Potravinarstvo, vol. 8, 2014, no. 1, p. 102-106
doi:10.5219/365
Received: 13 March 2014. Accepted: 22 March 2014.
Available online: 7 May 2014 at www.potravinarstvo.com

ISSN 1337-0960 (online)

SENSORY QUALITY, COLOUR AND OXIDATIVE STABILITY OF CURED COOKED HAM WITH PROPOLIS EXTRACT

Miroslav Kročko, Marek Bobko, Ondřej Bučko, Margita Čanigová, Viera Ducková

ABSTRACT

The effect of 0.06% propolis ethanol extract on the sensory quality, colour and oxidative stability of cured cooked ham was evaluated. Half of the experimentally processed hams treated with 0.06% ethanolic extract of propolis with ascorbic acid (EEP), only with ascorbic acid (AA) and control samples (C) were sliced and vacuum packaged. Samples were kept at 4 °C 21 days (sliced) respectively 20, 50 and 100 days (unsliced). The results revealed that all samples were characterized without any significant colour discrepancies. In general, the thiobarbituric acid value (mg malondialdehyde/kg) increased gradually in all samples examined, with a significantly lower ($P < 0.05$) level for treated samples than for controls. The significantly lowest ($P < 0.05$) sensory parameters in comparison to unsliced hams were observed in sliced hams packaged in vacuum. Sliced hams with EEP were characterized with significantly lowest ($P < 0.05$) intensity of characteristic aroma. Undesirable taste was detected in control sliced hams after storage period. Significantly ($P < 0.05$) more desirable taste of sliced hams was observed in those with only ascorbic acid in comparison with EEP. In our study was demonstrated that 0.06% ethanol extract of propolis positive affected oxidation stability and not negative affected others technological (pH, colour) and sensory characteristics of poultry meat product - cured cooked ham.

Keywords: chicken meat; propolis extract; oxidation; colour; sensory quality

INTRODUCTION

High consumption of poultry meat leads to concern that the products marketed should be safe, have a low spoilage rate and show the right composition, packaging, colour, taste and appearance **(Rio et al., 2007)**. The oxidation of lipids in meat products is a key problem that reduces shelf life of frozen meats, fermented processed meat such as dry sausages, and cured raw ham **(Ladikos and Lougovois, 1990)**. A reduction of oxidation processes in meat and meat products can also come from the application of natural substances like propolis.

Propolis is an adhesive, dark yellow to brown coloured balsam that smells like resin. It is collected from buds, leaves and similar parts of trees and plants mixed with wax, sugar and plant exudates collected by bees from certain plant sources. More than 300 constituents have been identified in different propolis samples **(Valle, 2000; Banskota et al., 2001; Shalmany and Shivazad, 2006)**. Propolis is rich in biochemical constituents, including mostly a mixture of polyphenols, flavonoid aglycones, phenolic acid and their esters, phenolic aldehydes and ketones, terpenes, sterols, vitamins, amino acids etc. **(Walker and Crane, 1987)**. These components possess antimicrobial, antifugal and antioxidant properties **(Lu et al., 2005; Trusheva et al., 2006)**.

It is worth mentioning that propolis can be used as a water or ethanolic extract; both extracts can reduce the total volatile basic nitrogen content in meat products and can thus serve as a good preservative and contribute to promote human health, because they are produced naturally **(Han et al., 2001)**. However, water - extracted propolis has a weaker antibacterial, antioxidant and antifungal action than ethanolic extract **(Garedew et al., 2004)**. In recent years, propolis has been taken for health reasons but has had limited use in meat processing and food preservation **(Ali et al., 2010)**.

Our study was designed to evaluate the effect of propolis added to cured cooked ham. The sensory, colour and antioxidant stability of sliced and unsliced hams packaged in vacuum were determined after 21 days (sliced) resp. 20, 50 and 100 days (unsliced) after refrigerated storage at 4 °C.

