Hyperplasia in interrenal cells of adrenal glands after forced training of turkeys

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The aim of this study was to see if there were any changes in the morphology of the adrenal glands of turkeys after varying levels of forced training. Birds of the first group had no training (Control); birds of the second group were trained from their second week of life to their eighth week (T 2-8) and birds of the third group were trained from their second week of life until 20 weeks of age (T 2-20). Training consisted of running 300 meters once per day, 5 days per week. At slaughtering the adrenal glands were taken out of ten animals per group, weighed, covered in Tissue Tek® and stored at -20 °C until cutting. The adrenal glands were cut and stained, using an adapted protocol of Masson Goldner. From these slices pictures were made with a “AxioCam” camera (Zeiss). From the pictures the areas of adrenal cells and interrenal cells, as well as size of the total investigated area, were measured using a picture analysis program (AxioVision LE Rel 4.3.; Zeiss). Additionally the weight of the adrenal gland in relation to body weight was determined.

Training improved the walking ability (T2-20), but in contrast the amount of interrenal cells was significantly higher in birds trained to 20 weeks compared to the control group (8.12 x 10-3 vs. 4.70 x 10-3, t27.2=2.84, p<0.05) with birds trained for 8 weeks in between (6.07 x 10-3). At this point of time we cannot say if the differences are physiological adaptations to the training or if this hyperplasia suggests that the animals were not able to cope with the highest level of training. It remains open, weather these unwanted morphological changes were due to the forced locomotion itself (duration, length, frequency), the handling procedure, or to the high weight and fast growth of the breeding line used in this investigation. Therefore further studies must be done.

Key Words: animal welfare, leg problems, turkeys, stress, locomotor activity

Introduction

The aim of this study was to investigate changes in the morphology of adrenal glands in turkeys experiencing forced training in order to decrease leg problems. Training was supposed to increase welfare by reducing leg problems as can be seen in turkeys (Berk and Cottin, 2005) and broiler chickens (Reiter and Bessei, 1995). To investigate eventual effects of locomotor activity on stress physiology we investigated adrenal gland morphology. The adrenal glands play...
an important role in the response to aversive stimulation. The initial rapid release of catecholamines may be followed by activation of the hypothalamus-pituitary-adrenocortical (HPA) axis with a resultant increase of corticosterone. Chronic stimulation of the adrenal glands can lead to a hyperplasia in interrenal cells because of the increased secretion rate of this hormone (Bhattacharya and Ghosh, 1972). The hypothesis was that training would not induce stress, and we did not expect any changes in the adrenal glands due to training.

Materials and methods

The animals were divided into three groups: first group was not trained (Control), the second group was trained from their second week of life to their eight week (T 2-8) and the third group was trained from their second week up to 20 weeks of age (T 2-20). Training consisted of running 50m (start of training) up to 300m (from seven weeks of age) once per day, 5 times a week (week 2-4) and 5 days per week (5-20). After slaughter the adrenal glands were taken out of ten animals per group, weighed, and stored at -20°C until cutting. The adrenal glands were cut and stained using an adapted protocol of Masson Goldner (Figure 1). From the slices pictures were done with a „AxioCam“ camera (Zeiss). From the pictures the areas of adrenal cells and interrenal cells, as well as size of the total investigated area, were measured using a picture analysis program (AxioVision LE Rel4.3; Zeiss). Additionally the weight of the adrenal gland in relation to body weight was determined. Data was analyzed with the mixed procedure with SAS software (SAS Institute, 1994). The following model was used:

\[ Y_{ijklm} = \mu_i + a_{j(i)} + s_{k(ij)} + g_{l(ijk)}, \quad i=1,2,3; \quad j=1,2,3,..,30; \quad k=1,2,3,..,43; \quad l=1,2,3,4, \]

where \( \mu_i \) was the fixed effect of the \( i \)'th treatment, \( a_{j(i)} \) was the effect of \( j \)'th randomly selected animal from the \( i \)'th treatment, \( s_{k(ij)} \) was the effect of the \( k \)'th randomly selected slide from the \( j \)'th animal from the \( i \)'th treatment, \( g_{l(ijk)} \) was the effect of the \( l \)'th counting field from the \( k \)'th slide from the \( j \)'th animal from the \( i \)'th treatment.

Results and discussion

Birds trained to 20 weeks had significantly more interrenal cells compared to the control group (8.12 x 10^-3 vs. 4.70 x 10^-3, \( t_{27.2}=2.84, P<0.05 \)) with birds trained for 8 weeks in between (6.07 x 10^-3, Figure 2) and the number of adrenal cells tended to differ (\( p=0.0589, \) Figure 3). The adrenal weights showed the same results with a significant increase (\( p<0.05, \) Figure 4) of the relative adrenal weight in birds trained to 20 weeks compared with the control. The gait score, which indicate the walking ability of the animals, showed significant differences between the three groups. We found an improvement of walking ability in the group trained to 20 weeks of age (T 2-20).

The hypothesis of this study, that training would not induce stress and that there would be no changes in the adrenal glands could be rejected. Training lead to changes of the adrenal glands which may be could be interpret as a chronic stress response. In general, the adrenal glands can adapt to stressful situations. But these changes are normally reversible. The T 2-8 group (training from week 2-8) tended to show changes even after 12 weeks without training.
It is widely accepted that various stressors of environmental, nutritional and pathological origins reduce the efficiency of animal production. The reason for training the turkeys was to increase the walking ability and to reduce leg problems. These goals were achieved. However, at this point of time it is not possible to say if the differences were physiological adaptation to the training sessions or if this hyperplasia suggests the animals couldn’t cope with the training and were perhaps overstrained. Therefore further studies must be done.

In conclusion, birds trained to 20 weeks showed signs of chronic stress, but training improved the walking ability. It remains open, weather these unwanted morphological changes were due to the forced locomotion itself (duration, length, frequency), the handling procedure, or to the fast growing strain used in this investigation.

Figure 1 Adrenal and interrenal cells stained with an adapted protocol of Masson Goldner

Figure 2 Birds trained to 20 weeks had significantly more interrenal cells (p<0.01) than controls
Figure 3 Training tended to affect the number of adrenal cells (p=0.0589)

Figure 4 Adrenal weight increased in birds trained to 18 weeks

References


