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EFFECTS OF ECOLOGICAL COMFORT AND ECOLOGICAL STRESS ON PRODUCTIVE TRAITS OF BROILER TURKEYS WITH EXPERIMENTALLY INDUCED MUSCULAR DYSTROPHY

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Summary

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The experiment was performed with four groups of broiler turkeys: I – control, reared under conditions of ecological comfort, II – control, reared under conditions of ecological stress, III –birds suffering from muscular dystrophy (MD), reared under conditions of ecological comfort, and IV –birds with MD, reared under conditions of ecological stress. The turkeys from groups I and III were kept in the same room separated into two sections, where the microclimate was set in accordance with the zoohygienic requirements. Groups II and IV were kept in another room, where the microclimate deviated from the norms: higher temperature, lower air humidity, and a concentration of ammonia close to the maximum allowed. The conditions of ecological comfort had a positive effect on the live weight of the birds during the first 14 days for both healthy and MD birds. During the first 14 days of rearing under ecological stress, weight gain was increased, regardless of whether they suffered from muscle dystrophy or not. However, during the following period until the 70th day, rearing under such conditions marked a slower development for diseased birds.

Key words: broiler turkeys, muscular dystrophy, stress, body weight

INTRODUCTION

A number of authors (Combs, 1991a; 1991b; Bartholomew *et al.*, 1998), have identified the deficiency of selenium (Se) and vitamin E in birds as the cause of many illnesses, decreased productivity, and increased embryonic mortality rate.

In an experiment by Combs & Scott (1974) with hens, the feeding at low Se content and peroxidized fats, considerably reduced their productive qualities and led to the occurrence of myopathies, which were treated by the addition of Se and vitamin E. In birds (Underwood, 1981) the necessity for Se varies depending on the animals' condition. For young chickens, under the age of 6 months, it is 0.15 mg/kg, while for the rest it is estimated at 0.10 mg/kg. Mensh (2004) also established that skeletal disorders and decreased mobility in meat-type fowl breeds are serious issues concerning their welfare and activity.

According to Scheele (1997), numerous pathological changes in the birds'

metabolism occur as a result of the constant productivity increase in the poultry industry. Selection methods in breeding programmes aim at accelerating growth and decreasing the food requirements (less food per unit of meat). These methods do not comply with basic physiological requirements of poultry. The lack of balance between productivity (accumulation of protein and fat) and the provision of energy for physiological purposes leads to a disruption in the regulation of homeostasis and the occurrence of illness.

It is necessary to control the live weight in the parent herds of broilers and turkeys, which is related to a restrictive feeding programme. The decrease of live body weight reflects on skeletal diseases (Hocking *et al.*, 1999a; 1999b), the stereotypical behaviour (Savory, 1989), and physiological changes caused by stress (Zuidhof *et al.*, 1995).

The aim of the current study was to examine the influence of experimentally induced muscular dystrophy in broiler turkeys on the live body weight of birds until the age of 70 days, under conditions of either ecological comfort or ecological stress.

MATERIALS AND METHODS

The experiments were carried out in the Experimental Base of the Department of Internal Diseases, Faculty of Veterinary Medicine, Trakia University, with 40 one-day old broiler turkeys.

The birds were identified by wing marks. From the 1st to the 14th day of life, all turkeys were put under the same regimen of feeding and rearing. On day 14, they were initially divided into 2 equal (n=20) groups: control birds, fed a starter ration and experimental group, fed a ration deficient in selenium, vitamin E and sulphur-containing amino acids, and further supplemented with 4% oxidized fat with peroxide number 200 (allowed peroxide number 0.20). Prophylactic treatment was performed in both groups with 0.06 mg/kg Seled except that this prophylactic treatment was not administered to the experimental group between the days 28 and 30 in order to enhance the development of muscular dystrophy (MD). After the clinical signs of muscular disease became evident, the groups were further divided into 4 groups (n=10): group I (healthy birds, reared under conditions of ecological comfort); group II (healthy birds, reared under conditions of ecological stress); group III (birds with MD, reared under conditions of ecological comfort), and group IV (birds with MD, reared under conditions of ecological stress.

