

Performance of kits that born in semi-group housing system or individual cages before and after weaning

Desempenho produtivo de l paros nascidos em sistema coletivo de semi-grupo e gaiolas individuais antes e ap s o desmame

Performance productiva de gazapos nascidos en sistema colectivo de semi-grupo y jaulas individuales antes e tras el destete

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ABSTRACT

Animal welfare is a subject of great interest and the housing of rabbit does in semi-group housing system is under investigation, but there is a lack of information about the effect on performance of kits in this system. A total of 1362 crossbred kits from the first four cycles of 48 rabbit does housed in semi-group housing system (24 does, six per pen, part-time system) and individual cages (24 does) were allocated at weaning into wire mesh cages (50 × 80 × 34 cm), eight kits per cage, maintaining or not the original litter (mixed or non-mixed). The kits were weighed at 18, 28 (weaning) and 56 d of age and their performance was evaluated. The feed intake (FI) of jointly does and kits was measured during the periods kindling – 18 lactation days (K-18L) and 18 days until weaning (18L-W). Kits from semi-group housing system were heavier at 18 d (300 vs 293 g, $P \leq 0.01$) being this related to a higher FI in the period K-18L ($P \leq 0.05$). Regrouping had a negative impact on the feed consumption of animals housed in semi-group housing system, so in the period 18L-W the FI in individual cages was higher (499 vs 526 g, $P \leq 0.01$). No differences were observed in kits' weight at 28 and 56 days, feed intake, daily weight gain or feed conversion ratio, and mortality of kits. In conclusions, no residual effect of the housing system was recorded on fattening rabbits performance and, considering performance aspects, kits from semi-group housing system can be housed litter-mixed or non-mixed in fattening cages.

Keywords: Animal welfare, growth performance, housing systems, part-time group-housing, rabbit breeding.

RESUMO

O bem-estar animal é um assunto de grande interesse e o alojamento de coelhos em sistema coletivo de semi-grupo está em desenvolvimento, faltando ainda informações sobre os efeitos no desempenho produtivo de lãparos após o desmame. Um total de 1.362 lãparos em crescimento, oriundos dos primeiros quatro ciclos reprodutivos de 48 coelhas alojadas em sistema coletivo (24 coelhas, seis por jaula, sistema de semi-grupo) e gaiolas individuais (24 coelhas), foram alojados em gaiolas de arame galvanizado (50 × 80 × 34 cm) após o desmame, sendo oito lãparos por gaiola, mantendo ou não a ninhada original (misturada ou não misturada). Os lãparos foram pesados aos 18, 28 (desmame) e 56 dias de idade e seu desempenho produtivo foi avaliado. O consumo de ração (FI) das coelhas e lãparos foi mensurado conjuntamente durante os períodos de parto – 18 dias de lactação (K-18L) e 18 dias até o desmame (18L-W). Os lãparos do sistema de alojamento coletivo semi-grupo foram mais pesados aos 18 d (300 vs 293 g, $P \leq 0,01$), sendo isso relacionado a um maior FI no período K-18L ($P \leq 0,05$). O reagrupamento teve um impacto negativo no consumo de ração dos animais alojados em sistema de alojamento semi-grupo e no período 18L-W o consumo de ração em gaiolas individuais foi maior (499 vs 526 g, $P \leq 0,01$). Não foram observadas diferenças no peso dos coelhos aos 28 e 56 dias, consumo de ração, ganho de peso diário ou conversão alimentar e mortalidade. Em conclusão, nenhum efeito residual do sistema de alojamento foi registrado no desempenho de coelhos em período de crescimento e, considerando aspectos de desempenho, os coelhos oriundos do sistema de alojamento coletivo em semi-grupo podem ser alojados misturados ou não misturados.

Palavras-chave: Bem-estar animal, cunicultura, desempenho produtivo, gaiolas coletivas, sistemas de alojamento.

