INFLUENCE OF CHILLING ON MICROBIOLOGICAL QUALITY OF PIG CARCASS SURFACE AND POSTMORTAL PROCESSES IN PORK

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SUMMARY

The aim of the study was to observe the microclimatic conditions in chilling room and their influence on pork temperature, pH value, amount of lactic acid, and microbiological quality of pig carcasses surface. During the experiment, the temperatures in chilling room and the temperatures of meat corresponded with valid food legislation. The values of relative humidity were in one third of measurements lower and in more than a half of measurements higher than limits prescribed. Higher values of relative humidity have adversely influenced the reduction of aerobic plate counts. In two cases, the non-standard post-mortal process (evaluated on the basis of pH value and the amount of lactic acid) was discovered.

Key words: *chilling, temperature, humidity, microbiological quality, pig carcasses*

INTRODUCTION

The maintenance of technological parameters of meat of slaughtered animals in time of their processing on the slaughter line constitutes one of the important and permanent measures. In the period following slaughter processing basic technological parameters of meat are influenced by numerous factors of both external and internal origin.

Quality of meat obtained in slaughterhouse depends on animal welfare and maintenance of raw meat. Optimal conditions in all steps, transport of animals, stunning, bleeding, evisceration, processing and storage must be met (Woltersdorf, 1994).

Chilling of meat of slaughtered animals after slaughtering can be considered as one of basic and requisite technological steps during meat processing. Chilling of meat is necessary to create basic conditions for handling with meat in high output facilities and for production of sufficient supply for continuous delivery of meat to human population. Quality of chilling process and storage at chilling conditions of meat has important influence on global qualitative level of meat production. Meat production presents production of raw meat, intermediate products for other processing and ready-to-use meat products (Turek, 1992).

Hygiene conditions of meat processing facilities have impact on meat quality and shelf life of meat products. Microbiological contamination can be practically present in all stages of slaughter processing of pigs from stunning up to transfer of carcasses into chilling storage rooms (Turek et al., 1989).

Ripening of meat and its texture depends on the course of post-mortem processes (rigor mortis), which are influenced by genetic differences, animal welfare before slaughtering (stress) and speed of chilling after slaughter processing. Monitoring of chilling process and its control and verification belong among the most important areas which must be included in good manufacturing practices (Joseph, 1997).

The system of production of safe food is based on the principles of prevention of any contact with microbiological contamination. Compliance of these criteria is frequently impossible because of contamination of animals before slaughtering or during slaughter processing. Under these circumstances good manufacturing practices introduce option for reduction, prevention or elimination of growth and

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multiplication of contaminated microflora. Control of hygiene conditions of processing and storage of food must be applied (Eley, 1996).

MATERIAL AND METHODS

Temperature and relative humidity in chilling room were measured and also temperature of muscles and pH value of muscles; lactic acid content and microbiological parameters (total plate count, count of Coliform bacteria, the presence of Escherichia coli, Salmonella sp., and Listeria monocytogenes) on the surface of slaughtered pigs were also examined. Twenty-four samples of muscles from pigs during processing, 12 samples after processing (approximately 1.5 hour) and 12 samples after unloading of carcasses from chilling room were collected. Samples were taken from pig carcasses in a low capacity slaughterhouse (capacity 30 pigs/day). Cotton swabs were used for the determination of microbiological contamination of the surface of pig carcasses. Microbiological samples were analysed at the Department of Food Hygiene in State Veterinary and Food Institute in Zvolen. Lactic acid content was examined at the Department of Food Hygiene and Technology in University of Veterinary Medicine in Košice.

Measurement of microclimatic conditions in chilling room and temperature of muscles

Microclimatic conditions in chilling room (temperature, relative humidity) and temperature of muscles were monitored using module ELPRO, type Ecolog TH 1 (Kucian, Switzerland).

Estimation of pH value

pH values of thigh muscles were measured before (60 minutes after slaughter) and after chilling (24 hrs after slaughter) with the use of digital pH-meter (WTW pH-90, Germany) in thigh muscle.

