always enriched with 1 block. Once the block was finished or the last part was fallen on the bottom of the cage, immediately a new block was introduced. Removed rests of blocs were weighed.

Females received during the experiment a balanced pelleted diet *ad libitum*. The dietary composition was in agreement with actual nutrient recommendations (Crude protein: 18.0%; ADF: 17.5% and DE: 10.2 MJ/kg).

Animals, husbandry and housing

In total 105 pregnant females were initially homogeneously assigned to one of the 4 experimental groups (no block and 3 different blocks types) taking into account their parity number (nulliparous and multiparous).

At parturition, litters were intra treatment standardised to 8 pups. Females were again inseminated 11 days post parturition while the weaning took place at the age of 35 days. Females were housed in dual purpose cages with the following dimensions: 0.78 x 0.50 x 0.50 m height and each cage was equipped with a feeder and a nipple drinker.

Recordings

Females were individually weighed at the start of the experiment, day 1 (1 day post parturition), day 11, day 22, day 28 and day 35 (weaning). Feed intake and block consumption was measured during the 5 respective periods. Litter weight was measured on the same days.
Behaviour of the females was studied in 5 females of the control group (no block) and 5 females with a gnawing block. Observations were executed 3 times on the same females: 3 days before parturition and 1 and 2 weeks after parturition always between 9 am and 12 am. The same person observed the females

during 1 hour (2 females simultaneously) in the stable after an initial 5 minutes adaptation period and distinguished 15 different behaviours.

Statistical analyses

The production data were statistically analysed using the ANOVA procedure of Statistica 10 (Statsoft, 2010). A linear model including the effects of treatment (1-4), parity (nulliparous, multiparous) and their interaction was used to carry out the analysis on lactating does' performances.

The frequency of the different types of behaviour, as well as the total number of behavioural transitions (i.e., the sums of the frequencies of all types of behaviour), were analyzed using a generalized linear mixed model (PROC GLIMMIX in SAS 9.3). A log link was used and an underlying Poisson distribution was assumed

RESULTS AND DISCUSSION

Performance results

Differences in litter size or litter weight were not significant (Table 1). Mortality before weaning in the standardised litters was quite low except for does without a gnawing block (12.5%).

Females of the control group had a higher (but not significant) weight at the start of the trial compared to the other treatments. This difference increased for does of the WM group being significant ($P<0.05$) at parturition and at day 22 and 28. A possible explanation could be the quite high intake of WM without nutritional value and at the expense of pelleted food. Indeed, in WM does the feed intake was somewhat lower than in the other groups. As a result weight loss during the lactation period of the females in this group was larger indicating a lower body condition.

Litter weight in WM does was about 4-5% ($P>0.05$) lower than in the other groups. At fattening age, weight of the litter in the CP group was about 1.5 kg higher than in the control group and 1.0 -1.2 kg compared with I and WM. However, due to the quite low number of litters this difference was not significant.

Table 1. Performances of does and litter in cages without or with a gnawing block.

	Controls	Enrichment blocks			SEM	P-value
		Wood mash	Chicory pulp	Inulin syrup		
Number of litters	27	25	23	26	-	-
Litter size (alive)						
Day 1 (parturition)	8.00	8.00	8.00	8.00	-	-
Day 22	7.41	7.52	7.65	7.69	0.08	0.585
Day 35 (weaning)	7.00	7.40	7.47	7.28	0.10	0.319
Litter weight (g)						
Day 1 (parturition)	571	578	609	582	6	0.147
Day 22	3350	3190	3365	3378	48	0.489
Day 35 (weaning)	7828	8038	8442	8133	138	0.480
Doe weight (g)						
Start of trial	4654	4451	4498	4432	45	0.334
Parturition	4301 [a]	4021 [b]	4152 [ab]	4055 [ab]	40	**0.049**
Day 22	4556	4288	4506	4376	46	0.097
Day 35	4500 [a]	4178 [b]	4366 [ab]	4308 [ab]	42	**0.043**
Feed consumption (kg/cage)						
Parturition-weaning	18.9	18.2	18.9	19.0	44	0.285

