

RAISING RABBIT DOES IN PLATFORM CAGES

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ABSTRACT

Fifty eight young-female does, derived from Italian ANCI selection scheme of Macchiata italiana (Macchiata.it) and Bianca Italiana (Bianca.it) strains were raised in a standard Flat-deck (F) cage or in a enriched Platform (P: 40 cm x 60 x 44 h wired) model under a mild breeding rhythm (31 d pp; weaning: 40 d). The Platform system negatively affected conception rate in the Bianca.it (1.43 vs. 1.05 AI/conception in Flat-deck; $P < 0.05$) while the Macchiata.it was unaffected. The Platform did not significantly increase the mortality in the peripartum phase but it reduced the partial mortality in the milking period (4-19 d: 7.3% vs. 8.2%; $P = 0.58$) and in the weaning period (20-35 d: 5.8% vs. 9.5%; $P = 0.019$). The Bianca.it strain was more suitable for the Platform system (19.9% vs. 29% for Macchiata.it). When the space availability was reduced to standard flat-deck restricted conditions, the Bianca.it reacted negatively, producing stillbirths (12% vs. 7.2% for Macchiata.it). Litter size at 19 days and at weaning was substantially increased by the Platform system (11% and 15%, respectively). The individual kit weight was slightly reduced at 19 d (-13%), but the delay was compensated for at weaning. The net result was an increase of 12% and 18% in the litter weight at 19 d and at weaning, respectively. Feed intake of the family, mainly due to the mother, was greater than 10% in the Platform. This pro-Platform pattern appeared particularly confirmed in the Macchiata.it strain because on the Flat-deck the live weight of the does was reduced by around 6% due to more stressful conditions, even though milking ability was similar.

Platform cages for rabbit does may be a solution to increase welfare conditions. According to these results further studies could be envisaged to outline genotype x environment x management interactions concerning the reproductive (mating, litters) and the productive (milking) abilities of different strains of animals.

Key words: Rabbit, Reproduction, Cage, Platform.

INTRODUCTION

Under intensive rabbit production both the housing system and the management may negatively affect the welfare as well as the productive and reproductive performance of the animals. In particular, regarding the housing system the main aspects to be considered are the quantity and quality of the available space. An exhaustive review on intensive rabbit breeding and welfare of fattening rabbits and does with suckling kits was presented at the 7th World Rabbit Congress (Verga, 2000; Verga *et al.*, 2007). Thus, the cage size of cm 60 x 40 x 32, utilized usually in rabbit husbandry, was demonstrated to be insufficient. In fact, in a study done on does housed in cages of the same size, Drescher (1996) showed that two-thirds of the animals (14 of 20) presented deformations of the vertebral column. In order to overcome this problem and to improve the does' welfare and productivity, the cage dimension can be widened by surface enlargement and(or) by increasing the volume available, by raising the cage height. Rommers and Meijerhof (1997) found a positive effect of cage enlargement and height on productivity, because the number of kits born alive was increased in the taller cages (h 50 cm) and the number of weaned rabbits was increased in both enlarged and in taller cages. In the latter the does could raise themselves, a behavior not seen in the standard cages (h 30 cm), due to the limited vertical space. Another possibility for increasing the cage floor surface available without widening the standard floor dimension was the use of a two-floor cage, consisting of a double height cage with a communicating platform inside it (Finzi *et al.*, 1996; Mirabito *et al.*, 1999). The aim of this work was

to investigate the effect of cage type (standard Flat-deck or Platform) on the does' reproductive performance.

MATERIALS AND METHODS

Animals and experimental design

Fifty eight young-female does, derived from an Italian ANCI selection scheme of *Macchiata italiana* (*Macchiata.it*) and *Bianca Italiana* (*Bianca.it*) strains were used. At ascertained pregnancy, the does were assigned randomly to two groups. In the first one the doe was placed individually in a standard Flat-deck (F) wired cage (cm 40 x 60 x h 44/ 1 rabbit). In the second group, the doe was housed in a two-floor Platform (P) cage, modified in relation to the previous one as proposed by Finzi *et al.* (1996) and Mirabito *et al.* (1999), i.e., using a two-floor cage prototype (cm 40 x 60 x h 44+30/ 1 rabbit).