MATERIAL AND METHODOLOGY

Preparation of propolis:

Propolis extract was prepared from minced propolis (50 g) in the conditions of the 96% ethanol in the 100 ml flask. After ten days of storage at room temperature the extract was filtered through Whatman no. 1. The resulting filtrate was evaporated and lyophilized. The ethanol and aqueous solutions as a solvent were utilized for resuspending and preparing 0.06% ethanol - water soluble propolis extract (EEP).

Preparation of cooked ham:

Chicken meat (12 kg of breasts and thighs) was minced with the 2 cm blade, cured (2.0% salt and 0.01% nitrite) and cooling 24 hours at 4 °C. The next day, minced meat was divided into three equal parts: non-treated meat was then tumbled with 10% of water (C), second part of meat was tumbled with 10% of water plus 0.5 g/kg ascorbic acid (AA) and third part was treated with 0.06% w/w ethanol-extracted propolis with 0.5 g/kg ascorbic acid

(EEP 0.06%). Each part were separately filled into polyamide casings and heat treated in water bath until the temperature in the core reached the value 70 °C for 10 min. Half of ham samples from each of the group were sliced and vacuum packaged. Samples were kept at 4 °C 21 days (sliced) respectively 20, 50 and 100 days (unsliced).

Determination of antioxidant activity:

Lipid oxidation was assessed in triplicate by the 2-thiobarbituric acid (TBA) test following the recommendations of **Grau et al. (2000)** and measured by spectrophotometric method at 532 nm (Jenway UV/VIS - 7305, UK). TBARS values were calculated from a standard curve of malondialdehyde (MDA) and expressed as mg MDA/kg sample.

Determination of pH value:

The pH value of cooked hams was measured using a Gryf 209 (Gryf HB, Czech Republic) apparatus during whole period of storage.

Determination of colour:

Colour spaces L*, a*, b* of cooked hams were determined by CM 2600D spectrophotometer (Konica Minolta, Germany) after homogenization according to **Hunt and Manciny (2002)**. Colour on the surface of homogenized hams was measured with SCE (Specular Component Excluded).

Sensory evaluation of cooked hams:

Samples of cooked hams were evaluated by a 6 member semi-trained panel of laboratory co-workers. Panelists evaluated, colour, aroma, juiciness and taste on 8 point hedonic scale where 1 (the worst) and 8 (the best) were the extremes of each characteristic.

RESULTS AND DISCUSSION

The pH value of unsliced hams of experimental and control groups fluctuated from 6.02 to 6.13. Significantly higher values of pH ($P < 0.05$) were determined in sliced hams (6.17 to 6.23). Final pH value of hams was near to pH values of both chicken thighs and chicken breasts. These values correspond with ultimate values of pH determined in chicken muscles by **Šulcerová et al. (2011)**. In both groups (sliced and unsliced) were not detected significant differences of pH value between experimental and control hams, so propolis had no negative effect to cooked ham acidity.

All samples were characterized without any significant colour discrepancies. It was found that propolis in combination with ascorbic acid not significantly improve intensity of red colour in sliced hams after 21 days of storage. Intensity of red colour (a*) in unsliced hams decreased ($P > 0.05$) but lightness (L*) was improved after 50 and 100 days of storage. Intensity of yellow colour (b*) was the highest in unsliced hams with ascorbic acid, but differences during storage were not significant (Figure 1).

Lipid oxidation is one of the main limiting factors for the quality and acceptability of this type of ham. The antioxidant activity has been measured in the past using a TBA assay in model meat systems with addition of essential oils, showing a potential for protecting meat from oxidation **(Ruberto and Baratta, 1999)**. The rate and extent of oxidative deterioration can be reduced by various means, such as curing to preserve the meat tissues, vacuum packaging to remove the oxygen source, or adding of antioxidants to scavenge the oxidants **(Wong et al., 1995)**.

