Usability of meat from immunologically castrated male pigs for packaging under a modified atmosphere.

Gallas, L.[1], Borilova, G.[1], Svobodova, I.[1], Steinhauserova, I.[1], Steinhauser, L.[1]

[1] University of Veterinary and Pharmaceutical Sciences Brno, Brno, Czech Republic

Abstract - **Immunological castration is used as an alternative to the physical castration of male pigs. The aim of this study was to evaluate the sensory acceptability of raw pork meat (leg, loin, belly, shoulder butt, jowl, liver, kidney) from immunologically castrated (Improvac) and physically castrated male pigs packaged in a modified atmosphere. Samples of raw pork meat were packed in an MAPAX 30 modified atmosphere containing 30 % CO_2 and 70 % O_2. All the types of meat were packed under the same conditions (temperature, relative humidity, etc.). The period of cold storage was 16 days at +4 °C. Samples of the packaged meats were analysed by chemical, microbiological and sensory methods. An analysis of volatile organic compounds from the headspace was performed by GC-MS. Analyses were performed on fresh material on the day of packing and subsequently on the fourth, eighth, twelfth and sixteenth days of storage. No differences were found in microbiological and chemical parameters such as total viable count, lactic acid bacteria count, pH and ammonia content. No significant differences were found between these two groups of samples at the end of storage for parameters such as TBARS content and colour parameters using CIEL*a*b*. The sensory evaluation found no differences in overall impression, colour, aroma and texture between these two groups of samples. This study showed that meat from immunologically castrated male pigs (Improvac) is appropriate for modified atmosphere packaging and cold storage.**

Keywords – **Improvac, quality, packaging**

I. INTRODUCTION

Boar taint is a sensory defect that affects pig meat quality and it is mainly due to the presence of androstenone, a compound with urine like odour and skatole, a compound with faecal odour. Skatole (3-methyl-indole) is the product of the anaerobic degradation of the tryptophan aminoacid in the gut. Androstenone (5a-androst-16-en-3-one) is a steroid synthesized in the testis of the maturing pigs. Its content mainly depends on the slaughter weight/age (maturity of the pig), testis size and genetics and to a lesser extent on rearing and feeding conditions. Elimination of the testes (physical castration) is the most efficient method to reduce androstenone levels. Surgical castration without anaesthesia is the most common methodology used in Europe to control boar taint but it is detrimental from the animal welfare point of view. Vaccination against gonadotropin releasing factor (GnRF) (also known as immunocastration) is an efficient alternative to physical castration as it reduces androstenone and skatole content [1, 2]. A commercial GnRF vaccine (ImprovacTM, Pfizer Animal Health) is registered for use in pig industries in the EU, Switzerland, Russia and in countries outside Europe such as Australia, Mexico and Brazil [3]. Vaccination strongly reduced the weight of testes and accessory reproductive glands. Regarding growth performance, the immunocastrated males showed comparable feed intake, feed efficiency and growth rate as boars in the growth period [4]. Vaccinated boars have lower content of fat and higher content of lean meat in carcass [4, 5]. The aim of this study is to characterize usability of a meat from immunocastrated pigs compared with meat from physicaly castrated male pigs under modified atmosphere packaging.

II. MATERIALS AND METHODS

A. Animals

The experimental design included two groups of pigs (crossbreeds from Danish Duroc x (Danish Landrace x Danish Large White). The first group included surgically castrated male pigs. Surgical castration was performed at the age of one week. The second group included vaccinated male pigs. Improvac vaccine was administered to pigs ten and six weeks before slaughter. The two groups of pigs were raised under the same husbandry and feeding condition. Pigs were slaughtered at the age of 25 weeks at an average live weight of about 110 kg.

B. Samples and sample preparation

The next day after the pigs slaughtering were pork half-carcasses divided into portions and trimmed in a

standard way. The following meat cuts were used for modified atmosphere packaging:

- Loin, boneless, trimmed
- Shoulder butt, boneless, trimmed
- Leg, boneless, trimmed
- Belly, boneless, trimmed
- Jowl, boneless, trimmed
- Liver, trimmed
- Kidneys, trimmed

Muscle and liver samples were standardized to the weight of 500 g each. Kidneys were packaged individually, one kidney per package. Samples were placed in AMILEN-OX 80 (VF Verpackungen GmbH, Germany) and packaged under standard modified atmosphere MAPAX 30 (Linde gas a.g., Czech Republic) containing 30 % CO_2 and 70 % O_2. For modified atmosphere packaging of samples, the Turbovac packing machine (HFE vacuum systems b.v., Netherlands) was used. Packaged samples were maintained at 4±0.5 °C until microbiological, chemical, and sensory analyses. Analyses were performed at 0, 4, 8, 12 and 16 days of storage.

