



# Aggressiveness in group-housed rabbit does: Influence of group size and pen characteristics

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## ABSTRACT

The aim of this work was to study how the group size and the number of doorways in a pen may influence the aggressive interactions throughout the reproductive cycle among does kept in a part-time group housing system. Thirty-two crossbred multiparous pregnant rabbit does were housed in individual modules (0.5 m<sup>2</sup>) that were connected to form collective pens with two (P2) or four (P4) does (8 and 4 replications, respectively) by using one (D1) or two (D2) doorways. The females were maintained in stable groups from the start of the trial, 8 d before kindling (−8 d), until 2 d before kindling and from 18 d after kindling (+18 d) until weaning (31 d). The aggressive interactions were video recorded through 24 consecutive hours at −8 d and +18 d and at 21 d and 30 d after kindling. Aggressive behaviour at 21 d and 30 d after kindling was not analysed due to its scarce (total interactions per doe in 24 h: 0.02 events) and null occurrences, respectively. Then, data of the first hour after grouping at −8 d and +18 d were analysed by Bayesian inference, and the posterior distributions of the differences between group size, number of doorways and observation day were estimated. Does in P4 pens showed a higher frequency of boxing (1.63 vs. 0.50 events per doe) and chasing (1.00 vs. 0.28) than those in P2 pens (probability of relevance, Prob<sub>R</sub> = 0.87). Does in D2 pens showed a higher frequency of attacking (2.00 vs. 0.46 events per doe), chasing (0.83 vs. 0.21), and mount attempts (0.38 vs. 0.08) than those in D1 pens (Prob<sub>R</sub> 0.80–0.83). Aggressive interactions were higher at the first group formation (−8 d) than at regrouping (at +18 d) (10.5 vs. 6.25 events per doe; Prob<sub>R</sub> = 0.69). In conclusion, aggression among does was affected by group size and pen characteristics and decreased throughout the reproductive cycle. Nevertheless, studies of more reproductive cycles and collective pens will be necessary to confirm the present results.

## 1. Introduction

Group housing in commercial rabbit production would satisfy the social nature of rabbits and make it possible for them to establish social contacts and interactions (Trocino and Xiccato, 2006). However, in the case of reproducing does, group housing implies major changes in management and farm facilities and is associated with specific welfare concerns. Aggressiveness is the major problem (Hoy and Verga, 2006); fights among reproducing does occur mostly in the first days after grouping the animals, when the social hierarchy has not yet been established (Rommers et al., 2011) and when the does are not familiar with each other (Andrist et al., 2012). These fights lead to severe injuries; in their epidemiological study, Andrist et al. (2013) found lesions in approximately 33% of controlled does. Accordingly, doe reproductive performance and productivity are impaired, as reviewed by Szendrő and McNitt (2012) and Hoy and Matics (2016). Moreover,

group housing of reproducing does is associated with high mortality and/or low weights of young rabbits since does enter the nest boxes of other does and bite and injure the kits (Ruis, 2006; Mugnai et al., 2009; Szendrő and McNitt, 2012).

Despite the problems caused by aggression and decreased productivity, public opinion is demanding more animal-friendly rearing systems, and the European Parliament is pushing to ban individual cages (European Parliament, 2017). Accordingly, alternative ways to tackle the main disadvantages of group housing have been subjects of study during the past decade. Rommers et al. (2014) found that providing hiding places such as platforms or PVC pipes slightly decreased the percentage of injuries. Andrist et al. (2014) sprayed the does with different odours (alcohol or vinegar) before regrouping but without any reduction effects on aggressive interactions and injuries. Graf et al. (2011) tested different regrouping methods: in the same home pen or in a novel disinfected pen, they observed no effect on the

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number and duration of aggressive interactions, and they observed only a small reduction of stress and severe injuries when regrouping in the home pen. Thus, the injuries caused by aggression among does remained an unsolved problem, as reviewed by Szendrő et al. (2016).

Group housing systems with four or eight does have been tested (Andrist et al., 2014; Rommers et al., 2014; Szendrő et al., 2013), but less information is available on pair-housing (Ruis, 2006). To our knowledge, only Buijs et al. (2016) evaluated the effect of group size on the post-grouping behaviour of rabbit does and found a higher frequency of aggressive behaviour when the group size increased from four to eight does.

The present work aimed at studying how group size and the number of doorways in a collective pen may influence the aggressive interactions throughout the reproductive cycle in does kept in a part-time group housing system with an isolation phase from 2 d before until 18 d after kindling. We hypothesized that i) housing pairs of does within a collective pen would limit the aggressiveness among the does; ii) using two doorways within adjacent modules would provide the attacked does with more escape routes and thus attenuate aggressive behaviour; and iii) the occurrence of aggressive interactions among the does would decrease over time.

## 2. Materials and methods

The study was approved by the Ethics 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. Animals and housing

The experiment was performed at the experimental farm of the University of Padova (Italy) in October and November. Artificial heating and controlled ventilation were used to control the environmental temperature and relative humidity, which ranged from 20 °C to 24 °C and from 53% to 63%, respectively.

