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CHEMICAL, MICROBIOLOGICAL AND SENSORY CHANGES OF *MUSCULUS SEMIMEMBRANOSUS* OF PORK STORED AT DIFERENT TEMPERATURES

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Abstract

The paper includes changes that occur in vacuum packed pieces of pork meat (*Musculus semimembranosus*) obtained by removing the haunch, vacuum packed and kept in a chamber at different temperature conditions of 4°C. and 6°C. The changes that occur during storage were examined during the second, the third, and the fifth day after production. It was found that during the storage of meat cuts, there were significant changes in reduction of water content, while protein, fat and mineral substances were increased. The total number of bacteria in meat cuts during storage was increased in those who were kept at a temperature of 6°C. During storage of meat cuts after the fifth day from production, the best sensory characteristics of meat had the meat cuts stored at 4°C.

Keywords: *pork ham, muscle, water, protein, fat.*

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ХЕМИСКИ, МИКРОБИОЛОШКИ И СЕНЗОРНИ ПРОМЕНИ НА *MUSCULUS SEMIMEMBRANOSUS* ОД СВИНСКО МЕСО СКЛАДИРАНО НА РАЗЛИЧНИ ТЕМПЕРАТУРИ

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Апстракт

Во трудот се изнесени промените кои настануваат кај вакуумирани парчиња свинско месо (*Musculus semimembranosus*) добиени по откостување на бут, вакуумирани и чувани во комора на различни температурни услови од 4°C и 6°C. Промените кои настануваат за време на чувањето се испитувани на 2, 3 и 5 ден по производството. Констатирано е дека за време на чувањето на парчињата месо значајни промени има во намалувањето на содржината на вода, додека белковините, мастите и минералните материи се зголемуваат. Вкупниот број на бактерии кај парчињата месо за време на чувањето се зголемува кај тие што се чувани на температура од 6°C. Во текот на чувањето на парчињата месо од производството до 5 ден најдобри сензорни карактеристики имаат парчињата месо чувани на 4°C.

Клучни зборови: свински бут, мускул, протеини вода.

Introduction

Vacuum packaging of meat and meat products have social and health importance. It protects the organoleptic, physicochemical and microbiological properties of these products from internal and external influences over the manipulation from the producer to the consumer Dzhinleski (1985).

Nowadays, meat and meat products must be healthy and attractively packed, because consumer demands are constantly growing (Phillips, 1996; Philips, 2001) as an outcome of the requirements that meet producers must accomplish and packing material also constantly grow (MC Milin, 1999; Dragoev, 2004; Antoniewski, 2007). Parallely, with the attention that the modern consumer pays to the quality of meat, the importance of packaging also increases. Packaging is the most dynamic area of meat industry.

In former times whole bodies were prepared in warehouses of retail facilities where they were cut off and boned in primary cuts of meat, stored in cool, so, cutting and packaging for presentation was conducted when needed. Today this practice is very rare. The present trend in packaging technology will not allow such operations, so, such cuts will be removed from trade and returned to manufacturing plants. This will not happen at once, but in stages depending on local conditions.



Packaging of fresh meat into wholesale cuts and its distribution to the point of sale were developed together with the centralization of cutting and boning of the corpses in the halls of removing. This tradition had evolved especially with the appearance of the packaging of fresh meat in vacuum. It first started in the United States. In Europe vacuum packaging had a significant progress only in Britain, Ireland and France than in Germany, Italy and Spain.

In Republic of Macedonia packaging of fresh meat (vacuum packaging), began with implementation in 1990, so that today many assortments of products of fresh meat are packaged in a vacuum.

Packaging in vacuum slows down the oxidation processes, the growth of aerobic bacteria, weight loss, and color changing, and it is used for magnification and achieving maturation of fresh meat.

Until now relatively few have tested chemical changes during storage of vacuum pieces of fresh pork meat at a certain temperature and the reflection of sensory characteristics of vacuum on packed slices fresh pork.