Groups I and III were housed in two sections of one premise, where microclimatic conditions were within the range recommended for the species (Anonymous, 2006). Groups II and IV were housed in another premise where the microclimate was unfavourable. The differences in microclimatic parameters are presented in Table 1. The ecological stress in this experiment consisted in high ambient temperature, reduced air humidity and ammonia concentrations near to the maximum allowed limit. Microclimatic conditions were determined by routine methods. The temperature and the relative humidity of air were measured by a weekly thermohygrograph (VEB Feingeratebau 9362 Drebach/ ERZG GDR, Type 405); the velocity of the air motion − with a catathermometer, the light intensity – with a luxmeter (LUX PU 150), the concentration of ammonia – with indicator tubes Hygitest Ammonia

Table 1. Microclimatic conditions under which broiler turkeys were reared during the different age periods

Groups	Age, days	Temperature (°C)	Humidity (%)	NH_3 (mg/L)	Light intensity (lx)	Ventilation (m/s)
I and III (ecological comfort)	1–10	29.7±0.89	70.9±0.38	0.005±0.0002	70.0±6.77	0.26±0.004
	11–20	23.8±0.69	67.0±0.82	0.005±0.0001	52.5±1.44	0.26±0.004
	21–40	20.0±0.24	65.0±0.82	0.006±0.001	47.5±1.44	0.27±0.005
	41–70	19.5±0.24	61.8±0.76	0.007±0.001	42.0±1.44	0.26±0.004
II and IV (ecological stress)	1–10	31.0±0.25	57.0±0.43	0.020±0.001	21.0±0.52	0.26±0.004
	11– 20	34.0±0.24	55.0±0.52	0.020±0.001	23.0±0.54	0.27±0.005
	21–40	34.0±0.24	55.0±0.52	0.020±0.001	23.0±0.54	0.27±0.005
	41–70	35.0±0.24	55.0±0.52	0.020±0.001	21.0±0.44	0.26±0.004
Reference values*	1–10	1–10	36–27	0.020	100–5	0.20–0.30
	11– 20	11– 20	27–22			
	21–40	21–40	22–18			
	41–70	41–70	18			

* as per Anonymous (2006).

Table 2. Nutritional value of concentrated food used for broiler turkeys

Age, days	Crude protein, %	Metabolizable energy, kcal/kg	Crude fibre, %	Lysine, %	Methionine +cysteine, %	Ca, %	Utilizable P, %
0–28	28.50	2820	4.205	1.745	1.081	1.346	0.520
29–56	25.00	2900	4.146	1.405	1.013	1.258	0.477
57–85	20.55	2830	4.000	1.150	0.920	1.060	0.510

0.2-A (Hygitest Association, Bulgaria) and Drager ammonia sensor.

In the centre of each section there was an infrared lamp with a power of 250 W with option for regulation of the height and the power depending on the air temperature for the respective period.

During the first weeks the forage was put into disinfected plastic dishes and thereafter – in a tubular feeder for each section with option for regulation of the height. Thus, a feeding front of 8 cm was ensured as per manufacturer's recommendations of 6 cm (Anonymous, 2000). The composition of the offered feed is presented in Table 2.

The watering during the first weeks was done with 2×2.5 L vacuum watering trays for each section and afterwards – with two large watering trays of 10 L each ensuring a drinking front of 3.5 cm vs. the recommended 3 cm (Anonymous, 2000). The ventilation was natural, depending on premise's microclimatic conditions. The bedding consisted of wood shavings with a thickness of 8–10 cm, conforming to zoohygienic requirements.

The treatment of diseased turkeys was initiated at the age of 58 days with Seledhydro, containing sodium selenite and vitamin E (Biovet, Peshtera, Bulgaria) at 1 mL/L drinking water.

The live body weight of turkey broilers was monitored by individual weighing at the age of 14, 28, 42, 56 and 70 days.

The statistical analysis of data was performed by Mann-Whitney's non-parametric test (StatMost, DataMost Co) at a level of significance 0.05.

RESULTS

Comparing the average values of tempera-ture and relative air humidity (Table 1) related to the rearing of broiler turkeys of 1st and 3rd group, with requirements per Act 44 for animal rearing facilities, it was determined that they were within the norms. The average temperature from the 1st through the 10th day was 29.7 ± 0.89 °C, with the norm being 36–27 °C. The average air humidity was 70.9 ± 0.38 %, with a norm of 75–70 % according to veterinary medical requirements of animal rearing facilities. From the 11th through the 20th day those values were 23.8 ± 0.69 °C (norm: 27–22 °C) and 67 ± 0.82% (norm: 70–65%). In the period between the 21st and 40th day the average temperature and air humidity were, respectively, 20.0 ± 0.24 °C (norm: 22–18 °C) and 61% ± 0.76 (norm: 60–65%). Only in the period between the 41st and 70th day those values were, respectively, 19.5 ± 0.24 °C, 1.5 °C above the norm (18 °C) and 61.8 ± 0.76% with a norm of 70–65%. The concentration of ammonia in the air was between 0.005 and 0.007 mg/L throughout the rearing period, i.e. under the allowed concentration of this toxic gas for poultry breeding facilities – 0.02 mg/L.

The light intensity from the 1st through he 3rd day was 100 lx, and afterwards, through the rest of the experimental period, it varied in the range 70–42 lx, which is within the norm of 100–5 lx. The speed of movement of the air in the birds' living area throughout the whole period varied in the range of 0.26–0.27 m/s, which is within the established norm– 0.2–0.3 m/s.