RESUMEN

El bienestar animal es un tema de gran interés y el alojamiento de conejas en sistema colectivo de semi-grupo está en desarrollo y aún falta información sobre los efectos en la performance productiva de conejos en cebo tras el destete. Un total de 1.362 gazapos, oriundos de los primeros cuatro ciclos reproductivos de 48 conejas alojadas en sistema colectivo (24 hembras, seis por jaula, sistema semi-grupo) y jaulas individuales (24 hembras), fueron alojados en jaulas de alambre galvanizado (50 × 80 × 34 cm) tras el destete, siendo ocho conejos por jaula, manteniendo o no la camada original (mixta o sin mezclar). Los conejos fueron pesados a los 18, 28 (destete) y 56 días de edad. El consumo de pienso (FI) de hembras e gazapos se medió en conjunto durante los períodos de parto hasta 18 días de lactancia (K-18L) y 18 días hasta el destete (18L-W). Los gazapos en el sistema de alojamiento semi-grupo fueron más pesados a los 18 d (300 vs 293 g, $P \leq 0.01$), lo que se relaciona con un mayor FI en el período K-18L ($P \leq 0.05$). El reagrupamiento tuvo un impacto negativo en el consumo de pienso de las hembras alojadas en sistema de alojamiento semi-grupo y en el período 18L-W el consumo de pienso en jaulas individuales fue mayor (499 vs 526 g, $P \leq 0.01$). No se observaron diferencias en el peso a los 28 y 56 días, consumo de pienso, ganancia diaria de peso o conversión alimenticia y mortalidad. En conclusión, no se registró ningún efecto residual del sistema de alojamiento sobre la performance de los conejos en período de cebo y, considerando la performance, los conejos del sistema de alojamiento colectivo en semi-grupo pueden ser alojados de manera mixta o sin mezclar.

Palabras clave: Bienestar animal, cunicultura, jaulas colectivas, performance productiva, sistemas de alojamiento.

Introduction

Nowadays, the improvement of farm animal welfare is one of most important subjects involved in animal production and the application of new technologies related to housing systems is one of the ways to enhance it (Szendrő *et al.*, 2016, EFSA, 2020).

Under the traditional individual cage system used in rabbit farms, the occurrence of stereotypy behaviours could be high (Rommers *et al.*, 2006). Recent works on rabbit welfare and behaviour have focused on evaluating the effects produced by increasing the size of the cages or group of animals, as well as different proposals based on environmental enrichment (Szendrő and Dalle Zotte, 2011, Trocino *et al.*, 2018). In nature, some wild animals live in society, providing benefits due to their mutual cooperation and protection (Szendrő and Dalle Zotte, 2011; EFSA, 2020).

The social contact among rabbits is more frequent when semi-group housing system are used and could be important to improve the welfare status of farmed animals. In this sense, among the new breeding collective systems evaluated, the part-time group housing promotes more social contact and space for rabbit does, although its improvements in animal welfare have

not yet been understood (Szendrő *et al.*, 2019). In fact, this idea of better life quality is questionable if considered that rabbits living in large groups (Szendrő and Dalle Zotte, 2011; Szendrő *et al.*, 2019; Huang *et al.*, 2021). Due to this situation, aggressiveness and fights can affect negatively the animal welfare, leading to higher levels of injuries and stress and so, many rabbits can live under threat all the time. There is still a lack of information and results in semi-group housing system for better understanding and to determine the best conditions to be adopted in farms.

Most of the research on semi-group housing system was focused on rabbit does and the scarce information about kits was obtained from new kinds of pens and different stocking densities (Szendrő and Dalle Zotte, 2011; Matics *et al.*, 2018). However, there is a lack of information about performance of kits originated from semi-group housing system during lactation and fattening periods. Therefore, this work aimed to evaluate and compare the performance of kits from semi-group housing system and individual cages that were housed in fattening cages after weaning.

Material and methods

This research was carried out in the experimental farm of Valencia

Polytechnic University (UPV), and the experimental protocols were approved by the UPV ethics committee, as set forth in Royal Decree 53/2013 on protection and use of animals for experiments and other scientific purposes, including teaching (BOE, 2013).

One thousand three hundred and sixty-two kits were used from the first four cycles of 48 rabbit does that were maintained in two housing systems: semi-group housing system and individual cages. The semi-group housing system was constituted by pens of $240 \times 100 \times 80$ cm (length \times width \times height) and each one housed six does. The individual cages were $38 \times 71 \times 57$ cm, with a wire mesh platform (26×38 cm) installed at 24 cm height. All cages had a plastic footrest. The average temperatures were 15°C (minimum) and 22°C (maximum). The reproductive rhythm adopted was 42 days, in which the rabbit does (H and LP crossbred of UPV maternal lines) were artificially inseminated 11 days after kindling with R line semen (UPV line selected for growth rate). Three days before kindling, the rabbit does from the semi-group housing system were housed individually, adding wire walls to divide the pen and form individual spaces. At this point, the nests were provided to all pregnant rabbit does in both housing

systems. For the first 18 days of lactation (K-18L period), all rabbit does were kept individually. The wire walls of collective pens were subsequently removed, transforming the place into a collective housing system again, with groups of 3 to 6 does with their kits (not balanced groups because not all does became pregnant at the same time) that were maintained until weaning at 28 days of lactation (18L-W period). The rabbit does and the kits had *ad libitum* access to fresh water through automatic drinkers and a commercial pelleted feed (91% dry matter, 8% ash, 17% crude protein, 34% NDF, 17% ADF and 3.2% ADL).

