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CHANGES IN THE CHEMICAL COMPOSITION OF *Musculus quadriceps femoris* OF BEEF KEPT AT DIFFERENT TEMPERATURES

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Abstract: The study contains the result from the test f the vacuum – packed meat sliices (*M.quadriceps femoris*) obtained from ox Simmental breed. After the primary treatment, the refrigeration an the sorting out , the meat slices were vacuum –packed and kept and a temperature of 4°C and 6°C. At the 2nd, the 3rd and the 5th day, a chemical analysis of the meat slices was made. At the 2nd and the 5th day it was made a microbiological test of the meat slices in relation to the overall number of bacteria, as well as a sensor analysis in terms of outward appearance, consistence, color, odor and taste. It was noted that, during the storage the water content in the meat slices significantly reduced, and the fat, protein and mineral substance content was increased. The overall number of bacteria was increased in the meat slices kept at a temperature of 6°C. The best sensor marks were given to the meat slices kept at a temperature of 4°C.

Key words: booth, *M. quadriceps femoris*, water, protein, fat

Introduction

Packaging of meat and meat products is the most dynamic area of the meat industry. It protects the organoleptic, physico - chemical and microbiological characteristics of these products during the manipulation from the producer to the consumer *(Brewer and Novakofski, 2006; Antoniewski et al., 2007)*. The meat and meat products must be attractively packed today because consumer demands are constantly growing *(Philips et al., 2001)*

As the present consumer's attention paid to the meat quality grows, the importance of the packing is growing as well. Packaging is the most dynamic domain of the meat industry.

Formerly, whole carcasses were distributed to the retail stocks where the bones were removed and the carcass was sliced into primary meat slices and kept

in a meat safe, while slicing meat for sale and packaging was being done as necessary. Today it is not the case. Today's trend of the packing technology, the vacuum-packing, allows a constantly growing number of vacuum-packing meat slices in the market by seeking to do this operation into the production halls instead for the retail stores. At all events, this does not happen at once, but in phases depending on the local circumstances.

Packing fresh meat slices for wholesale and for retail, as well as its distribution to the sales points, developed as the bone removal and the slicing process moved into the production halls. This practice expanded even more with the advent of the fresh meat slices vacuum-packing. This process appeared for the first time in the USA. As for Europe, the vacuum-packing has a significant progress in Britain, Ireland and France, and some less in Germany, Italy and Spain.

In R. Macedonia packaging of the fresh meat (vacuum packaging) starts its usage from 1990; therefore, today many assortments of products of fresh meat are packed in a vacuum. Packaging in vacuum slows down the oxidation processes, the growth of aerobic bacteria, weight loss and color changing, and is used for magnification and achieving maturation of the fresh meat. The objective of this research was to investigate the chemical and microbiological changes that occur during storage at 4 and 6°C and how they affect on the sensory characteristics of vacuum-packed pieces of fresh beef meat.

Materials and Methods

The weight of the beef half's before cutting was 100 kg. From the cold sides of the thigh together with the knee-joint it is separated by cutting which goes between the last flank and the first vertebra and then separates the abdominal wall which is close to the thigh. The knee-joint is separated from the thigh with a cut which passes through the joint wrist. Then the removal of the adipose tissue of the thigh is done with a knife and the thigh is finally removed. After removal of the thigh the polyhamstring muscle is separated from other muscles of the thigh after a natural connection. By cooling the pieces of meat, achieving the medium temperatures of 4º C they are vacuum packed in foil vacuum type Vebomatic. After vacuuming from the same meat 12 packages are taken randomly and they are divided into two groups, the first group was kept in a refrigerator at a temperature of 4ºC and the second group is stored at a temperature of 6ºC.

Meat cuts that are subject to examination are measured at 2^{nd}, 3^{rd} and 5^{th} day on electronic scales Bizerba with a punctuality point of 0.1 g. Although they are packed in vacuum foil the measurement was carried out so the change in the weight of meat slices or shrinkage during storage to be followed. A test on the chemical composition, sensor analysis and microbiological analysis on the change

and development in microorganism in meat cuts during storage was done on the 2nd and 5th day. On the 3rd day only a chemical analysis of the meat cuts is carried out.

Moisture content was determined after drying to constant weight; protein content was determined by the Kjeldahl method and the factor 6.25 was used for conversion of nitrogen to crude protein; crude fat content was determined after extraction of lipids by means of an automated Soxhlet procedure *(AOAC, 1995)*. The content of mineral substances is melt by combustion in muffle oven at a temperature of 550°C *(Pozarskaja et al., 1964)*. The pH value of the meat is measured by pH-meter, German manufacturing type Lu-co. Sensory analysis was performed by using the 9 - level scale developed by the Higher Institute for local prudence in Moscow (*VNIIMP*) with 10 trained analyzers. Sensory analysis was done on the appearance, colour, consistency, smell and taste. Each sensor feature analyzer has the opportunity to assess in a rating from 1 to 9 where 1 indicates undesirable and 9 indicates desirable. Microbiological tests were performed according to usual practice that is used in the local industry by seedling of the aqueous solution from the taken tests of the nutritious ground and of the incubation at a temperature of 30°C in a period of 72 hours.