Estimation of lactic acid content in muscles by analytical capillary isotachophoresis method

Estimation of lactic acid content in muscles (thigh) was performed by analytical capillary isotachophoresis method using analyser ZKI 001 (Labeco, the Slovak Republic).

Microbiological examination of swabs

Swabs were taken according to Veterinary laboratory methods (1990) from the right half of pig carcasses (area of 10 cm2) using detoxicated cotton swabs (wetted with Burger solution).

The swabs were examined according to STN ISO standards as follows:

- STN 4833. Microbiology. General guidance for counting of microorganisms. Colony count technique at 30 °C.
- STN ISO 4832. Microbiology. General guidance for counting of Coliform bacteria. Colony count technique.
- STN ISO 7251. Microbiology. General guidance for counting of presumptive Escherichia coli. Most probable number technique.
- Confirmation of Salmonella. STN ISO 6579. Microbiology. General guidance on methods for the detection of Salmonella.
- STN 10560. Milk and milk products. Detection of Listeria monocytogenes.

RESULTS

Chilling temperatures measured in the slaughterhouse chilling room ranged from 1.0 to 4.0°C at the beginning of chilling process and from 2.0 to 4.5°C at the end of the process (Graph 1). These data were in accordance with provisions established in Food code of the Slovak Republic. Values of relative humidity (Graph 2) ranged from 57 to 95% at the beginning of the process and from 88 to 100% at the time of unloading of carcasses from chilling room. In four cases (33.33%) at the beginning of chilling the values of relative humidity were below the permissible level and in seven cases (58.33%) after finishing of chilling above the upper level established by Food code SR (XXVII, 14, 1996).

Mean temperature of pig carcasses before chilling was 40.0°C and 2.15°C after chilling (Graph 3). Measured data are in accordance with requirements, which should ensure health safety and hygiene conditions of red meat. These requirements provide need of chilling of pork meat at the internal temperature of + 7°C within 24 hours.

The pH values of thigh muscles ranged from 5.7 to 6.8, one sample showed values suspicious for

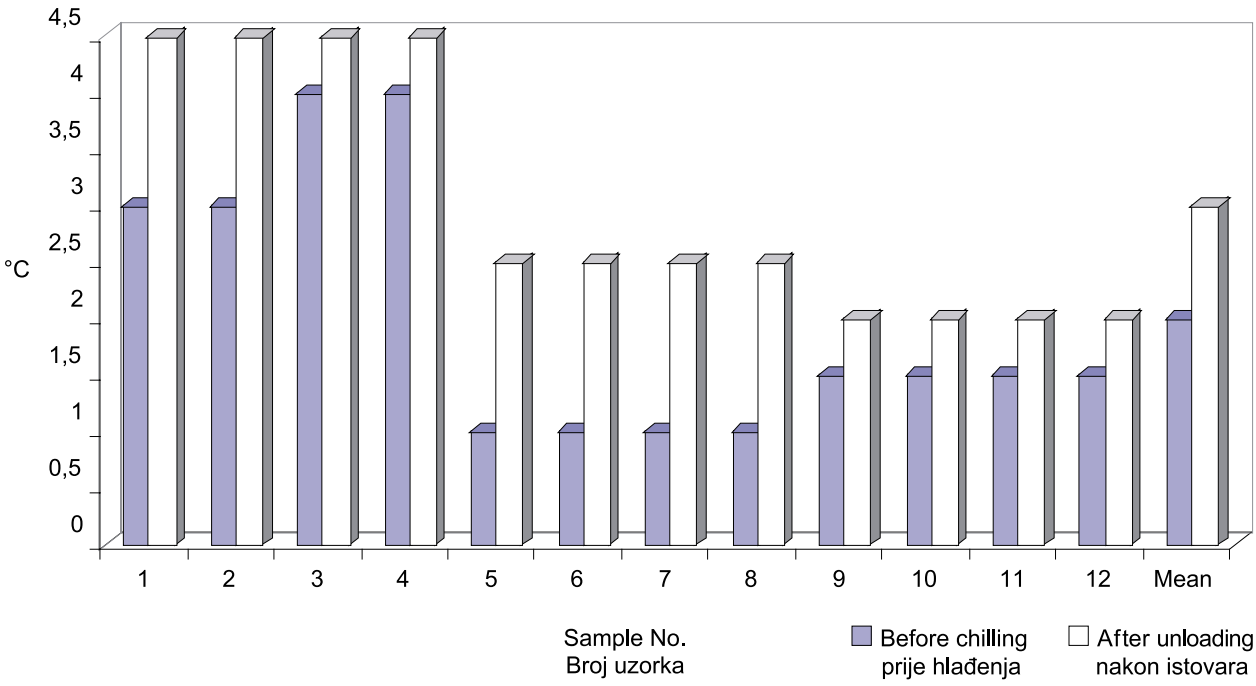
PSE meat (5.8) and one sample was slightly above this level (5.9) (Graph 4). Mean lactic acid content in samples of muscles taken immediately after slaughtering was 0.35 g•100g-1. During storage at chilling conditions significant increase in lactic acid content (0.47 g•100g-1) was recorded (Graph 5). The lowest increase of lactic acid concentration was recorded in samples with initial pH value 5.8 (suspicious for PSE).

