

TECHNOLOGY OF SLAUGHTERING LAMB, THE CHEMICAL COMPOSITION AND THE NUTRITIONAL VALUE¹

Vlora Rama, PhD. c

University of “St. Kliment Ohridski”, Bitola,

vlora_rama@hotmail.com

Elena Joshevska, PhD

University of “St. Kliment Ohridski”, Bitola

elena.josevska@uklo.edu.mk

ABSTRACT

The aim of the research is to identify the quality, chemical composition and nutritional value of lamb meat. Were taken three samples, at different points of the lamb carcass and fresh immediately after slaughter, while the distance from industry to laboratory was about 1 hour. The samples were packaged with vacuum to avoid the contamination or any damage and were analyzed in the chemistry laboratory at the Kosovo Food and Veterinary Agency. Analyzed parameters are: protein, fat, moisture and collagen. According to the results and reference values we conclude that the first and the third sample exceed the value of the moisture because by 76,15 and 77,05 it should have up to 73 based on the reference values, while the second sample exceed the value of fat because by 11,72 it should have up to 5-6. The reason of sampling points is that we wanted to do the research of the quality of the meat at different part of the lamb carcass because as we know that is difficult to determine the quality of the whole carcass taking just one sample.

KEY WORDS: Lamb, slaughtering, nutritional value.

¹ professional paper

INTRODUCTION

The meat of young sheep in their first year is known as lamb so, lamb is the meat of young domestic sheep (*Ovis aries*). The meat of a lamb is taken from the animal between one month and one year old, with a carcass weight of between 5.5 and 30 kg because this meat generally is more tender than that from older sheep. Lamb is often sorted into three kinds of meat: forequarter, loin, and hindquarter. The forequarter includes the neck, shoulder, front legs, and the ribs up to the shoulder blade. The hindquarter includes the rear legs and hip. The loin includes the ribs between the two. The meat industry that was taken for research is slaughterhouse "Malësia", which is located in Kosovo, respectively in Gjilan. The factory in general, include the slaughterhouse and the processing part, it has 3700m², which has a capacity of up to 250 slaughters but, because the demand for slaughter of lambs is small, they are slaughtering up to 5 lambs per day and often by hands even though they possess the automatic line of slaughter. It is one of the most completed slaughterhouses with European standards. It has implemented the HACCP system, is certified with the ISO 22000 standard and is certified by Canada for HALAL slaughter. All these standards are important to the meat industry and a good quality of meat. So, fulfilling all the necessary conditions and having all these standards, there can be no irregular slaughter process or poor meat quality.

Sheep behavior and transport

Pre-slaughter handling greatly influences the welfare of animals. According to the OIE standards "Animal handlers should be experienced and competent in handling and moving farm livestock, and understand the behavior patterns of animals and the underlying principles necessary to carry out their tasks". Because of their instinct to stay close together, sheep will move toward another sheep. They learn that a farmer can be a friend, particularly if he feeds them. If they are not provided with any feed they will soon figure out that they are being fooled and will not respond.¹ According to research on transport, sheep are animals that cope with average transport conditions better than pigs and cattle. The maximum angle of loading and unloading ramps should be 20 degrees. Space allowances for sheep during transport in m²/animal should be: 0.2 to 0.3 m² for shorn lambs <55 kg live weight, >0.3

m² for shorn lambs >55 kg, 0.3 to 0.4 m² for unshorn lambs <55 kg, >0.4 m² for unshorn lambs >55 kg, 0.4 to 0.5 m² for pregnant ewes <55 kg, and >0.5 m² for pregnant ewes >55 kg.¹

Stunning methods and bleeding after stunning

Electrical stunning (Electronarcosis) involves passing an electric current through the brain. The effect on the animal is only temporary so the objective is to induce unconsciousness quickly and ensure the duration of unconsciousness lasts until the main blood vessels in the chest to be cut. The three key rules for effective electrical stunning are: correct electrical parameters, correct application position, and sufficient time of application. At a constant voltage the amount of current flowing through the brain is inversely proportional to the total electrical resistance pathway. This is known as Ohm's Law where: $I \text{ (amps)} = V \text{ (volts)} / R \text{ (ohms)}$.¹ Other stunning and slaughter methods that can use for sheep and lamb are:

1. Carbon dioxide, 2. Water jet and air pressure, 3. Neck dislocation and neck cutting, 4. Heating, 5. Cooling down, 6. Fragmentation and 7. Magnetic stimulation.³ The time taken for an animal to become unconscious will depend on the number of vessels that are cut and the efficiency of cutting. Experiments with sheep by Gregory and Wotton show that if sheep are bled by cutting both carotid arteries and jugular veins, unconsciousness occurs in around 14 seconds. If only one artery and vein are cut, it takes 70 seconds. However if sheep are bled by chest stick it takes only 4 seconds to observe brain unresponsiveness. Bleeding has to be done by making a deep, transverse cut across the throat close to the head to sever the four major blood vessels in the neck. This is an acceptable method of bleeding in sheep and goat.¹

What is meat quality, how it can be measured and the nutritional value of lamb meat

Meat quality is a complex concept that includes a lot of different parameters. The parameters could be: color, water holding capacity, structure, tenderness, juiciness, flavor, smell, chemical composition and nutritional quality of the meat. Methods for analyzing these parameters are for example the Warner-Bratzler method for tenderness, the CIELAB-method for color and sensory tests for flavor, taste and smell. The muscle pH and temperature

values are used to indicate the tenderness of meat.⁴ The tables below show the full range of nutrients in cooked domestic lamb (leg shank) per 100 grams.

Table 3. Nutrients in cooked domestic lamb⁶

Macronutrient/Calories	Amount (Grams/Kcal)
Calories	243 kcal
Carbohydrate	0 g
Fat	13,5 g
Saturated fat	5,6 g
Monounsaturated fat	5,7 g
Polyunsaturated fat	1,0 g
Omega-3	190 mg
Omega-6	730 mg
Protein	28,4 g

As shown above, lamb fat mainly comes from equal parts saturated and monounsaturated fat. Among the fatty acids, oleic acid is the most predominant. Compared to most meat, lamb also has a much higher omega-3 content.⁶

Protein

Like other types of meat, lamb is primarily composed of protein. The protein content of lean, cooked lamb is usually 25–26%. Lamb meat is a high-quality protein source, providing all nine essential amino acids your body needs for growth and maintenance.⁵

Fat

Lamb contains varying amounts of fat depending on how much of it has been trimmed away, as well as the animal's diet, age, gender, and feed. The fat content is usually around 17–21%. It is composed mainly of saturated and monounsaturated fats in approximately equal amounts but also has small amounts of polyunsaturated fat. Lamb fat usually contains slightly higher levels of saturated fat than beef and pork.⁵

Vitamins and minerals

Lamb is a rich source of many vitamins and minerals, including:

- Vitamin B12
- Niacin - vitamin B3
- Selenium
- Zinc and Iron⁵

Methodology

The slaughterhouse that was taken for research is "Malësia", which is located in Kosovo, respectively in Gjilan. The factory in general, include the slaughterhouse and the processing part, it has 3700m², which has a capacity of up to 250 slaughters but, because the demand for slaughter of lambs is small, they are slaughtering up to 5 lambs per day and often by hands even though they possess the automatic line of slaughter. It is one of the most completed slaughterhouses with European standards. It has implemented the HACCP system, is certified with the ISO 22000 standard and is certified by Canada for HALAL slaughter. All these standards are important to the meat industry and without them we will not have a good quality of meat. The age of lambs dedicated for slaughter is 2-3 months.

Slaughter process of lamb

As one of the largest factory in the country, it meets all the conditions, works with the latest technology equipment and produce high quality meats and meat products. Before they come to the factory, the animals are subjected to many veterinary checks. When a lamb arrive to the factory, it rest for 24-48 hour before slaughter to avoid stress of transport. Place for rest before slaughter is separate from the slaughterhouse so, a lamb should go to the slaughterhouse, passing through a stainless steel plateau, in this way the animal is not in direct contact with the floor. After passing this plateau, the lamb enters to the slaughterhouse where it is subjected to halal slaughter. After the lamb enters the factory, it's done the halal slaughter and the bleeding.

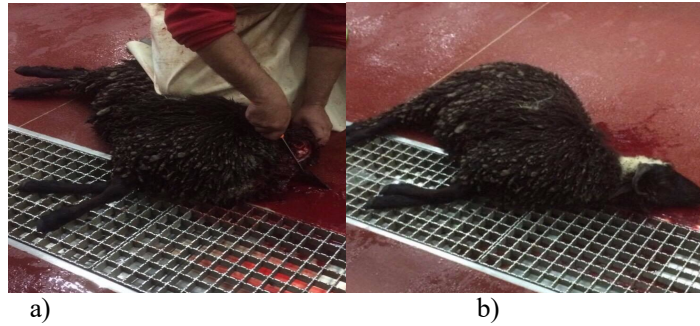


Figure 3. a) Slaughtering lamb, b) Bleeding

After the lamb is slaughtered and the bleeding is finished, should pass on the process of removing the skin and the internal organs. After removal of the internal organs, carcasses are stored at the temperature of 0-4°C and the internal organs are stored at the temperature of 0-2°C.