After weaning the kits were housed in groups of eight per cage and for semi-group housing system, kits from the original litter was maintained or not (these kits had been marked before regrouping and after weaning, the original litter was regrouped or not, mixed or not mixed). The fattening cages were $50 \times 80 \times 34$ cm. Pelleted feed (91% of dry matter, 8% of ash, 15% of crude protein; 38% of NDF, 20% of ADF and 2.8% of ADL) and fresh water *ad libitum* through feeders and automatic drinkers were offered. Kits were fattened until 56 days of age (W-56D period).

All kits were weighed at 18, 28 and 56 days of age and marked at the first weighing using tattoo equipment (549

kits from semi-group housing system and another 813 kits from individual cages). The average daily weight gain (ADG, g/d) of each kit was calculated from 18L-W and W-56D periods. Likewise, in each fattening cage, the dry matter feed intake (FI, g/d) was measured and the feed conversion ratio (FCR) calculated. Feed intake of does for K-18L period, FI jointly of does and litters for 18L-W period and FI of fattening rabbits for W-56D period were determined. Kit mortality was measured during K-18L, 18L-W and W-56D periods.

The data were analysed by ANOVA using the Statgraphics Centurion tool and considering two different housing systems, two different housing handling (mixed or no mixed kits after weaning) and three ages for body weight, or two periods for ADG, wherever each rabbit kit was considered

as an experimental unit. FI and FCR during lactation and fattening periods were analysed considering the two housing systems and each fattening cage was considered as an experimental unit. For the trait FI of does, the two housing systems, the four cycles order and the two periods inside cycle (K-18 and 18-W) were considered. The level of significance considered was 5%. Means comparisons were performed by Scheffé test. Mortality rates were compared using a χ^2 function.

Results and discussion

There is not effect from the handling housing for kits, maintaining or not the original litter, and so, the results from semi-group housing system are fully presented without considering this factor. Performance of kits and feed intake during lactation and fattening periods are shown in Table 1.

Table 1 – Performance of kits and rabbit does housed in semi-group housing system (Collective) and individual cages during lactation

<i>Variables</i>	<i>COLLECTIVE</i> (mean±SE)	<i>INDIVIDUAL</i> (mean±SE)	<i>P value</i>
Kit weight at 18 days (g)	300±2.1	293±1.7	0.006
Kit weight at 28 days (g)	584±4.3	581±3.5	0.601
Kit weight at 56 days (g)	1933±8.6	1936±7.0	0.779
Daily weight gain 18-28 days (g)	28.4±0.3	28.9±0.2	0.181
Daily weight gain 28-56 days (g)	48.0±0.2	48.2±0.2	0.467
Feed intake K-18L (g DM/day)	384±5.2	373±4.4	0.050
Feed intake 18L-W (g DM/day)	499±6.6	526±5.6	0.002
Feed intake 28-56 days (g DM/day) ¹	113±0.9	114±0.7	0.231
Feed conversion 28-56 days ¹	2.61±0.02	2.65±0.02	0.159

SE: standard error of the means; DM: dry matter; K-18L: Kindling to 18 days of lactation period; 18L-W: 18 days of lactation to weaning period.

¹Only weaned kits.

Kits from semi-group housing system were heavier at W18 ($P < 0.01$), but this difference was not observed at W28, except in the first cycle, when kits from semi-group housing system were heavier. In the third cycle this situation was almost reversed (Figure 1). The W28 variation observed throughout the

cycles was different between the housing systems. In individual cages, W28 increased until third cycle with a slight decline after it, although the W28 was statically equal between the cycles three and four. This increase in semi-group housing system was moderate (Figure 1).