However, for the birds in groups II and IV, the microclimatic parameters were very different from what is normal for rearing broiler turkeys. Throughout the whole test period the temperature varied between 31–35 °C, significantly higher than the norm's upper limit. Air humidity was lower than the optimal values, varying between 55–57% with the norm being 60–65%. The concentration of ammonia was at the highest allowed limit of 0.02 mg/L.

Table 3. Live body weight of broiler turkeys, healthy (group I and II) and with experimental muscular dystrophy (MD): groups III and IV, reared under either ecological comfort (EC) or ecological stress (ES)

Groups	Age, days				
	0–14	14–28	28–42	42–56	56–70
I (healthy, EC)	0.236±0.01 ^	0.722±0.02^	1.588±0.04^	2.586±0.06^	3.163±0.09^
II (healthy, ES)	0.267±0.01	0.831±0.04	1.73±0.08	2.756±0.11	3.38±0.14
III (MD, EC)	0.296±0.01 *&	0.748±0.08 &	1.475±0.08 *	2.178±0.14 *	2.95±0.12 &
IV (MD, ES)	0.324±0.01 ##	0.870±0.02#	1.515±0.08##	2.124±0.19 ##	2.681±0.19 ##

* P<0.01 between groups I and III; # P<0.05; ## P<0.01 between groups II and IV; ^ P<0.01 between groups I and IV; & P<0.01 between groups III and IV.

The dynamics of live body weight of broiler turkeys from the age of 1 to 70 days are presented in Table 3. During the first two weeks, highest mass was exhibited by the turkeys from group IV – 0.324±0.01 kg, followed by group III with 0.296±0.01 kg, II – 0.267±0.01 kg, and I – 0.236±0.01 kg (P<0.01). Until the 14th day all turkeys were healthy and reared under the same conditions, with the differences in the live weight being caused by the individual specific features of the birds.

From the 14th to the 28th day we observed a plausible gain in live body weight in turkeys from groups II and IV, which were put under thermal stress, compared to groups I and III, which were reared under the conditions of ecological comfort.

At the end of the 28th day, the healthy and stressed turkeys from group II had the highest weight – 1.73±0.08 kg, followed by group I, healthy birds reared in ecological comfort – 1.59±0.04 kg.

After the 28th day a tendency, which persisted until the end of the experimental period, was established – the healthy turkeys from groups I and II advanced much more than the ill birds in groups III and IV, P<0.01. At the end of the 70th day the birds with the lowest weight were the ones in group IV with 2.681±0.19 kg, while the highest weight was gained by the healthy birds under thermal stress from group II – 3.385± 0.14 kg.

DISCUSSION

Our results indicate that the broiler turkeys from groups I and III were reared under microclimatic conditions (temperature, humidity, air movement speed, lighting, and ammonia concentration) in accordance with the zoohygienic norms (Anonymous, 2006) for veterinary requirements towards animal rearing facilities for this category of poultry, i.e. under conditions of ecological comfort. In contrast, the birds in groups II and IV were reared under conditions including high temperature, lowered air humidity, and a concentration of ammonia close to the highest allowed.

Between the 14th and 28th day we observed a significant gain in the live weight of the turkeys from groups IV and II, which were put under the conditions of thermal stress, compared to groups III and I, which were under conditions of ecological comfort. This can be explained by the fact that during the third, compensatory phase of stress the initial condition of the body is restored and anabolic processes are stimulated. As a result of these anabolic reactions to stress, the body increases its energy reserves in order to increase resilience to further stress promoters. Under the conditions of thermal stress the recuperative process of the body are active (Arschavskii, 1976; Tomov *et al.,* 2007).

After the 28th day we observed a tendency that went on until the end of the test period – the healthy turkeys from groups I and II advanced much more in their development than the ill birds in groups III and IV, P<0.01. This can be explained with the dystrophic processes, which are provoked in the muscles of the birds, and the lack of dystrophy in healthy birds (Rant & Lalitha, 1996; Surai, 2002; Nier *et al.*, 2006).

At the end of the 70th day the birds with the lowest weight were the ones in group IV, while the highest was observed in the healthy turkeys, reared under ecological stress, as a result of the stimulated recovery processes that helped overcome thermal stress (Madzharov, 1988; Zuidhof *et al.*, 1995; Tomov *et al.*, 2007).

CONCLUSIONS

During the first 14 days of rearing under the conditions of ecological stress, the live body weight gain of the birds was stimulated, regardless of whether muscular dystrophy has been provoked or not. The conditions for ecological comfort during rearing had a positive effect on live weight of the birds after the first 14 days, for the healthy as well as for the birds suffering from muscular dystrophy.

Muscular dystrophy in broiler turkeys had a negative effect on their live weight after the 14th day since the start of its alimentary induction.

However, during the subsequent period until the 70th day, rearing under these same conditions led to a slower development of turkey breeders.

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