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THE EFFECT OF CAGE FLOOR AND STOCKING DENSITY ON GROWTH PERFORMANCE AND WELLBEING OF GROUP-HOUSED RABBITS

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Abstract

In order to evaluate the effect of stocking density and type of cage floor on behavior, health status, growth performance, and carcass and meat quality. The evaluation of carcass and meat quality was at 78 d. We measured the dimensions and resistance to fracture of the femur. Sanitary status and growth performance were highly satisfying in all treatments: growth rate averaged 45.5 g/d and final weight 2967 g, with a feed conversion rate of 3.49. Stocking density did not affect growth performance, meat quality, or animal reactivity.

The reactivity of the animal was also affected by the type of the floor: the number of attempts necessary to induce immobility, considered inversely correlated with fear towards humans, was lower in rabbits kept on straw; these rabbits also showed a more passive reaction during the open field test, spending less time exploring and more time in an immobile state ($P<0.01$) in contrast with the animals kept in cages with plastic slat or wire net floors.

Key words: Stocking density, Cage floor, Growth performance, German gray rabbit

INTRODUCTION

A lot of discussions about rabbit procreation were brought recently, after the increasing attention of consumers to the wellbeing of intensively reared animals.

Since 1996, the Standing Committee of the European Council for the protection of Animals kept for intensive purposes has been working on specific recommendations for the welfare of domestic rabbits. The European Commission asked the European Food and Safety Authority (EFSA) for its opinion on "The impact of the current housing and husbandry systems on the health and welfare of farmed domestic rabbits" (EFSA, 2005a and 2005b). Animal comfort and wellbeing during rearing are affected by different aspects of cages or pens (dimensions, type of floor, enrichment, etc.). The intention is to substitute the individual or two-animal cages used in some countries (e.g. Italy) for group cages or pens to permit social interaction and to increase the space available per animal, trying to facilitate natural behavior.

The groups sheltered at high stocking densities negatively affects growth performance and favors animal violence especially with increasing age. Some behaviors shown by wild animals, like scratching or digging

were not expressed by the animals kept in cages with wire net floors; therefore those are not suitable for their wellbeing.

The objective of our study was to evaluate the type of cage floor and the effect of stocking density on behavioral patterns and reactivity, growth performance, carcass and meat quality of group-housed rabbits.

MATERIALS AND METHODS

There were 240 German gray rabbits of both sexes were weaned at 36 d (LW=1103±41 g). They were put into 40 cages holding groups of 6 animals each.

The cages were 64 cm-wide and had 120 cm-high sides made of wire net, a large wire net front door for inspection and no ceiling. The back wire net wall was movable, allowing adjustment of the cage dimensions (78 x 64 cm; 58 x 64 cm) that yielded two stocking densities (D12=12.1 rabbits/m^2, 825 cm^2/rabbit; D16=16.2 rabbits/m^2, 617 cm^2/rabbit). Within stocking density, the cages had four types of floor: steel slat (galvanized steel bars of 2.0 x 1.5 cm section and 1.5 cm span), plastic slat (plastic surface with 7.3 x 1.0 cm holes at a distance of 1.0 cm each other), wire net (galvanized wire net of 2.5 mm diameter forming grids of 7.5 x 1.5 cm) or wire net bedded with 5-cm layer of wheat straw. The experiment was planned according to a 2 x 4 factorial arrangement (2 stocking densities x 4 floor types) with 5 replicates (cages).

Two nipple drinkers were placed on the back side and two 20 cm-wide manual feeders on the front side of the cage. The rabbits got a commercial diet for growing rabbits (CP: 15.8%, ADF: 19.3%, DE: 9.8MJ/kg as-fed basis) during the whole research. No antibiotic was administered in feed or water.

