Performance of growing rabbits in bicellular cages and collective pens

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ABSTRACT: The study aimed at evaluating whether housing growing rabbits in pairs in bicellular cages (18 animals/m^2) or in group of 20 to 54 animals kept in small (1.40 x 1.20 m) or large pens (1.40 x 2.40 m) with wooden floor at low (12 animals/m^2) or high stocking density (16 animals/m^2) might influence growth performance and slaughter traits. The rabbits kept in bicellular cages showed higher final live weight (2839 vs. 2655 g; P<0.01), daily weight gain (+10%; P<0.01), and feed intake (+11%; P<0.001), without differences for feed conversion ratio, compared with the rabbits housed in collective pens. At slaughter, the former rabbits also displayed higher dressing percentage (60.5% *vs*. 59.6%), dissectible fat proportion (3.0% *vs*. 2.1% reference carcass) and hind leg muscle-to-bone ratio (7.53 *vs*. 6.63) (P<0.001) compared with the group-housed rabbits. Within the collective pens, the increase in the stocking density from 12 to 16 rabbits/m^2 increased only the slaughter dressing percentage (59.4% *vs*. 59.8%; P=0.05), whereas no significant effect of pen size was measured. In conclusion, rearing rabbits in collective pens impaired growth performance and slaughter results compared to rabbits kept in bicellular cages, regardless of stocking density or pen size.

Key words: Housing systems, Pen size, Stocking density, Growth performance.

INTRODUCTION – Under commercial intensive systems for meat production, the welfare requirements of rabbits are not fulfilled because of constrains in social behaviours and movement possibilities. In fact, rabbits are usually kept in bicellular or small collective cages (4-6 rabbits per cage) at stocking densities higher than recommendations, i.e. 16 rabbits/m^2 and 40 kg slaughter weight/m^2 (EFSA, 2005; Trocino and Xiccato, 2006). However, rearing rabbits in collective cages or pens with large groups (>10 animals) may impair carcass and meat quality (Combes and Lebas, 2003; Szendrő and Dalle Zotte, 2011). The present study aimed at comparing growth performance and slaughter traits of rabbits housed in bicellular wire net cages (2 rabbits per cage) and collective pens (20 to 54 rabbits per pen) with wooden floor of different dimensions and at different stocking densities.

MATERIALS AND METHODS – A total of 456 Hyplus crossbred rabbits (Hypharm, Groupe Grimaud, Roussay, France) of both genders were reared from weaning (35 d of age) until the day (76 d) before slaughter. The animals were divided into five

experimental groups as follows: B18 group, 80 rabbits kept in 40 bicellular cages (28 x 40 x 28 cm; 18 animals/m^2; 2 rabbits/cage); S12 group, 80 rabbits in 4 small pens (1.40 x 1.20 m) at low stocking density (12 animals/m^2; 20 animals/pen); S16 group, 108 rabbits in 4 small pens at high stocking density (16 animals/m^2; 27 animals/pen); L12 group, 80 rabbits in 2 large pens (1.40 x 2.40 m) at low stocking density (12 animals/m^2; 40 animals/pen); L16 group, 108 rabbits in 2 large pens at high stocking density (16 animals/m^2; 54 animals/pen). The open-top pens were equipped with wooden slatted floor, manual feeders and nipple drinkers. Individual weight and cage/pen feed intake were recorded weekly; health status was controlled daily. At 77 d of age, a total of 396 rabbits (78-80 per experimental group) were slaughtered according to harmonized European protocols. After 24-h cooling, the carcasses of 160 rabbits (32 per experimental group) were dissected to measure the proportions of *longissimus lumborum*, hind legs, and dissectible fat, and the muscle-to-bone ratio of hind legs (Xiccato et al., 2013). The data of growth performance (cage or pen data) and slaughter traits (individual data) were submitted to ANOVA by using the GLM and MIXED procedures of SAS (SAS Institute, Cary, NC), respectively. The differences between housing system (bicellular cage *vs*. collective pens), pen size (small vs. large), and stocking density within collective pens (12 *vs*. 16 rabbits/m^2) were tested by the CONTRAST statement of SAS.

