

EFFECT OF GROUP SIZE ON PERFORMANCE, BONE STRENGTH AND SKIN LESIONS OF MEAT RABBITS HOUSED UNDER COMMERCIAL CONDITIONS

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ABSTRACT : Research was conducted to investigate the effect of group size (6, 12, 18, 30, 42 and 54 animals) on performance, bone strength and skin lesions of meat rabbits housed in cages at a density of 17 animals/m². The research was performed in three succeeding experiments (A, B and C) from March 1995 until July 1996 in a compartment with 16 cages. Weaned rabbits of 31 days of age were placed. Body weight, feed intake and mortality were recorded until 73 days of age. At start and the end of each trial the animals were weighed individually to determine uniformity per cage. In the second and third experiment the trial period was prolonged until 80 days of age to investigate the effect of group size on aggressiveness by scoring skin injuries. At the end of the second and third experiment bone strength was determined. No influence of group size on growth, feed intake and mortality was observed. At 73 days the animals had gained an average live weight of 2462 g at a daily growth of 40.5 g and a daily feed intake

of 122.7 g. There was a tendency ($p < 0.1$) for a better feed efficiency of 6 animals/cage (3.02) compared to 12, 30 and 54 animals/cage (resp. 3.11, 3.07 and 3.12). No effect of group size on uniformity and bone strength was found. The percentage of injured animals was not related with group size, but the severity of the injuries increased with age. At 73 days of age 5.7%, 16.4% and 12.6% of the total number of animals in experiment A, B and C had skin injuries, with more than 80% of the injuries located at head and ears. At 80 days of age 42.5% and 20.1% of the total number of animals in resp. experiment B and C were scored with injuries, 50% of which were observed at the genitals. The results of this research show that at a density of 17 animals/m² floor, space use efficiency can be improved by increasing group size, without altering performances. Our findings support the recommendation to finish the fattening period before 80 days of age.

RESUME : Effet du nombre d'individus par cage sur les performances, la solidité des os et les lésions cutanées de lapins produits dans un élevage de type commercial.

Cette étude tend à montrer l'effet de la taille du groupe (6, 12, 18, 30, 42 et 54 animaux) sur les performances, la solidité des os et les lésions cutanées de lapins en engraissement logés en cage à la densité de 17 animaux/m². Trois répétitions successives de cette expérimentation (A, B, C) se sont succédées de mars 1995 à juillet 1996 dans un espace contenant 16 cages où ont été placés les lapins sevrés âgés de 31 jours. Le poids vif, la consommation et la mortalité ont été enregistrés jusqu'à 73 jours d'âge. Au début et à la fin de chaque expérimentation les lapins ont été pesés individuellement pour déterminer l'homogénéité par cage. Les secondes et troisièmes périodes expérimentales ont été prolongées jusqu'à 80 jours d'âge pour déterminer l'effet de la taille du groupe sur l'agressivité (évaluée par le dénombrement des lésions cutanées) et mesurer la solidité des os. La taille du groupe n'a pas eu d'influence sur la croissance, la

consommation ou la mortalité. A 73 jours les lapins ont atteint un poids vif moyen de 2462g pour une vitesse de croissance et une consommation journalières de 40,5g de 122,7g respectivement. L'indice de consommation du lot de 6 lapins / cage (3,02) est légèrement meilleur ($P < 0,1$) que celui des lots comptant 12, 30 ou 54 lapins / cage (3,11 ; 3,07 et 3,12 respectivement). La taille du groupe n'a pas d'effet sur l'homogénéité ni sur la résistance mécanique des os. Le pourcentage d'animaux blessés et la gravité des blessures augmentent avec l'âge. A 73 jours, 5,7 %, 16,4% et 12,6% des animaux des expérimentations A, B et C avaient des blessures cutanées, dont 80% se situaient sur la tête et les oreilles. A 80 jours 42,5% des animaux B et 20,1% des animaux C portaient des blessures dont 50% localisées sur les parties génitales. Les résultats de cette étude montrent qu'avec une densité de 17 animaux / m² de cage, il est possible d'accroître la taille des groupes sans diminution des performances. Enfin les résultats des auteurs indiquent qu'il convient d'arrêter l'engraissement des lapins avant l'âge de 80 jours.

