Oxidative stability of organic pig meat

Karwowska M. and Dolatowski Z.J.

Department of Meat Technology and Food Quality, University of Life Sciences in Lublin,
ul. Skromna 8, 20-704 Lublin, Poland

Abstract - **The aim of the research was to investigate the influence of organic pig production on oxidative stability of pork loin. Investigations were carried out on organic pork meat compared to those from conventional production. Loin muscles (*m. longissimus dorsi*) were purchased from animals (Puławska and crossbreds of Puławska x Polish Landrace). The meat samples were examined at the following times *post mortem:* 2, 4, 7 days. Measurements of lipid oxidation showed that the organic meat samples were characterized by lower TBARS values during whole storage period compared to those of conventional system production. Results of oxidation-reduction potential measurements of the organic meat sample were significantly lower at the beginning of experiment than those for the conventional meat sample. It was also indicated that the production system had no effect on iron content and myoglobin oxidation during storage.**

Keywords – **organic meat, oxidation**

I. INTRODUCTION

Organic farming in Europe has grown over the last years because the interest of organic animal products has increased. Organic food are purchased by consumers mainly for health reasons. Consumers perceive that this food is safer [1]. Moreover, organic livestock farming is reputed to be environmentally friendly, sustaining animals in good health, with high welfare standards and resulting in high quality products [2].

Oxidation processes are one of the major problems encountered in meat processing and storage because affect the sensory attributes, nutritional values and generates compounds that may be unsafe for human health [3]. Since organic animal products contain more poluansaturated fatty acids it seem to be more susceptible to oxidation [4].

The purpose of the research was to study the influence of organic pig production on oxidation-reduction potential, lipid and myoglobin oxidation as well as total iron content of pork loin.

II. MATERIALS AND METHODS

Investigations were carried out on organic pork meat compared to those from conventional production. Loin muscles (*m. longissimus dorsi*) were purchased from animals (Puławska and crossbreds of Puławska x Polish Landrace) with a body weight of approximately 125 kg at slaughter. The meat samples were packed into the HDPE bags and then stored in a refrigerator at 4°C and were examined at the following times *post mortem:* 2, 4, 7 days.

Oxidation- reduction potential (ORP)

ORP measurements of muscles homogenates were carried out using a digital pH-meter CPC-501 (Elmetron) equipped with redox electrode (ERPt-13, Elmetron).

Lipid oxidation

Thiobarbituric acid reactive substances (TBARS) for the meat samples were calculated and equated to lipid oxidation of meat. The rose-pink color obtained by the reaction between malondialdehyde (MDA) and 2-thiobarbituric acid was measured at 532 nm (Nicole Evolution 300, Thermo Electron Corporation). The amount of TBARS was expressed as milligrams of malondialdehyde (MDA) per kilogram of meat.

Total iron content

Measurements of Fe were carried out according to the Polish Standard [5]. The samples were dry-mineralized and determined using atomic absorption spectrophotometry.

Myoglobin oxidation

Metmyoglobin content was calculated using the method described by Fernández-López et al. [6]. The absorbance of supernatant was read at 525, 572 and 730 nm. Percentage of MetMb was determined using the formula [7]:

$$\text{MetMb (\%)} = 1.395 - ((A_{572} - A_{730})/(A_{525} - A_{730})) \times 100$$

Statistical analysis

Obtained results were statistically analysed using the Microsoft Office Excel 2007. Significance of differences between samples at the same storage time and the same sample at different storage times was determined (at the significance level $p \leq 0.05$) using T-Tukey's test.

III. RESULTS

Results of oxidation-reduction potential measurements of the organic meat sample were significantly lower at the beginning of experiment than those for the conventional meat sample (Fig. 1). It was also noticed that ORP values varied slightly during storage for conventional and organic samples.

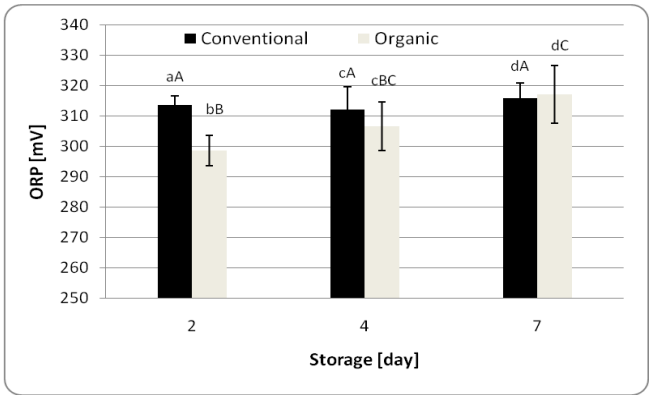

Fig. 1 Oxidation-reduction potential (ORP) of meat during storage. Means followed by the same lower case letters between the samples at the same storage time and capital letters between the same sample at different storage times are not significantly different at $p \leq 0.05$.

Measurements of lipid oxidation indicated that the formation of malondialdehyde did not change for conventional and organic meat samples with storage time (Fig. 2). The results showed that organic meat samples were characterized by lower TBARS values during whole storage period compared to those of conventional system production.