C. Microbiological analyses

Total viable counts (TVC) were performed in accordance with ISO 4833. **Lactic acid bacteria counts** (LAB) were performed in accordance with ISO 13721. Results were converted to log values and used for statistical analyses of data.

D. Physical and chemical analyses

The **pH** was measured in duplicate with a pH meter (pH 340i, WTW GmbH, Weilheim, Germany) with a needle tip pH electrode (SenTIX SP, WTW GmbH, Weilheim, Germany). **Ammonia content** was determined using Conway microdiffusion method. Determination of fat content was performed in accordance with ISO 1444. **TBARS content** - The distillation method with 2-thiobarbituric acid was performed using a method of Tarladgis et al. (1960). **Instrumental colour analyses** (CIEL*a*b* colour system) of meat were performed with a KonicaMinolta Colorimeter CM 2600d (Minolta, Japan) using light source D65, CIE standard illuminates for daylight. L* describes the lightness of the sample, a* redness and b* yellowness. Red colour was expressed as the a* value: the higher the a* value, the redder the sample. Five measurements were made directly on each meat surface selected locations with a measuring area of 8 mm and standard observer with a 10° field of view. The instrument was standardized using white standard plates.

Measurements were made in duplicate. Mean values were used for statistical analyses of data.

E. Volatile organic compounds analyses

The analysis of volatile organic compounds (VOC) in modified atmosphere was performed on each sample. The headspace samples were pumped through needle on sorptive tube with active carbon with flow 200 $cm^{-3}.min^{-1}$ for 10 min. Desorption of these captured compounds were carried out by 0.5 ml carbon disulphide. The analyses was performed using GC-MS according to Li (2003) [6].

F. Sensory analyses

Sensory analysis was performed on all samples. Overall impression, colour, smell and texture were evaluated. Evaluations were performed by 18 specially trained panellists from among employees of the Institute of Meat Hygiene and Technology (Univ. of Veterinary and Pharmaceutical Sciences Brno).. Rating scores were recorded in a report using unstructured graphic scales 100 mm long. The scales with records of rating were measured and the values ascertained were converted into an electronic format.

G. Statistical analyses

Data analysis was performed with StatSoft, Inc. (2005). STATISTICA Cz, version 7.1. Student´s t-test and analysis of variance (ANOVA) were used.

III. RESULTS

A. Microbiological parameters

The initial values of total viable counts were approx. 1.0 log $CFU.g^{-1}$. This values increased to approx. 2.5 - 3.0 log $CFU.g^{-1}$ during storage. Samples of liver and kidney resulting values ranged around 4.0 log $CFU.g^{-1}$. Differences in the numbers of total viable counts between the both groups of samples were not statistically significant during storage.

Lactic acid bacteria were not found in samples of meat at the beginning of storage. The values of lactic acid bacteria increased to a maximum value about 2.0 - 2.5 log $CFU.g^{-1}$ at the end of storage. Samples of liver and kidney resulting final values ranged around 3.0 log $CFU.g^{-1}$. Differences in the numbers of lactic

acid bacteria between the both groups of samples were not statistically significant during storage.

B. Physical and chemical parameters

The initial values of pH ranged from 5.7 to 5.8 in samples of meat. The pH values increased to 6.0 - 6.2 during storage. Differences in pH values between both groups of samples were not statistically significant during storage.

The initial values of ammonia content ranged about 12 mg.100g in samples of meat. Those values increased to approx. 16 mg.100 g during storage. Differences in ammonia content values between both groups of samples were not statistically significant during storage.

The concentrations of TBARS in samples of the same type of meat was similar. The differences in TBARS concentrations between samples of the same type of meat were not statistically significant during storage.

Colour parameters L*, a* and b* measured in the CIEL*a*b* system were similar between samples of the same type of meat. No statistically significant differences were found between them during storage.