INTRODUCTION

In the Netherlands meat rabbits are usually housed in groups in cages at a density of approximately 17-18 animals / m² cage surface (standard density). The number of animals per cage varies between 6-8 rabbits, depending on age. During the last weeks of the fattening period the number of animals is almost always reduced to 6 animals per cage.

From a management and welfare point of view it is preferable to house meat rabbits in larger groups. This implicates the use of cages with an increased surface area. The efficiency of the space in a rabbitry can be improved and the housing costs will be reduced. From a welfare point of view an increased cage surface will give the animals more room for locomotion behaviours as hopping and running. Disadvantages of increasing group size might be a an increased aggressiveness, an increased number of injuries and a decreased uniformity.

Several studies have been conducted on group size

and cage density. These studies focussed on either management or welfare. From a management point of view the effect of cage density on performance was studied (AUBRET and DUPERRAY, 1992; MAERTENS and DE GROOTE, 1984, MAERTENS, 1992). The number of animals per cage ranged from 3 to 10 animals using standard cages (maximum density: 28.2 animals / m²). The major conclusion of these studies was that performance is influenced by live weight/m². When live weight exceeded 40 kg/m² in cages with 0.26 m² surface area, growth decreased and aggressiveness occurred. Overcrowding was given as major explanation. When an increased surface area was used (0.35 m² / cage) the negative aspects were postponed until the live weight exceeded 50 kg/m². Other research focused on the development of alternative housing systems to enable the animals to perform their normal behaviour patterns. In these experiments larger group sizes (up to 64 animals) at low densities (5 animals/m²) were studied, using ground pens with litter or slatted floors (REITER and

DRESCHER, 1993; TAWFIK and SCHNEIDER, 1993). Although group size didn't influence growth, feed efficiency was increased compared to the cage system. Aggressiveness increased with age and it was recommended to finish the fattening period at 80 days of age. There is no information available about the effects of housing large groups of animals in cages under commercially used densities (17-18 animals / m²).

The objective of our research was to investigate the effect of group size of meat rabbits under commercial conditions (17 animals/m² surface area) on the performance, bone strength and aggressiveness. Three experiments were conducted. In the first experiment the effect on performance was investigated and behaviour was observed during a normal fattening period of 6 weeks, in which the animals reached a live weight of 2.5 kg (73 days of age). In the second and third experiments the fattening period was extended till 80 days of age (7 weeks after weaning) to investigate the effect of group size on aggressiveness.

MATERIAL AND METHODS

Animals and housing system

The first experiment (A) was performed from March until May 1995, the second experiment (B) from September until November 1995 and the third (C) from May until July 1996. All experiments were done in one compartment for 348 meat rabbits with 16 cages. The cages were placed in two rows.

The cages consisted of a synthetic floor (Vencomatic, Eersel, Holland) with walls and top of metal wire. The height of all cages was 30 cm. In all group sizes the density was 17 animals / m² cage surface.

The meat rabbits were bred at the Centre, using a strain of New Zealand White rabbits and weaned at 30 days. The animals were housed under controlled illumination (8L:16D). A minimum inside temperature of 16 °C was maintained. The animals were given feed and water *ad libitum*. A commercial feed for meat rabbits was used (9.8 MJ ME (Produktschap voor Veevoeder, 1990), 15-16% CP).

Group size

Six different group sizes were studied: 6 (control), 12, 18, 30, 42 and 54 animals/cage. The different group sizes were formed by enlarging the cage surface area, maintaining a density of 17 animals/m². There were 6 cages of 6 animals and 2 cages for each of the other group sizes. The number of cages used per experiment depended on the available amount of weaning rabbits. Table 1 gives the number of replicates per treatment in the three experiments.

The weaning rabbits from one litter were distributed over the different treatments. However, to be able to fill up the cages with the larger group sizes more animals of

Table 1 : Number of replicates per treatment used in the different experiments

Treatment (number of animals/cage)	6	12	18	30	42	54
experiment A	5	2	2	2	2	2
experiment B	6	2	2	2	1*	2
experiment C	6	2	2	2	2	2

* Due to an insufficient number of available weanlings, one cage was excluded.

the same litter had to be put into the same cage.

