

THESIS OF DOCTORAL (PhD) DISSERTATION

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PERFORMANCE AND BEHAVIOUR OF RABBIT
DOES IN VARIOUS HOUSING CONDITIONS

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1. ANTECEDENTS OF THE RESEARCH, OBJECTIVES

In recent decades rabbits have been kept mainly in intensive husbandry systems in wire-mesh cages. There is a growing interest worldwide about the animal welfare and well-being of farmed animals. Cage housing of rabbits is considered as not enough animal friendly system. New proposals are regularly announced by animal protection groups concerning housing of rabbits which are based on human way of thinking and emotions; and they are not based on the real needs of the animals and show lack of professional and practical experiences.

A special aim is to elaborate group housing of does, which provides near-to-nature environmental conditions for domestic rabbits. Another, newly developed system is semi-group housing of does which means that a pen system is used where the does are alternately housed during some weeks individually and some weeks in a group. Occasionally enlarged single cages are used which have to be equipped with foot rest and can be enriched with an elevated platform, hay rack or other environmental enrichment (e.g. wooden sticks).

It is clear that current housing of rabbits requires putting emphasis on the aspect of animal welfare but it is also important not to ignore the scientific results and aspects of hygiene, health and economy.

Before proposing a new housing system development and testing of new housing conditions for does with kits and for growing rabbits has

an important role to take the specific needs of animals and all other possible aspects into account.

Aims

The general aim of this research was to examine the production and behaviour of rabbit does under different housing conditions to expand the range of knowledge useful for farmers. Moreover, I would like to contribute to the development of well-founded recommendations for housing of rabbits.

The goals are written more detailed at the parts of different experiments.

2. RESULTS AND CONCLUSIONS

All experiments were published in peer reviewed scientific journals, therefore the aims, material and methods, results and conclusions of the experiments are summarised based on three papers.

Paper 1

Comparison of performance and welfare of single-caged and group-housed rabbit does

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Comparison of performance and welfare of single-caged and group-housed rabbit does

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Aim - The objective of this study was to compare the generally used individual-housing system (single-caged) with the group-housing system of rabbit does recommended by an animal protection group.

Material and Methods – From 10 weeks of age, female rabbits were housed individually and at the age of 17 weeks they were randomly allocated to three treatments. In two treatments (S-33 and S-42), does

were housed individually in wire mesh cages. The individually housed rabbits were inseminated artificially (AI). The litters were equalized only within treatments. In case of individual housing, does that died or were culled during the experiment were not replaced. The characteristics of the three experimental treatments were as follows:

Treatment S-33 (n = 18): a reproduction rhythm of 33 days was used; does were inseminated 2 days after kindling, applying a single-batch system. The does could freely nurse, and the kits were weaned at 28 days of age.

Treatment S-42 (n = 16): a reproduction rhythm of 42 days was used. Does were inseminated 11 days after kindling, applying a single-batch system. The does could freely nurse. However, for 3 days before AI, as biostimulation method, does were allowed to nurse their kits only once a day (in the morning). Kits were weaned at 35 days of age.

Treatment G (n = 16): does were housed according to the recommendation of an animal protection group (Vier Pforten). Four does and one buck were placed in each of the four pens, with a basic area of 7.7m². Within the pen, one part of the basic area (2.8 x 1.5 m) was covered with straw (replaced as needed), whereas the floor of the other part (2.8 x 1.25 m) was made of plastic mesh. Every pen was equipped with a 40-cm-wide feeder, five nipple drinkers, a hay rack, four wooden nest boxes and a plank tube for hiding. The does could build their own nests. (Before the first kindling, straw was placed in the nest boxes; this material was removed by the does and they collected the nest material in the pen). Kits were weaned at 28 days. In group housing, to maintain the group size, does that had died or were culled were replaced on a single occasion (126 days after the start of

the study) with females of similar age (production of these does were not evaluated). The duration of the experiment was 193 days. Throughout the experiment, the does of the G and S-33 treatments had possibility for five kindlings, whereas S-42 does had maximum four kindlings.

At 145 days after the start of the experiment, faecal samples were collected to determine corticosterone metabolite concentrations. Individual samples were easily collected from single-caged (S) does, whereas from G treatment mix faeces, as pooled samples, were collected.