Microbiological examination of pork samples during the chilling storage showed a significant decrease in the aerobic plate count from 5.7x104/10 cm2 to 2.1x104/10 cm2 (Graph 6). An average aerobic plate count examined on the medial surface of the thigh muscles after completed chilling decreased by 57.96% in comparison with the aerobic plate count measured immediately after slaughtering. A significant reduction of aerobic plate count after chilling was confirmed at lower values of relative humidity (67.2% at 88% relative humidity 88%, 53.3% at 100% relative humidity respectively) in comparison with the values after slaughtering. Coliform bacteria were found on the surface of pig carcass muscles in 10 samples. However, only two samples were positive for the presence of Coliform bacteria after chilling. The count of Coliform bacteria ranged from 2.0x10/10 cm2 to 1.6x102/10 cm2 (Graph 7). After slaughtering of pigs, Escherichia coli was confirmed in two samples at a level 2.0x10/10 cm2, all samples were negative at the end of chilling process. Salmonella and Listeria monocytogenes were not found in any of analysed samples.

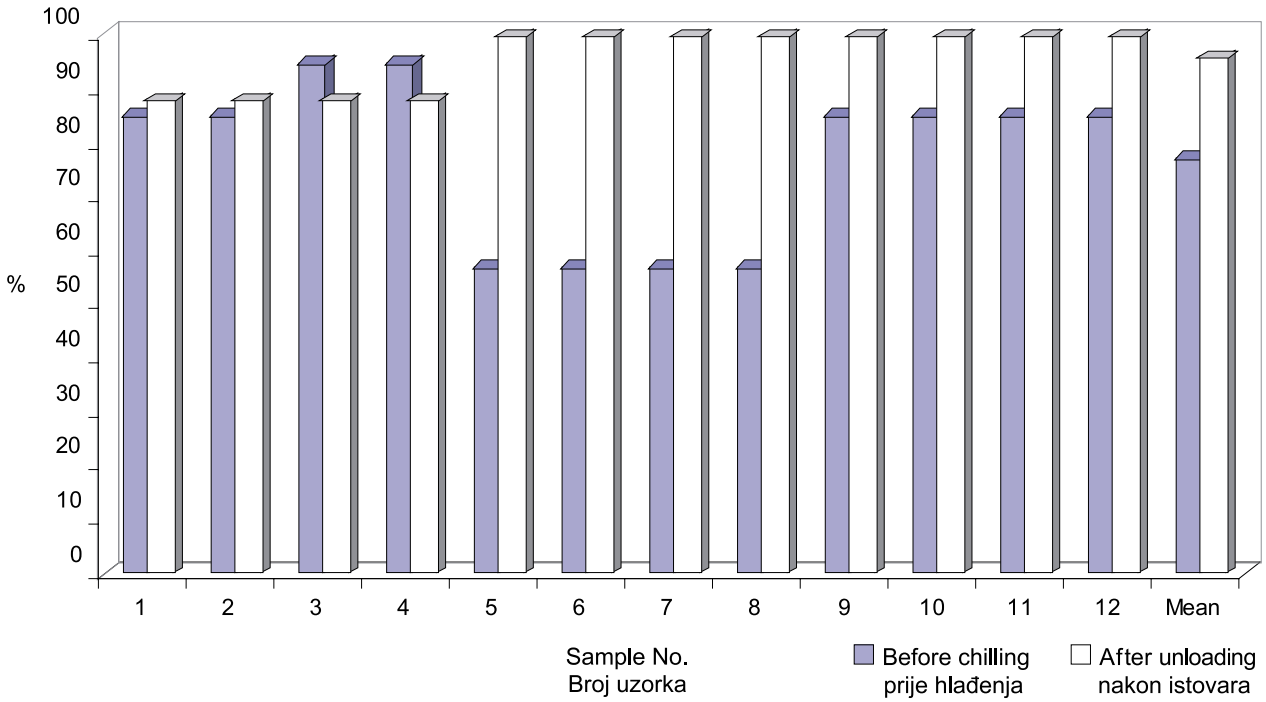
CONCLUSION

No violations of temperature conditions in the chilling room were recorded. The temperatures measured in the meat corresponded with the temperature conditions in chilling room (were in accordance with Food code of the Slovak Republic). On the other hand, the values of relative humidity have negatively influenced the claimed reduction of aerobic plate count. The nonstandard course of postmortal processes was ascertained in two cases. It was evaluated on the basis of the pH value and the amount of lactic acid.

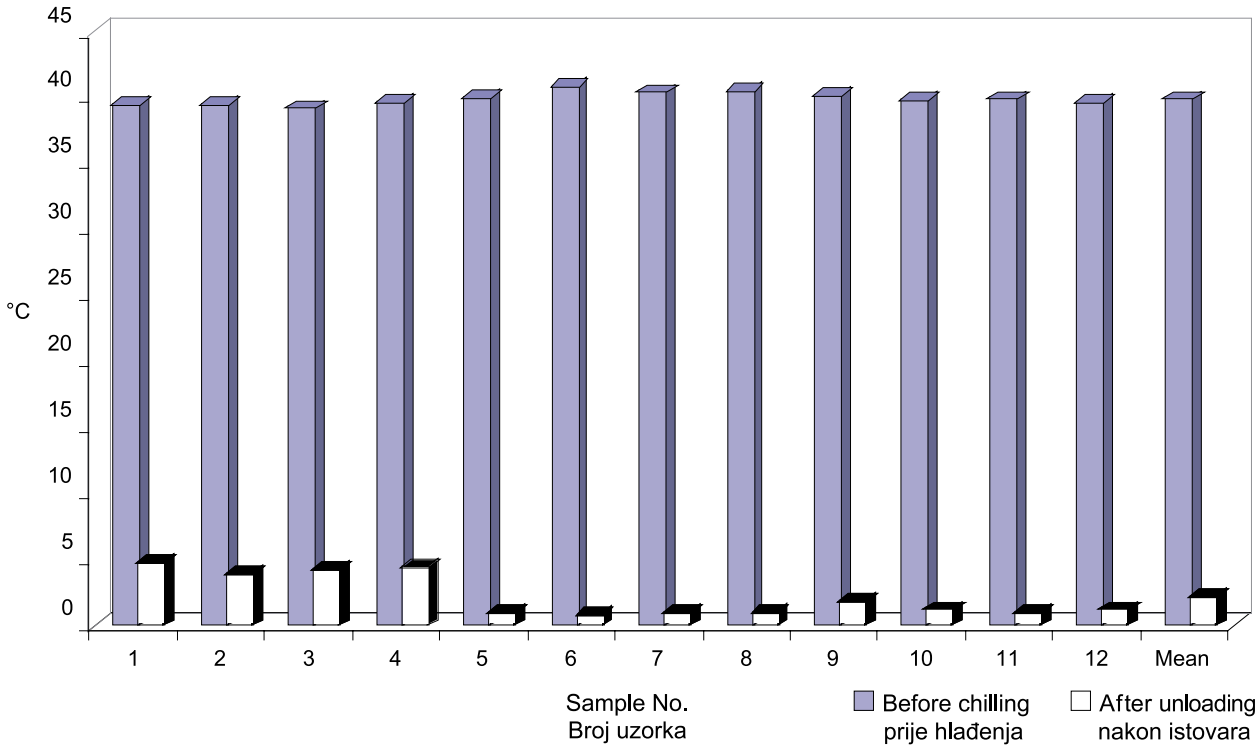
▼ **Graph 1** Comparison of chilling temperatures before loading and unloading of pork carcasses
▼ **Graf 1.** Usporedni prikaz temperatura hlađenja prije utovara i nakon istovara svinjskih polovica



