Effect of aloe preparation and 5-oxo-1,2,4-triazine on mineral composition of tissues of turkey hens subjected to stress

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ABSTRACT

The aim of this study was to determine the influence of aloe preparation and 5-oxo-1,2,4-triazine on mineral composition of muscles and liver of turkey hens under conditions of stress. Groups C and C (+) stress were control that did not receive any additive. Birds from groups A and A (+) stress were administered aloe preparation in a dose of 0.70 ml/kg (BW)/day. Turkey hens from groups T and T (+) stress received 5-oxo-1,2,4-triazine in a dose of 30 μg/kg BW/day. The applied stress factors did not affect the mineral composition of the analysed tissues of turkey hens. Administration of 5-oxo-1,2,4-triazine caused a significant decrease in iron concentration and an increase in zinc concentration in thigh muscles and liver. In turn, aloe preparation contributed to an increase in tissue levels of calcium (except for shank muscles), zinc (in leg muscles and liver) and copper (in thigh muscles). A decrease in iron concentration in leg muscles and liver in birds supplemented with aloe preparation was also determined.

1. Introduction

It has been reported that stress, mainly pre-slaughter handling operations and heat exposure, negatively affects many physiological processes and chemical composition of meat (Ali et al. 2008; Zhang et al. 2012). In order to reduce the adverse effects of stress factors the birds are exposed to, attempts are made to use mineral-vitamin preparations (Wójcik et al. 2001) or herbal plants, especially those with adaptogenic, immunostimulatory and antioxidative properties (Pande 2002; Pandurang et al. 2011). Preparations with proven capability to stimulate immune and antioxidative reactions in poultry include juices and extracts from aloe (Aloe arborescens) (Ognik and Sembratowicz 2007, 2012). ‘Aloes Plus’ is a preparation based on the synergistic action of active compounds of aloe, trans-resveratrol (an antioxidant isolated from Japanese knotweed) and vitamin C. The stimulating effect on immune and antioxidative defence mechanisms of turkey hens was also demonstrated for a newly synthesized amidrazon derivative 5-oxo-1,2,4-triazine (Ognik and Sembratowicz 2011). This compound exhibits anti-inflammatory, antibacterial, antiviral and antifungal (in vitro analysis) properties (Modzelewksa-Banachiewicz and Kamińska 2000). Studies on turkeys have shown that 5-oxo-1,2,4-triazine had a stimulatory effect on weight gain and on the mineral composition of tissues (Ognik and Merska 2011).

The aim of the present study was to determine whether the introduction of stress affects the mineral composition of tissues of turkey hens, and whether additives used in conjunction with stress, such as aloe extract supplemented with trans-resveratrol and vitamin C or 5-oxo-1,2,4-triazine, mitigate adverse changes that may occur in these parameters.

2. Material and methods

2.1. Animals and sampling

Three hundred and sixty 6-week-old turkey hens of the BUT-9 line were randomly assigned to 6 experimental groups of 60 birds (6 replicates each with 10 birds). The birds had free access to drinking water and were fed ad libitum with complete feed mixtures balanced according to Nutrient Requirements for Poultry (2005).

Groups C and C (+) stress were control groups that did not receive any additive. Birds from groups A and A (+) stress were administered aloe extract with trans-resveratrol and vitamin C added in the amount of 0.70 ml/kg body weight (BW)/day. The additive is a Polish preparation with the commercial name Aloes Plus, produced by Herbapol Lublin, a producer of herbal products. The analysed contents of main active compounds are as follows: resveratrol (486.3 mg/l) and vitamin C (35.12 mg/l). Turkey hens from groups T and T (+) stress received the amidrazon derivative 5-oxo-1,2,4-triazine in the amount of 30 μg/kg BW/day, dissolved in a small quantity of ethanol (ca. 2 ml). The 5-oxo-1,2,4-triazine was synthesized by the Department of Organic Chemistry of the Medical University of Lublin. The additives were administered to the birds in their drinking water for 28 days starting from the 36th day of life. The dose of the additives per kg BW/day was determined on...
Table 1. The effect of aloe preparation and 5-oxo-1,2,4-triazyne on macroelement content of tissues of turkey hens (g/kg).