The does were subjected to a semi-extensive rhythm and artificially inseminated 31 d *postpartum* with weaning at 40 d. Does were introduced gradually into the trial and examined across a period of 15 months having a mean parity of 3.15. They were eliminated from the trial for two reasons: pathology or infertility, after three consecutive sterile matings or persistent male refusal. A total of 211 litters providing viable rabbits (BA) were examined (94 and 117 in F and P groups, respectively). Data of fertility (expressed as number of services per conception) and of numeric reproductive performance: number of alive and dead kits at birth (0 d), litter size and litter weight at 3 d, at 19 days and at weaning (40 d) were recorded. Does were weighed at 3 d *postpartum* (35 d since conception) and re-weighed at 19 days. The total intake of pelleted feed consumed ad libitum (crude protein 16.5%, crude fibre 15.7%, three-antibiotic prevention active), from kindling until 19 following days, was also controlled.

Statistical analyses

The data were analysed using the general linear model for the analysis of variance (GLM procedure of SAS, 1987) in a completely randomised design. The following model with four factors and one interaction was used: $Y_{ijkl} = m + C_i + B_j + P_k + (C*B)_{ij} + P_k + e_{ijkl}$ where: Y_{ijkl} = dependent variable; m = general mean; C_i = fixed effect of cage type of does ($i=1$: Flat-deck, $i=2$: Platform); B_j = fixed effect of the breed of the doe ($j=1$: Bianca Italiana; $j=2$: Macchiata Italiana); $(C*B)_{ij}$ = interaction effect between the cage type and the breed; P_k = fixed effect of parity (two classes: $k=1$ first kindling; $k=2$: parity >1); M_l = Mating type ($l=1$: Purebred; $l=2$: Crossed); e_{ijklm} = random effect. Data regarding the partial mortality rate in the litters at kindling, littering, milking and weaning were analysed by using the χ^2 test into 2x2 tables of contingency, according to the interaction C x B subgroups and to the main effects C and B. In this analysis all the parities were pooled.

RESULTS AND DISCUSSION

The number of litters decreased on average by around 13% at each littering while the overall average parity was 3.15 ± 2.41 . The total mortality in the litters was about 26.4% (Table 1). Castellini *et al.* (2006), who studied these strains, observed lower figures of renewal rate (10% per parity in the post-weaning rhythm) and in 3-32 d litter mortality: 11.5% vs. 15.1 in this work (Table 1).

The partial mortality rate was maximum at kindling (0 d: 11%) and almost halved at littering (0-2 d: 5.9%), during the milking period (3-19 d: 7.7%) and during the weaning period (20-35 d: 7.4%). The Platform system reduced significantly the litter mortality occurrence only in the weaning period 20-35 days (5.8% vs. 9.5%), but the effect according to the breed of the dam was different under the two conditions. The *Bianca.it* strain appeared more suitable for the Platform condition, with a reduction of total mortality (19.9% vs. 29% for *Macchiata.it*), particularly at birth and in the weaning period. On the contrary, when the space availability was reduced to a standard flat-deck condition this strain

appeared to be constrained and reacted negatively mainly regarding stillbirths (12% vs. 7.2%). This ability may be related to differences in behavior between the two strains rather than to a difference in live weight (about 120 g) (Table 3).

Table 1: Partial mortality rate in the litters

Cage	Breed	Periods									
		0		0-3 d		4-19 d		20-35 d		0-35 d	
		Kindling	Prob	Littering	Prob	Milking	Prob	Weaning	Prob	Total	Prob
Flat-deck	<i>Bianca.it</i>	0.120		0.062		0.103		0.091		0.312	
Flat-deck	<i>Macchiata.it</i>	0.072	0.0540	0.044	0.4188	0.071	0.3115	0.097	0.8754	0.250	0.0966
Platform	<i>Bianca.it</i>	0.062		0.046		0.092		0.031		0.199	
Platform	<i>Macchiata.it</i>	0.123	0.0043	0.077	0.1278	0.061	0.1794	0.075	0.0188	0.290	0.0030
Flat-deck		0.097		0.050		0.082		0.095		0.272	
Platform		0.114	0.4224	0.065	0.3422	0.073	0.5885	0.058	0.0194	0.258	0.5881
	<i>Bianca.it</i>	0.095		0.052		0.096		0.055		0.247	
	<i>Macchiata.it</i>	0.114	0.3560	0.063	0.5425	0.065	0.0750	0.085	0.0673	0.273	0.2760
Average		0.107		0.059		0.077		0.074		0.264	