C. Volatile organic compounds

The spectrum of volatile organic compounds was the same for both types of meat. We found no statistically significant differences in the spectrum and concentrations of volatile organic compounds between both groups of meat samples.

D. Sensory parameters

The sensory evaluation found no differences in overall impression, colour, aroma and texture between these two groups of samples (Fig. 1).

IV. DISCUSSION

Has been published many studies on the effects of the Improvac vaccine on growth of pigs during fattening and pork quality in recent years. However, these studies concerned with the quality of fresh raw, non-processed meat [1, 4, 7,].

Microbiological parameters of the packaged meat are the same as in similar studies dealing with quality and durability of packaged meat [8, 9, 10, 11].

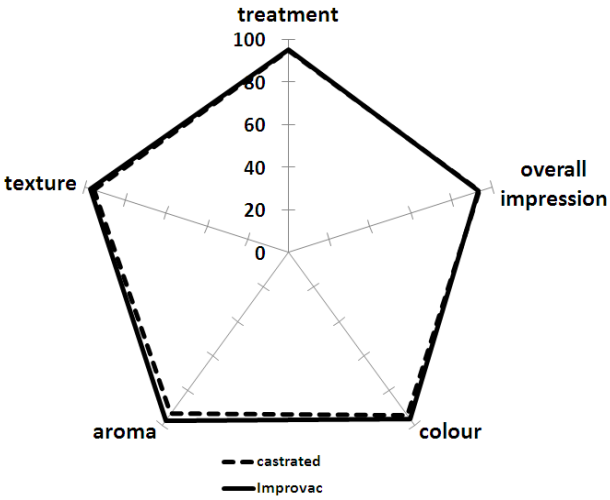

Fig. 1 Sensory evaluation of shoulder but at the end of storage

Physical and chemical parameters of the packaged meat are also the same as in other published studies [8, 9, 10, 11].

The results of sensory analysis confirm the good shelf-life of pork meat from vaccinated pigs packaged in modified atmosphere [8, 9, 10, 11].

V. CONCLUSIONS

This study showed that meat from vaccinated male pigs (Improvac) is appropriate for modified atmosphere packaging and cold storage. The results of microbiological, chemical and sensory analysis shows that between meat of physically castrated pigs and vaccinated pigs are no differences.

VI. REFERENCES

1 Font i Furnols M, González J, Gispert M et al. (2009) Sensory characterization of meat from pigs vaccinated against gonadotropin releasing factor compared to meat from surgically castrated, entire male and female pigs. Meat Sci 83:438-442

2 Frederiksen B, Font i Furnols M, Lundström K et al. (2009) Practice on castration of piglets in Europe. Animal 3:1480-1487

3 Baumgartner J, Laister S, Koller M et al. (2010) The behaviour of male fattening pigs following either surgical castration or vaccination with a GnRF vaccine. Meat Sci 124:28-34

4 Škrlep M, Šegula B, Zajec M. et al. (2010) Effect of immunocastration (Improvac®) in fattening pigs I: gro wth performance, reproductive organs and malodorous compounds. Slov Vet Res 47:57-64
5 Jaros P, Bürgi E, Stark KDC et al. (2010) Effect of immunization against GnRH on androstenone concentration, growth performance and carcass quality in intact male pigs. Livest Prod Sci 92:31-38
6 Li K, Fingas M (2003) Evaluation of the HP 6890/5973 bench-top gas chromatograph/mass selective detector for use in mobile laboratories. J Hazard Mater 102:81-91
7 Škrlep M, Šegula B, Prevolnik M et al. (2010) Effect of immunocastration (Improvac®) in fattening pigs II: Carcass traits and meat quality. Slov Vet Res 47: 65-72
8. Singh P, Wani AA, Saengerlaub S et al. (2011) Understanding critical factors for the quality and shelf-life of MAP fresh meat: a review. Crit Rev Food Sci 51:146-177
9 Zhang M, Sundar S (2005) Effect of oxygen concentration on the shelf-life of fresh pork packed in a modified atmosphere. Packag Technol Sci 18: 217-222
10 Faucitano L, Ielo MC, Ster C et al. (2010) Shelf life of pork from five different quality classes. Meat Sci 84:466-469
11 Knox BL, van Laack RLJM, Davidson PM (2008) Relationships between ultimate pH and microbial, chemical, and physical characteristics of vacuum-packaged pork loins. J Food Sci 73:M104-M110