The objective of this research was to investigate the chemical and microbiological changes that occur during storage at temperatures between 4°C and 6 ° C and how they affect the sensory characteristics of vacuum-packed pieces of fresh pork.

Material and methods

Pieces and *Musculus semimembranosus* were taken from the pigs of the breed Durok. The mass of the pigs before scattering and after was around 100 kg.

Slaughter and primary processing of pigs was performed paying attention on all veterinary sanitary regulations applicable in the Republic of Macedonian. Cooling of pig halves are performed in a chamber for cooling of pig halves at +4 ° C temperature. From the cooled halves by separating the meat from the bones were separated pieces of *M. semimembranosus*.

The pieces of meat were cooled at achieved medium temperature of 4 ° C and were vacuum packed in foil vacuum type Vebomatic. After vacuuming from the same meat randomly were taken 12 packages that were divided into two groups, the first group was kept in a refrigerator at a temperature 4 ° C, and the second group of sausages was stored at a temperature of 6 ° C.

All meat cuts as a subject of examination were marked and measured during the second, third and fifth day by using electronic scales Bizerba mark at the nearest point of 0.1 gram. The measurement was carried out in order to observe the change of the mass of meat slices or shrinkage during storage, although they were packed in vacuum foil. During the second and the fifth day testing was conducted on the chemical composition, sensor analysis and



microbiological analysis on the change and development in microorganism in meat cuts during storage. During the fifth day was carried out only chemical analysis of meat cuts.

Chemical tests were performed with the standard recognized methods used for scientific purposes.

Water content in the pieces of meat was investigated by drying in a temperature of 105 ° C during 24 hours period, or until reaching the same table in two consecutive measurements. The content of fat in meat cuts was investigated by the standard method of extraction with organic solvent Wochs (1961), proteins were examined by the method of Kjeldahl. The content of mineral substances was melted by combustion in muffle oven temperature of 550 ° C Pozarskaja (1964). PH value of meat was measured by PH-meter by German manufacture, type Lu-co.

Sensory analysis was performed using the 9 - level scale developed by the Higher Institute for local prudence in Moscow (VNIIMP) with 10 trained analyzers. Sensory analysis was conducted in the appearance, colour, consistency, smell and taste. Each sensor feature researcher has had the opportunity to assess a rating from 1 to 9, where 1 indicates undesirable and 9 indicates desirable.

Microbiological tests were performed according to usual practice that applies in the local industry by seeding the aqueous solution from the taken test of the nutritious ground and of the incubation temperature of 30°C during 72 hours.

The results obtained in the examinations were processed according to standard methods used for scientific purposes by using a standard computer program ANOVA MS Excel program 1997-2003 in accordance to established statistical methods, ANOVA single factor (Statistica vol. 6 Stat Soft 2003).

Results and discussion

The results of changes in chemical composition of meat cuts that were kept at a temperature of 4 ° C are given in (Table 1).

On the fifth day of keeping the water content, it was reduced in relation to the second day to 0,9 %, while fat was increased of 0,10 % in relation to the beginning the proteins were increased for 0,28%, and the content of mineral substances in relation to initially increased by 0,05 %.

The results of changes in chemical composition of meat cuts that were kept at a temperature of 6 ° C are given in table 2.

On the last day of keeping the pieces of meat at the temperature of 6°C water content decreased 0,9 % compared to the second day , while fat increased and amounted to 0,12 % protein increased at 0,58% and mineral matter of 0,15 %.



The differences of chemical composition in the pieces of meat kept at 4° - 6°C were in significant but they'll exist.

During the keeping of the meat cuts, it was noted that by reducing the mater content, adequately the total content of dry substances was increased (proteins, fats, minerals). The increasing of the dry substances wasn't proportional in all three components; it showed lower or higher variability. The biggest increase was during the second, the third and the fifth day, which was found in fats of meat kept at 6°C. In the meat that was kept at 4°C there was constant and standard fat and protein content. The differences between fats and proteins were statistically insignificant. The differences that existed in the chemical structure in pieces of meat kept at 4°C and 6°C were not statistically significant $p>0,05$

During storage there were some changes of microorganisms in the meat, and that change was under influence of reduction of water and increased concentration of dry substances, especially salt and then from change of pH. Pieces of meat kept at 6°C temperature had significant increase in the number of bacteria, in contrast to the pieces of meat kept at 4°C.

