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Effects of group housing system, pen floor type, and lactation management on performance and behaviour in rabbit does

Cristina Zomeño[a], Marco Birolo[b], Francesco Gratta[b], Andrea Zuffellato[c], Gerolamo Xiccato[b], Angela Trocino[a,*]

[a] Department of Comparative Biomedicine and Food Science (BCA), University of Padova, Viale dell'Università 16, I-35020 Legnaro, Padova, Italy
[b] Department of Agronomy Food Natural Resources Animals and Environment (DAFNAE), University of Padova, Viale dell'Università 16, I-35020 Legnaro, Padova, Italy
[c] A.I.A. Agricola Italiana Alimentare S.p.A., P.le Apollinare Veronesi 1, I-37036 San Martino Buon Albergo, Verona, Italy

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ABSTRACT

This work aimed at evaluating the effects of housing system, pen floor type, and lactation management on rabbit doe and kit performance throughout a reproductive cycle, including categorization of aggressiveness and injuries. Forty multiparous pregnant does were assigned to six experimental groups: *i*) individual pens with plastic floor (4 does), *ii*) individual pens with wire floor and plastic mats (4 does), *iii*) collective pens with plastic floor and fixed lactation (8 does), *iv*) collective pens with plastic floor and random lactation (8 does), *v*) collective pens with wire floor and plastic mats and fixed lactation (8 does), and *vi*) collective pens with wire floor and plastic mats and random lactation (8 does). In collective pens, does were kept in groups from 8 d until 2 d before kindling and from 2 d until 33 d after kindling. In the fixed group, does always nursed their own litter; in the random group, a random litter from pen-mates. Behaviours were video-recorded at 8 d before kindling (−8 d), and 2 d (+2 d) and 18 d (+18 d) after kindling. Injuries were scored at 5, 12, 19, 26, and 34 d after kindling. Bayesian inference was used to study the differences between experimental groups. During controlled lactation, doe feed intake (+17.3 g/d; $Prob_R = 0.84$) and milk production (+11.5 g/d; $Prob_R = 0.83$) were higher in collective pens than in individual modules, and kit weaning weight was slightly lower (−20.4 g; $Prob_R = 0.55$). Feed intake and kit weight at weaning were lower in the fixed than in the random lactation group ($Prob_R = 0.61 - 0.89$). Aggression was lower at −8 d than at +2 d (−39.1 events; $Prob_R = 0.98$), higher at +2 d than at +18 d (+50.2 events; $Prob_R = 1.00$), and higher in pens with plastic mats than with plastic slats (average across all observation days, −14.7 events; $Prob_R = 0.69$). Injury rate was higher at 3 d (34%) and 10 d (47%) after does regrouped from an isolation period, compared with later time points ($P < 0.05$). In conclusion, aggression was high in collective pens during the short period around kindling, but doe and kit performance were not substantially affected compared with individual housing. Plastic-slatted floors reduced aggression more than plastic mats, without affecting performance. Finally, lactation method had no relevant effect. Thus, random lactation in part-time collective systems may be transferred to commercial farms without negative outcomes.

1. Introduction

The replacement of individual cages with collective pens for housing meat rabbits has been recently proposed to improve animal welfare under commercial production systems (European Parliament, 2017). Some European countries like Belgium, Germany, and The Netherlands have already begun to implement a gradual transition from single to collective systems in rabbit farms (Hoy, 2012; Maertens, 2013; Service Public Federal Sante Publique, Securite de la Chaine Alimentaire et Environnement, 2014). Nevertheless, the technical conditions of group housing are not yet sufficiently standardized for the fattening or reproduction sectors, hindering a rapid and widespread switch from existing systems in meat rabbit-producing countries.

In the reproduction sector, group housing in pens provides does with more space for movement than individual housing in standard cages. Moreover, does can express a wider behavioural repertoire (locomotion and social interactions), thus reducing stereotypical behaviours (Chu et al., 2004; Mugnai et al., 2009). However, continuous group housing during the reproductive cycle decreases production performance and increases aggression frequency, resulting in severe wounds that may elevate culling rates (Mirabito et al., 2005; Rommers et al., 2006; Szendrő et al., 2013, 2016a;). Does can also attack kits of

* Corresponding author.
E-mail address: angela.trocino@unipd.it (A. Trocino).

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other does, causing high mortality or low weight in juveniles (Ruis, 2006; Mugnai et al., 2009; Szendrő and McNitt, 2012).

Part-time collective systems (also known as semi-group systems) have been proposed to solve these problems (Hoy and Matics, 2016). This method involves keeping does in individual modules around kindling and during early lactation, then connecting adjacent modules together (through removing walls or opening holes) during the remaining periods, forming collective pens. Initial results have shown that part-time collective housing may improve reproductive performance compared with continuous collective systems (Szendrő et al., 2016b). Currently, only a few comparisons are available between part-time collective systems and individual housing (Machado et al., 2016; Maertens and Buijs, 2016a).

Nevertheless, aggressiveness remains present in part-time systems, especially after rabbits are returned to collective housing after being isolated (regrouping) (Andrist et al., 2013; Rommers et al., 2014; Buijs et al., 2015; Maertens and Buijs, 2016b). Reduced group size (Buijs et al., 2016; Zomeño et al., 2017) and stable group composition (Andrist et al., 2012) are known to decrease post-regrouping aggression. Moreover, doe physiological state and doe-kit interactions influence the behaviour of other does in a group; thus, the timing of regrouping affects aggression likelihood (Zomeño et al., 2017). Intense competition for lactation and for nests in a collective system is likely a key factor in aggression risk; indeed, agonistic encounters decrease with pre-kindling training to use a specific nest (Mugnai et al., 2009). Nevertheless and differently from the current system, lactation management in collective systems would also imply that every doe would nurse a random litter of the group in a random nest rather than its own litter in its own nest. In fact, rabbit does in individual cages did not show selective nursing when given kits from other does in the nest (González-Mariscal and Gallegos, 2007). However, they exhibited higher latency time to enter an alien nest (from another female, containing synthetic or male hair, or even containing some of its own original nest material) compared to their own nest.