Results were statisticaly elaborated by ANOVA MS Excel program (2003) in accordance to the established statistical methods. Determined average values, standard deviation, and x – average of the experiment reliable intervals and presence of statistically important differences using Duncan test.

Results and Discussion

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

Table 1. Change in the chemical composition of *Musculus quadriceps femoris* during storage at a temperature of 4°C

Indicator	2nd day	3rd day	5th day
	$\overline{X}$ ± Sd	$\overline{X}$ ± Sd	$\overline{X}$ ± Sd
Weight kg)	100 8,2	97,52 7,5	93,28 7,8
Water (%)	75.00 ± 0.012	74.88 ± 0.010	73.80 ± 0.010
Fat (%)	1.5 ± 0.028	1.52 ± 0.014	1.54 ± 0.012
Protein (%)	22.0 ± 0.010	22.02 ± 0.014	22.20 ± 0.011
Min.sub. (%)	1.5 ± 0,022	1.51 ± 0,011	1.52 ± 0.018
pH	6.14 ± 0,012	6,12± 0,010	5,92±0,08

As it can be seen from the presented data at beginning of the trial and regarding to the 2nd day after the production the average water content is 75.0%, protein 22.0%, 1.5% fat and mineral substances 1.5%.

On the 3rd day of storage at a temperature of 4°C there is a change in the weight of meat and its chemical composition, although the water content is reduced to 74,88%, while the fat and protein have increased to 1.52% fat and 22.02% protein and mineral substances are increased from1to1.51%.

On the 5th day after manufacturing the chemical composition of meat cuts is changing because the water content had dropped to 73.80%, the weight increases to 1.54%, the level of protein is 22.20% and the content of mineral substances is 1.52%. Such changes in chemical composition result from the evaporation of free water from the pieces of meat.

On the 5th day keeping the water content is reduced in relation to the 2nd day to 1.2%, while fat increases and it is increased in relation to the beginning for 0.04% and protein is increased in relation to the beginning for 0.2%, and the content of mineral substances in relation to the beginning increases by 0.02%.

The results from the changes in chemical composition of meat cuts that are kept at a temperature of 6°C are presented in (Table 2).

Table 2. Change in the chemical composition of *Musculus quadriceps femoris* during storage at a temperature of 6°C.

Indicator	2nd day	3rd day	5th day
	$\bar{X} \pm Sd$	$\bar{X} \pm Sd$	$\bar{X} \pm Sd$
Weight (kg)	100±8,18	98,80±7,7	97.78±7,5
Water (%)	75,00 ± 0,018	74,85 ± 0.010	73,70 ± 0,040
Fat (%)	1,5 ± 0,032	1,54 ± 0,040	1,56 ± 0,021
Protein (%)	22,0 ± 0,021	22,59 ± 0,022	22,61 ± 0,011
Min.sub. (%)	1,5 ± 0,021	1,52 ± 0,012	1,54 ± 0,014
pH	6,18± 0,010	6,15 ±0,010	5,85±0,07

As it can be seen from the presented data from (Table 2) the weight of the meat on the 3rd day of storage at a temperature of 6°C is reduced and it is 98.80%, the water content is 74.85%, fat content is slightly increased and it is 1.54%, the protein is 22.59% and the mineral material is 1.52%.

On the 5th day of storage of the meat pieces there is a change in the reduction or lowering on the weight of meat cuts which is reduced to 97.78%

compared to those on the 2nd day, the water is reduced to 73.70% fat are increased to1.56%, protein is present with 22.61% and mineral substances 1.54%.

On the 5th day of keeping pieces of meat at the temperature of 6°C the water content decreases in comparison the 2nd day to 1.3%, while fat increases and it is0.06%, protein grows to 0.61% and mineral material is 0.04%.

During the keeping, by reducing the water content adequately the total content of dry substances is increased (proteins, fats, minerals). That increase of the dry substances is not proportional to all three components; it shows smaller or bigger variability.

The biggest increase on the 2nd, 3rd and 5th day is found in fats in the meat which is kept on 6ºC. In the meat that is kept on 4ºC there is constant and standard fat content and proteins. The differences that exist in the chemical structure in the pieces of meat kept on 4ºC and 6ºC are not statistically significant $p>0.05$.

During the keeping there are some changes of microorganism in the meat, and those changes are influenced by reducing the water and then the concentration of dry substances increases, and then there is a change of the pH value. As a result of that change in the chemical structure of the pieces of meat which are set in during the keeping, changes are noticed in the microbiological pictures...pieces of meat that are kept on a temperature of 6ºC there is significant increase in the number of bacteria contrasting with the pieces of meat that are kept on 4ºC.