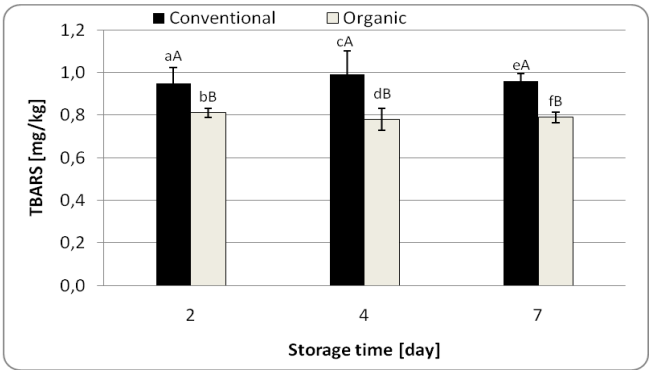

Fig. 2 Lipid oxidation (mg MDA/kg meat) of meat during storage. Means followed by the same lower case letters between the samples at the same storage time and capital letters between the same sample at different storage times are not significantly different at $p \leq 0.05$.

In table 1, the data obtained for total iron content of meat products during storage is shown. The results indicated, that there was not a significant difference for total iron content between samples.

Table 1 Total iron content [mg/kg] of meat during storage. A statistically significant difference between samples was not detected ($p \leq 0.05$)

	Total iron content [mg/kg]
Conventional	17.7±0.49
Organic	17.4±1.36

Percentage metmyoglobin (%MetMB) did not change for conventional and organic meat samples with storage time (Fig. 3). Additionally, there was not a significance difference for metmyoglobin content between conventional and organic meat samples.

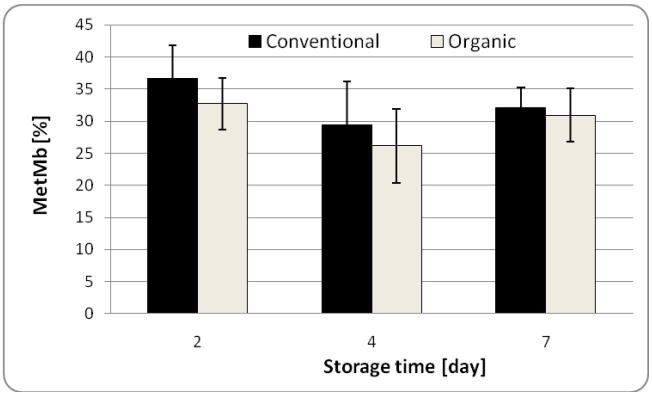

Fig. 3 Metmyoglobin content (%) of meat during storage. A statistically significant difference between samples was not detected ($p \leq 0.05$)

IV. DISCUSSION

Oxidative stability of meat is a central parameter in estimation of these food products because of the susceptibility of meat components to oxidative degeneration [8].

Lipid and myoglobin oxidation are one of the major problems encountered in meat processing and storage. Myoglobin oxidation is affected by many factors [9] including lipid oxidation and nonheme iron. Iron is also known as the most probable catalyst for the initiation of lipid peroxidation [3]. It was also indicated that free radicals derived from lipid oxidation can initiate the oxidation of myoglobin to metmyoglobin [10].

In the current study, lipid peroxidation measurement (TBARS) showed that organic meat

samples were characterized by lower TBARS values during whole storage period compared to those of conventional system production. However, no significance difference for metmyoglobin and total iron content between conventional and organic meat samples was indicated during 7 days of storage period.

V. CONCLUSIONS

Obtained results pointed out that the organic pig meat was characterized by higher oxidative stability during the whole storage time compared to meat from conventional production system.

REFERENCES

1. Bonneau M, Lebret B (2010) Production systems and influence on eating quality of pork. Meat Sci. 84:293-300
2. Sundrum A (2001) Organic livestock farming. A critical review. Liv Prod Sci 67:207–215
3. Min B, Ahn DU (2005) Mechanism of lipid peroxidation in meat and meat products – a review. Food Sci Biotechn 14:152-163
4. Lairon D (2010) Nutritional quality and safety of organic food. A review. Agron Sustain Dev 30:33-41
5. Polish Standard PN-EN 14082:2004. Determination of Pb, Cd, Zn, Cu, Fe and Cr using method atomic absorption spectrophotometry (in Polish)
6. Fernández-López J, Sevilla L, Sayas-Barberá ME et al. (2003) Evaluation of the antioxidant potential of hyssop (Hyssopus officinalis L.) and rosemary (Rosmarinus officinalis L.) extract in cooked pork meat. J Food Sci 68:660–664
7. Krzywicki K (1979) Assessment of relative content of myoglobin, oxymyoglobin and metmyoglobin at the surface of beef. Meat Sci 3(1):1–10
8. Gray JI, Gromaa EA, Buckley DJ (1996) Oxidative quality and shelf life of meats. Meat Sci 43:111-123
9. Reneree M (2000) Oxidative processes and myoglobin. Antioxidants in muscle foods. Nutritional strategies to improve quality. New York: John Wiley & Sons, Inc.
10. Faustman C, Sun Q, Mancini R, Suman SP (2010) Myoglobin and lipid oxidation interactions: Mechanistic bases and control. Meat Sci. 86:86-94