

Preliminary communications

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THE IMPACT OF THE MODE OF PHEASANT HANGING  
ON THE BIOGENIC AMINE CONCENTRATION IN MUSCLES

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The aim of this study was to assess the impact of hanging position of hunted pheasant carcasses (secured by the head as compared to hanging position secured by the legs) on the biogenic amine concentration in the thigh and breast muscles. The carcasses of feathered game (*Phasianus colchicus*), left entirely untreated after hunting and placed in a storage space at a pre-set temperature of 7 °C for 21 days were used in the study. Samples of breast and thigh muscles were taken at regular weekly intervals. Measurement of biogenic amines (putrescine, cadaverine, tyramine, tryptamine, histamine, phenylethylamine) was based on high-performance liquid chromatography coupled with triple quadrupole tandem mass spectrometry. Higher biogenic amine concentrations were detected in the muscles (both breast and thigh) of pheasants hanging by their legs compared to pheasants hanging by their heads (no statistically significant difference in biogenic amine concentration between monitored groups was, however, established). Higher concentrations of biogenic amines were found in the thigh muscles compared to breast muscles in both monitored groups. The obtained results show, that hanging the carcasses of pheasants during storage by the head is more suitable method in term of biogenic amine concentration than storing carcasses hanging by the legs.

**Keywords:** biogenic amine, common pheasant, hygienic quality, mode of hanging, storage

Biogenic amines are organic compounds of low molecular weight that are often classified as potential chemical indicators. In particular, putrescine, cadaverine, tyramine, and histamine are often considered indicators of freshness, and may be used as indicators of microbial spoilage (YANO et al., 1995; BÓKA et al., 2012). HERNANDEZ-JOVER and co-workers (1996) proposed the following limits for the sum concentrations of the aforementioned biogenic amines (putrescine, cadaverine, tyramine, and histamine) for the evaluation of the freshness of pork: <5 mg kg<sup>-1</sup> fresh meat; 5 to 20 mg kg<sup>-1</sup> meat of acceptable quality with incipient signs of spoilage; 20 to 50 mg kg<sup>-1</sup> meat of low hygiene quality; >50 mg kg<sup>-1</sup> spoiled meat. In previously presented studies concerning presence of biogenic amines in pheasant meat (HUTAROVA et al., 2013b), six biogenic amines were used for evaluating of hygienic meat quality (tryptamine and phenylethylamine were added due to their occurrence in similar extremely low concentrations as the concentration of histamine).

Venison is becoming increasingly popular with consumers in view of its specific composition. There are also increasing requirements for ensuring the hygiene safety and quality of this product in view of this fact (NUERNBERG et al., 2011). The method, in which the carcasses of wild animals are handled, is, to a certain extent, extremely specific. Unlike the carcasses of livestock, the carcasses of hunted game are stored for some time in the feathers

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or with the skin still attached so that the characteristic properties of game can develop. The carcasses of feathered game (especially common pheasants) are in some cases left for the storage period untreated (without removal of the intestines from the body cavity). Earlier studies (STANDAROVA et al., 2012; HUTAROVA et al., 2013a) show that when pheasants are stored in the typical way (hanging in pairs from the head), higher concentrations of biogenic amines were found in the thigh muscle tissue. Authors of studies focusing on the hygiene quality of the muscle tissue of pheasants during storage give two possible reasons for this phenomenon. The differing proportions of proteins in the breast and thigh muscle is one possibility (STANDAROVA et al., 2012), while the influence of the method of hanging the pheasant carcasses during storage has also come under consideration (HUTAROVA et al., 2013a).

The aim of this study was to assess the rate and extent of development of biogenic amines in the muscle tissue of hunted common pheasants stored in their feathers at a temperature of 7 °C in the hanging position secured by the head as compared to the hanging position secured by the legs, and to compare the results obtained for each type of pheasant carcass hanging during storage.

## 1. Materials and methods

### 1.1. Muscle samples

Carcasses of common pheasants (*Phasianus colchicus*) shot during a hunting trip in the Moravian-Silesian Region of the Czech Republic in the autumn of 2012 from a distance of approximately 30 m were used in the study. The carcasses of the feathered game (n=20) were left entirely untreated after hunting and placed in a storage space at a pre-set temperature of 7 °C, where they were stored for 21 days. Whole breast and thigh muscle tissue was removed from five carcasses at regular weekly intervals (1st, 7th, 14th and 21st day after pheasant hunting), from which samples were subsequently prepared (m=0.5 g) for the determination of the biogenic amine concentrations.