Pen design elements may play a large role in mitigating or encouraging aggression. For example, aggressive behaviour may change in response to the number of open doorways between modules (one or two) (Zomeño et al., 2017) and to the presence of hiding places (e.g. platforms, PVC pipes); the latter slightly decreases the percentage of injured does (Rommers et al., 2014). Likewise, flooring type affects rabbit condition and behaviour. Juveniles exhibit more fearful behaviours when kept on an uncomfortable floor (straw-bedded wire floor) (Trocino et al., 2008), and reproducing does experience frequent footpad injuries on the wire-net floor of commercial cages (Rosell and de la Fuente, 2009). Accordingly, collective pens primarily use plastic flooring or wire nets covered with perforated plastic mats in response to juvenile preferences (Szendrő and Dalle Zotte, 2011) and a lower rate of footpad injury in reproducing does (Buijs et al., 2014; Rosell and de la Fuente, 2009). However, plastic mats do not fully cover the wire net and may make the cage flooring less stable. Lastly, we still know little about the effect of floor type on doe behaviour.

The present work aimed at evaluating how housing system (individual vs. part-time collective), floor type (plastic-slatted vs. wire-net floor with plastic mats) and lactation management (fixed: doe nurses its own litter vs. random: doe nurses a random litter of the group) influence doe and kit performance. We also assessed variation in general behaviour, aggressive interactions, and injury rates of group-housed does during the reproductive cycle, according to floor type and lactation. We hypothesized that *i*) doe/kit performance would decrease in group housing than in individual housing, *ii*) plastic-slatted flooring would influence doe/kit performance and behaviour through improving comfort, *iii*) fixed lactation would reduce doe agonism through minimizing competition for nursing and nests, and *iv*) aggressive encounters between does would decrease over time after grouping.

2. Materials and methods

The study was approved by the Ethic Committee for Animal Experimentation of the University of Padova (Italy). All animals were handled according to the principles stated in EC Directive 2010/63/EU regarding the protection of animals used for experimental and other scientific purposes.

2.1. Experimental facilities, animal management, and experimental groups

The study was performed at the experimental farm of the University of Padova (Italy) during September and October 2015. Artificial heating and controlled ventilation were used to maintain environmental temperature (18–26 °C) and relative humidity (45–60%) within comfortable ranges.

On day 22 of pregnancy, 40 crossbred multiparous rabbit does (Hyplus, Hypharm, Groupe Grimaud, Roussay, France) from a commercial farm were moved to the experimental farm. The rabbits had originally been housed in standard individual cages for does and their litters (95 cm length × 38 cm width × 35 cm height). The trial began when the does arrived (8 d before kindling) and lasted until kits were weaned (33 d after kindling).

At the experimental farm, the does were individually identified by ear mark and housed in 40 individual open-top modules (0.5 m^2; 78 cm length × 64 cm width × 110 cm height) equipped with manual feeders, automatic nipple drinkers, and removable nest boxes (40 cm length × 22 cm width × 30 cm height) (Fig. 1). Adjacent modules were connected via a doorway (20 cm width × 30 cm height) in the wire-net walls that could be opened to form collective pens (Fig. 1).

The following experimental groups were formed, controlling for parity and doe weight: *i*) individual plastic-floor pens (4 does in 4 individual pens), *ii*) individual wire-floor pens with plastic mats (4 does in 4 individual pens), *iii*) collective plastic-floor pens with fixed lactation (8 does in 2 collective pens), *iv*) collective plastic-floor pens with random lactation (8 does in 2 collective pens), *v*) collective wire-floor pens with plastic mats and fixed lactation (8 does in 2 collective pens), and *vi*) collective wire-floor pens with plastic mats and random lactation (8 does in 2 collective pens).

Thus, subjects were split into two experimental groups based on housing system: 8 individual pens with one doe and 8 collective pens containing four connected modules with four does. Litters were

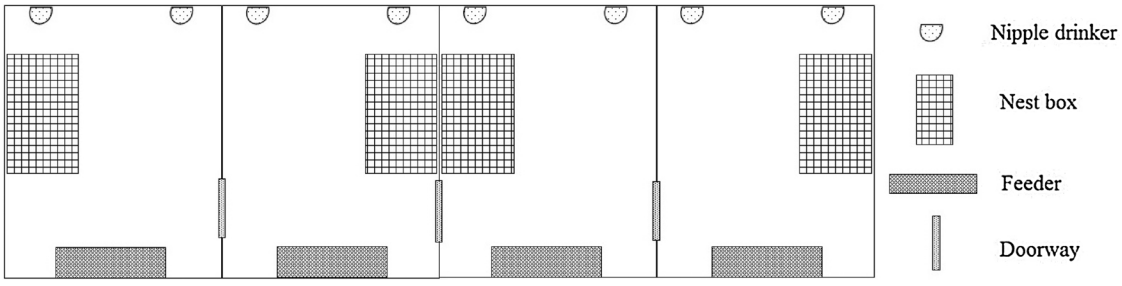

Fig. 1. Schematic top view of part-time collective pens.