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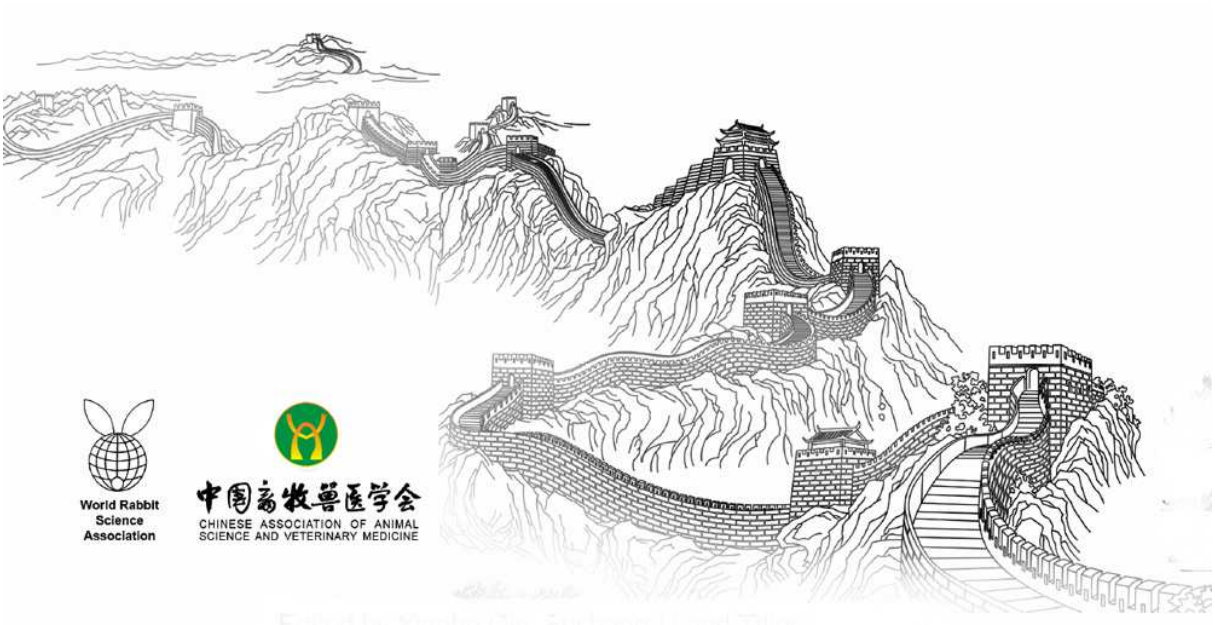

EFFECT OF A PROTOTYPE OF COLONY CAGE WITH REMOVABLE WALLS ON THE REPRODUCTIVE PERFORMANCE OF RABBIT DOES

Martino M.[1*], Mattioli S.[1*], Cambiotti V.[2], Mugnai C.[3], Moscati L.[2], Castellini C.[1], Dal Bosco A.[1]

[1] *Dept of Agricul., Food and Environ. Sci., University of Perugia ,Via Borgo 20 Giugno, 74, 06100 Perugia, Italy.*
[2] *Istituto Zooprofilattico dell'Umbria e delle Marche, Via G. Salvemini 1, 06100 Perugia, Italy.*
[3] *Facoltà di Bioscienze e Tecnologie Agro-Alimentari e Ambientali, Università di Teramo, Via R. Balzarini, 1, 67100, Teramo, Italy.*
[*]Corresponding author: simona.mattioli@hotmail.it

ABSTRACT

The aim of this study is to evaluate the effect of a new colony cage prototype upon the reproductive performance of rabbit does. Forty-eight New Zealand White nulliparous rabbit does were artificially inseminated and transferred to different cages: Standard colony group (SC), Prototype colony group (PC; five days before kindling partition walls were closed and removed one week after it) and a positive control (C, does in single cage). The following reproductive traits were recorded along one year: sexual receptivity, fertility rate and live-born kits. Several indices of reproductive efficiency were also calculated: overall productivity, production losses and efficiency of the system. The percentage of does that had severe skin injuries and the distribution of such injuries was also registered. The SC group showed lower sexual receptivity, fertility, live-born kits and weaned kits, whereas the PC one reached higher indexes of global productivity (rabbits sold/year/doe, live weight sold/year/doe, production losses, kindling interval and annual replacement of does). Reproductive performance of female reared in the new prototype, were higher in terms of receptivity and fertility rate as well as the numbers of live-born kits and milk production. Rearing does in a colony cage, without the possibility to remain isolated for the period around the kindling, results in disagreeable social encounters, and does not assure adequate welfare or productive performance. The prototype studied permits to obtain lower but comparable performance (-17.0 % live weight sold/year/doe) of does reared in standard cages with some improvement on welfare status of does.