Chi-square Fisher's exact test, by MATFORSK, <http://www.matforsk.no/ola/fisher.htm>

In general the envisaged statistical model accounted only for a small amount of the variability in the biological traits (Table 2: R^2 from 1 to 15%) and the type of mating, pure or crossed, was ineffective. In spite of this fact 9 out of the 15 considered variables appeared to be statistically relevant for the cage system and 4 out of 15 for the breed of dam, while in 3 cases the interaction was significant. The parity effects accounted for some differences in viability parameters; litter size and litter weight showed an unexpected decrease (Table 3) which could be interpreted as a sign of precocity in the maternal ability of the two strains. The regular patterns in milking ability were confirmed in the parallel increase in kit weight according to parity.

Table 2: Statistical analyses of main factors and interaction in the linear model

Variables	R^2_{model}	RMSE	Average	Cage ¹	Breed ¹	Interaction ¹	Parity ¹	Mating ¹
AI per conception (no.)	0.05	0.61	1.29	0.02	0.93	0.06	0.12	0.66
Kits born alive (no.)	0.01	3.33	6.38	0.17	0.80	0.61	0.74	0.31
Litter size at 19 d (no.)	0.08	1.71	6.75	0.01	0.67	0.11	0.01	0.92
Litter size at weaning (no.)	0.12	1.78	6.43	0.00	0.92	0.20	0.00	0.27
Litter weight at 35 d post-AI (g)	0.06	212	738	0.18	0.12	0.97	0.02	0.20
Litter weight at 19 d (g)	0.10	499	2140	0.00	0.01	0.91	0.53	0.28
Litter weight at weaning (g)	0.12	1866	7120	<.001	0.05	0.41	0.47	0.48
Mean pup weight at birth (g)	0.02	25	105	0.80	0.15	0.45	0.70	0.38
Mean kit weight at 19 d (g)	0.04	304	714	0.04	0.79	0.49	0.16	0.50
Mean kit weight at weaning d (g)	0.15	180	1125	0.47	0.00	0.71	<.001	0.39
Does live weight after kindling (g)	0.13	355	4256	0.03	0.11	0.04	0.01	0.21
Does live weight at 19 d (g)	0.10	340	4308	0.02	0.58	0.04	0.31	0.27
Does live weight variation (g)	0.04	210	40	0.87	0.06	0.85	0.08	0.39
Feed intake 1-19 days (g)	0.08	1191	5726	0.00	0.13	0.20	0.40	0.45
Feed conversion per litter 1-19 days	0.03	0.95	2.83	0.70	0.16	0.77	0.14	0.68

¹= (Pr > F)

The cage system strongly affected conception rate in the *Bianca.it* housed in the Platform (1.43^b AI/conception); the best performance for this strain was recorded under the Flat-deck condition (1.05^a). The *Macchiata.it* reproductive ability was apparently unaffected by the cage system.

The litter size at birth was unaffected by the cage system (+11%; P=0.17) but the litter size at 19 d and at weaning was substantially increased by 11% and 15%, respectively under the Platform system. The individual kit weight was slightly reduced at 19 d (-13%) but the delay was compensated for at weaning. The net result was an increase of 12% and of 18% in the litter weight at 19 d and at weaning, respectively. This higher mass found at 19 d may be due to a higher milking ability of the does which was supported by a slightly higher body weight of the dams after kindling (123 g) and maintained up

to the 19th day (130 g). This presumed superior milking ability could have continued after the 19th d because of the mild reproductive rhythm applied. Indeed, the feed intake, mainly due to the mother, was larger than 10% in the Platform. This pattern *pro*-Platform appeared particularly confirmed in the *Macchiata.it* strain because on the Flat-deck the live weight of the does was substantially reduced by around 6% by more stressful conditions, at a similar milking ability level.