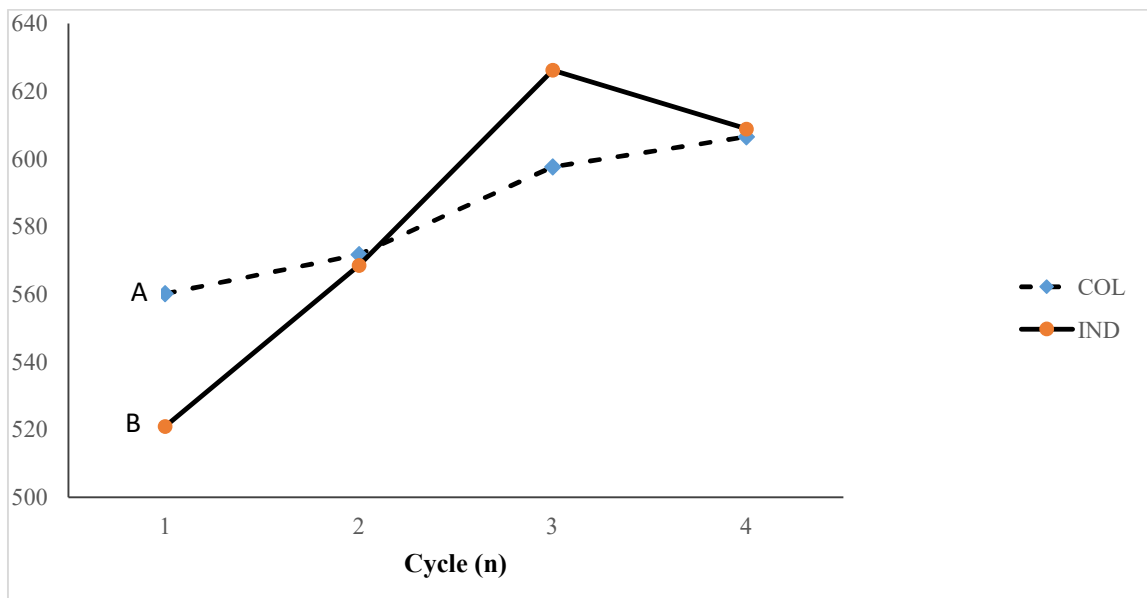


Figure 1 –Weight of kits (Y-axis, g) at 28 day of age from semi-group housing system (COL) and individual

cages (IND) during the first four cycles. The different letters in the first cycle show statistical differences between values ($P \leq 0.05$). There are no differences between the other cycles ($P \geq 0.05$).

The heavier kits observed at 18 days of age in semi-group housing system (+7 g) could be related with the higher FI of rabbit does in K-18L period (+11 g of dry matter/day), which was also observed by Zomeño *et al.* (2018). In this sense, these authors found a higher milk production in semi group housing system during the first 16 days of lactation.

On the other hand, the cycle order had a great influence on the weight development of the growing kits throughout the cycles and, in general, it is accepted that their weight reflects the FI capacity of their mothers, which is greater after the second cycle (Machado *et al.*, 2019). However, considering the first three cycles, the variation in kit weight was more pronounced in individual cages (figure 01). The reason for this was that does housed in individual cages had higher FI after regrouping (499 vs. 526 g of dry matter/day, respectively) being statically different in second and third cycles.

The causes for the higher weight

of kits observed in semi group housing system at first cycle are not clear, and may be related to a high feed intake after the first individualization of these does, with a great accumulation and mobilization of nutrient reserves. The result of similar W28, found for cycles two, three and four, contrasts with that found by Maertens and Buijs (2016) and Cervera *et al.* (2017), which found lighter growing kits when they came from semi-group housing system, although the size of the does group varied among the different works.

The FI of rabbit does was different between housing groups in period K-18L (Table 1). In 18L-W period, the FI jointly of rabbit does and litters was lower in semi-group housing system after regrouping compared to individual cages ($P < 0.01$; Table 1), except in the first and fourth cycles, which were similar between housing systems (Figure 2). The FI of fattening rabbits in W-56D period was similar (Table 1).