Key words: Rabbit does, Colony cage, Removable walls, Performance.

INTRODUCTION

Most of the housing and management systems used in commercial rabbit farms are not coherent with the behavioural of animals, and need to be reconsidered. The main critical points, in term of welfare, are mainly due to the lack of social interaction between animals and the available space for movement. In recent years the group-housing of rabbit does was studied by some researchers, but in the commercial farms, this practice ceased because of behavioural problems and poor productivity. Szendrő and McNitt (2012) affirmed that group-housing of does, independently on the larger area for moving and social contact, contravenes the welfare recommendations often resulting in chronic stress, aggressiveness and injuries, higher risk of diseases and mortality; accordingly, the reproductive performance is lower and the costs of production are higher.
Thus, the current housing systems proposed for does (colony cage) do not meet the needs of the animals and they negatively impact the well-being and the reproductive efficiency of rabbit does (pseudopregnancy, abortion) and need to be reshaped in a more efficient way (Szendrő and McNitt, 2012).

Considering the application difficulties of the colony cages, the aim of this study was to evaluate the effect of a prototype of colony cage upon the reproductive performance of rabbit does.

MATERIALS AND METHODS

Animals and experimental design

All procedures were carried out according to EU Regulations for experiments on living animals and Italian directives (Gazzetta Ufficiale, 2014) on animal welfare for experimental and other scientific purposes.

The research was carried out in the experimental rabbit farm of the Department of Agricultural, Environmental and Food Science of Perugia University. The environmental temperature and relative humidity were conditioned (range: +15/+28 °C; 60/75 %, respectively) and the light program was 16L/8D. The building was artificially ventilated (0.3 m/sec) (International Rabbit Reproduction Group, 2005).

The colony cages (Standard and Prototype) were planned in collaboration with Metac-Ellebi s.r.l. manufacturing (Fabriano, Italy) and were built for four females reared at the same density as in the conventional system. Its dimensions were 76W x 150L x 60H cm and it was equipped with 4 external shut-out nest boxes (38 x 25 x 35 cm) at the two ends of the cage. The new colony cage prototypes had removable walls to manage the different production cycle phases (single or colony reared).

Thirty-two New Zealand White nulliparous rabbit does were artificially inseminated and transferred to eight colony cages as following:

- Standard colony group (**SC**; n=16);
- Prototype colony group (**PC**; n=16): five days before kindling partition walls were closed and removed one week after it.

Sixteen does were also allocated in single cages (**C**) and used as positive control.

Artificial insemination (AI) was performed by inseminating 0.5 mL of diluted fresh semen, containing about 10 million spermatozoa (Castellini and Lattaioli, 1999). No oestrus synchronisation was done. Ovulation was induced by inoculating 10 μg of GnRH (Lutal-Hoechst).

Reproductive Performance

Does were managed according to a cycled production system (AI post-weaning at 30 days *post-partum*) and were checked over a period of one year.

The following reproductive traits were recorded: sexual receptivity (colour and turgescency of the vulva; a doe was judged receptive when its vulva was red or purple and turgid), fertility rate (kindling/inseminations x 100) and live-born kits. Weight of does and litters was also recorded. After 3 consecutive AIs, does that were never pregnant were replaced by rabbit does of the same age and genetic strain. The indices of efficiency were calculated in terms of: overall productivity (number and weight of rabbits sold/year/doe), production losses (difference between actual and theoretical production considering fertility rate=100, mortality of the young rabbits=0 and kindling interval=60) and efficiency of the system (Castellini et al., 2006). The percentage of does that had severe skin injuries was also calculated and the distribution of injuries over the different body parts was registered.

Statistical Analysis

Data were analyzed with a linear model of STATA package (2015) with the rearing system as a fixed effect. The level of statistical significance was set at $P<0.05$.

RESULTS AND DISCUSSION

Experimental groups showed different reproductive performance and indexes of global productivity (Tables 1 and 2), but both the groups analysed did not reach the productivity of convention rabbit does (respectively, -17.0 and -43.1% weight sold/year/doe compared to C). The SC group showed lower sexual receptivity, fertility and live-born kits.

Compared to the SC, the rabbit does reared in the cage with removable walls (PC) reached better indexes of global productivity (higher number of rabbits sold/year/doe and live weight sold/year/doe; lower production losses, kindling interval and annual replacement of does). In the SC, a higher percentage of replacement was associated with severe skin lesions on their heads, ears and backs due to severe attacks from dominant does.
According to these findings, the reproductive performance of PC female, that did not have any social relationships along the *peri-partum* period, were higher in terms of receptivity and fertility rate as well as the numbers of live-born kits and milk production respect to SC ones, whereas such parameters had lower values respect to C ones.