Measurements

1. Growth and feed intake were measured in all experiments from start to 73 days of age.
2. In all cages the animals were weighted individually at start and at 73 days of age.
3. At the end of experiment B and C from 24 animals per treatment (4 animals/cage for group size 6 and 12 animals per cage for the other group sizes) the tibia of the left hindleg was taken to determine bone strength. With an Instron Universal Machine in the tension mode a three point compression test was done. The third point was lowered with a speed of 50 mm/min onto the middle of the bone until it was broken. The breaking strength (in kg) was read as the peak of the curve produced by the connected printer.

Observations

1. In experiment A the behaviour of the animals was observed during the sixth and tenth week of age. The life observations were done from 8.00 until 10.00 hrs. In this period each cage was observed for 15 minutes. The following behaviours were scored every three minutes : resting (laying and sitting), comfort behaviour (grooming, licking, scratching directed to the body), eating and drinking and locomotion behaviour (hopping and running). It was registered if the animals were resting individually or huddled in groups.
2. The number of animals performing abnormal (digging, scratching and object licking) and/or aggressive behaviour was recorded continuously during the observation time.
3. The number of animals with skin injuries was determined at 73 days (trial A, B and C) and 80 days of age (trial B and C). According to KALLE (1994), it was registered which part(s) of the animal was injured (head or ears, body or limbs, tail, genitals or anus) and the seriousness of the injuries, according the following classification :
 - score 1 = superficial bites, area diameter < 1 cm.
 - score 2 = superficial bites, area diameter > 1 cm.
 - score 3 = severe bites giving open wounds.

Table 2: Effect of group size on rabbit performance at 73 days of age (means with standard errors within brackets)

	Group size					
	6	12	18	30	42	54
Weight at weaning (g)	790 (15)	796 (6)	776 (22)	750 (20)	775 (6)	773 (18)
Live weight at 73 days (g):	2489 (23)	2452 (28)	2477 (29)	2415 (48)	2434 (16)	2450 (40)
Daily live weight gain (g/day)	40.7 (0.4)	39.4 (0.7)	40.5 (0.5)	39.6 (0.8)	39.5 (0.3)	39.9 (0.6)
Feed intake (g/day)	122.9 (1.5)	122.6 (1.4)	124.1 (1.4)	121.6 (2.3)	120.0 (2.0)	124.3 (1.5)
Feed efficiency (feed(g)/gain(g))	3.02 ^A (0.02)	3.11 ^B (0.05)	3.07 ^{AB} (0.04)	3.07 ^B (0.03)	3.04 ^{AB} (0.05)	3.12 ^B (0.03)

Means in a row with a different letter give an indication for a difference ($p < 0.10$)

Statistical analyses

The growth performance, feed intake and feed efficiency were analysed using linear regression models, with trial and group size as explanatory variables and weight at weaning as covariable. Non-significant interaction terms were dropped from the models.

The within cage variance for live weight was taken as a measure for uniformity of animals per cage. At start and 73 days of age the sample variance of live weight percentage was calculated. To assess effects of group size on the within cage variance a weighed loglinear regression analyses was performed with trial and group size as explanatory variables and with weights $w_i = (n_i - 1)/2$, where n_i denotes the number of animals in the cage (McCULLAGH and NELDER, 1989).

Chi-square-test for the deviance ratio was used to assess group size effects. T-tests were used for testing pair wise differences between treatment means on the log-scale.

The average bone strength was analysed with ANOVA procedures, with trial and group size as explanatory variables.

Statistical analyses were performed using the GENSTAT program (GENSTAT 5, Committee, 1993).

RESULTS AND DISCUSSION

Growth performance, feed intake and feed efficiency

Table 2 gives the growth performance, the feed intake and the feed efficiency for the different group sizes. There was no interaction for trial and treatment; the average results of the three experiments are presented.

The three experiments were performed with intervals of approximately 6 months. Between the first and the last experiment the weight at weaning had been improved by almost 40 gram. A covariable was used to balance out the difference in the weight at weaning within the three experiments. At 73 days of age the animals had reached a live weight of almost 2.5 kg, which equalizes a density of 42.5 kg per m².