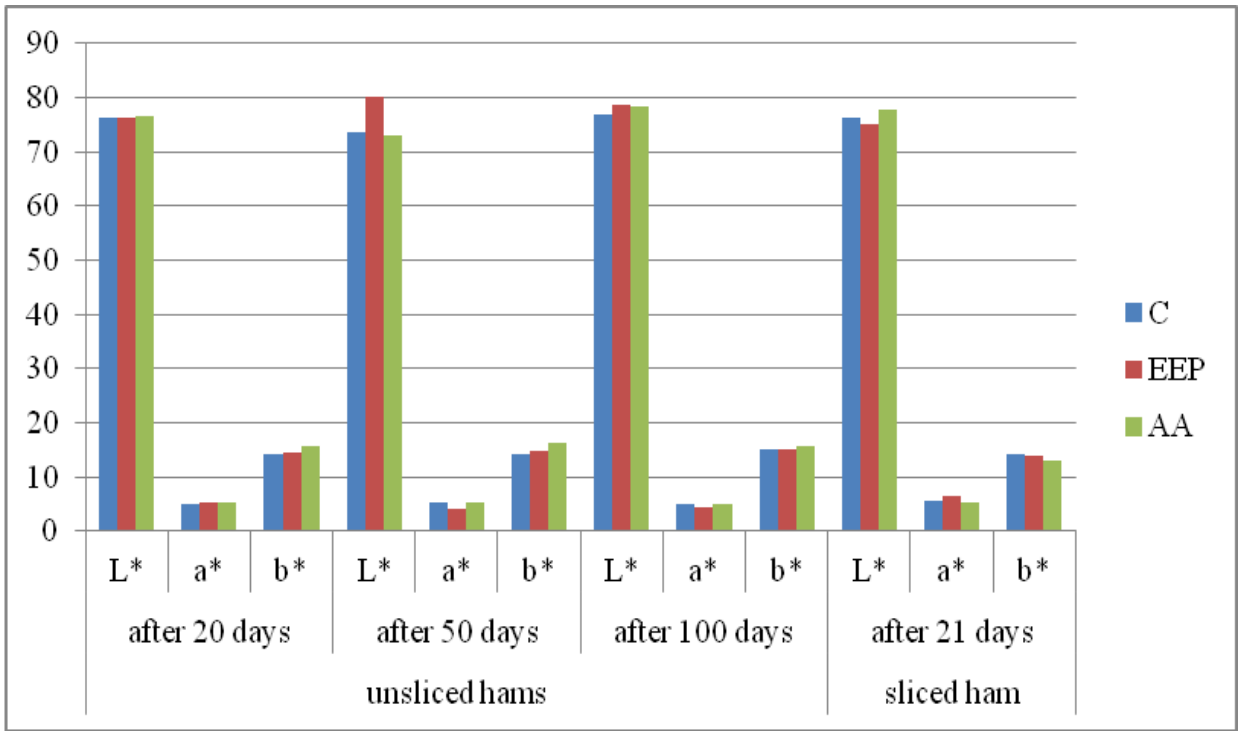

Figure 1 Effect of propolis extract on the ham colour during chilling storage (4°C)

