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Planimetric measurement of floor space covered by fattening rabbits and breeding does in different body positions and weight classes

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ABSTRACT

The aim of this study was to measure the floor space that a rabbit occupies due to its physical size and shape. For this purpose the colour contrast planimetric method "KobaPlan" was used which had originally been developed to calculate the surface of chickens. A total of 704 images of fattening rabbits and breeding does were taken from a top view. The rabbits were weighed individually, and photographed digitally in a special planimetric box. In the photo, the number of animal associated pixels was counted by the "KobaPlan" software, and thus the area covered by the animal was calculated. The calculated surfaces of the rabbits were assigned to weight classes which covered a range from 1.0 to 5.5 kg. We defined four body postures of rabbits, one sitting position and three different recumbent positions. The mean floor space covered by sitting rabbits at the beginning of the fattening period was 246 ± 34 cm², whereas recumbent rabbits covered 294 ± 45 cm², 360 ± 51 cm² and 338 ± 39 cm² in different positions. At the time of slaughter, the covered floor spaces increased to 509 ± 23 cm² for sitting rabbits, and to 697 ± 45 cm², 724 ± 26 cm² and 719 ± 23 cm² for recumbent rabbits, respectively. The calculated surface of breeding does with a body weight of 4.5 kg was 657 ± 17 cm² in sitting position, and 828 ± 7 cm², 874 ± 23 cm² and 882 ± 14 cm² in the different recumbent positions. The heaviest does (5.5 kg) covered 739 cm² sitting and 1026 ± 27 cm² recumbent. There was a linear increase in the surface covered by rabbits in all defined body positions as a function of live weight. Furthermore, sitting rabbits covered significantly less floor space than lying rabbits ($P < 0.05$). It was shown that the colour contrast planimetric method "KobaPlan" provides reliable results regarding the floor space covered by growing rabbits and breeding does. This study is a first step towards an optimization of current rabbit housing regarding individual space requirement, and it represents a useful basis for planning new environmental enrichment structures (e.g. withdrawal areas) in rabbitries.

1. Introduction

In the EU, 489,569 t of rabbit meat were produced in 2012 (FAOSTAT, 2012). The most common housing systems for breeding and fattening rabbits in Europe are barren wire mesh cages with slatted floors (EFSA (European Food Safety Authority), 2005). The legal framework for keeping farm animals in general is provided by the EU Directive 98/58/EC

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(EU Directive, 1998). However, no specific statutory requirements for commercial rabbitries, except for the Netherlands, Austria and Switzerland have been available in other European countries up to now. In February 2014, an amendment of the Animal Welfare regulations in Farm Animals was published in Germany (TierSchNutztV, 2014). According to this national directive, each fattening and breeding rabbit deserves a certain unobstructed floor area which is considerably larger than the space usually provided in conventional cages. For instance, the space requirements for breeding does with litters are now with 7000 cm² more than twice as high as the former 3200 cm².

Basically, the issue of adequate space allowance in livestock housing is very complex, since biological, ethological and economic parameters have to be considered. In addition, animal welfare, and thus also sufficient space allowance in animal production, became an increasingly important factor in purchasing decisions concerning animal products. Nevertheless, little is known about the amount of space that animals require in modern livestock housing (Petherick, 2007). Petherick (1983) defined three different kinds of space: the area required by an animal due to its size and shape (body space), the space that is necessary to carry out various maintenance behaviours (behavioural space), and the space needed for interactions between animals in group housing (social-interaction space). The few previous studies on space requirements of domestic rabbits mainly focused on the effects of space restriction on the rabbits' behaviour. However, these studies led to contradictory results. Whilst Buijs et al. (2011a) found only minimal support for the hypothesis that welfare in fattening rabbits was impaired by decreased cage size, several authors concluded that more available space resulted in less resting behaviour and a wider range of activity behaviours, and thus in higher welfare in fattening rabbits (e.g. Morisse and Maurice, 1997; Princz et al., 2008; Verga et al., 2004). Dixon et al. (2010) observed a rebound effect in the rabbits' activity when moved from a small sized pen to a larger one, and thus concluded that larger pens provide behavioural opportunities which are restricted in smaller pens. Since the studies using behavioural effects as indicators for adequate space allowances for rabbits did not lead to clear results, it might be useful to initially determine the amount of space a rabbit occupies by its physical dimensions in order to assess space allowance in current rabbit housing systems.

However, there is no information available on the floor space a rabbit covers due to its body dimensions. Planimetric studies collecting biometric data on the physical dimensions of animals particularly focus on Petherick (1983)'s definition of "body space", even if some authors also used planimetric techniques for the measurement of space-occupying behaviours i.e. "behavioural space" (Bogner et al., 1979; Spindler et al., 2012). In the field of poultry, various planimetric methods have been developed. Bogner et al. (1979) photographed laying hens from the top view, measured the contours of the hens in the pictures, and calculated their surfaces using the cage area as a known reference and a correction factor. Several modifications to assess the area occupied by domestic fowl followed (Freeman, 1983; Dawkins and Hardie, 1989; Ellerbrock and Knierim, 2002). The colour contrast planimetric method "KobaPlan" applied in the present study was used first by Briese and Knierim (2006) for the measurement of ducks, and by Briese and Hartung (2009) for planimetric studies in laying hens. This method is based on the calculation of the number of pixels with constant surfaces representing the animal in digital pictures. In these previous studies, the number of pixels associated to the animal was detected using Photoshop software (Adobe Systems Incorporated, San Jose, California, USA) and calculated based on the number of pixels of a reference area. By using the "KobaPlan" software (v.01.teta © Briese, 2007–2013, eduToolbox@Bri-C GmBH, Sarstedt, Germany) it was possible to calculate the floor space covered by an animal largely automatically. Thus, Spindler et al. (2011, 2012, 2013) calculated the surfaces of broiler chickens and pullets. Giersberg et al. (2013) used the method to collect biometric data of suckling piglets and weaners during the rearing period.

The aim of our study was to collect biometric data to obtain useful results to define an animal-based minimum floor area for fattening and breeding rabbits. For this purpose the colour contrast planimetric method "KobaPlan" (Briese and Hartung, 2009) was used. Knowing the space allowance per animal given in the legislation, and the exact area an animal covers by its own body, it is possible to calculate the free space that remains for specific behaviour and locomotion patterns in husbandry systems fulfilling the legal requirements.

2. Animals, material and methods

2.1. Animals and housing

The study was carried out on a commercial farm for fattening and breeding rabbits in Lower Saxony, Germany. During a service period of one year, about 1100 breeding does (genetics: Grimaud Freres) were housed in conventional wire mesh cages with a lockable nest box. Furthermore, about 2400 fattening rabbits were kept up to 75 days of life in 100 cm × 50 cm × 34 cm (length × width × height) sized wire mesh cages in groups of four to nine animals, depending on their age. After this period, the rabbits were sold for slaughter at a mean weight of 2.8 kg.

2.2. Planimetric study of rabbits

To determine the floor area covered by a rabbit, the colour contrast planimetric method "KobaPlan" (Briese and Hartung, 2009) was used. In order to measure each rabbit individually, it was weighted and photographed digitally from top view in a special box (63 cm × 63 cm bottom plate). A camera (Sony optical steady shot, HDR-GW 55; 20.4 megapixels, lens 5.0 m, Sony, Tokyo, Japan) was fixed to a metal frame, 140 cm above the base of the box. In addition, a reference standard with known surface area (an A4 sheet of paper; 623.70 cm^2) placed at the level of back of the rabbit was photographed using the same camera settings. Subsequently, all images were transferred to a personal computer and analysed using the "KobaPlan" software.