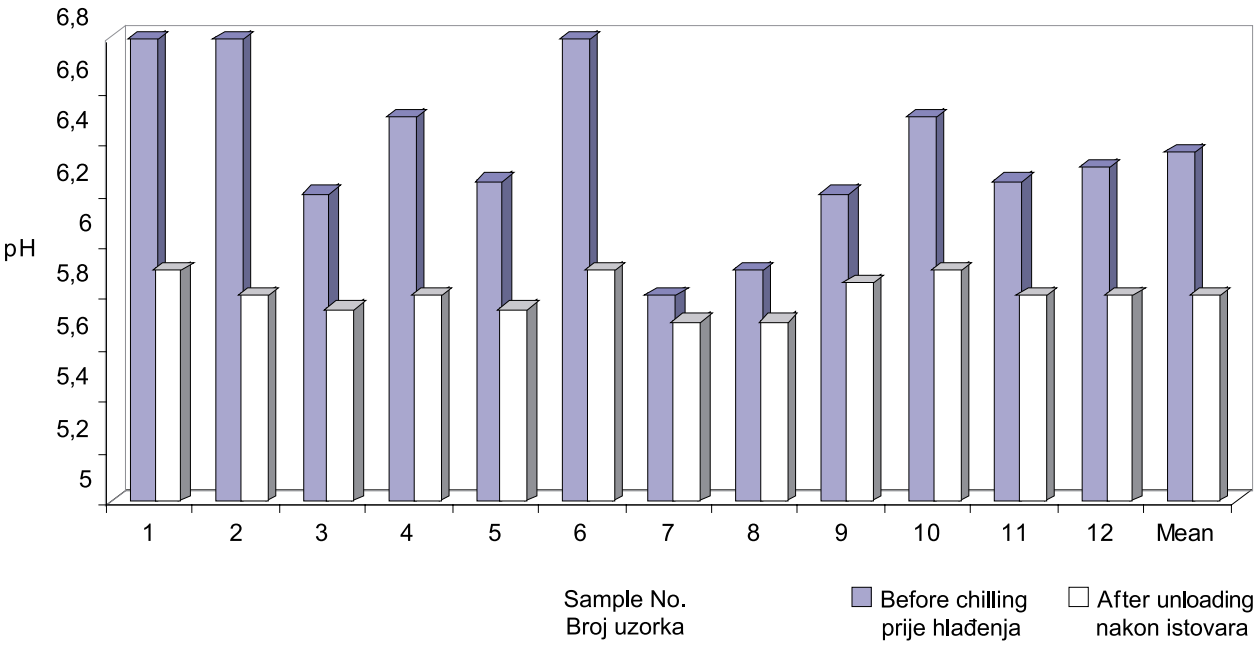
▼ **Graph 2** Comparison of relative humidity values in chilling room during loading and unloading of pork carcasses
▼ **Graf 2.** Usporedni prikaz vrijednosti relativne vlage u prostoriji za hlađenje prije i nakon hlađenja svinjskih polovica