Individual live weight and cage feed intake were recorded three times a week. Health status was controlled daily. The tonic immobility test and the open-field test were performed at 70 and 74 d of age, respectively, on 64 rabbits (2 rabbits per 32 cages). 120 rabbits (3 per 40 cages) were slaughtered at 78 days in a commercial slaughterhouse according to international scientific protocols. After 24 h, pH and color were assessed on the *longissimus lumborum* and *biceps femoris* muscles. Carcasses were dissected to separate hind leg and dissectible fat and to measure in the hind leg the meat to bone ratio. Femur dimensions and resistance to fracture were measured. Growth performance data were analyzed, considering the cage as the experimental unit and stocking density, cage floor and their interaction as the variability factors. Individual data of carcass and meat quality were analyzed including in the model the effect of the cage.

RESULTS AND DISCUSSION

Rabbit growth performance from 36 to 78 d of age is reported in Table 1. Average performance showed group to be compatible with the full expression of growth capability of the commercial rabbit hybrid, which reached a mean live weight of 2967 g at 78 d of age. Growth performance was significantly impaired when rabbits were kept on a wire net bedded with straw: final live weight was the lowest (2865 g *vs.* 3000 g on average, P=0.03); both daily weight gain and feed intake were reduced, thus not affecting feed conversion rate. In previous studies, feed intake reduction was attributed to the ingestion of straw. The plastic floor was apparently cleaner than the steel one. Previous studies did not show important differences in growth performance of rabbits kept on steel slat or wire net floors. Weight gain and feed intake were not affected by reducing the stocking density from 16 to 12 animals/m^2. Previous studies on group housing found that reducing stocking density from 20-23 to 15-16 rabbits/m^2 significantly improved growth performance.

In the present experiment, maximum weight was 35 kg/m^2 in D12 and 48 kg/m^2 in D16 groups. According to EFSA (2005a), fattening rabbits in collective cages should be kept at a minimum individual surface of 625 cm^2 and maximum weight at slaughter of 40 kg/m^2.

Tabel 1

Growth performance from 36 to 78 d of age

	Cage floor					Stocking density			RSD
	Steel slat	Plastic slat	Wire net	Straw on net	Prob	D12	D16	Prob.	
Number of cages	10	10	10	10		20	20		
Initial live weight	1105	1101	1100	1104	0,83	1104	1100	0,34	17
Final live weight	2986	3024	2991	2866	0,03	2945	2988	0,29	118
Daily weight gain	45,9	46,8	46,1	43,0	0,02	44,9	46,0	0,23	2,8
Feed intake (g/d)	163	162	161	148	0,001	157	159	0,39	7
Feed conversion	3,57	3,46	3,49	3,44	0,14	3,51	3,47	0,25	0,13

Residual standard deviation

Throughout the immobility test, the number of attempts necessary to induce immobility, considered inversely related with fear towards humans, was lower in rabbits kept on a floor bedded with straw (P=0.02), while the duration of immobility was not affected (Table 2). During the open- field

test, rabbits kept in cages with straw showed a more passive reaction towards the new environment, exploring less the arena and staying immobile for a longer time (P<0.01) in contrast with the animals reared in cages with plastic slat or wire net.

The choice of providing litter on the floor does not seem justified because, despite the amplified animal wellbeing claimed, the two behaviors may be negatively considered. Our results confirm previous findings: when rabbits reared in collective cages with wire net floor were given free access to an area bedded with straw, they preferred the floor without straw. The animals kept in groups in pens bedded with straw dedicated more time to cleaning their dirty fur and moving around in search of a more comfortable place inside the cage, as a result of an express of a lower wellbeing condition.

