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# ETHOLOGICAL ASPECTS OF IMPROVING THE WELFARE OF TURKEY BREEDERS IN THE HOT SUMMER PERIOD BY DIETARY L-ARGININE SUPPLEMENTATION

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**Summary**

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The utilization of food additives to improve poultry welfare during the hot summer months is essential under farm production conditions. The most accurate indicator for that is the behaviour of birds. The aim of this study was to observe the changes in the the behaviour of turkey breeders during a thermoneutral and hot summer period (32 $^{o}$C), as well as the possibility to improve their welfare through the addition of 1% L-arginine in their feed during the hot summer days. The behaviour of the turkey breeders was observed with a video camera. During the hot summer period there was a significant increase in turkey breeders exhibiting drinking and aggressive behaviour, while there was a decrease in the number of birds performing dustbathing, feather pecking, egg-laying, and sexual behaviour. The addition of 1% arginine to the feed contributed to a significant improvement in turkey breeders' welfare during the hot summer period, which was manifested through more frequent dustbathing, improved egg-laying and sexual behaviour, as well as less aggression among birds.

**Key words**: additive, behaviour, high temperatures, L-arginine, turkey breeders' welfare

## INTRODUCTION

During the hot summer months the issue of finding economically profitable means of improving poultry welfare within the specific production conditions becomes more important (Rodenburg *et al.,* 2005; Anonymous, 2006a; 2006b; Lin *et al.,* 2006). According to Ensminger (1992) and the requirements of Act 44 (Anonymous, 2006a) for veterinary medical conditions of animal rearing facilities, turkey breeders should be reared under temperatures in the range of 15−17 $^{o}$C; air humidity of 60−65%; air movement velocity of 0.2−0.3 m/s; maximum allowed concentration of ammonia − 15 ppm, and lighting intensity of 50 lx. However, during the summer months the temperature in the rearing halls of poultry farms is much higher and the air humidity − lower.

During this period the primary factor for the poorer birds' welfare is thermal stress (Hocking *et al.,* 1999; Hai *et al.,* 2006). According to a number of authors (Wiesinger, 2001; Heinzen, 2003; Rodenburg *et al.,* 2005; Lin *et al.,* 2006), an important part of maintaining poultry welfare is having a proper feeding strategy, aimed at limiting the negative effect of stress through the usage of specific food additives (microelements, vitamins, and minerals) to satisfy the body's needs under the conditions of thermal stress. According to Popova-Ralcheva *et al.* (1998); Wiesinger (2001) and Heinzen (2003), one of the ways to reduce stress in birds is the addition of L-arginine in their food. There is not enough data on the influence of L-arginine in improving the thermal resilience of turkeys under conditions of thermal stress, thus improving their welfare. The most accurate indicator of poultry welfare is their behaviour (Sherwin & Kelland, 1998; Hocking *et al.,* 1999; Martrenchar *et al.,* 2001; Popova-Ralcheva *et al.,* 2002, Platz *et al.,* 2003).

The goal of the current study was to follow the changes in the behaviour of turkey breeders during a thermoneutral and the hot summer period (32 °C), as well as to examine the possibilities for improving their welfare through the addition of L-arginine to the food during the hot summer days.

## MATERIALS AND METHODS

The tests were performed at the turkey farm in the village of Malko Kadievo in a hall with 700 turkey breeders, divided into group boxes.

Thirty turkeys at the age of 10 months from the meat-oriented heavy line were randomly selected, and were divided into 2 groups of 15 birds – control and experimental, put in separate boxes of 10.50 $m^2$. They were kept on litter floors at a density of 1.43 birds per 1 $m^2$ (with the norm being 1.7 per 1 $m^2$ according to Act №44). They were identified by wing marks.

During the thermoneutral period (5−11 May) the turkey breeders from both groups were fed with the same balanced compound feed, produced by the food preparation facility at the Agricultural Institute in Stara Zagora. The feed contained: metabolizable energy 9.40 MJ/kg; crude protein 17.084 %; crude fat 5.479%; calcium 2.90; phosphorus 0.875%; methionine + cysteine 0.906%; L-arginine 1.386%, that was in accordance with the category of the birds (Todorov *et al.,* 2001).

During the high temperature period (23−29 June), the food of the experimental group was supplemented with L-arginine ("Roanal", Budapest, Hungary) at a dose of 1%, balanced with the other amino acids. The food with the additive was given for 7 days, with the beginning of this period coinciding with the increase in the average daily temperatures above 34 °C. The control group was given feed without L-arginine.

Feed was provided through a chain feeder, with 23 cm feeding front for every bird (norm 15 cm). Water was provided in a water trough of 23 cm drinking front, with the norm being 4 cm (Anonymous, 2006a). Ventilation was natural. A light coefficient of 1:10 was provided. Egg-laying nests were wooden, sized 60/60/50 cm. Artificial insemination of the turkey breeders was performed once weekly.

Microclimatic conditions were determined by routine methods. The temperature and the relative humidity of air were measured by a weekly thermo-hygrograph (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 0.2-A (Hygitest Association, Bulgaria) and Drager ammonia sensor.