The total number of bacteria in the pieces of meat kept at 6 °C on the fifth day from production was 130, but in the pieces of meat kept at 4°C was 90 (Figure 1).

The increasing number of bacteria in the pieces of *M. semimembranosus* meat kept at 6°C, was because there were better conditions for their evolution.

The results obtained from the test of sensory meat pieces stored at 4 ° C and 6 ° C indicate that there are major differences. Meat pieces stored at 4 ° C after five days storage largely retain sensory characteristics, which can best be seen in the graphic display 2, whereas the analysis of the second and fifth day showed minimum difference. Meat pieces stored at 6 ° C for five days showed large differences in terms of appearance and taste. These properties significantly deteriorated on the fifth day in comparison to the characteristics that they had on the second day from production.

Results got from sensory testing of meat pieces kept at 4°C and 6°C showed great differences. Pieces of meat stored at 4°C, after five days had retained its sensory characteristics, which best can be seen from (Figure 2), The differences in sensory characteristics of the meat kept at 6°C for five days, were large .

Pieces of meat kept at 6°C, for five days, had significant bad sensory characteristics which are around 1/3 from that they had on the 2nd day from packaging.

The results we obtained are consistent with the results from studies of: Djinleski (1985); Robertson (1993); Bell (1994); Philips (2001); Stamenkovic



(2007); Petrovic (2009) who have been analyzing the viability of vacuum pieces of pork meat at different storage temperatures found that the pieces of meat that were kept at lower temperatures had better sensory characteristics than of meat cuts from those which were held at relatively higher temperatures.

The results we got indicate that in good production conditions (ice chain) and storage with constant verification of slaughter hygiene and separating the meat from the bones, sustainability and sensory characteristics of vacuum pieces of pork stored at +4 °C lower temperature can continue.

Conclusion

During the keeping of meat at 4°C and 6°C quantity of mater was reduced in both tests. Differences in reducing are statistically not significant. As mater content reduces, the percentage of dry substances grows. The biggest growth was found in fats, then come proteins and the smallest quantity is in minerals. In pieces of meat kept at 6°C, the total number of microorganism on the fifth day was higher (130), and those kept at 4 °C was lower (90 in 1 g).Sensory characteristics in pieces of meat tested during the second and fifth day after their production were changed. The biggest changes were found in meat stored at 6°C, and minimal in those stored at 4°C between the second and the fifth day.

It can be concluded that good manufacturing conditions (ice chain), storage and with constant verification of slaughter hygiene and separating the meat from the bones, sustainability and sensory characteristics of vacuum pieces of pork stored at +4 °or lower temperature can continue .

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Table 1 Dynamics in changing the chemical composition of *Musculus semimembranosus* during storage at a temperature of 4°C

Табела 1. Динамика во промената на хемискиот состав на *Musculus semimembranosus* за време на чувањето на температура од 4°C

	Indicator	Chemical composition 2,3,and 5 day		
		2	3	5
1.	Weight%	100,00	97,58	97,52
2.	Water,%	73,00±0,015	72,82±0,012	72,10±0,012
3.	Fat %	1,7±0,042	1,75±0,018	1,80±0,015
4.	Protein	21,0±0,020	21,22±0,019	21,28 ±0,017
5.	Min.sub. %	1,2±0,028	1,22±0,012	1,25±0,020
6	pH	6,12		

Table 2 Dynamics in changing the chemical composition of *M. semimembranosus* during storage at a temperature of 6 °C

Табела 2. Динамика во промената на хемискиот состав на *Musculus semimembranosus* за време на чувањето на температура од 6°C