### 1.2. Biogenic amines assessment

Measurement of six underivatized biogenic amines (putrescine, cadaverine, tyramine, histamine, tryptamine, and phenylethylamine) was based on high-performance liquid chromatography coupled with triple quadrupole tandem mass spectrometry. The total amount of 0.5 g of homogenised muscle tissue from each animal was used. Samples were employed by one-step extraction using 5% mixture of trichloroacetic acid in water followed by clean-up step using a 0.45 µm syringe filter. Biogenic amines were separated from extract by reverse phase liquid chromatography using C<sub>18</sub> column (2.1 mm × 50 mm, 1.9 µm; Thermo, San Jose, CA, USA) and detected by tandem mass spectrometry using a heated electro spray-ionization in a positive ion mode. The method used for purposes of this study was carried out according to the method described in the study of HUTAROVA and co-workers (2013b).

### 1.3. Statistical analysis

The results obtained were subjected to a Kruskal-Wallis ANOVA and subsequently to nonparametric Tukey-type multiple comparison tests with ranked sums to assess the differences between all possible pairs of groups. The P-value of P<0.05 was considered statistically significant.

**2. Results and discussion**

The sums of selected biogenic amines in the breast and thigh muscles of the two groups of pheasants (hanging by the legs – group A; hanging by the head – group B) are shown in Figures 1 and 2.

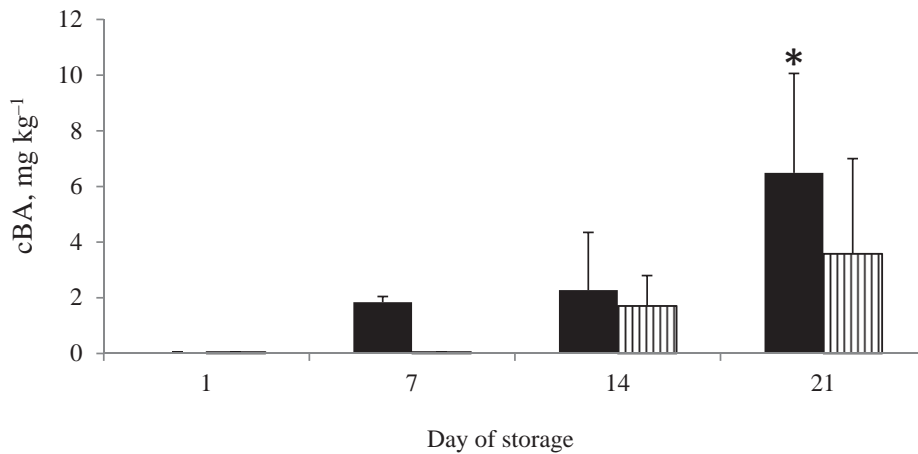


Fig. 1. Biogenic amine concentrations (cBA) in the breast muscle of carcasses of pheasants hanging by the legs (A) and pheasants hanging by the head (B). ■: A; ▨: B

\*Statistically significant difference (when compared with the cBA value determined in the same group on the first date of sampling)

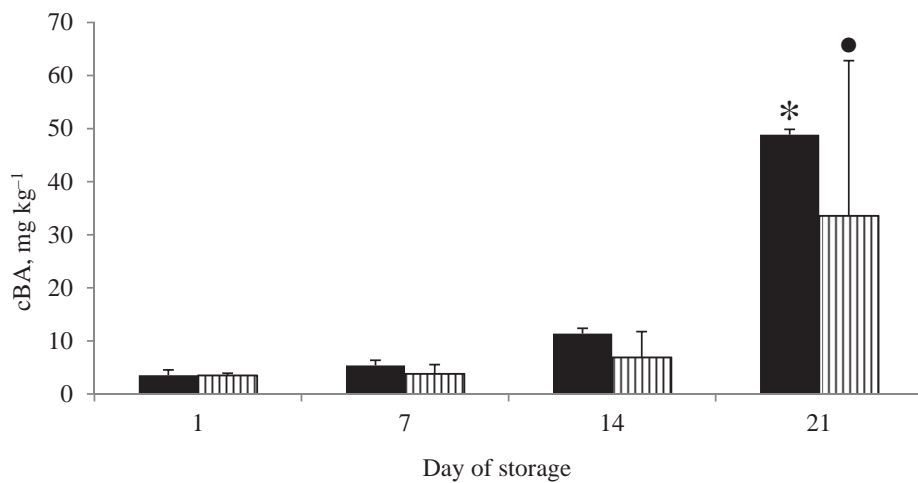


Fig. 2. Biogenic amine concentrations (cBA) in the thigh muscle of carcasses of pheasants hanging by the legs (A) and pheasants hanging by the head (B). ■: A; ▨: B

\* Statistically significant difference in group A pheasant carcasses (when compared with the cBA value determined in the same group on the first date of sampling)

• Statistically significant difference in group B pheasant carcasses (when compared with the cBA value determined in the same group on the first date of sampling)

The resulting concentrations of biogenic amines in the muscle groups of the individual groups of pheasants are compared with the values proposed in the work of HERNANDEZ-JOVER and co-workers (1996) for the evaluation of the freshness of pork. According to the results, it is clear that the breast muscle of pheasants, stored hanging by the legs, retained the character of meat of high hygiene quality for a period of 14 days of storage (the sum of the concentrations of biogenic amines on day 21 of storage was  $6.49 \text{ mg kg}^{-1}$ ). In pheasants, stored hanging by the head, the breast muscle corresponded to meat of high hygiene quality throughout the whole storage period (the highest value of the sum concentration of  $3.58 \text{ mg kg}^{-1}$  was found on day 21).