The behaviour of turkey breeders was studied with a video camera for 12 hours for two consecutive days during the thermoneutral days (5–11 May) and during the hot summer period (23–29 June). Based on the recordings we prepared ethogrammes as per Popova-Ralcheva *et al.* (2002). During the ethological study we counted the number of birds engaged in specific forms of behaviour: ingestive (ingestion of water or food), gregarious (resting, standing, moving, egg-laying, dust bathing and feather pecking) as per Wojcik & Filus (1997), and agonistic and sexual behaviour as per Popova-Ralcheva (1994).

Statistical processing of the results was performed by means of one-way ANOVA using the GraphPad InStat 3.06 software at level of significance $P<0.05$.

## RESULTS

The data for the microclimatic indicators of turkey breeders rearing during the thermoneutral and the hot summer periods are given in Table 1.

Comparing the average temperature values, air humidity, and air movement velocity in the birds' living area during the thermoneutral period with the parameters of veterinary requirements for animal rearing facilities, we determined that they were within the norms.

During the period 23–29 June the microclimate deviated significantly from the norms of rearing turkey breeders (Table 1). The average daily temperature was significantly above the upper limit. Air humidity was lower than optimal. Therefore, during the 7-day period, the turkey breeders were kept under conditions of thermal stress.

Observing the changes in the turkeys' behaviour during the thermoneutral and the hot summer period, we determined significant differences between the control and the test group, in the ingestive, gregarious, agonistic and sexual behaviour. (Table 2).

Our observation of the birds' ingestive behaviour revealed that the number of drinking birds, during the 7 days of higher temperatures, was significantly higher in groups I and II (1.88±0.14 and 2.04±0.18 respectively), compared to the thermoneutral period (1.23±0.15 and 1.46±0.14) ($P<0.01$). We did not observe any significant difference in the frequency of water drinking between the control and the group, supplemented with 1% L-arginine .

With regard to egg-laying rates, we determined that during the period of high temperatures there was a significant decrease in the number of birds laying eggs vs the control group (group I – 0.42±0.11), compared to both the experimental group (1.48±0.09), and to egg-laying during the thermoneutral period ($P<0.01$). During the hot period, the number of egg-laying turkey breeders that received the L-arginine supplement marked a significant increase, compared to

**Table 1.** Microclimatic parameters during the thermoneutral and hot summer period

| | Temperature, ($^0$C) | Humidity, % | Ventilation, m/s | $NH_3$, ppm | Light intensity, lx |
|---|---|---|---|---|---|
| Thermoneutral period | 16.00±0.15 | 63.13±0.50 | 0.25±0.01 | 12.83±0.41 | 49.21±1.87 |
| Hot summer period | 32.21±0.51 | 51.88±0.54 | 0.78±0.04 | 12.54±0.36 | 51.25±1.74 |
| Reference values* | 15–17 | 60–65 | 0.2–0.3 | < 15 | 50 |

* Reference values as per Anonymous (2006a).

**Table 2.** Number of turkey breeders exhibiting a specific type of behaviour during the thermoneutral and the hot summer period: control (group I) and experimental (group II) (mean ±SEM, n=15)

| Behaviour | Thermoneutral period | | Hot summer period | |
|---|---|---|---|---|
| | Group I | Group II | Group I | Group II |
| feeding | 2.90±0.22 | 2.77±0.25 | 3.73±0.37$^{\#}$ | 3.52±0.36^ |
| drinking | 1.23±0.15 | 1.46±0.14 | 1.88±0.14$^{\#\#}$ | 2.04±0.18^^ |
| egg-laying | 0.83±0.10 | 0.83±0.11 | 0.42±0.11$^{\#\#}$ | 1.48±0.09** ^^ |
| moving | 1.42±0.13 | 1.33±0.13 | 1.21±0.13 | 1.23±0.12 |
| standing | 2.15±0.19 | 1.88±0.18 | 2.42±0.25 | 1.21±0.21** ^^ |
| lying | 2.17±0.28 | 2.96±0.29* | 2.75±0.33 | 2.73±0.24 |
| feather pecking | 2.75±0.19 | 2.02±0.21** | 1.94±0.19$^{\#\#}$ | 1.73±0.17 |
| dust bathing | 0.35±0.11 | 0.56±0.14 | 0.08±0.04$^{\#}$ | 0.56±0.12** |
| aggression | 0.23±0.06 | 0.29±0.07 | 0.21±0.06 | 0.06±0.04* ^^ |
| sexual behaviour | 0.96±0.13 | 0.81±0.12 | 0.40±0.10$^{\#\#}$ | 0.48±0.08^ |

*P<0.05; ** P<0.01 between groups I and II during the thermoneutral and hot period; $^{\#}$P<0.05; $^{\#\#}$ P<0.01 between the thermoneutral and hot period for group I (control); ^P<0.05; ^^ P<0.01 between the thermoneutral and hot period for group II (L-arginine-supplemented).

the thermoneutral period – 0.83±0.11 even though the number of eggs during the hot period went down, according to our observations. One of the turkeys was engaged in brooding behaviour, expressed in constant lying in the nest. The daily number of egg-laying of experimental birds was significantly higher than it was in the control group (P<0.01).