Results – For the whole period (193 days), G does had lower ($P < 0.05$) kindling rate than that of S-33 and S-42 treatments (Table 1). Twenty-three and 25% of does that survived until the end of the experiment in the S-33 and S-42 treatments, respectively, kindled at every occasion (5 times and 4 times, respectively), although none of the G does had similar performance. None of the does in the S-33 or S-42 treatments kindled only once or twice during the experiment, whereas that occurred in 41.7% in the G treatment. Litter size was not significantly different among treatments (Table 1). Suckling mortality was more than twofold in the G treatment compared with the S-33 or S-42 treatments ($P < 0.001$; Table 1). The frequency of multiple kindling in the same nest box was 7.7% for the does housed in groups. For example, on one occasion, a doe gave birth to 10 well-developed kits. Four days later, another doe kindled 15 kits in the same nest box. Until 20 days of age, 80% of the kits born into this nest box had been died. In addition, two does kindled in deep litter, and all kits died

within 1 or 2 days. In the G treatment, 49 young rabbits (<14 days old) were found outside the nest box, either on the plastic slats or in deep litter. Many of these kits had injuries attributed to biting or chewing, some of which may have incurred when kits were removed from the nest box. At the end of the experiment, the survival rates of the S-33, S-42 and G does were 71%, 81% and 50%, respectively (P=0.084). Most of the G does that died were emaciated.

Table 1 The effect of housing system on reproductive traits and stress hormone level

Traits	S-33	S-42	G	S.E	P-values
Kindling rate, %	77.6 ^b	85.2 ^b	45.6 ^a		<0.05
Litter size, total	9.10	9.44	9.88	0.26	0.534
Litter size, alive	8.77	8.58	9.64	0.25	0.246
Suckling mortality, %	10.4 ^a	15.2 ^a	38.5 ^b		<0.001
Survival of does, %	71	81	40		0.084
Faecal corticosterone concentration, nmol/g	61.0 ^a	53.6 ^a	174.6 ^b	10,2	<0.001

^{a,b}: different superscripts show significant differences between means (P<0.05)

The ‘kit index’ (kindling rate times number of total born kits) led to large differences between treatments, calculating the number of total born kits per 100 inseminated does at 706, 804 and 451 in S-33, S-42 and G treatments, respectively. During the entire experiment (193 days), the number of weaned rabbits per doe calculated on the basis of the number of reproductive cycles (five or four in treatments G and S-33 vs. S-42, respectively), kindling rate, litter size (number of kits

born alive) and suckling mortality in the S-33, S-42 and G treatments were 29.3, 24.9 and 13.6, respectively. Faecal corticosterone metabolite concentration of does housed in groups was approximately 3 times higher than for does caged individually ($P < 0.001$; Table 1).

Conclusions - In conclusion, the production of G rabbit does was substantially lower than that of the S does. From the aspect of animal welfare, group housing of rabbit does had several disadvantages: stress related to aggressive behaviour, frequent and harmful injuries, high suckling mortality and short lifespan. Therefore, there was no advantage of the group housing management.

Paper 2

Location preference of rabbit does between common sized and double sized cages

LOCATION PREFERENCE OF RABBIT DOES BETWEEN COMMON SIZED AND DOUBLE SIZED CAGES

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Aim – The aim of the experiment was to observe the location preference of non-pregnant, pregnant and lactating rabbit does between cages of different size.

Material and Methods – Each cage-block consisted of two wire-net cages. The length, width and height of the smaller cage were 57.5, 38 and 30 cm, respectively. The basic area of the large cage was twice as large (57.5 × 76 × 30 cm) than that of the small cage. At the beginning of the experiment half of the does were put into the small and the other half into the large cage. The does could move freely between the two cages through a swing door. Using infrared cameras, 24-hour recordings were performed. A total of 44 non-pregnant and 19 pregnant and lactating multiparous does were observed. After one-day adaptation period, the preference of non-pregnant does was recorded for 5 days. The pregnant and lactating does were placed to the cages 7 days prior to the expected kindling date. The nest boxes were opened 3 days prior to the estimated kindling. The location preferences of the

pregnant and lactating does were continuously monitored until the kits reached the age of 3 weeks. By analysing the video recordings, the actual location of the does was registered at each half hour (48 times a day).

Results - The average time spending of non-pregnant rabbit does was 35% and 65% in small and large cages, respectively. Cage preference seemed to be proportional to the cage sizes (1/3 and 2/3), thus cage choice may be considered as random. The cage choice of rabbit does differed the most from the expected frequencies during the 05:00–11:00 period. During the resting period (11:00–17:00) and between 17:00 and 23:00 their location preferences were more balanced than at the other parts of the day.

The pregnant and lactating rabbit does spent most of their time (73.1%) in the large cage ($P < 0.001$). Difference between cage preferences was larger 1-4 days prior to kindling than immediately after parturition or on day 12–14 of lactation (Figure 1). Location preference was affected by the cage where the kindling took place. When parturition took place in the nest box of the small or in the large cage, the cage preferences were 23 and 77%, and 29.2 and 70.8%, respectively. Thus, the location preference of rabbit does was significantly different ($P < 0.001$) from the expected frequencies (33.3% and 66.6%). During the later stage of lactation the lactating does preferred to stay more frequently in the cage without nest box. When the kits activity was increasing (leaving the nest box first), the does tried to avoid the contact with them.