RESULTS AND CONCLUSIONS – The housing system significantly affected rabbit growth performance (Table 1). During the first period (35-54 d of age), the rabbits housed in bicellular cages showed higher daily weight gain (17.4%) and feed intake (14.1%) and better feed conversion compared with those in collective pens (probability of the contrast "bicellular cages" vs. collective systems", $P \leq 0.01$) (data not reported in table). During the fattening period (54 to 76 d), rabbits had similar growth rate, but those kept in bicellular cages continued to consume more (6.9%) and showed a worse feed conversion ($P<0.05$) (data not reported in table). Consequently, on the whole trial, the rabbits in bicellular cages had higher daily weight gains and feed intakes and heavier final live weights compared with the rabbits in pens ($P<0.01$), but similar feed conversion (Table 1). Within collective pens, growth performance was not affected either by the pen dimension or the stocking density (Table 1). At slaughter, the rabbits in bicellular cages showed higher dressing percentage (60.5 *vs*. 59.6%) and higher weights of the reference carcasses (1372 *vs*. 1277 g) compared with the rabbits kept in collective pens ($P<0.001$) (Table 1). The former rabbits had also higher dissectible fat proportions (3.0% *vs*. 2.1%) and hind leg muscle-to-bone ratios (7.53 vs. 6.63) ($P<0.001$). Within the collective pens, stocking density affected dressing percentage which was lower in the rabbits reared at lower stocking density (59.4 *vs*. 59.8% for 12 and 16 animals/m^2, respectively; $P=0.05$).

Our results confirm previous studies: the growth performance of rabbits housed in large groups in wire-net cages (Szendrő *et al*., 2009) or in pens (Lambertini *et al*., 2001; Princz *et al*., 2009) were worse compared with rabbits kept in bicellular cages or in small-group cages (≤8 rabbits). Differently, rabbits kept in conventional wire-net bicellular cages and in small groups (9 rabbits) showed similar growth rates and carcass and meat quality (Xiccato *et al*., 2013). The better performance of the rabbits in the bicellular and small-group cages compared with those in large-group pens depends on the possibility of the latter to express behaviours other than feeding. The type of floor inside the pen can also play an important role, because it can be unsuitable for rabbits

movement and displacements (e.g. slippery surface), as it likely happened in the case of the wooden slatted floor of the pens used in the present trial.

Table 1 – Performance during fattening (from 35 d to 76 d of age), slaughter results at 77 d of age and carcass traits after 24-h chilling

	Housing system					Prob.[1]	RSD
	B18	L12	L16	S12	S16		
Growth performance							
Live weight at 35 d, g	864	864	859	851	864	0.78	48
Live weight at 76 d, g	2839	2598	2665	2655	2702	<0.01	185
Weight gain, g/d	48.2	42.3	44.0	44.0	44.8	<0.01	3.9
Feed intake, g/d	152	135	136	139	139	<0.001	12
Feed conversion index	3.15	3.21	3.09	3.14	3.11	0.60	0.13
Carcass traits							
Dressing percentage, %	60.5	59.3	59.5	59.4	60.0	<0.001	1.6
Reference carcass (RC), g	1372	1264	1265	1261	1316	<0.001	110
Dissectible fat, % RC	3.0	2.0	2.0	2.0	2.2	<0.001	0.7
Hind legs, % RC	33.2	33.3	34.0	33.5	33.3	0.28	0.9
L. lumborum, % RC	12.4	12.1	12.5	12.6	12.2	0.77	1.0
Hind leg muscle to bone ratio	7.53	6.66	6.49	6.64	6.71	<0.001	0.45

[1]Probability of the contrast "Bicellular vs. collective pens". RSD, residual standard deviation.

In conclusion, regardless of stocking density (12 to 16 animals/m^2) or pen/group size (small: 1.68 m^2 with 20-27 rabbits; large: 3.36 m^2 with 40-54 rabbits), rearing rabbits in collective pens with wooden slatted floor impaired growth performance and carcass traits compared to rabbits kept in bicellular cages.

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