In the pieces of meat kept on 6ºC, on the 5th day from the production the total number of bacteria was 130 in ml. but in the pieces of meat kept on 4ºC the total numbers of bacteria was 80 in ml (Figure 1). The increased number of bacteria in the pieces of meat that are kept on 4ºC is resulting on the better conditions during their evolution.

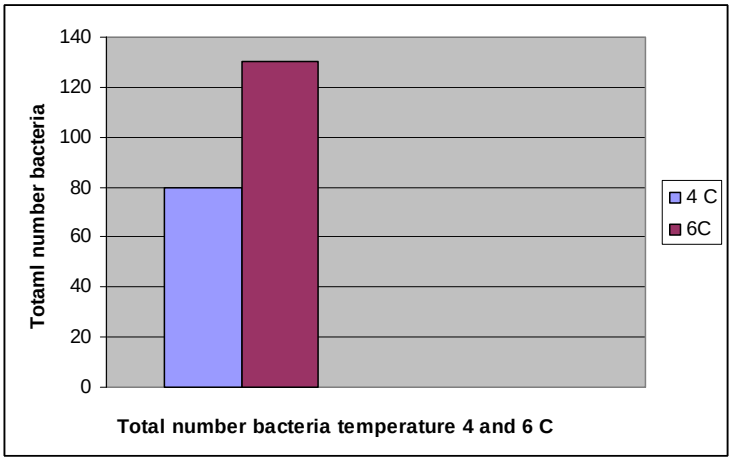

Figure 1. Graphic is showing the total number of bacteria in vacuum M.quadriceps femoris kept at a temperature +4ºC and +6ºC at 2nd and 5th day of production

The result from the sensor analysis of the meat slices kept at a temperature of 4°C and 6°C show the existence of many differences. The meat slices kept at a temperature of 4°C have considerably kept their sensor characteristics after the 5th day. On the other hand, there are considerable differences in the sensor characteristics of the meat slices kept at a temperature of 6°C during 5 days (Figure 2).

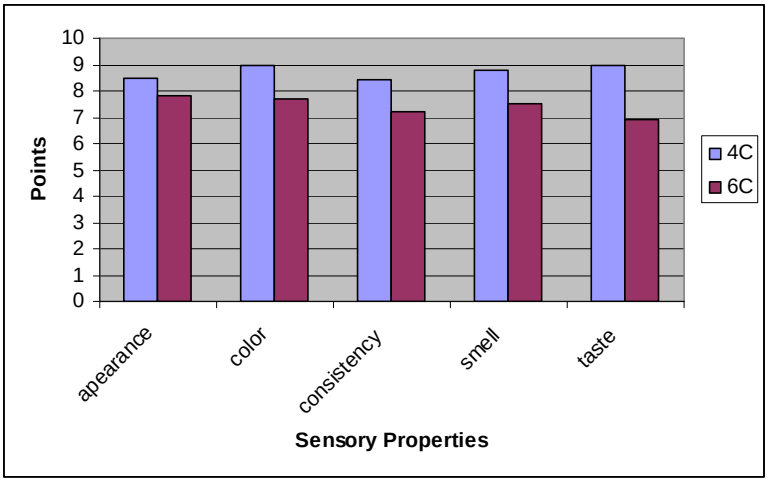

Figure 2. Figure for sensory characteristic of pieces of meat kept on 4ºC and 6ºC on the fifth day at the producing.

Pieces of meat kept on 6ºC in 5 days period had significantly had sensory characteristics taste and consistency) which are around 1/3 from those that they had on the 2nd day from the producing.

Many authors have examined the impact of sustainability on the vacuum packaging of beef meat *(Bell and Garout., 1994; Lawrence et al., 2003; Stamenković et al., 2007; Stetzer et al., 2008)*, examined the sustainability of vacuum packed meat pieces cooling at different temperatures and they found that the meat cuts that have been kept at lower temperature had better sensory characteristics of meat cuts than those that have been kept at relatively higher temperatures. Our examinations are in accordance with the tests they have been doing previously.

Conclusion

During the keeping of meat at 4ºC and 6ºC the quantity of water is reduced in both tests. Differences in reduction are statistically not significant. With the

water content reduction the percentage of dry substances is growing. The biggest growth is found in fats, then in the proteins and it is smallest in minerals. In pieces of meat that are kept on 6ºC, the total number of microorganism on the 5th day is significantly bigger and it is 80, and those kept on 4ºC the total number bacteria is 50 in ml.

Sensory characteristics in pieces of meat which were tested on 2nd and 5th day after their production were changed. The biggest changes are found in meat kept on 6ºC, and the smallest has the meat kept on 4ºC between the 2nd and the 5th day.