Block consumption

During the reproduction cycle, females increased their intake of the blocks (WM and CP) before the young started to consume significant amounts (d 22) (Table 2). The week before weaning quite high amounts were consumed (9.0; 13.6 and 11.0 g/day in I, CP and WM groups, respectively) and the difference between citrus pulp and inulin enriched blocks was significant. A remarkable difference

Table 2. Block consumption in the female cages

	Wood mash	Chicory pulp	Inulin syrup	SEM	P-value
Per doe (cage)**(g/d)**					
Start – parturition	5.5	3.4	3.0	0.50	0.102
Parturition – Day 11	7.0[a]	4.9[b]	3.0[b]	0.51	0.003
Day 11 – Day 22	9.7[a]	5.5[b]	2.7[b]	0.71	<0.000
Day 22 – Day 28	20.6[a]	13.1[b]	7.3[c]	1.23	<0.000
Day 28 – Day 35	21.7[a]	13.6[b]	9.0[b]	1.40	<0.000
Total period	11.0[a]	6.8[b]	4.4[b]	0.62	<0.000
Mini – maxi	2.4 – 23.8	1.1 – 18.2	0.8 – 15.6	-	-
Blocks per doe/cycle	4.4[a]	2.3[b]	1.8[b]	0.21	<0.000
Mini – maxi	1 – 9	1 – 5	1 – 5	-	-

was observed between cages (females); from a very small amount (< 1g/day) till very high amounts (23.8 g/day in a WM cage). Expressed as blocs per reproduction cycle, this means from 1 till 5 (I and CP does) or even 9 blocs (WM).
The quantity of blocks consumed (both in g/day or in number of blocks) and the increased intake during the lactation stage or fattening stage indicate that the rabbits did not decline their interest in gnawing structure. The high consumption and continuous interest is an evidence that gnawing material is a real environmental enrichment and increases the welfare of rabbits (Verga *et al*., 2007; Prinz *et al.* 2007; Buijs *et al.*, 2011).

Behaviour
The presence of a gnawing block did not have a significant effect (P>0.05) on the sum of the behavioural transitions although on average 49.8 movements were observed in females without a block and 62.4 when a block was available (Table 3). However, an extremely high variability between females was observed from females being nearly constantly inactive till females with over 100 behavioural transitions during the 1 hour observation period. Nevertheless, the presence of a block induced a significant (P<0.05) higher locomotion and intake observations while the inspection of the nest box was reduced.

Table 3. Behavioural transitions observed in does without or with a gnawing block*