Table 1 Reproductive performance (mean ± SD)

		Prototype colony	Standard colony	Single cage
Sexual receptivity*	%	69.6b ± 2.9	56.2a ± 3.6	79.8c ± 4.4
Fertility*	%	60.3b ± 5.0	46.1a ± 4.3	72.6c ± 3.8
Doe weight at kindling	grammes	3450 ± 315	3305 ± 230	3750 ± 410
Doe weight at weaning	grammes	3855 ± 305	3740 ± 255	4195 ± 457
Alive-born	N	6.5b ± 1.3	5.6a ± 1.8	6.5b ± 1.4
Weaned kits	N	5.6 ± 2.0	5.1 ± 1.5	6.0 ± 1.7
Individual weight at weaning	G	565 ± 36	578 ± 31	559 ± 28
Pre-weaning mortality*	%	7.2 ± 2.0	8.3 ± 1.6	6.4 ± 1.8

N°: 288 (16 does x 3 groups x 6 breeding cycles). *: χ2. a,…c: P<0.05.

Table 2 Indexes of global productivity (mean ± SD)

		Prototype colony	Standard colony	Single cage
Rabbits sold/year/doe	N	26.3b ± 2.8	15.6a ± 1.7	31.8b ± 4.2
Live weight sold/year/doe	kg	59.1b ± 10.1	40.5a ± 14.2	71.2b ± 13.1
Production losses	kg	47.2ab ± 9.6	63.8b ± 10.4	38.8a ± 8.2
Kindling interval	Days	83.3b ± 7.1	95.5c ± 6.2	73.3a ± 2.3
Kindling/year/doe	N	4.4ab ± 0.9	3.8a ± 0.8	4.7b ± 0.6
Annual replacement of does*	%	78.1b	85.6c	63.2a
Severely injured does	%	5.6a	7.9b	1.5a

N°: 288 (16 does x 3 groups x 6 breeding cycles). *: χ2. a,...c: P<0.05.

These results agree with findings of other authors (Bilkó and Altbacker, 2000; Verga et al., 2004), who found satisfactory reproductive performance in daily handled does, in particular in terms of receptivity and fertility, nest quality and number of weaned kits.
It is assumed that stress induces an increase of plasma prolactin level (Manteca, 1998), which is responsible for the hormonal antagonism that negatively affects the reproductive functions (Kermabon et al., 1995). Bench and Gonyou (2007) indicate that stress can reduce fertility by affecting the frequency and amplitude of LH pulses, ultimately depriving the ovarian follicle of adequate LH support. This will lead to reduced oestradiol production by slower-growing follicles. Rommers et al. (2006) and Theau-Clement et al. (2000), in studying colony-reared does, attributed the low reproductive performance to pseudo-pregnancy.

In our study, the aggressiveness found in social relationships and the presumable incidence of pseudo-pregnancy, especially in the SC group (data not shown), could have caused the lower reproductive performance in these females. The stress observed in this group might have triggered the high levels of maternal failure recorded, resulting in nest-building failures and in low kit survival rates. In fact, there is a multiplicity of hormones and cerebral structures involved in the maternal behaviour of does, particularly during nest-building (González-Mariscal, 2001). Stress acts upon neuro-hormonal centres leading to alterations that affect hormone release. Moreover, the behaviour patterns of both the mother and her kits during the *peri-partum* and lactation are stereotyped and lack the flexibility that is characteristic of most mammals (Hudson and Distel, 1986). This suggests that any alteration of the environment in which birth and nursing take place, e.g. stressful episodes, could lead to a failure in the ability of kits to survive because they depend on the maternal attitude (nesting material, milking ability). In addition, we can deduce that the entry of does to nest boxes of other does and the aggressions of the dominant doe observed in SC group were responsible for the low kit survival rates

and the high percentage of severely injured does. Regarding global productivity, PC does showed satisfactory results, even if about 15% lower than standard performance obtained in single cage; the high annual replacement was mainly due by the higher percentage of severely injured does. On the other hand, it should be underlined that PC, in comparison to C does, permits social interactions and higher kinetic activity.

CONCLUSIONS

Rearing does in a colony cage, without the possibility to remain isolated for the period around the kindling, results in disagreeable social encounters, and does not assure adequate welfare and productive performance, as well as increasing the frequency of injury caused by attacks from other does.
Some problems could be solved by using the removable walls in order to isolate the does during a delicate phase such as kindling. This study of new welfare-friendly housing systems could represent a contribution to the present literature considering the future development of EU Regulations. Further research is needed to determine how solve welfare problems without excessively increasing the production cost.

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