There was no effect of group size on growth and feed intake. These results are supported by the behavioural observations. In the larger cages there was more total surface area available for the animals for

locomotion. Increased locomotion will negatively affect feed intake and/or growth rate. However, at 6 and 10 weeks of age in all groups more than half of the animals were resting during the behavioural observations. Although more free floor space was available in the larger group size, because the animals were mostly huddled together in groups along the sides or somewhere in the middle of the cage, no increase in activity was observed compared to the standard. A tendency ($P < 0.1$) for decreasing feed efficiency with increasing group size was found. In the groups of 12, 30 and 54 animals per cage the feed to gain ratio was increased compared to 6 animals per cage. An explanation for this is not clear.

Mortality

The total mortality rate for the three experiments was respectively 3.6, 3.9 and 7.2%. No effect of group size on mortality was found but the number of animals used in the experiments was limited, which implicates that effects only can be found with large differences in mortality between group sizes. Most of the mortality was caused by diarrhea in the first two weeks after weaning. In the third experiment coccidiosis was determined in 6 animals (1.7%) in the larger group sizes (30, 42, 54). In all experiments straw was given on top of all cages for three successive days in the second week after weaning.

Uniformity

The effect of group size on the uniformity at 73 days of age is presented in table 3. Increasing the group size had no effect on the uniformity. However, within the larger groups (18, 30, 42 and 54 animals) the uniformity of the group of 54 animals was increased compared to the group size of 18, 30 and 42 animals. This could be due to the experimental set-up.

Bone strength

In table 4 the results of the bone strength is presented (average of two experiments). No effect of group size on bone strength could be determined. These findings also support the results of the behavioural observations, in which no obvious differences in locomotion was observed between group sizes.

Table 3: Effect of group size on uniformity in live weight at 73 days of age
(predictions of within cage variance of live weight from the fitted regression model with approximate standard errors within brackets)

	Group size					
	6	12	18	30	42	54
Variance at 31 days (g)	12 (2)	11 (2)	13 (2)	14 (1)	13 (1)	16 (1)
Variance at 73 days (g)	67 ^{ab} (10)	57 ^{ab} (10)	50 ^a (7)	59 ^a (6)	54 ^a (6)	77 ^b (6)

Means in a row with a different letter differ significantly ($P < 0.05$)

Table 4: Effect of group size on bone (tibia) strength at 80 days of age(means with the standard error within brackets)

	Group size					
	6	12	18	30	42	54
Average bone strength (kg)	37.8 (1.6)	38.9 (1.8)	39.0 (1.4)	39.1 (2.2)	40.8 (3.3)	39.9 (3.3)

The determination of the tibia strength is a simple technique, which is less labour-intensive as behavioural observations. However, from this research it is not clear if bone strength can be used as a reliable indicator for the amount of movement of rabbits.

Observations of skin injuries and aggressiveness

At 73 days minor skin injuries (score 1 and 2) were observed. Most of these injuries were seen on the head and ears. It was noticed that a part of these superficial injuries healed within one week. The number of animals removed due to severe bite wounds (score 3) was limited. In the first two experiment no animals were removed with skin injuries. In the third trial 2 animals of one group of 54 rabbits had to be removed.

The percentage of animals with injuries increased with age. At 73 days of age 5.7%, 16.4% and 12.6% of the total number of animals in experiment A, B and C had skin injuries, with more than 80% of the injuries located at head and ears. When the fattening period was prolonged with one week (80 days of age) 42.5% and 20.1% of the total number of animals in resp. experiment B and C were scored with injuries, 50% of which were observed at the genitals and were more severe (score 2 and 3). It is not clear as to how far the handling of the animals and chec-king of the genitals at 73 days of age might have been of influence on the animals. At 80 days of age the average live weight of the animals was 2720 and 2825 grams in respectively experiment B and C.

The group size did not seem to play an important role in the appearance of aggressive behaviour. At 10 weeks of age aggressiveness was observed in three different group sizes (respectively 6, 18 and 30 animals/cage) for short periods of time, mainly caused by one animal in a cage. Aggressiveness varied within and

between experiments. For example, in experiment A one rabbit in a group of 18 started biting and damaged the 17 others, while in the other group of 18 no biting was observed. In experiment A in one cage of 18 animals aggressiveness was observed, while in experiment B and C it was observed also in other groups. It is known that the biting can be stopped by removing the aggressor and this will be more complicated in a larger group. The observations of this research support the recommendation to finish the fattening period at 80 days at the latest.

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