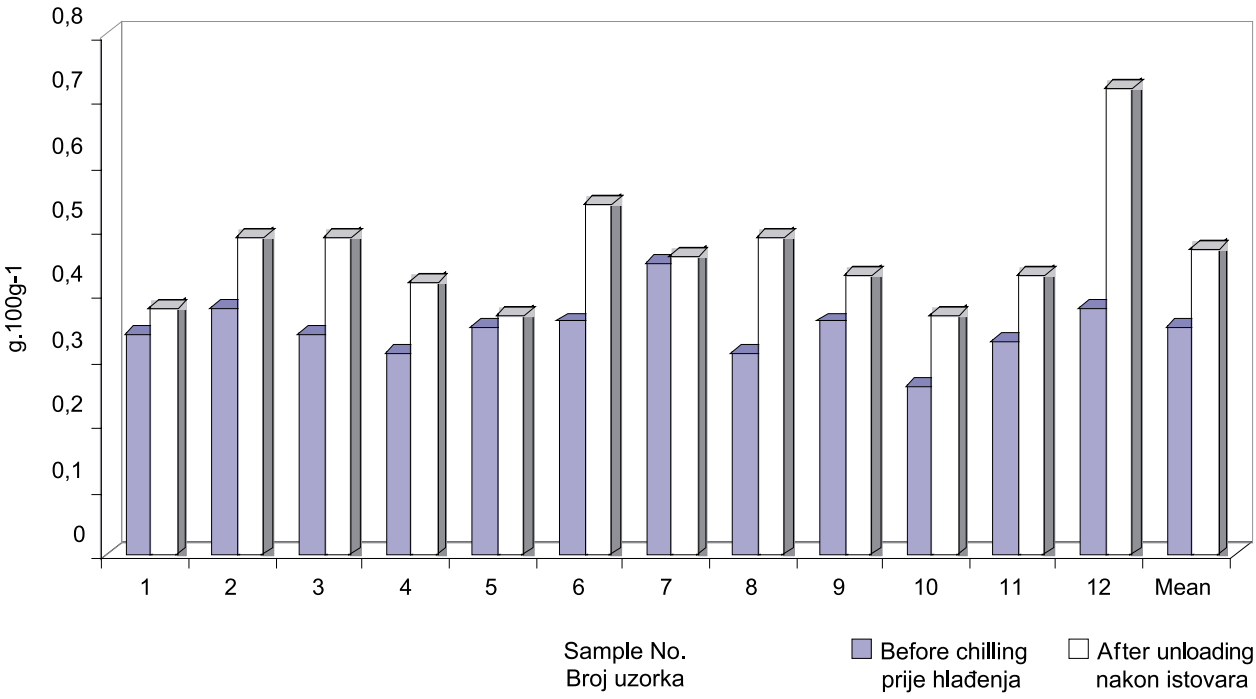
▼ **Graph 3** Comparison of internal temperatures in pork muscles before and after chilling
▼ **Graf 3.** Usporedni prikaz temperatura u dubini mišića svinja prije i nakon hlađenja



▼ **Graph 4** Comparison of pH values of muscles before chilling and after unloading of pork carcasses from chilling room
▼ **Graf 4.** Usporedba pH vrijednosti mišića prije i nakon hlađenja svinjskih polovica