Tabel 2

Reactivity tests

	Cage floor					Stocking density			RSD
	Steel slat	Plastic slat	Wire net	Straw on net	Prob	D12	D16	Prob.	
Number of rabbits	16	16	16	16		32	32		
Tonic immobility test									
Attempts(n)	2,39	2,25	1,99	1,54	0,02	1,9	2,18	0,17	0,69
Duracion(sec)	33	32	34	34	0,82	31	34	0,29	15
Open-field test									
Latency (sec)	50	45	47	53	0,34	51	47	0,16	-
Movements(sec)	54	58	61	43	0,35	52	57	0,42	35
Exploration(sec)	342	375	371	330	0,02	348	360	0,30	47
Grooming(sec)	0.37	0.82	1.62	1.85	0.38	7	0.8	0.75	-
Immobility(sec)	71	36	34	108	0.01	75	51	0.16	64

The reactivity in the tonic immobility or the open field tests was not affected by the stocking density. In contrast, there has been observed a reduction of movements in rabbits reared in pens on the field at a high density (17 *vs.* 12 animals /m^2) associating this result with the more stressful conditions that reduced animal interactions with the environment.

Major differences among treatments in carcass and meat quality (Table 3) mainly depended on differences in live and slaughter weight among animals: dressing percentage and separable fat of the carcass were lower (P<0.01) in the lightest rabbits reared on straw (58.6% and 2.3%, respectively) compared with the heavier animals of the other three experimental groups (average values 59.9% and 3.0%, respectively). The quality of meat (pH and colour of *longissimus lumborum*) was moderately affected by floor type, and the rabbits kept on straw showed the red index (a*) significantly lower than the other animals. Stocking density did not modify carcass traits or the pH and colour of rabbit muscles.

Tabel 3

Carcass and meat qulity

	Cage floor					Stocking density			RSD
	Steel slat	Plastic slat	Wire net	Straw on net	Prob	D12	D16	Prob.	
Number of rabbits	30	30	30	30		60	60		
Cold dressing percentage (%)	59.5	69.9	60.1	58.8	<0.001	59.5	59.6	0.17	1.7
Separable fat (% carcass)	2.9	2.7	3	2.5	<0.01	2.8	2.9	0.18	0.9
Hind leg muscle to bone ratio	5.91	5.76	5.67	5.56	0.28	5.69	5.65	0.91	0.5
L. lumborum traits:									
pH	5.7	5.8	5.8	5.8	0.38	5.8	5.8	0.54	0.1
Lightness index, L*	49.7	50.2	51.0	50.8	0.7	50.3	49.9	0.15	2.8
Red index, a*	-1.9	-1.6	-1.9	-1.9	0.05	-1.9	-1.7	0.08	0.6
Yellow index, b*	2.5	2	2.4	1.3	0.23	1.8	2.3	0.3	2.3

In order to find abnormal skeletal development in animals kept in innappropriate housing systems, we can analyze the bone qualities. Femur dimensions and resistance to fracture were not affected by floor type or stocking density (table 4), while in a previous study tibia diameter increased when stocking density decreased.

Tabel 4

Femur characteristic

	Cage floor					Stocking density			RSD
	Steel slat	Plastic slat	Wire net	Straw on net	Prob	D12	D16	Prob.	
Number of rabbits	30	30	30	30		60	60		
Weight (g)	12.3	12.6	12.5	12.3	0.25	12.4	12.4	0.96	0.85
Maximum length (mm)	9.26	9.26	9.28	9.30	0.60	9.28	9.29	0.19	0.21
Maximum diameter (mm)	0.90	0.91	0.9	0.91	0.61	0.9	0.91	0.37	0.06
Minimum diameter (mm)	0.68	0.69	0.66	0.67	0.70	0.67	0.67	0.67	0.02
Resistance to fracture (kg)	38.5	37.6	37.6	37.3	0.90	37.9	37.6	0.89	5.4

CONCLUSIONS

The rabbits group kept in cages allowed optimum sanitary status and growth results regardless of the type of floor and stocking density. Rearing rabbits in group on alternative floors, different from the classical wire net (like steel or plastic slat) was successful considering both animal performance and reactivity, management and technical aspects, and hygienic situation of the system. On the contrary, bedding the cage floor with straw litter clearly impaired performance, slaughter results and comfort of rabbits. The reduction of stocking density from the value of 16 animals /m^2, proposed by EFSA, to12 animals/m^2 did not produce any appreciable modification of rabbit performance and wellbein.

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