Promene hemijskog sastava *Musculus quadriceps femoris* goveđeg mesa čuvanog na različitim temperaturama

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Rezime

U radu su iznete promene koje nastaju kod vakmiranih komada goveđeg mesa (*M. quadriceps femoris*) dobijenih od simentalske rase koji su vakumirani i održavani pri različitim temperaturnim uslovima od 4ºC i 6 ºC. Promene koje nastaju za vreme čuvanja mesa na tim temperaturama su ispitivane 2, 3, i 5 dana nakon proizvodnje mesa.

Konstatovano je da za vreme čuvanja komada mesa značajne promene se javljaju u smanjenju sadržaja vode, dok belkovini, masti i mineralne materije se uvećavaju. Ukupan broj bakterija za vreme čuvanja bio je veći kod komada mesa čuvanih na temperaturi od 6 ºC. Najbolje senzorne karakteristike su imali komadi mesa čuvani na 4ºC.

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THE DYNAMIC OF THE NUMBER OF COLIFORM BACTERIA IN WHITE CHEESE

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Original scientific paper

Abstract: The aim of this research is that the presence of coliform bacteria in cheese is characterized undesirable, because it can cause a variety of defects on quality of cheese. For this reason, it is very important for this bacteria to be destroyed or to prevent their appearance in a number during processing and during the cheese ripening in the brine. During the cheese making, in the milk prepared for making cheese the number of coliform bacteria shows a small decrease comparing with their number in the raw milk, which proves that the number of microorganisms is less after pasteurization. During the cheese ripening in the pickle the number of coliform bacteria has kept at 3.0×10^3 /g of cheese for the second repetition, but for the first and the third repetition they disappeared which avoided the danger of early blowing or appearance of any other defect.

Key words: milk, coliform bacteria, soft white cheese.

Introduction

White cheese is the traditional product on the whole Balkan peninsula, and the Serbian Republic too. The specific geographic and the climate conditions of Pcinja region, the particularity of technological operations are all connected with the white soft cheese characteristics. Microflora which is present in milk in certain number is not static during the cheese production; it is changing constantly. The causes of these changes are: the change of temperature, pH, the presence of microb's products etc. Every aspect of microorganisms is in dynamic balance with the other aspects and with its influence it gives its contribution to the final look of the cheese. The microflora's research of any cheese is of specific importance for the standardization of the cheese type.

Materials and Methods

White pickled cheese is the product of "Dairy Han" from Vladicin Han. Cow milk from the whole Pcinja region in the Republic of Serbia is used as raw material for producing the white soft cheese.

Microbiological and physical-chemical researches in a dairy are done on three special production processes in the production of white soft cheese, and done in tri repetitions with the milk of summer lactation, in the microbiological and physical-chemical laboratory which are in the dairy itself.

Samples for the microbiological analysis are taken sterile and left in the sterile glass dishes. The number of the coliform bacteria is determined due to classic cultural method, based on the number of colonies grown on the hard stratum. The researches of the coliform bacteria are done on the standard Torlak's substratum, endo agar-selective substratum for detection, isolation and counting fecal E. coli and the coliform bacteria in different materials.

Measuring of pH has been done by the digital pH-meter HANNAHI99161 FOOD CARE. Titra acid of the samples is determined due to the method Soxhlet-Henkel.

Results and Discussion

The presence of the coliform bacteria in cheese can cause some defects in organoleptic characteristic of cheese. The number of coliform bacteria in white soft cheese (Table 1) are considering on the whole group of coliform bacteria.

Table 1. The number of coliform bacteria (CFU/mL or g test) in particular phases of cheese making

TEST	I	II	III
Raw milk	3.8×10^6	3.2×10^5	1.9×10^6
Milk before cheese making	2.8×10^6	3.0×10^5	1.7×10^6
Whey	2.4×10^6	1.2×10^5	1.0×10^5
Coagulate before manipulation	5.8×10^7	2.5×10^5	2.1×10^6
Coagulate after pressing	6.1×10^6	2.3×10^6	2.5×10^6
Cheese after forming and salting	8.7×10^5	6.8×10^5	3.4×10^5
The first day of salting	3.95×10^7	1.1×10^5	2.9×10^5
The 10 day of brining	1.6×10^6	8.0×10^5	7.1×10^4
The 20 day of brining	6.0×10^5	2.8×10^4	1.2×10^5
The 30 day of brining	3.0×10^4	2.1×10^4	2.5×10^4
The 45 day of brining	/	3.0×10^3	/

In the raw cow milk from which white soft cheese is made, the number of coliform bacteria was high I varied from 3.2 x 10^5 CFU/mL to 3.8 x 10^6 CFU/mL (Table 1), which shows on the low degree of hygiene during the production of milk. The highest value of number of coliform bacteria in milk for producing white soft cheese is marked on the first repetition, and the lowest value on the third repetition.

Table 2 shows the values of active and titra acids during all the production phases of white soft cheese in three repetitions (I, II, III).