|                        | K    | Ca   | Mg   |
|------------------------|------|------|------|
| **Breast muscle**      |      |      |      |
| Stress                 | 1.73 | 1.59 | 0.14 |
| + Stress               | 1.65 | 1.59 | 0.46 |
| T                      | 1.69 | 1.55 | 0.14 |
| + Stress               | 1.64 | 1.59 | 0.38 |
| **Thigh muscles**      |      |      |      |
| Stress                 | 1.69 | 1.59 | 0.32 |
| + Stress               | 1.69 | 1.59 | 0.32 |
| T                      | 1.71 | 1.59 | 0.31 |
| + Stress               | 1.69 | 1.67 | 0.37 |
| **Shank muscles**      |      |      |      |
| Stress                 | 1.65 | 1.59 | 0.23 |
| + Stress               | 1.67 | 1.59 | 0.38 |
| T                      | 1.65 | 1.59 | 0.32 |
| + Stress               | 1.69 | 1.67 | 0.38 |
| **Liver**              |      |      |      |
| Stress                 | 1.54 | 1.73 | 0.23 |
| + Stress               | 1.53 | 1.69 | 2.23 |

Sem = 0.05

Means in the same column without common superscripts differ signifi-
cantly at *p ≤ 0.01; **p ≤ 0.05; ns p > .05.

2.2. Statistical analyses

Data achieved were analysed using the STATISTICA software package version 6.0 (StatSoft Corp., Kraków, Poland). A two-way repeated measures ANOVA was applied to assess the effect of main factors: stress (S), additives (D) and their interactions (S × D). If the analysis revealed a significant interaction or that both factors had a significant influence, the differences among the individual groups were then analysed using Tukey’s multiple range post hoc test. Data had been checked for normality before the statistical analysis was performed. Differences were considered to be significant at p ≤ .05. The pooled SEM was calculated as the standard deviation from all measurements divided by their square root.

3. Results and discussion

Under stress conditions the demand for minerals increases signifi-
cantly because they are utilized in reactions involving energy release and in mechanisms of antioxidative defence. Effects of stress factors may, therefore, include a loss of many valuable macro- and microelements, first in blood serum and then in tissues and muscles (Blahova et al. 2007; Truchliński et al. 2007). Finally, deficiencies of minerals deteriorate the quality of poultry meat. A study by Wójcik et al. (2009) on the impact of transport duration on the level of minerals in tissues of chickens has demonstrated that it decreases during long-time exposure to stress stimuli (transportation of long distances) when the body is incapable of covering for the deficiencies.
Results of our experiment indicate that the introduction of stress factors in the form of simultaneous crowding and changes in temperature and lighting conditions had no significant effect on concentrations of the analysed elements in tissues of turkey hens (Tables 1 and 2). Probably, the applied stress stimuli were not intense enough to cause more severe changes. However, earlier investigations conducted by Ognik et al. (2015) confirmed that these manipulations were stressogenic, because in stressed turkey a significant increase in plasma corticosterone (hormonal mediator of stress in birds) was observed.

Analysing the influence of tested additives on mineral composition of muscles and liver of turkey, both these exposed and not exposed to stress, it was stated that aloe preparation caused a significant increase in tissue levels of calcium (except for shank muscles), (Table 1) zinc (in leg muscles and liver) and copper (in thigh muscles) (Table 2). The increased concentration of calcium in muscles of turkey hens upon various doses of aloe extract was also demonstrated in a study by Ognik and Merska (2011). The increased concentration of selected macro- and microelements in tissues of the analysed turkey hens might have been due to their additional supply with aloe preparation or to beneficial effects of the active substances of aloe on their absorbability and retention. The investigations conducted on chicken (Stef and Gergen 2012) indicate that the addition of herbs or herbal preparations may facilitate the absorption of selected elements in the gastrointestinal tracts and increase their retention in tissues. In contrast, a significant decrease in tissues of turkey hens receiving aloe preparation was noted for iron concentration (except for breast muscles). It could probably result from a high concentration of calcium in the preparation, as its derivative of 1,2,4-triazole, also noted a significant decrease in iron concentration in liver of turkey hens.

4. Conclusion

In summary, it may be concluded that the applied stress factor in the form of simultaneous crowding and changes in temperature and lighting conditions did not affect mineral composition of the analysed tissues of turkey hens. Hence, the effects noted upon the administration of both analysed additives were not dependent on stress stimuli.

Advantages of aloe preparation application included a significant increase of calcium and zinc content in tissues. In turn, positive effects of applying a derivative of 5-oxo-1,2,4-triazine included only increased zinc content of the muscles and liver.

Disclosure statement

No potential conflict of interest was reported by the authors.