At the 22nd d of pregnancy, 32 crossbred multiparous rabbit does were moved from a commercial farm to the experimental farm. At the commercial farm, the rabbit does were individually housed in standard cages for reproducing does and litters (95 cm length × 38 cm width × 35 cm height). The trial started the day after the arrival of the does (8 d before kindling) and lasted until the weaning of the kits (31 d after kindling). The groups were balanced based on the doe weight and parity number. The does were housed in 32 individual open-top modules (0.5 m<sup>2</sup>; 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) with one doorway. Two or four adjacent modules could be connected by opening doorways (20 cm width × 30 cm height) in the wire-net walls to form double or quadruple pens. Accordingly, two experimental treatments were constituted: double pens (P2), two connected modules with two does and their respective litters (when present) (8 replications), and quadruple pens (P4), four connected modules with four does and their respective litters (when present) (4 replications) (Fig. 1). Furthermore, the individual adjacent modules were connected by using one doorway (D1) (6 replications; 4 P2 and 2 P4) or two doorways (D2) (6 replications; 4 P2 and 2 P4). The doorways between the modules were opened from 1 d after arrival (at the 23rd d of pregnancy) to 2 d before kindling (the first grouping period). Thereafter, the doorways were closed and the does were housed individually until 18 d after kindling (18th d of lactation). On that day, the doorways were opened again (the second grouping period) and remained open until the weaning of the kits. The same groupings of the does were maintained during the two periods.

As usual in commercial farms, controlled lactation was used during

the first 18 d after kindling. The nest doorway was opened only once a day to permit the doe to enter the nest and nurse its litter. Once nursing was finished (10–15 min), the doe left the nest and the doorway was closed. At the 18th d of lactation, after nursing, the nest doorways were opened, the kits were free to leave the nests, and the does were free to enter the nests. The nest boxes were removed from the pens at 22 d after kindling.

A lactation diet (17.1% crude protein, 4.3% ether extract, 31.1% NDF, 16.5% ADF, 4.4% ADL, as-fed basis) until the 21st d of lactation and a weaning diet (15.3% crude protein, 3.3% ether extract, 35.0% NDF, 19.8% ADF, 5.1% ADL, as-fed basis) from the 21st d of lactation to the end of the trial were given *ad libitum*. The diets were formulated to meet the needs of the lactating does and postweaning rabbits (de Blas and Mateos, 2010).

### 2.2. Behavioural observation

All pens were submitted to video recording with colour infrared cameras (Atlantis, Hellatron S.p.A., Milano, Italy) for 24 consecutive hours at four moments: 8 d before kindling (–8 d), immediately after the first group formation; 18 d after kindling (18th d of lactation), immediately after the group reconstitution (+18 d); and 21 d and 30 d after kindling (21st and 30th d of lactation) (+21 d and +30 d).

Aggressive interactions were classified according to Andrist et al. (2012) as biting (gripping with the teeth); boxing (hitting with the front paws); chasing (aggressive following of another individual for at least three jumps); ripping (two does kicking each other with the hind legs); carousel-fights (rapid chasing around and around in one spot with the rear end of the opponent gripped between the teeth); threatening (quick head movement towards another doe); and attacking (abruptly running towards a group mate). Mount attempts were also recorded as an aggressive interaction, since does use them to establish the dominant position (Mugnai et al., 2009). The frequency (n) of each interaction and the duration (sec) of chasing, ripping, carousel-fights and mount attempts were measured for each doe within a pen in time windows of 15 min. During the first hour after grouping, the behaviours were evaluated in four 15-min time windows at 09:30, 09:45, 10:00, and 10:15 (observation time: 60 min); then, for the following 23 h, the behaviours were measured for 15 min each hour (total observation time in 23 h: 345 min; total observation time in 24 h: 405 min).

At +18 d and +21 d, the number and the duration of nest visits (does with the entire body inside the nest box) were monitored during the whole 24 h. Aggression of does towards kits was monitored at +18 d and +21 d, but no aggressive interaction was observed.

The does and kits were individually inspected for skin injuries attributed to aggression at the end of the trial (31 d after kindling). The animals were taken out of the pen for a visual inspection (head, back, ano-genital region, legs and paws), and then a gentle palpation was performed on the body to detect the presence of fresh and healed injuries (scratches and wounds).

### 2.3. Statistical analysis

The aggressive interactions registered at +21 d and +30 d were not considered in the statistical analysis because of their scarce and null frequency, respectively.

The frequency of behaviours registered per pen in 24 h was analysed separately for –8 d and +18 d. The PROC GLIMMIX of the SAS software (version 9.4, SAS Institute, Cary, USA) was used to estimate the least square means of each behaviour at each observation time window (09:30, 09:45, 10:00, 10:15, 10:30, 11:30, 12:30, 13:30, 14:30, 15:30, 16:30, 17:30, 18:30, 19:30, 20:30, 21:30, 22:30, 23:30, 00:30, 01:30, 02:30, 03:30, 04:30, 05:30, 06:30, 07:30, 08:30), using a mixed model with group size, number of doorways in the walls and observation time window as fixed effects and pen as a random effect. A Poisson distribution was assumed for all data.

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