Table 2. pH and acidity in °SH in milk, cheeses during cheese making

TEST	I		II		III	
	pH	°SH	pH	°SH	pH	°SH
Raw milk	6.60	6.20	6.70	6.50	6.50	6.40
Milk before cheese making	6.67	6.00	6.73	6.40	6.47	6.68
Whey	6.60	4.00	6.64	3.60	6.46	3.38
Coagulate before manipulation	6.67	12.80	6.53	13.90	6.31	14.60
Coagulate after pressing	6.56	31.10	6.29	29.80	6.11	28.60
Cheese after forming and salting	5.83	76.80	5.93	68.60	5.98	59.20
The first day of salting	6.03	75.60	5.22	76.70	5.21	72.20
The 10 day of brining	5.03	74.00	4.78	73.80	4.81	68.80
The 20 day of brining	4.43	62.00	4.05	74.00	4.28	66.00
The 30 day of brining	4.29	55.60	4.13	59.50	4.25	63.80
The 45 day of brining	4.27	72.40	3.90	56.00	4.11	62.00

After termic treatment on milk at the moment of making cheese, it has been noted the decreasing of number of coliform bacteria 1.36 times at first repetition, 1.07 at second repetition and 1.12 times at third repetition, which approximately is 1.18 times.

After forming chafer, coliform bacteria in higher percentage stay in it.

The comparative analysis of whey and chafer show that with the whey 3.97%, 32.43% and 4.55% of coliform bacteria have been destroyed, while in chafer they stay 96.03%, 67.57% and 95.45% at first, second and third repetition, which means in the limits from 67.57% to 96.03%.

During the phase of self-pressing and pressing, the number of coliform bacteria is decreasing for the first repetition 9.5 times, and increasing 9.2 times and 1.19 times at second and third repetition. At the first repetition in this phase of cheese making, pH is decreasing for 0.11 units (Table 2), and at second and third repetition for 0.24 and 0.20 units (Table 2). For increasing the number of coliform bacteria at the second and third repetition, no matter on pH values, is responsible added pollution the pressed mass during the handle manipulation of employees.

In the phase of moulding and dry salting comparing with the phase of self-pressing and pressing, the number of coliform bacteria is decreasing at all the three repetitions in the limits from 3.38 to 7.35 times, and 6.99 times, 3.38 times and

7.35 times for all the three repetitions. So as reducing fact when the number of coliform bacteria is in question also mention *Zarate et al.(1997*). In this phase of production, pH se moving in the limits from 5.83 to 5.98, and titra acid is increasing for 38.36 ^{0}SH (Table 2), which also increases the quantity of milk acid.

After the phase of standing white soft cheese in pickle, the number of coliform bacteria at the first repetition has increased comparing with the start number 10.4 times. The increase of the number of coliform bacteria at the first repetition is probably the result of some added pollution of pickle which contains coliform bacteria, similar as the cheese. The number of coliform bacteria in cheese was 3.95 x 10^7 CFU/g, and in pickle 3.90 x 10^7 CFU/mL (Table 1).

Maximum increase of the number of coliform bacteria is marked at the second repetition on the tenth day of pickling. The increase of number of coliform bacteria at the second repetition on the tenth day of pickling is the result of additional pollution of cheese by handle manipulation of staff.

On the twentieth day of pickling the number of coliform bacteria is also representing the tendency of decreasing for the first and second repetition.

On the thirtieth day of pickling, the number of coliform bacteria is decreasing too. This statement is due to the researches of *Núñez et al. (1985*), that states that the pH values are lower than 5.0 to 5.2 necessary for the inhibition of this bacteria.

On the forty-fifth day of pickling at the first and third repetition, coliform bacteria completely die from cheese (Table 1), and at the second repetition, the number of coliform bacteria is decreasing, but the bacteria is still present in cheese with the number of 3.0 x 10^3 CFU/g (Table 1).

The disappearance of coliform bacteria from cheeses before the end of their ripening have also marked *Tornadijo et al. (1993*) in cheese Armada made of goat's milk and *Rodrígez et al. (1995*) in cheese Leon made of cow milk. In pickle, on the forty-fifth day of pickling, coliform bacteria disappear at the first repetition, they are present at the second repetition 1.2 x 10^6CFU/mL, and in the third repetition is counted 3.8 x 10^4 CFU/mL (Table 1).

This results are equal with the *Kakurinov (1997*). The author has stated the decrease of number of coliform bacteria during the ripening of kumanovo's bitten cheese in pickle and their disappearance from the cheese mass after thirty days of ripening.

Rašić (1961) has shown the fact that pH, as an inhibitive factor for the development of coliform bacteria in some cases didn't influence, which has caused the early puffing of cheese. To the same statement have come *Tornadijo et al. (2001*), styding the cheese San Simon. They have shown the weak influence of pH on the number of Enterobacteriaceae. This results are not matching with the results got in the "Han dairy".

The presence of enterococa, according to *Giraffa (2003)* during the ripening of cheese is thanks to their tolerance to the temperature from 10 to 45

degrees celzius, pH value from 4.0 to 9.0, and the tolerance to the specific concentration of salt 6.5%, too.