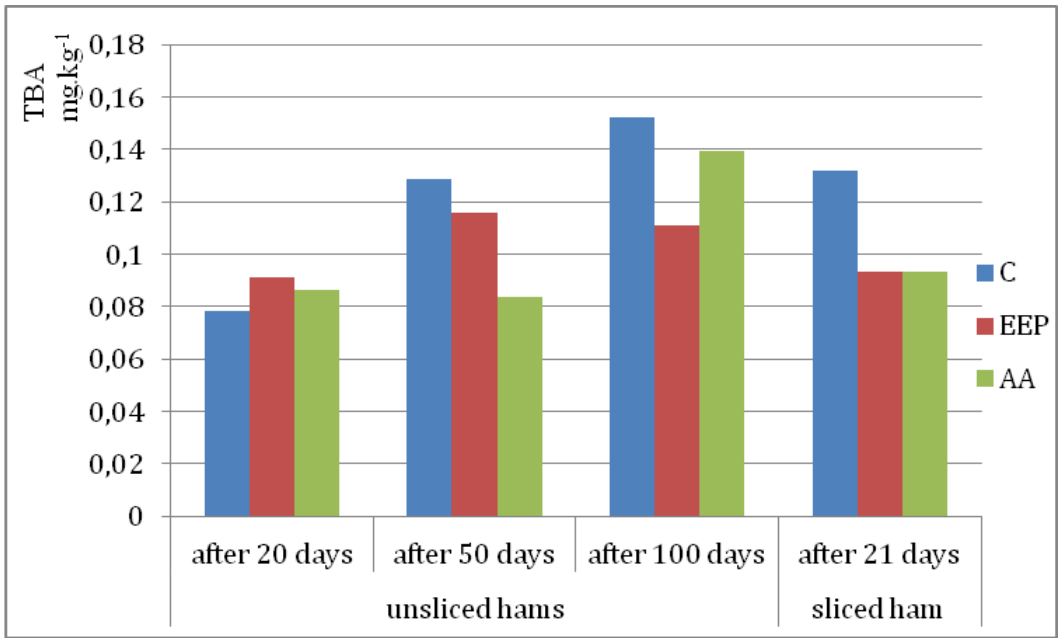

Figure 2 Effect of propolis extract on the amount of malondialdehyde during chilling storage (4°C)