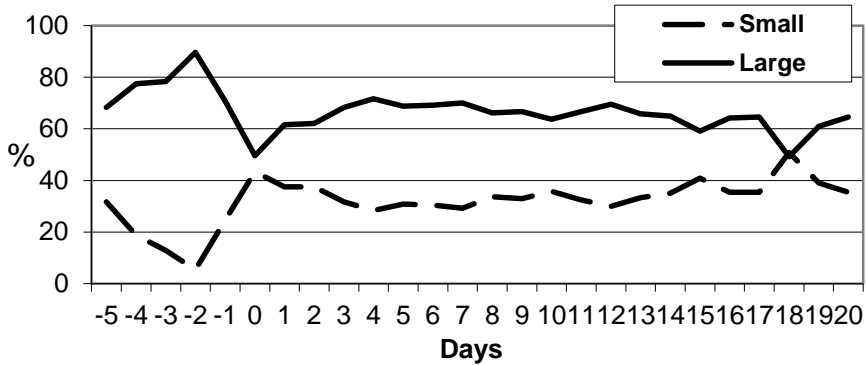


Figure 1. Location preference of does between small and large cages
(0 = day of parturition)

Conclusions - The cage preference of non-pregnant rabbit does was proportional to the basic area of the two cages. Although, parturition and lactation influenced the does' location preference, the cage of kindling had the largest effect on the cage choice. In this case the cage preference was different from the expected frequencies and the does preferred to stay more frequently in the other cage than that of the place of kindling. The location preference showed large individual variation, that requires further analysis.

Paper 3

Performance and welfare of rabbit does in various caging systems

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Performance and welfare of rabbit does in various caging systems

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Aim - The aim of the experiment was to compare four commercial cages: conventional cages with footrests; conventional cages without footrests; alternative (large) cages equipped with wire-mesh platforms and footrests; and alternative (large) cages with plastic-mesh platforms and without footrests. In addition to reproductive performance, nursing behaviour, the occurrence of sore hocks and, in cages with platforms, the location preference of rabbit does and platform utilization of the kits were also monitored.

Material and Methods – Crossbred rabbit does (n = 108) were used in this experiment. They were randomly allocated to four groups with the following cage types:

CN: conventional wire-mesh flat-deck cage (86 × 38 × 30 cm, including the 25 × 38 cm floor sized nest box, total surface for the does and their kits: 0.33 m²; wire diameter of the cage floor was 2 mm

and the hole size of wires was 48×10.5 mm), without footrest ($n = 30$);

CF: similar as CN cage, with plastic footrest (40×25 cm, width of the plastic-mesh: 17 mm; hole size: 64×12 mm; $n = 30$);

ECWP: enlarged cage ($102.5 \times 38 \times 61$ cm, including the 25×38 cm floor sized nest box) with wire-mesh platform, the cage floor was wire-mesh (wire diameter 2.5 mm, hole size of wires: 60×12.5 mm), the platform (28.5×38 cm) was fixed 26.5 cm above the cage floor, a plastic footrest (40×25 cm, width of the plastic-mesh: 17 mm, hole size: 64×12 mm) was placed on the bottom level, 2/3 part of the footrest was below the platform; the total surface (floor and platform) for the does and their kits was 0.50 m^2 ($n = 24$);

ECPP: extra enlarged cage ($102.5 \times 52.5 \times 97$ cm, including the 21.5×52.5 cm floor sized nest box) with plastic mesh platform, the cage floor was wire-mesh (wire diameter: 3 mm, hole size of wires: 73×12 mm), the platform (41.5×52.5 cm) was fixed 25 cm above the cage floor; the total surface (floor and platform) for the does and their kits was 0.76 m^2 (width of the plastic-mesh: 16 mm; hole size: 60×13 mm) ($n = 24$).

Does were first inseminated at 16.5 weeks of age, and they were inseminated on 11 days after kindling (42 days reproductive rhythm, single-batch system). Litter size of the first and subsequent parities was standardized to 8 and 10 kits, respectively. Rabbits were weaned at 35 days of age. Reproductive performance of five consecutive inseminations was evaluated.