Conclusion

Due to all of the facts that are already stated, we can give the following conclusions:

The high number of coliform bacteria is marked in raw milk, which indicates the bad hygiene during the cheese production.

Salting the cheese is limitated fact for the development of the microorganisms.

During the cheese ripening in pickle, the number of coliform bacteria is rapidly decreasing. The biggest decrease of the number of microorganisms is matching with the biggest decrease of pH.

Until the forty-fifth day of ripening, the coliform bacteria disappear or rapidly decrease in cheese. On the decrease of number of coliform bacteria and their disappearance from cheese influence: the decrease of pH, the increase of the concentration of milk acid, the concentration of pickle and the ripening in pickle.

Dinamika broja koliformnih bakterija u belom siru

J. Stojiljković, V. Kakurinov

Rezime

Cilj rada je da prisustvo koliformnih bakterija u belom siru okarakteriše nepoželjnim s obzirom na to da mogu izazvati razne defekte i nedostatke kvaliteta sira. Iz tih razloga, veoma je važno da ove bakterije odumru ili da se spreči njihova pojava u većem broju pri izradi i zrenju sireva.

U toku proizvodnje belog mekog sira, u mleku pripremljenom za podsirivanje, broj koliformnih bakterija pokazuje izvesno smanjenje u odnosu na njihov broj u prijemnom mleku, što ukazuje da se pasterizacijom mleka smanjuje broj mikroorganizama. Tokom dalje proizvodnje, broj koliformnih bakterija svoj maksimum dostiže u fazi samopresovanja i presovanja, kalupljenja i soljenja. Tokom zrenja sira u salamuri, broj koliformnih bakterija počinje da se smanjuje, da bi se na kraju salamurenja zadržao na 3,0 x 10^3/g kod drugog ponavljanja, a kod prvog i trećeg one su odumrle, čime je izbegnuta opasnost od ranog naduvavanja sira i pojave raznih drugih defekata.

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ANALYSIS OF REARING TECHNOLOGY USED BY SHEEP BREEDERS IN SLOVENIA

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Abstract: In Slovenia low and medium production systems are prevalent in sheep breeding. The rearing technology depends on a large number of factors. The main factors affecting the choice of rearing technology are sheep breed, local conditions, season of mating and weaning time. In the present study the rearing technology in sheep breeding was analysed. This analysis included the results of 293 questionnaires from sheep breeders of autochthonous Jezersko-Solčava and Improved Jezersko-Solčava breed. Data were subjected to the frequency analysis, using the FREQ procedure of the SAS Statistical Software (1990). The population size in the flocks of these breeders was mostly from 5 to 50 animals (73.3%). The lambing system is year-round (80%) and seasonal (7.5%). The wanted litter size of 47% of breeders is just one live born lamb. Breeders weaned their lambs at 60-90 days of age or even later. Lambs stayed with their mothers almost till the end of lactation (16-20 weeks) or till the sale to the market when they weighted 30-35 kg. Early spring and summer born lambs stayed with their mothers on the pastures with no supplement. Winter born lambs stayed with their mothers in the stable, fed by hay and supplement (cereals or commercial concentrate). The rearing technology used by Slovenian sheep breeders is sustainable and gives the opportunity for conservation of autochthonous breeds in the original environment.

Key words: survey, sheep farming, rearing technology, lambing system, autochthonous Jezersko-Solčava, Improved Jezersko-Solčava

Introduction

Sheep breeding in Slovenia is characterized by low input production systems, which are present in 3/4 of all farms and some 3/5 of the total animal population. Sheep production is generally characterized by small flock-size. Thus, sheep breeding can be ranked among the very sustainable production *(Šalehar et al., 2003)*. Sustainability of sheep production has been strengthened by well adapted local breeds. In Slovenia lamb meat production is still low and contributes

less than 1% of gross agricultural production *(Zagorc et al., 2010)*. Most of lamb meat is produced outside of abattoirs and sold on local market. The price of lambs in Slovenia is lower compared to the other EU countries. In years 2006-2008 the price of lambs was 30% lower than the average price in EU *(Zagorc et al., 2010)*. In Slovenia two lamb production systems are characteristic depending on time of weaning and slaughter weight of lambs. Early weaning and slaughtering of suckling lambs is characteristic for dairy breeds. Those lambs are traditionally sold as suckles for slaughtering mainly to Italy *(Cividini et al., 2001)*. Weaning lambs after 60 days of age and slaughtering lambs at 25 to 35 kg of live weight is characteristic for meat breeds. For lamb meat production mainly autochthonous Jezersko-Solčava (JS) sheep breed and Improved Jezersko-Solčava with Romanov (JSR) are used. The JS sheep is one of four autochthonous sheep breeds in Slovenia. The breed has been developed over the centuries as a result of local conditions. Its eminence is year-round lambing. The main characteristics of the JS sheep breed have been described elsewhere *(Feldman et al., 2005)*. From 1982 the local JS breed was crossbreed with Romanov to improve the fertility and increase the litter size. Today the JS and JSR sheep breeds are the most numerous sheep breed populations in Slovenia. Both populations are mainly suited for lamb production in the Alpine and pre-alpine region where they stay on Alpine pastures in summer. Despite year-round lambing the fertility traits of recorded JS and JSR flocks have been decreased in recent years *(Kastelic and Kompan, 2007)*. One possible explanation for the reduction of production in JS and JSR flocks was thought in the differences in rearing technologies *(Cividini et al., 2009; Petrović et al., 2009)*. We prepared a survey to determine current rearing technologies used by sheep breeders in Slovenia.