The number of turkey breeders in the control group perfoming feather pecking during the hot period was significantly lower, compared to the thermoneutral period: 1.94±0.19 and 2.75±0.19 respectively (P<0.01). We did not observe such a difference with birds, whose feed was supplemented with L-arginine.

The number of dust bathing birds during the hot period was significantly higher in the experimental group, compared to the control group – 0.56±0.12 and 0.08±0.04, respectively (P<0.01). During the hot period, the number of dust bathing control birds dropped significantly, as compared to the thermoneutral period (0.35±0.11; P<0.05).

The observation of the agonistic behaviour during the hot period revealed an insignificant decrease in aggressive acts among the experimental birds, compared to controls.

During the hot period we registered a significant decrease in sexual acts among the birds in the control group, compared to the thermoneutral period (P<0.01). Such a tendency was observed in arginine-supplemented group as well (group II), yet the difference was not significant.

## DISCUSSION

Comparing the average values of the microclimatic indicators of rearing turkey breeders during the thermoneutral period (5–11 May) with the veterinary requirements for animal rearing facilities, we determined that in May the conditions in the poultry rearing halls of the Malko Kadievo turkey farm were within the zoohygienic norms. During the hot summer (23–29 June) breeders were reared under conditions of thermal stress: higher temperature and lower air humidity.

The higher number of water-drinking turkey breeders during the summer period is a normal thermoregulatory reaction, aimed at enhancing heat loss through contact with water and at restoring water balance in conditions of high ambient temperatures (Smith & Teeter, 1981; Gudev *et al.,* 1998).

During the hot period, there was a significant drop in the number of egg-laying turkeys in the control group, compared to both the experimental one and to the thermoneutral period (P<0.01). Similar results are reported by Star *et al.* (2008) and Yardibi & Turkay (2008) for decreased egg-laying during the hot summer period in breeder hens. The daily rate of egg-laying during the hot period for experimental birds was significantly higher than that for controls (P<0.01). Therefore, the addition of 1% L-arginine to the food benefited egg-laying in turkey breeders. This can be explained with the arginine's limiting effect on corticosterone's negative effect on the luteinizing hormone, which stimulates egg-laying (Gudev *et al.,* 1998; Popova-Ralcheva *et al.,*1998; Wiesinger, 2001; Heinzen, 2003).

Observing feather pecking and dust bathing of turkey breeders, it was determined that the number of control birds engaged in such behaviour dropped significantly during the hot period, compared to the thermoneutral period. Such a difference was not observed in turkeys that received L-arginine with their feed, which suggested a better welfare. According to Sherwin & Kelland (1998), the higher welfare in turkeys also increases time spent in stretching, feather pecking, and dust bathing. The number of experimental dust bathing turkeys was significantly higher during the hot period vs controls, but in the control group that number decreased, compared to the thermoneutral period. This confirms the higher welfare of the birds that received L-arginine and corresponds to the results of Iliev *et al.* (1999), which claimed that dust bathing was the uppermost demonstration of comfort in birds. This is also the opinion of Sherwin & Kelland (1998) and Stoyanchev *et al*. (2006) – dust bathing is an indicator of poultry welfare.

Concerning the agonistic behaviour, a tendency of less frequent aggressive acts among the experimental birds, compared with the control group was observed, even though the difference was not significant. This can be explained with the inhibiting role of nitric oxide (a metabolite of arginine) on the secretion of ACTH and corticosterone (Cymering *et al.,* 1998; Gudev *et al.* 1998; Tsai *et al.,* 2002), which provoke stress and distress in birds (Popova-Ralcheva *et al.,* 2002). Therefore, birds receiving the 1% L-arginine supplement were better protected from stress and their welfare was at a higher level.

During the hot period we determined a significant decrease of sexual activities in the control group of birds, compared to the thermoneutral period. Such decrease in sexual activities under thermal stress has been reported by Star *et al.* (2008) and Yardibi & Turkay (2008). Similar tendency was observed in the birds receiving L-arginine, but the difference was not significant. This can also be explained with the inhibiting role of nitric oxide on the secretion of ACTH and corticosterone (Cymering *et al.,* 1998; Gudev *et al.,* 1998). Thus, the suppressing role of corticosterone on the gonad functions and sexual behaviour is reduced (Popova-Ralcheva, 1994; Yang *et al.*, 1998). Therefore, turkey breeders supplemented with L-arginine were better protected against the thermal stress. They were calmer and found it easier to follow their natural line of behaviour, since their welfare was greater.

In conclusion, during the hot summer period we observed a significant increase in the rate of turkey breeders' drinking of water, which was an adaptive reaction related to their thermoregulation. There was also a significant drop in the rate of feather pecking and dust bathing during the hot period. The addition of 1% L-arginine benefited feather pecking and dust bathing – indicators of higher poultry welfare. The supplementation of turkey breeders' feed with 1% L-arginine improved egg-laying and the libido of turkey breeders, helped reduce their aggression, and thus contributed to increasing the welfare during the hot summer period.

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