Results - Kindling rate, litter size (born total, born alive and stillborn, at 21 and 35 days), and kit mortality were not significantly influenced by the cage types. There were no significant differences between the two conventional cages (CN and CF), and between the two enlarged cages with platforms (ECWP and ECPP) in litter and individual weight at 21 and 35 days; however, comparing the conventional cages (CN and CF) with enlarged cages (ECWP and ECPP), these characteristics were higher in the enlarged cages ($P < 0.001$ and $P < 0.01$).

The severity of shore hocks increased significantly with advancing insemination order. The most favourable cage type was the enlarged cage with plastic-mesh platform followed by enlarged cage with wire-mesh platform and footrest on the bottom level; however, even flat-deck cage with footrest was much better for the rabbits than the CN cages.

The platform usage of does and their kits in the enlarged cages, between days 3 and 31 of lactation, are shown on Figure 2. In the ECPP cages, the percentage of observations that the does were observed on the platform ranged between 55.9% and 64.4% during the first 17 days of lactation. However, once the kits left the nest boxes, utilization of the platform by does increased substantially and reached a peak on day 21 (67.1%). Thereafter, the increased use of platform by the kits was associated with decreased usage of platform by the does. Lesser use of the platform by the does (25% to 38%) occurred in the ECWP group compared with the ECPP group between kindling and weaning, but the changes in platform usage were similar in both cage

types. When the kits left the nest boxes, the does used the platform more often, and then after day 21, when the kits started to visit the platform, the platform usage by the does decreased. The kits started to visit the platform at the age of 17 days, and the platform usage of the kits increased until weaning. The use of the wire-mesh platform by kits was lower than that of the plastic platform ($P < 0.001$).

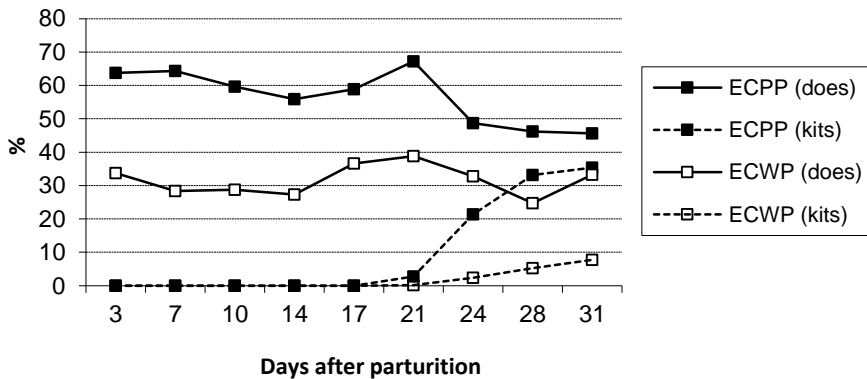


Figure 2: Platform usage of does and their kits in different types of platform cages.

(ECWP = wire-mesh platform, ECPP = plastic-mesh platform. The presence of rabbit does on the platform is expressed as the percentage of observations. The presence of kits on the platform is expressed as the percentage of number of kits in the cage. The platform usage of the does during the whole observed period and the platform usage of their kits after day 21 of lactation differed significantly ($P < 0.05$) in the groups ECPP and ECWP.)

Conclusions - plastic-mesh platforms or footrests have the potential to improve doe's welfare because of the reduced incidence of sore hocks. Housing rabbit does in enlarged cages with platform is advantageous

because kit weaning weight increased, but the number of rabbits per rabbit house is reduced, and thus production costs are also higher.

3. NEW SCIENTIFIC RESULTS

1. It was stated, that the continuously group housed rabbit does have substantially lower production and higher stress level than that of the individually housed ones (kindling rate: 45.6% vs. 77.6-85.2%, $P < 0.05$; suckling mortality: 38.5% vs. 14.0-15.2%, $P < 0.001$; faecal corticosterone metabolite concentration: 175 nmol/g vs. 54-61 nmol/g; $P < 0.001$; in group housed and individually housed rabbit does in 33 d and 42 d reproduction rhythm, respectively), therefore the group housing of does is contrary to animal welfare.

2. It was stated, that in case of free choice between two different sized cages, rabbit does stayed with increasing frequency in cage farther from the nest during the 3rd week of lactation, independently of the cage size.

3. It was stated, that rabbit does spent more time on elevated platform made of plastic mesh than that of wire mesh (56.9 % vs. 31.7%, respectively; $P < 0.001$). However, does can not escape from the suckling attempts of the kits, because the platforms were also used by kits after 17 days of age. When kits are able to jump up the platform does stay less frequent on it.

4. It was stated, that individual weight of kits at 21 days of age was significantly higher in does housed in enlarged cages with elevated platform compared to flat-deck housing (401-402 g vs. 372-382 g, respectively; $P < 0.001$) which is related to the better milk supply of kits.

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