Materials and Methods

We conducted a survey of the sheep flocks structures and breeding management practices as traditional in Slovenia. The breeds surveyed were local Jezersko-Solčava (JS) and Improved Jezersko-Solčava (JSR). A sample of 293 farmers was individually interviewed regarding their flock structure, farm structure and rearing technology. The statistical analysis of 293 surveys was conducted with FREQ procedure by SAS/STAT statistical package. We analyses the results of survey and compared the results of rearing technologies between JS and JSR flocks. There was 36% (106) of JS flocks and 64% (187) of JSR flocks included into the survey. The survey was extended and included 10 sections of questions on six pages. Therefore, we individually interviewed the farmers when being on annual meetings of the sheep breeding association.

First five sections of the questionnaire included the general breeder, breed and farm and production system information. The last five sections of the questionnaire gathered the information about rearing technology, marketing, environmental adaptation of the breed and politics. We included factors (political,

environmental) affecting future lamb production and factors that may have changed flock sizes. However, we want to get a general idea of how the breed production stands by taking a cross section of views from breeders.

Results and Discussion

Farmer and flock structure. According to information obtained on the age structure of farmers we evaluated the increasing trend of aging sheep farmer's population. There was 34% of farmers from 51 to 60 years old and 29% from 41 to 50 years old. Farmers older than 60 years were 27% and only 11% of farmers younger than 40 years. Only a third of the farmers were included in Breeding Selection Program (recorded flocks to control the origin and production) but all of them were the members of local Breed society. Most abundant was conventional farming (39%), 26% of farmers had organic farming and 34% of farmers was engaged in rearing sheep just as hobby. The production system was mainly aimed at the production of meat (95%), which stands to a reason that both investigated breeds were meat breeds. The remaining 5% of farmers are concentrating on the combined production of meat and wool. Farms are spread throughout Slovenia. The flock size identified by the survey is presented in Table 1.

Table 1. Flock size in Jezersko-Solčava (JS) and Improved Jezersko-Solčava (JSR) flocks

	Flocks (%)	
Number of ewes	JS	JSR
5-10	12.3	12.3
11-20	20.8	26.2
21-30	17.9	23
31-50	15.1	16.6
51-100	13.2	11.2
>100	6.6	4.3

Flock size of JS and JSR flocks was generally small. There was 51% of JS and 61.5% of JSR flocks counting not more than 30 ewes. Just 6.6% of JS and 4.3% of JSR flocks counted over 100 ewes. The results of the flock structure determined small-holder conditions.

Rearing technology. In sheep breeding, there are lots of factors that have impact on choosing one of the rearing technologies. Most important factors are mating/lambing system, time of weaning and the genotype of the ewes. A lambing system denotes when lambing will occur (what season or months), how often a ewe will lamb, and how and where lambing will occur (shed *vs*. pasture). There is no one "best" lambing system or way to raise sheep. Breeders need to match the lambing system to their goals and objectives, resources, and market demand. The genotype of the ewe directed the farmer in the specific technology of farming. Thus, for example the choice of breed which allows year-round lambing

can increase the production of lamb per ewe per year. Lambing system used by Slovenian breeders are shown in Table 2.

Table 2. Lambing system used by Slovenian sheep breeders of JS and JSR flocks

	Lambing system							
Breed	Seasonal		Year-round		No answer		Total	
	n	%	n	%	n	%	n	%
Jezersko-Solčava (JS)	9	8.5	82	77.4	15	14.2	106	100
Improved Jezersko-Solčava (JSR)	13	7.0	152	81.3	22	11.8	187	100
Total	22	7.5	234	79.9	37	12.6	293	100

Seasonal lambing system (spring lambing) is when rams are kept with the flock only in month when sexual activity of the ewes and the ram is the highest. Year-round lambing system is when rams are kept with the ewes on a continuous basis through the whole year and can included winter and fall lambing system. Nearly 80% of the breeders use year-round lambing system and 7.5% of the breeders keep their ram with the flock only in seasonal months. Lambing distribution of recorded JS and JSR flocks in Slovenia confirmed our results *(Kranjc, 2009)*. In recorded JS and JSR flocks there was equally lambing distribution through the year with the highest percentage of lambing occurred in winter (December, January, and February). The majority of mating occurred in summer time, but lot of matting was also observed in early fall *(Kranjc, 2009)*.