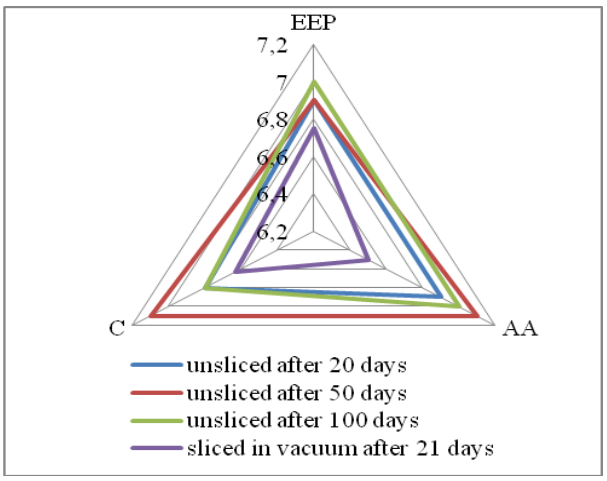

Figure 3 Effect of propolis on ham colour determined by sensory evaluation

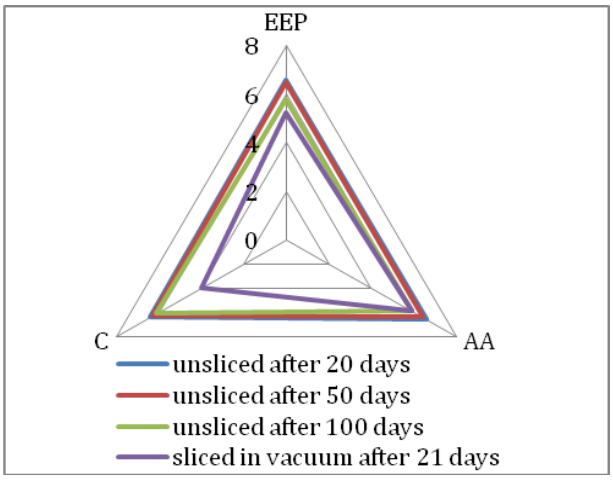

Figure 5 Effect of propolis on ham taste determined by sensory evaluation

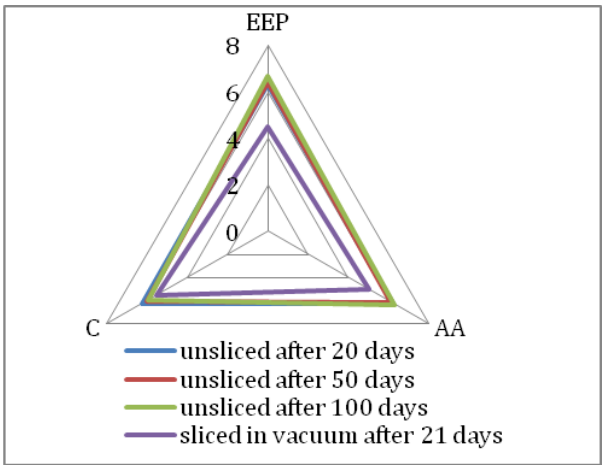

Figure 4 Effect of propolis on ham aroma determined by sensory evaluation

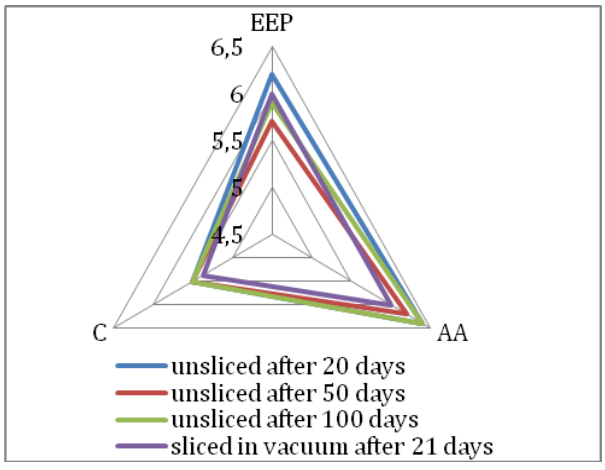

Figure 6 Effect of propolis on ham juiciness determined by sensory evaluation

The application of antioxidants is one of the simplest ways of reducing lipid oxidation. Antioxidants minimise lipid peroxidation, act as oxygen scavengers, react with free radicals and chelate catalytic metals and consequently retard oxidative deterioration **(Shahidi and Wanasundara, 1992)**.

It was found that the TBA value increase during storage in unsliced and also in sliced hams mainly in control group (Figure 2). In the unsliced hams with ascorbic acid addition was determined higher oxidative stability than in the hams with the addition of EEP. However, the highest oxidation stability in unsliced hams was found after 100 days of storage in hams with EEP. In sliced vacuum packaged hams significantly lower ($P < 0.05$) TBA values were found in hams treated with EEP and AA in compare to control. In comparison with unsliced hams, after 20 days higher amount of TBA was found in sliced hams packaged in vacuum. The strong antioxidative and antibacterial activity of honey, propolis, pollen and royal jelly after to different kind of meat addition confirmed the work of **Koo et al. (2000)**.

Propolis has a very characteristic and strong odour; the addition of its extract in formulations could confer its color and particularly its odour, to the product, and affect the acceptance of the product by the consumer **(Gonçalves et al., 2011)**. However, **Yang et al. (2010)** reported that concentrations of aroma-active components in propolis were closely related to the regions of propolis origin and components with high concentrations did not always play important roles in odour contribution.

Storage period had not significant effect ($P > 0.05$) on colour and aroma sensory parameters of unsliced hams (Figure 3 and 4,). Intensity of typical taste (Figure 5) of unsliced hams with EEP not significantly decreased after 100 days of storage. Significantly increased ($P < 0.05$) juiciness (Figure 6) was observed in ham only with ascorbic acid in compare with EEP and C. However, overall acceptability of unsliced hams with EEP during 100 days of storage was not changed. The significantly lowest ($P < 0.05$) sensory parameters in comparison to unsliced hams were observed in sliced hams packaged in vacuum. Sliced hams with EEP were characterized with significantly lowest ($P < 0.05$) intensity of characteristic aroma.

Undesirable taste was detected in control sliced hams. Significantly ($P < 0.05$) more desirable taste of sliced hams was observed in those with only ascorbic acid in comparison with EEP.