Table 3: Least squares means of the effects in the model

Variables	# items	C – Cage		B – Breed		Interaction C x B				Parity	
		F-Flat-deck	P-Platform	B– <i>Bianca.it</i>	M– <i>Macchiata.it</i>	F-B	F-M	P-B	P-M	P = 1	P = 2
AI per conception (no.)	211	1.14 ^a	1.34 ^b	1.24	1.24	1.05 ^a	1.22 ^{ab}	1.43 ^b	1.26 ^{ab}	1.16	1.32
Kits born alive (no.)	211	6.00	6.68	6.40	6.28	5.93	6.06	6.86	6.49	6.43	6.24
Litter size at 19 d (no)	181	6.58 ^b	7.33 ^a	6.90	7.01	6.31	6.85	7.48	7.17	7.39 ^a	6.52 ^b
Litter size at weaning (no.)	176	6.27 ^b	7.22 ^a	6.73	6.76	6.08	6.47	7.39	7.05	7.28 ^a	6.21 ^b
Litter weight 35 d post-AI (g)	183	741	786	789	738	766	716	812	759	810 ^a	717 ^b
Litter weight at 19 d (g)	176	2065 ^b	2307 ^a	2296 ^a	2078 ^b	2170	1961	2421	2194	2217	2156
Litter weight at weaning (g)	175	6618 ^b	7855 ^a	7525	6948	6785	6452	8266	7444	7365	7108
Mean pup weight at birth (g)	183	106	105	109	103	111	102	107	104	107	105
Mean kit weight at 19 d (g)	176	747 ^a	647 ^b	690	703	757	737	624	670	655	739
Mean kit weaning weight (g)	183	1081	1102	1140 ^a	1043 ^b	1135	1028	1146	1059	1023 ^b	1160 ^a
Doe live weight after kindling (g)	183	4152 ^b	4275 ^a	4258	4169	4254 ^a	4051 ^b	4263 ^a	4287 ^a	4124 ^b	4303 ^a
Doe live weight at 19 d (g)	176	4225 ^b	4355 ^a	4305	4275	4295 ^{ab}	4154 ^b	4315 ^a	4396 ^a	4256	4324
Doe live weight variation (g)	176	53	48	19 ^b	81 ^a	25	81	14	82	87	14
Feed intake 1-19 d (g)	169	5418 ^b	5974 ^a	5840	5553	5440	5397	6240	5708	5596	5797
Feed conversion per litter 1-19 d	169	2.74	2.68	2.60	2.82	2.61	2.87	2.60	2.77	2.57	2.85

a, b: means differ for P<0.05

In a previous experiment carried out at 10 days *postpartum* and not at 31 days (Masoero *et al.*, 2003) with 110 females in the Platform or in Flat-deck cages fertility was reduced (-15%), incidence of abortion increased (17 vs. 10%; P<0.05) and the litter size decreased by about 5%. The weight of the kits at 19 d appeared reduced by 4%, because of a significant reduction of feed intake by the family (-6.5%); yet, at weaning no difference was found. On the contrary, Mirabito *et al.* (1999) did not observe differences in the reproductive or productive traits in hybrid does on Platform cages intensively bred.

CONCLUSIONS

Pro-Platform: litter size and litter weight increase, doe's live-weight stability and increased feed intake (different from Masoero *et al.*, 2003, using intensive breeding); reduced mortality at weaning (confirming previous findings); interaction with genetic type (new). *Contra*-Platform: reduced conception ability, kit and weight reduction at 19 d, but disappearing at weaning (confirming previous findings).

Platform cages for rabbit does may be a solution for increasing welfare conditions (Verga *et al.*, 2007). According these results further studies could be envisaged to outline genotype * environment * management interactions concerning the reproductive (mating, litters) and the productive (milking) abilities of different strains of animals.

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