Period	3 days before parturition		1 week post parturition		2 weeks post parturition		Significance*	
Block presence	No	Yes	No	Yes	No	Yes	Block	Period**
Sum of movements	49.8	62.4	11.6	15.8	21.4	28.8	NS	**0.000**
Posture/movement								
Locomotion	8.2 *(0-17)**	10.8 *(0-19)*	2.8 *(1-7)*	4.4 *(3-6)*	1.8 *(0-3)*	7.4 *(5-10)*	**0.043**	**0.011**
Lying	0.8 *(0-2)*	0.2 *(0-1)*	0.2 *(0-1)*	0.8 *(0-2)*	0.8 *(0-1)*	2.8 *(2-3)*	0.076	**0.012**
Sitting	4.0 (*0-12)*	5.2 *(0-13)*	1.4 *(0-2)*	3.2 *(3-4)*	3.6 *(0-10)*	4.2 *(3-6)*	NS	NS
Standing	1.8 *(0-7)*	0	0	0	0	0	NS	NS
Rearing up on hind legs	1.2 *(0-4)*	0.4 *(0-2)*	0.6 *(0-2)*	0	1.6 *(0-6)*	0.2 *(0-1)*	0.070	NS
Look around	4.2 *(0-12)*	5.6 *(0-14)*	0.6 *(0-1)*	1.4 *(1-3)*	2.8 *(0-6)*	1.8 *(1-5)*	NS	**0.026**
Grooming	11.4 *(0-25)*	15.0 *(3-38)*	1.8 *(0-4)*	2.6 *(2-3)*	3.2 *(0-10)*	6.8 *(3-9)*	NS	**0.003**
Activity								
Cage manipulation	6.4 *(0-18)*	7.2 *(0-25)*	0.2 *(0-1)*	0.4 *(0-1)*	1.2 *(0-3)*	0.8 *(0-3)*	NS	**0.004**
Nest box inspectation	0.6 *(0-3)*	0.2 *(0-1)*	2.0 *(0-7)*	0	1.2 *(0-2)*	0.6 *(0-1)*	**0.039**	NS
Visit of the nest box	4.6 *(1-8)*	8.6 *(0-29)*	0.6 *(0-1)*	0	2.8 *(0-6)*	0	NS	**0.016**
Sniffling	4.4 *(0-8)*	4.0 *(0-7)*	0.6 *(0-2)*	1.00 *(0-3)*	1.4 *(0-4)*	1.0 *(0-3)*	NS	**0.002**
Gnawing on the block	-	2.4 *(0-7)*	-	0	-	0.4 *(0-1)*	NS	NS
Drinking or eating	1.0 *(0-3)*	2.4 *(0-3)*	0.2 *(0-1)*	1.6 *(0-2)*	0.6 *(0-1)*	1.6 *(0-4)*	**0.006**	NS
Urinating or defaecat.	0.4 *(0-1)*	0.2 *(0-1)*	0.4 *(0-1)*	0.4 *(0-1)*	0	0.6 *(0-1)*	NS	NS
Caecotrophy	0.8 *(0-3)*	0.2 *(0-1)*	0.2 *(0-1)*	0	0.4 *(0-1)*	0.6 *(0-1)*	NS	NS

*Average value of 5 does during 1 h observation with the lowest and highest number between brackets
* Interactions between block presence and period were not significant
** If significant, only between observations before parturition and week 1 and 2 after parturition

Before parturition females were very active during the observation period while 1 and 2 week post parturition a significant (P<0.01) lower number of behavioural transitions was observed (on average 56.1 vs. 13.7 and 25.1, respectively). The difference between before and after parturition was significant

($P<0.05$) for locomotion, grooming, cage manipulation and sniffling. However, the overall ethogram was on average quite comparable between both groups.

This preliminary behavioural observation study did not reveal an overall effect on the activity of females. However, the significant increased locomotion and intake behaviour, the decreased number of inspection of the nest box together and the trend to a reduced lying and rearing up behaviour indicates that females are more active and less nervous when they have a gnawing block. This is in line with the observations in fatteners when a gnawing stick is available (Jordan *et al*., 2006; Princz *et al*., 2007).

However, the main objective of cage enrichment (e.g. gnawing block) is to reduce cage manipulation, considered as a frequent abnormal behaviour in caged rabbits (Lidfors, 1997). The provision of a gnawing stick (Prinz *et al*., 2007) or a wooden structure (Buijs *et al*., 2011) decreased cage manipulation in fatteners but was not clear in our trial. Before parturition cage manipulation was even more frequently observed in cages with a block. During the lactation stage cage manipulation was so rare that a block effect could not be determined.

Therefore, a more detailed observation study is necessary with video recordings at different times to judge effects on the behaviour.

CONCLUSIONS

The tested gnawing blocks were intensively used and high amounts of intake were observed with especially the soft wood mash enriched blocks. Although the preliminary behaviour observations did not allow to detect differences in cage manipulation between does with and without a block, the high intake confirmed that the presence of gnawing material is helpful to increase rabbits' welfare. Based on consumption pattern of the blocks and rabbit performance, blocks enriched with chicory pulp fitted best with the objectives.

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