Farmers stated that winter lambing systems have several advantages. Lambs born early in the year are usually gone by the time summer comes. Historically, the breeders sold the lambs at the first half of the year, especially during the Easter period. When lambing occurs in winter the breeders can usually carry more ewes on their pastures or on the Alpine pastures, since ewe feed requirements are only maintenance. Early-born lambs stayed with their mothers and are then fattened with hay and cereals and are weaned at 60-90 days (55.4%) of age or after 90 days of age (42.8%). They usually grow faster than those born later in the year, but their cost of gain is usually higher. Farmers that reared JS breed stated that they are usually favoured in a fall lambing system. Fall lambing has several advantages over the winter and spring systems. Late-gestation and lactation coincide with fall forage growth. Weather conditions are usually ideal for pasture lambing in lowland. There are fewer problems with parasites and predator animals. Lambs can usually be sold when prices are the highest. However, fall lambing is a challenge because conception rates are much lower than with spring breeding. From an industry standpoint, if more lambs were born in the fall, the supply of lamb would be more even distributed, resulting in more stable prices and steadier demand. Lambs born in fall were used for next grazing season on poor high mountain pastures over 1500 m above sea level in the Alps. Thus, the mating needs to occur from April to June.

Spring lambing coincides with the natural breeding and lambing seasons and takes optimal advantage of the spring flush of grass. On the other hand, for most of the winter, ewes can be maintained on a maintenance diet of relatively inexpensive hay or silage. The primary benefit to spring lambing is reduced production costs: lower feed costs, less labour, and overhead. However, spring lambing requires better pasture management than early lambing, since lambs are usually fed or finished on grass. Lambs from all lambing systems stayed with their mothers are weaned at 60-90 days of age and slaughtered at 30-35 kg.

In many cases, the crucial factors to focus on specific rearing technology are the basic conditions for farming in hard environment, such as available feed, forage conditions, period of grazing and winter feeding period *(Zagožen, 1982)*. The JS and JSR breed with appropriate rearing technology enabled free choice of lambing system and can improve period between parity *(Zagožen, 1982)*. *Kranjc (2009)* reported about impact between month of lambing (lambing system) and period between parities for JS and JSR ewes. When lambing occurred in winter the period between parities was the longest. With using late summer and fall lambing system the period between parities was shorter *(Kranjc, 2009)*.

Although, the year-round lambing system is dominated the farmers didn't want to increase the litter size. Wanted litter size is present in Table 3.

Table 3. Wanted litter size by Slovenian sheep breeders of JS and JSR flocks

	Wanted litter size							
Breed	Singles		Twins		No answer		Total	
	n	%	n	%	n	%	n	%
Jezersko-Solčava (JS)	64	60.4	34	32.1	8	7.5	106	100
Improved Jezersko-Solčava (JSR)	74	39.6	92	49.2	21	11.2	187	100
Total	138	47.1	126	43.0	29	9.9	293	100

Nearly half of the farmers (47.1%) rather have singles than twins or triplets and 43% of all farmers rather have twins than singles. JS farmers preferred to select ewes with one liveborn lamb per litter (60.4%). Only 32.1% of JS farmers preferred twins or triplets per litter. They stated that ewes having singles request less labour, the growth of singles is faster and there is less losses. For JSR farmers higher litter size was wanted. However, *Kranjc (2009)* found that the period between parities decreased with decreasing the litter size.

Conclusion

Sheep breeding in Slovenia is characterized by low input production systems with small-holder conditions. Rearing technologies used by breeders have some specificity attributed to a lambing system and weaning time and are adapted to local breeds. The farmers do not aware to improve the litter size. Sheep breeding can be ranked among the very sustainable production.

Analiza tehnologije odgoja koju koriste odgajivači ovaca u Sloveniji

A. Cividini, D. Kompan

Rezime

Frekvencijskoj analizi za utvrđivanje trenutne tehnologije gajenja ovaca autohtonih Jezersko-Solčavske i poboljšane Jezersko-Solčavske rasa bilo je podvrgnuto 293 ispitanika-odgajivača. Prema informacijama dobijenim iz istraživanja ocenili smo trend povećanja starosti odgajivača ovaca. Rezultati o strukturi stada govore o preovladavanju sitnih gazdinstava. Dominira (80%) celogodišnji sistem jagnjenja koji može da poboljša plodnost rase. Jedno živorođeno jagnje je poželjno kod odgajivača JS dok su kod JSR odgajivača poželjni kako jedinci tako i blizanci. Jagnjad tradicionalno ostaju uz majku u štali ili na paši i kolju se sa 30-35 kg žive vage. Tehnologija gajenja slovenačkih odgajivača ovaca je održiva i pruža mogućnost za konzervaciju autohtonih rasa u u lokalnoj sredini.

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