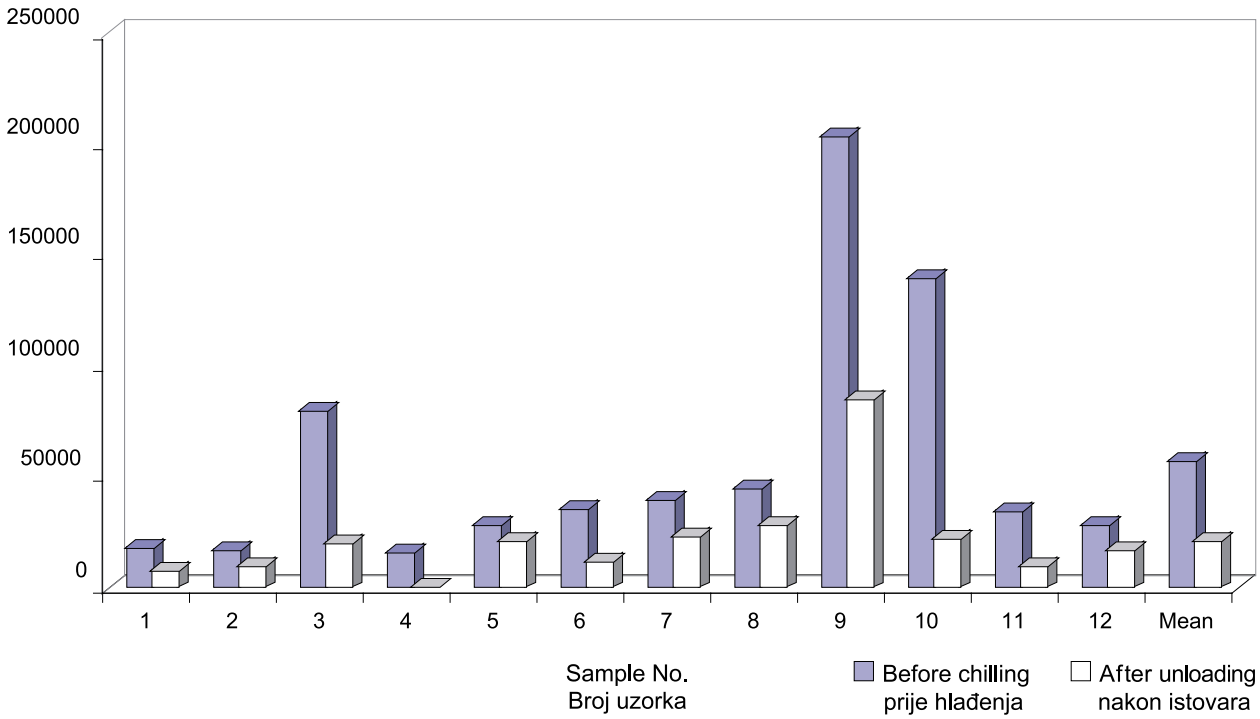


▼ **Graph 5** Comparison of lactic acid content in muscles before chilling and after unloading of pork carcasses from chilling room
▼ **Graf 5.** Usporedni prikaz sadržaja mliječne kiseline u mišićima svinjskih polovica prije i poslije hlađenja