	Indicator	Chemical composition 2, 3 and 5 day		
		2	3	5
1	Weight%	100	98,92	93,22
2	Water ,%	73,00±0,015	72,52±0,012	72,10±0,050
3	Fat %	1,7 ±0,042	1,77±0,042	1,82±0,028
4	Protein %	21,0 ±0,020	21,42±0,028	21,58±0,017
5	Min.sub.,%	1,2±0,028	1,28±0,018	1,35 ±0,018
6	pH	6,18		

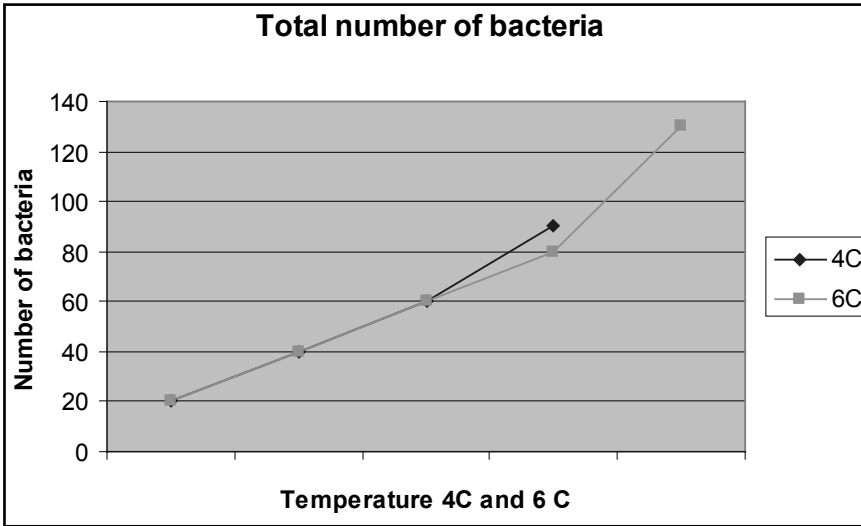


Figure 1. Graphic showing the total number of bacteria in vacuum *M. semimembranosus* kept at a temperature +4 and +6 °C at 2 and 5 day production

Графикон 1. Графички приказ на вкупниот број на бактерии кај вакуумиран *M. semimembranosus* чуван на температура +4 и +6 °C на 2 и 5 ден од производството

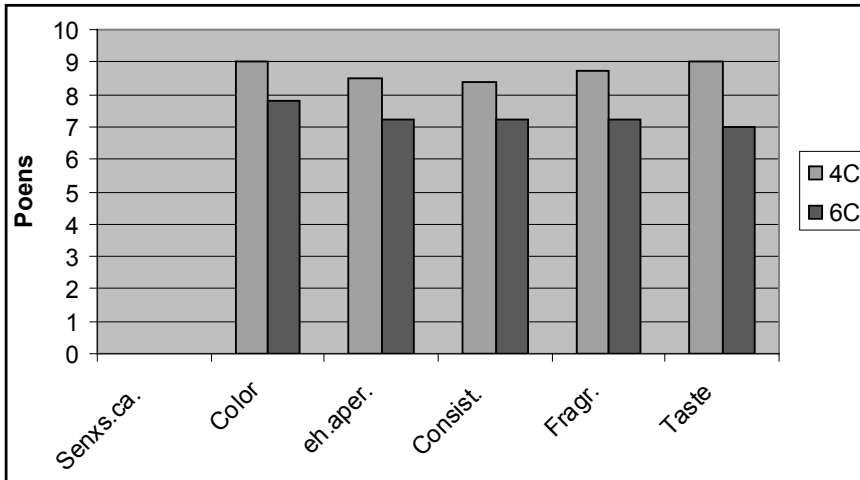


Figure 2. Figure for sensory characteristic of pieces of meat kept on 4°C and 6°C on the fifth day at the producing

Графикон 2. Графички приказ на сензорните карактеристики на парчиња месо чувани на 4°C и 6°C на петтиот ден од производството