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Table 2. The effect of aloe preparation and 5-oxo-1,2,4-triazine on microelement content of tissues of turkey hens (mg/kg).

| Experimental factors | Breast muscles | Thigh muscles | Shank muscles | Liver |
|----------------------|----------------|--------------|---------------|-------|
|                      | Fe  | Zn  | Cu  | Fe  | Zn  | Cu  | Fe  | Zn  | Cu  |
| Stress – A           | 25.6| 2.0 | 23.1| 66.2a| 2.01a| 22.0b| 61.1a| 1.72a| 22.2a| 75.5a| 1.68a| 23.4a|
| Stress – T           | 25.7| 2.12| 23.6| 40.3a| 4.42a| 23.6b| 37.5a| 2.19b| 22.3a| 50.7a| 3.58a| 24.1a|
| Stress + C           | 23.3| 1.91| 22.3| 53.2a| 1.94a| 21.7a| 53.2a| 1.91b| 21.8a| 69.1a| 1.58b| 22.8a|
| Stress – A           | 23.3| 2.05| 22.7| 38.3a| 3.96a| 23.7a| 34.8b| 2.81a| 23.1a| 41.1b| 3.58a| 25.2a|
| Stress + T           | 24.8| 2.14| 22.8| 39.1b| 3.84a| 23.1a| 38.6a| 1.95a| 21.5b| 45.4b| 3.66a| 23.3a|

**SEM** 0.26 0.05 0.17 2.19 0.27 0.32 2.27 0.10 0.28 2.92 0.24 0.32

Additive effect (D)

|                      | C   | A   | T   |
|----------------------|-----|-----|-----|
| Stress – C           | 24.4| 2.13| 23.5| 59.7a| 1.97a| 21.8a| 57.1a| 1.81b| 22.0a| 72.3a| 1.63c| 23.1a|
| Stress + A           | 24.3| 2.13| 23.5| 38.3a| 4.73a| 24.2a| 25.6c| 2.82a| 23.7c| 44.6b| 4.03a| 25.6a|
| Stress + T           | 25.2| 2.13| 23.2| 39.7a| 4.15a| 23.3b| 38.0a| 2.07a| 21.9b| 48.0a| 3.62a| 23.7a|

**SEM** 0.26 0.05 0.17 2.19 0.27 0.32 2.27 0.10 0.28 2.92 0.24 0.32

Stress effect (S)

|                      | C   | A   | T   |
|----------------------|-----|-----|-----|
| Stress – C           | 25.5| 2.11| 23.7| 48.3a| 3.98a| 23.4a| 45.0a| 2.24a| 22.9a| 58.1b| 3.25a| 24.5a|
| Stress + A           | 25.2| 2.13| 23.2| 39.7a| 4.15a| 23.3b| 38.0a| 2.07a| 21.9b| 48.0a| 3.62a| 23.7a|
| Stress + T           | 25.5| 2.11| 23.7| 48.3a| 3.98a| 23.4a| 45.0a| 2.24a| 22.9a| 58.1b| 3.25a| 24.5a|

**SEM** 0.26 0.05 0.17 2.19 0.27 0.32 2.27 0.10 0.28 2.92 0.24 0.32

|                      | C   | A   | T   |
|----------------------|-----|-----|-----|
| Stress – C           | 24.8| 2.14| 22.8| 39.1b| 3.84a| 23.1a| 38.5a| 1.95b| 21.5b| 45.4b| 3.66a| 23.3a|
| Stress + C           | 24.4| 1.95| 22.7| 38.4b| 3.96b| 23.7b| 34.8b| 2.81b| 23.1b| 41.1b| 3.58b| 25.2b|

**SEM** 0.26 0.05 0.17 2.19 0.27 0.32 2.27 0.10 0.28 2.92 0.24 0.32

D effect

|                      | ns  | ns  | ns  |
|----------------------|-----|-----|-----|
| Stress – C           | **  | *   | ns  |
| Stress + A           | **  | *   | ns  |

S effect

|                      | ns  | ns  | ns  |
|----------------------|-----|-----|-----|
| Stress – C           | ns  | ns  | ns  |
| Stress + A           | ns  | ns  | ns  |

D × S interaction

|                      | ns  | ns  | ns  |
|----------------------|-----|-----|-----|
| Stress – C           | **  | *   | ns  |
| Stress + A           | **  | *   | ns  |

**Means in the same column without common superscripts differ significantly at *p ≤ 0.05; **p ≤ 0.05; ns p > 0.05.**
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