CONCLUSION

Addition of 0.06% propolis extract not substitute addition of ascorbic acid, but the results clearly confirm that the quality of the hams with the addition of EEP is due to their oxidative stability, color and sensory parameters significantly higher than without the addition of antioxidants. Also, the additions of natural antioxidant - propolis in this concentration to the hams enrich the food chain of human with natural flavonoids and polyphenols.

REFERENCES

Banskota, A. H., Tezuka, Y., Kadota, S. 2001. Recent progress in pharmacological research o propolis. *Phytotherapy Research*, vol. 15, no. 7, p. 561-571. http://dx.doi.org/10.1002/ptr.1029 PMid:11746834

Ali F. H., Kassem G. M., Atta-Alla O. A. 2010. Propolis as a natural decontaminant and antioxidant in fresh oriental sausage. *Veterinaria Italiana*, vol. 46, no. 2, p. 167-172. PMid:20560126

Garedew, A., Schmolz, E., Lamprecht, I. 2004. Microbiological and calorimetric investigations on the antimicrobial actions of different propolis extracts: an in vitro approach. *Thermochimica Acta*, vol. 422, p. 115-124. http://dx.doi.org/10.1016/j.tca.2004.05.037

Gonçalves, G. M. S., Srebernich, S. M., Souza, J. A. M. 2011. Stability and sensory assessment of emulsions containing propolis extract and/or tocopheryl acetate. *Brazilian Journal o Pharmaceutical Sciences*, vol. 47, p. 585-592. http://dx.doi.org/10.1590/S1984-82502011000300016

Grau, A., Guardiola, F., Boatella, M., Barroeta, A., Codony, R. 2000. Measurement of 2-thiobarbituric acid values in dark chicken meat through derivative spectrophotometry: influence of various parameters. *Journal of Agricultural and Food Chemistry*, vol. 48, p. 1155-1159. http://dx.doi.org/10.1021/jf990518q PMid:10775365

Han, S. K., Yamauchi, K., Park, H. K. 2001. Effect of nitrite and propolis preservative on volatile basic nitrogen changes in meat products. *Microbios*, vol. 105, no. 411, p. 71-75. PMid:11393750

Hunt, M. C., Mancini, R. A. 2002. Guidelines for measuring pork color. In 3rd Annual Pork Quality Improvement Symposium, Michigan State University, 2002, s. 17.

Koo, H., Gomes, B. P. F. A., Rosalem, P. L., Ambrosano, G. M. B., Park, Y. K., Cury, J. A. 2000. In vitro antimicrobial activity of propolis and *Arnica montana* against oral pathogens. *Archives of Oral Biology*, vol. 45, no. 2, p. 141-148. PMid:10716618

Ladikos, D., Lougovois, V. 1990. Lipid oxidation in muscle foods: A review. *Food Chemistry*, vol. 35, no. 4, p. 295-314. http://dx.doi.org/10.1016/0308-8146(90)90019-Z

Lu, L. C., Chem, Y. W., Chou, C. C. 2005. Antibacterial activity of propolis against *Staphylococcus aureus*. *International Journal of Food Microbiology*, vol. 102, no. 2, p. 213-220. http://dx.doi.org/10.1016/j.ijfoodmicro.2004.12.017 PMid:15992620

Río, E., Panizo-Morán, M., Prieto, M., Alonso-Calleja, C., Capita, R., 2007. Effect of various chemical decontamination treatments on natural microflora and sensory characteristics of poultry. *International Journal of Food Microbiology*, vol. 115, no. 3, p. 268-280. http://dx.doi.org/10.1016/j.ijfoodmicro.2006.10.048 PMid:17320231

Ruberto, G., Baratta, M. T. 1999. Antioxidant activity of selected essential oil components in two lipid model systems. *Food Chemistry*, vol. 69, no 2, p. 167-174. http://dx.doi.org/10.1016/S0308-8146(99)00247-2