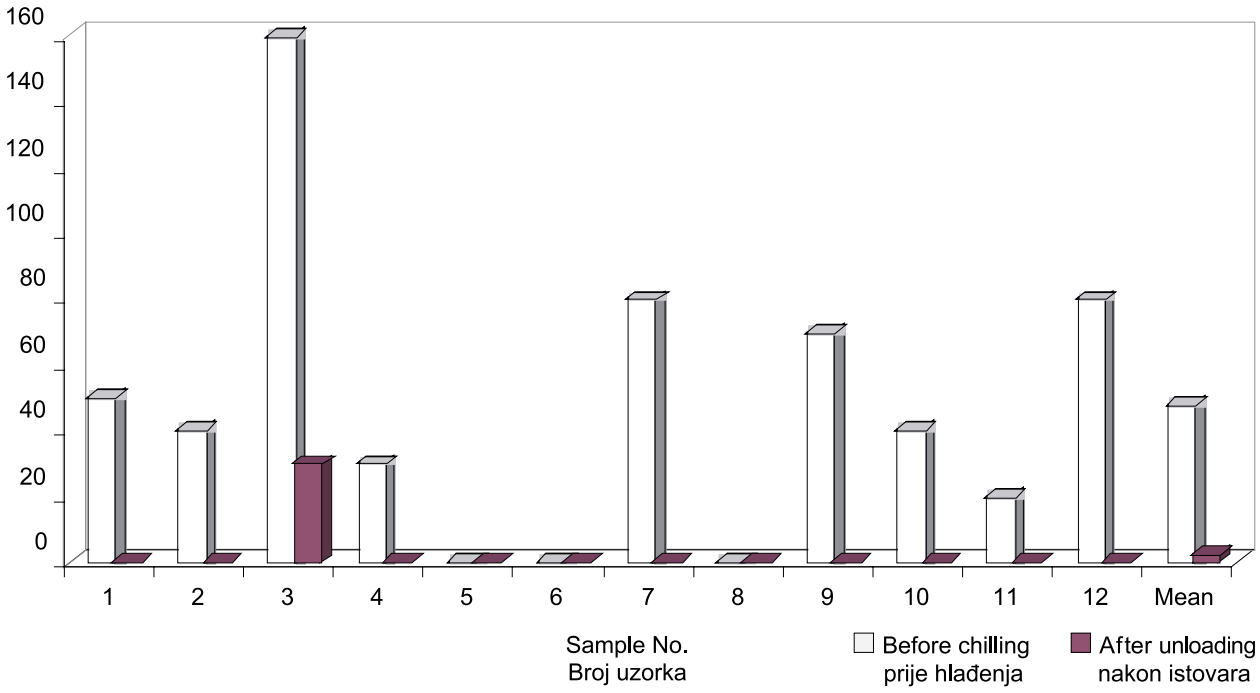
▼ **Graph 6** Comparison of TPC from surface (10 cm 2) of pork carcasses before chilling and after unloading from chilling room

▼ **Graf 6.** Usporedni prikaz ukupnog broja bakterija s površine (10 cm2) svinjskih polovica prije i poslije hlađenja



▼ **Graph 7** Comparison of Coliforming bacteria count (10 cm2) from surface of pork carcasses before chilling and after unloading from chilling room

▼ **Graf 7.** Usporedni prikaz broja koliformnih bakterija (10 cm2) s površine svinjskih polovica



SAŽETAK

UTJECAJ HLAĐENJA NA MIKROBIOLOŠKU KVALITETU POVRŠINE SVINJSKIH POLOVICA I POST MORTALNE PROCESE U MESU SVINJA

Cilj istraživanja je bilo praćenje mikroklimatskih uvjeta u prostoriji za hlađenje svinjetine i njihov utjecaj na temperaturu mesa, pH vrijednost, količinu mliječne kiseline kao i mikrobiološku kvalitetu površine svinjskih polovica. Tijekom pokusa temperature u prostoriji za hlađenje i temperature mesa bile su sukladne važećim propisima za hranu. Rezultati mjerenja relativne vlage su kod jedne trećine mjerenja pokazivali niže a kod više od polovine mjerenja više vrijednosti od propisanih. Više vrijednosti relativne vlage štetno su utjecale na smanjenje broja aerobnih bakterija. U dva je slučaja utvrđen nestandardni post mortalni proces (procijenjen na temelju pH vrijednosti i količine mliječne kiseline).

Ključne riječi: *rashlađivanje, temperatura, vlaga, mikrobiološka kvaliteta, svinjske polovice*

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SUGGESTIONS ON THE REVISION OF MEAT INSPECTION METHODS

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ACTIVITIES OF THE EFSA

The European Food Safety Authority was created on 28th January 2002, with a Regulation of the European Parliament and of the Council (178/2002), to protect the safety and the interests of consumers. The name was translated in the EU languages with variable results. If, for example, French, German and Portuguese with, respectively, Autorité européenne de sécurité des aliments, Europäische Behörde für Lebensmittelsicherheit and Autoridade Europeai para a Segurança dos Alimentos, give the exact idea of what the authority deals with, namely of how safe foods are, the Italian and Spanish translations (Autorità europea per la sicurezza alimentare and Autoridad Europea de Seguridad Alimentaria) cause some confusion in Anglophone readers. As a matter of fact, the Italian translation for food safety is sicurezza degli alimenti, while sicurezza alimentare,

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