In the case of thigh muscle, a loss of the character of meat of high hygiene quality was discovered on day 7 of storage in the carcasses of pheasants stored hanging by the legs (sum concentration of BA:  $5.37 \text{ mg kg}^{-1}$ ), and on day 14 of storage in carcasses of pheasants hanging by the head (sum concentration of BA:  $6.90 \text{ mg kg}^{-1}$ ). At the end of the storage period (sum concentration of BA:  $48.85 \text{ mg kg}^{-1}$  in pheasant carcasses hanging by the legs;  $33.58 \text{ mg kg}^{-1}$  in pheasant carcasses hanging by the head), the thigh muscle of both groups of pheasants corresponded to meat of low hygiene quality (HERNANDEZ-JOVER et al., 1996).

Furthermore, it is clear from the above results that higher concentrations of biogenic amines (the sum of putrescine, cadaverine, tyramine, histamine, tryptamine, and phenylethylamine) were detected in the muscle tissue (both breast and thigh) of pheasants hanging by their legs (group A) throughout the entire storage period. No statistically significant difference between the concentrations of biogenic amines in group A (pheasant carcasses stored hanging by the legs) and group B (pheasant carcasses stored hanging by the head) was, however, established.

A gradual increase in the concentrations of biogenic amines was observed in the breast and thigh muscle tissue of both groups of pheasants during storage. Statistically significant differences in concentrations were, however, only detected between sampling days 1 and 4 in the cases indicated in Figures 1 and 2.

Higher concentrations of biogenic amines were found in the thigh muscle tissue in both monitored groups (A, B); with statistical significant difference at all sampling days in the case of group A and the first two sampling days in the group B. Contrasting results were found by STANDAROVA and co-workers (2012) and SILVA and GLORIA (2002) in their studies with pheasant and poultry muscle tissues, respectively, where higher biogenic amine concentrations were found in breast muscle. The reason for their not even distribution in the breast and thigh muscle, however, was not solved in these studies.

The possible influence of method of storage (specifically the method of hanging the pheasant carcasses during storage) on the concentration of biogenic amines in the muscle tissue of pheasants is mentioned in the work by HUTAROVA and co-workers (2013a). The general assumption is that the way the bodies hang during storage influences the more distal parts, meaning that they may be predisposed to a more rapid loss of hygiene quality (and therefore have a higher content of biogenic amines).

When comparing the concentrations of biogenic amines in the breast muscle in the studied groups, higher concentrations were found in the muscle tissue in the carcasses of pheasants hanging by the legs (group A) – breast muscle could therefore be considered to be the part of the body that is predisposed to a more rapid loss of hygiene quality (no statistical significance was, however, confirmed). The same situation was, however, observed in the thigh muscle (a higher concentration of biogenic amines in the thigh muscle of the carcasses of pheasants in group A – hanging by the legs – as compared to the thigh muscle of carcasses hanging by the head – group B). If the method of hanging really affects the rate of loss of

hygiene quality of the more distal parts of the body during storage, this would lead to the opposite result for the concentration of biogenic amines in the thigh muscle.

The same conclusion also comes from the results of a comparison of the concentrations of biogenic amines in the breast and thigh muscles in the individual groups A and B. Both groups were found to have higher concentrations of biogenic amines in the thigh muscle. The results we obtained point, therefore, to the fact that the higher content of biogenic amines in the thigh muscle is unrelated to the method of hanging carcasses during storage.

The given results also show that higher concentrations of biogenic amines were detected at the beginning of storage in the muscle tissue (breast and thigh) of group B pheasants (pheasants hanging by the head). After just 7 days of storage, however, higher concentrations of biogenic amines were detected in group A pheasants (pheasants hanging by the legs); the same situation was observed right up to the end of the period for which the pheasant carcasses were stored. These results, therefore, highlight the fact that hanging the carcasses of pheasants during storage by the head appears to be, in terms of rate and extent of formation of biogenic amines, a more suitable method than storing carcasses hanging by the legs.

### 3. Conclusions

The aim of this study was to assess the impact of mode of hanging of pheasant carcasses on the concentration of biogenic amines in breast and thigh muscle of hunted common pheasants stored in their feathers at a temperature of 7 °C. Even if the results show that hanging the carcasses of pheasants during storage by the head appears to be more suitable method than storing carcasses hanging by the legs, the fact that the higher concentration of biogenic amines in the thigh muscle compared to breast muscle is related to the method of hanging carcasses during storage was not established.

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