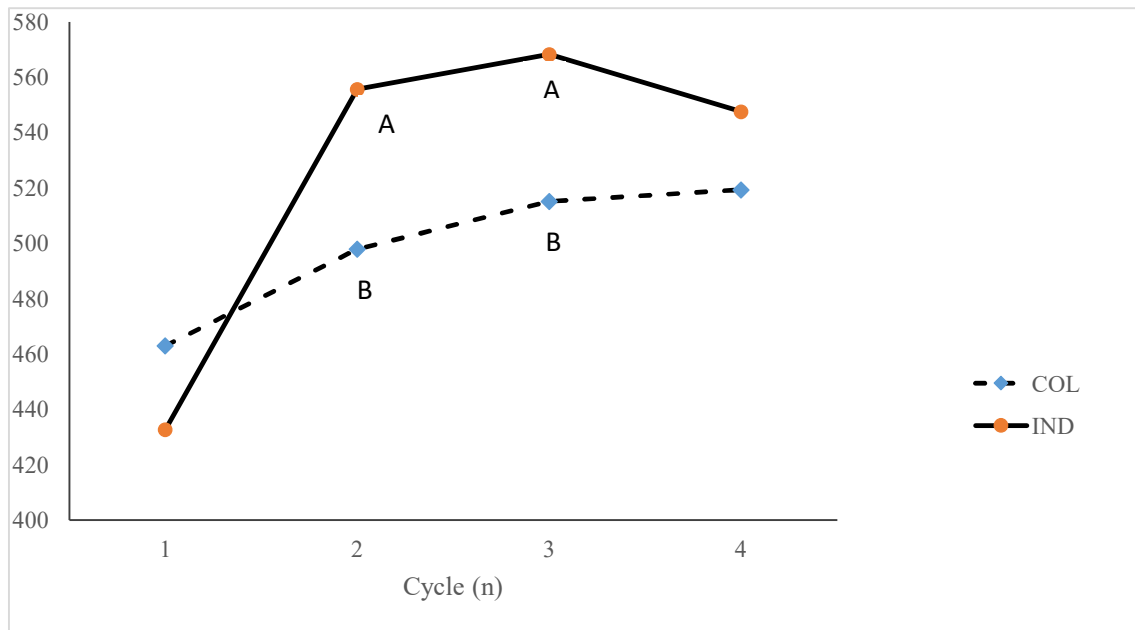


Figure 2- Feed intake (Y-axis, g dry matter/day) jointly of does and litters from 18 to 28 days of lactation housed in semi-group housing system (COL) and individual cages (IND) during the first four cycles. The different letters in the second and third cycles show statistical differences between values ($P < 0.05$).

It seems that the act of does individualization in the semi-group housing system, at third day before kindling, had a positive impact on FI of K-18L period and, conversely, the regrouping of these animals had a negative influence on FI of 18L-W period. A possible explanation may be related to the greater level of insecurity of does to approach to the feeders, considering that the feed can be one of the resources in dispute between does.

It seems to be clear that the kit post-weaning FI is not influenced by the housing system used prior to weaning, as well as the FCR and ADG, as also observed by Maertens and Buijs (2016). There is a lack of studies on the residual effects of the doe housing systems on the

performance of growing animals. In general, when a larger group per cage after weaning or the housing of rabbits in high density are considered, the performance is usually impaired and a higher number of injured animals and an increase in mortality are verified (Leblatier *et al.* 2017). These problems were not observed in this study, even with density of 20 animals/m² (38.7 kg/m² at 56 days). It is necessary to highlight that in the present essay the animals were slaughtered at 56 days, and the attacks among cage mates are usually observed in older animals, in the period close to sexual maturity, as verified by Szendrő *et al.* (2009).

Cervera *et al.* (2018) assessed the performance of animals from semi-

group housing system or individual cages by placing them in conventional fattening cages after weaning (50 × 80 × 34 cm). In contrast to the results obtained in this research, the rabbits from individual cages were heavier at 56 days. This fact is associated with a higher weaning weight of these kits observed by the authors, as the daily weight gain in the 28-56 days period was similar (45.9

Table 2 – Mortality of kits (%) from semi-group housing system (collective) and individual cages during lactation and fattening periods.

Period	<i>COLLECTIVE</i>	<i>INDIVIDUAL</i>	<i>P</i>
From 18 days of lactation to weaning	1.45	0.98	0.960
From weaning to 56 days of age	2.58	2.73	0.999

In this study, pre-weaning mortality was not influenced by the housing system and was very low (5.5%) when compared to Mugnai *et al.* (2009) and Mikó *et al.* (2014), that found 8,8% and 8,5%, respectively. After weaning, the mortality assessed in this work was very low and similar to Leblatier *et al.* (2017) and Cervera *et al.* (2018), that found 2.1 and 3.6 respectively, considering traditional fattening cages for eight rabbits.

The management applied for the rabbit does in the semi-group housing system contribute for the mortality reduction. If we consider the hierarchical dispute among the rabbit does and the new coexistence with other unknown animals, the period after the regrouping

vs 45.1g/day). As reported in the present assay, Maertens and Be Bie (2017) did not find differences for slaughter weight at 71 days among animals, although in that case, after weaning, the rabbits were maintained in the original place.

There were no differences for mortality between kits in the two housing systems during lactation and fattening periods (Table 2).

of adult females can be critical for the young kits. This effect is diminished when the regrouping is carried out after 18 days of lactation (Szendrő *et al.* 2009). Maertens and De Bie (2017) found a high mortality rate after regrouping (3.9%), higher than in the present assay (1.45%).

CONCLUSIONS

There is no residual effect of the housing system on fattening rabbits performance until 56 days of age. Considering performance aspects, kits from semi-group housing system can be housed litter-mixed or non-mixed in fattening cages.

ACKNOWLEDGEMENTS

The first author thanks the National Council for Scientific and Technological Development Brazil (CNPq) for the postdoctoral fellowship.

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