Shahidi, S., Wanasundara, B. K. 1992. Phenolic antioxidants. *Critical Reviews in Food Science and Nutrition*, vol. 32, no. 1, p. 67-103. http://dx.doi.org/10.1080/10408399209527581 PMid:1290586

Shalmany, S. K., Shivazad, M. 2006. The effect of diet propolis supplementation on ross broiler chicks performance. *Journal of Poultry Science*, vol. 5, no. 1, p. 84-88. http://dx.doi.org/10.3923/ijps.2006.84.88

Šulcerová, H., Mihok, M., Jůzl, M., Haščík, P. 2011. Effect of addition of pollen and propolis to feeding mixtures during the production of broiler chickens ross 308 to the colour of thigh and breast muscle and pH determination. *Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis*, vol. 59, p. 359-366. http://dx.doi.org/10.11118/actaun201159060359

Trusheva, B., Popova, M., Bankova, V., Simova, S., Marcucci, M. C., Miorin, P. L., Da Rocha Pasin, F., Tsvetkova, I. 2006. Bioactive constituents of Brazilian red propolis. *Evidence-based Complementary and Alternative Medicine*, vol. 3, no. 2, p. 249-254. http://dx.doi.org/10.1093/ecam/nel006 PMid:16786055

Valle, M. L. 2000. Quantitative determination of antibacterial capacities of propolis. *Apiacta*, vol. 35, no. 2, p. 152-161.

Walker, P., Crane, E. 1987. Constituents of propolis. *Apidologie*, vol. 18, no. 4, p. 327-334. http://dx.doi.org/10.1051/apido:19870404

Wong, J. W., Hashimoto, K., Shibamoto, T. 1995. Antioxidant activities of rosemary and sage extracts and vitamin E in a model meat system. *Journal of Agricultural and Food Chemistry*, vol. 43, p. 2707-2712. http://dx.doi.org/10.1021/jf00058a029

Yang C., Luo, L., Zhang, H., Yang, X., Lv, Y., Song, H. 2010. Common aroma-active components of propolis from 23 regions of China. *Journal of the Science of Food and Agriculture*, vol. 90, no. 7, p. 1268-1282. http://dx.doi.org/10.1002/jsfa.3969 PMid:20394010

Acknowledgments:

This work was supported by grant VEGA 1/0129/13 and co-funded by European community under project no 26220220180: Building Research Centre „Agrobiotech“.

Contact address:

Miroslav Kročko, Slovak University of Agriculture in Nitra, Faculty of Biotechnology and Food Sciences, Department for Evaluation and Processing of Animal Products, Tr. A. Hlinku 2, 949 76 Nitra, Slovakia, E-mail: mirokrocko@yahoo.com.

Marek Bobko, Slovak University of Agriculture in Nitra, Faculty of Biotechnology and Food Sciences, Department for Evaluation and Processing of Animal Products, Tr. A. Hlinku 2, 949 76 Nitra, Slovakia, E-mail: marek.bobko@uniag.sk.

Ondřej Bučko, Slovak University of Agriculture in Nitra, Faculty of Biotechnology and Food Sciences, Department of Department of Animal Husbandry, Tr. A. Hlinku 2, 949 76 Nitra, Slovakia, E-mail: ondrej.bucko@uniag.sk.

Margita Čanigová, Slovak University of Agriculture in Nitra, Faculty of Biotechnology and Food Sciences, Department for Evaluation and Processing of Animal Products, Tr. A. Hlinku 2, 949 76 Nitra, Slovakia, E-mail: margita.canigova@yahoo.com.

Viera Ducková, Slovak University of Agriculture in Nitra, Faculty of Biotechnology and Food Sciences, Department for Evaluation and Processing of Animal Products, Tr. A. Hlinku 2, 949 76 Nitra, Slovakia, E-mail: viera.duckova@uniag.sk.