Summary „Adequate Perches for Laying Hen Husbandry -
Ethological Studies and Pressure Measurements to Supply Hens' Needs"
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Commercial laying hen husbandry is Europe-wide highly discussed. Different housing systems shall fulfil the economic demands of egg production but also supply laying hens' needs. Thus, hens shall be allowed to perform a natural behavioural repertoire, amongst others to rest in an elevated position. Although the provision of perches allows hens a more natural resting behaviour and increases the possibility of movements, it is also associated with several welfare problems, such as keel bone deformations and foot pad lesions. It is assumed that these welfare problems result from high mechanical long-term pressure during extended perching on inadequate perch designs.
The aim of my thesis was to study for the first time laying hens' requirements for perching and to identify an adequate perch design that can increase animal welfare in laying hen husbandry. In two studies I investigated the behaviour of laying hens on perches and analysed the effect of varying perch materials, diameters, as well as perch temperatures. In addition, I analysed the pressure-load on feet and keel bone of laying hens on different perches in a third study.
In study 1 laying hens were randomly offered one of nine round perches, which differed in material (wood, steel, rubber cover) and diameter (27, 34, 45 mm). Duration of resting, standing and preening and frequencies of balance movements and comfort behaviours shown by hens on each perch were recorded at night. It appeared that balance movements decreased with increasing perch diameter. In addition, balance movements occurred less often on rubber perches compared to wood and steel perches. These results show that a higher perch diameter and a surface made of rubber improve the footing stability of hens, what may reduce the risk of injury. This study also revealed differences in hens' resting postures on the tested perches. On steel perches, hens rested more with the head tucked backwards into the feathers and less with the head forward compared to wood and rubber perches irrespective of perch diameter. Furthermore, hens stood less often on steel compared to wood or rubber perches. It was hypothesised that these differences might have been caused by different thermal properties of the tested perch materials.
Study 2 verified this hypothesis. This study focused on the effect of different perch surface temperatures (15°C, 18°C, 28°C) on the resting behaviour of laying hens. It could be shown that the temperature of a perch had a strong effect on the resting postures of hens. On the 28°C perch, hens rested more with the head forward in a standing position and showed more active behavioural patterns compared to both cooler perches. On the cooler perches, hens rested more with the head tucked backwards into the feathers in a sitting and standing position. The results provide important information on optimal thermal properties of an adequate perch and on the degree of resting comfort during perching. High temperatures of a perch disturb the resting behaviour of hens, low temperatures seem to require behavioural patterns that prevent heat loss.
Because pressure load seems to play a key role in the development of foot pad lesions and keel bone deformations, pressure peak and contact area of the keel bone and foot pads in perching laying hens were for the first time analysed in study 3. This study was divided in two substudies. In substudy 1 solid test perches of square, round, and oval shape with three different diameters each were investigated. In substudy 2 commercially used perches (round steel tube, two sizes of mushroom-shaped plastic perches, and a flattened round plastic perch) together with two newly designed prototypes of perches were tested. The prototypes were soft, round polyurethane perches equipped with an air cushion on the upper side and a stabilising part below. All test perches were covered with a pressure sensor film and placed in an experimental cage. In the dark period laying hens were consecutively placed on each test

perch and peak forces and contact areas of sitting and standing hens were measured and analysed. The study showed that in general the pressure peak on the keel bone of a sitting hen is on average approximately five times higher compared with single foot pad pressure peaks. This result supports the assumption that keel bone deformations are caused by unphysiological long-term pressure during perching. Regarding adequate perch designs, which are able to minimize pressure, substudy 1 revealed that solid square perches seem to be most advantageous in relation to the keel bone, whereas oval perches are more suitable for hens' foot pads. Among the commercially used test perches in substudy 2, no differences in keel bone and foot pad peak forces were observed in sitting hens. In standing hens, foot pad peak force was least beneficial on round steel perches, hence this perch was found to be least favourable. The newly developed soft perches could successfully reduce both keel bone and foot pad pressure peaks. Furthermore, the prototype with a width of 48 mm provided the largest keel bone and foot pad contact areas.
In summary, this thesis showed that round steel perches, which are often used in commercial housing systems, are obviously inadequate for laying hens because of two reasons: Firstly, round steel perches cause an unphysiological high pressure load on foot pads and keel bones what probably may lead to keel bone deformations and food pad diseases. Secondly, such perches provide not enough grip revealed by an increased number of balance movements thereby may cause a higher risk of injury. Soft perch materials imply a better grip and footing stability during perching as well as improved pressure conditions on foot pads and keel bones. Thus, the developed prototype of a perch fulfils the needs of laying hens best and contributes to an increase in animal welfare in laying hen husbandry.

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