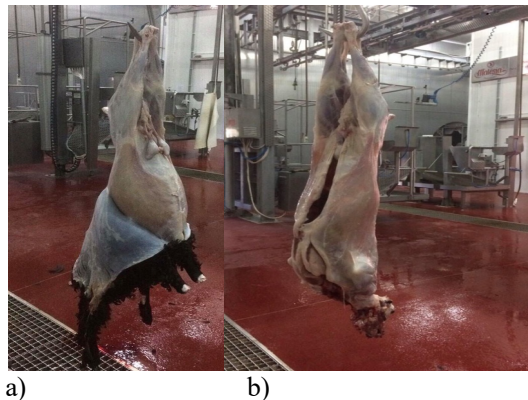


Figure 4. a) Removing the skin, b) Removing the internal organs

Sampling

The samples were taken in the meat industry-“Malësia”. Samples are taken in three different point of carcass: 1. Spine; 2. Chest and 3. Thigh. The aim of this research was to see the quality of the meat and the halal slaughter process of a lamb.



Figure 5. Sampling point on lamb carcass⁷

The samples were taken fresh immediately after slaughter, while the distance from industry to laboratory was about 1 hour. The amount for a sample was about 300 gr. The samples were packaged with vacuum to avoid the contamination or any damage.



Figure 6. Samples taken on this point of carcass: a) Spine, b) Chest and c) Thigh

The samples were analyzed in the chemistry laboratory at the Kosovo Food and Veterinary Agency. Samples analysis were made by Food Scan with these parameters: protein, fat, moisture and collagen. 300gr sample is homogenized in the blender, 150gr of the homogenized mass placed on the plate of instrument for analysis, while the rest of the sample is stored in case the first sample is damaged.



Figure 8. Samples prepared for analysis

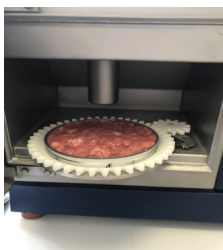


Figure 9. Placement of the plate with sample in FoodScan instrument

FoodScan™ Meat Analyser is the instrument for analysing all stages of meat production - from raw material to final product. It delivers accurate results in just 50 seconds. Is based on Near Infrared Transmittance, NIT, which is an advantage when measuring in-homogeneous products. The NIT-principle, where light is transmitted through the sample, is a major reason for FoodScan's success. The NIT-principle secures a higher accuracy at analysis of meat, compared to methods, where the result is based on light reflected from the surface of the meat.⁸

Results

In the following tables we will present the results obtained by the FoodScan instrument. To make the results as accurate as possible, two measurements have been made and their average value is obtained.

Table 6. Results of first sample-Spine

Sample 1			
Point of sampling-Spine			
Parameters	First measurement	Second measurement	Average values
Protein	19,73	19,80	19,765
Fat	3,08	3,16	3,12
Moisture	75,98	76,32	76,15
Collagen	1,30	2,11	1,705

Table 7. Results of second sample-Chest

Sample 2			
Point of sampling-Chest			
Parameters	First measurement	Second measurement	Average values
Protein	17,26	17,17	17,215
Fat	11,76	11,68	11,72
Moisture	69,59	69,45	69,52
Collagen	1,92	1,45	1,685

Table 8. Results of third sample-Thigh

Sample 3			
Point of sampling-Thigh			
Parameters	First measurement	Second measurement	Average values
Protein	18,39	18,51	18,45
Fat	4,94	5,01	4,975
Moisture	77,01	77,09	77,05
Collagen	1,60	1,24	1,42

Table 9. Composition in % of pulp meat in different animals-Reference values⁹

SPECIES	WATER	PROTEIN	FAT	ASHES
Beef meat	70-73	20-22	4,8	1,0
Chicken meat	73-75	20-23	4,7	1,0
Lamb meat	73	20	5-6	1,4
Pork meat	68-70	19-20	9-11	1,4

Discussion of the results

During the research are taken 3 samples of lamb carcass, in three different point. The point of sampling are: 1. Spine, 2. Chest and 3.

Thigh. The samples were analyzed with the Food Scan instrument for these parameters: protein, fat, moisture and collagen. The reason why these three samples were taken for analysis is that we wanted to do the research of the quality of the meat at different points of the lamb carcass because as we know that is difficult to determine the quality of the whole carcass taking just one sample. Based on the above results, we see that the sample of spine is richer in protein and collagen, the sample of chest is richer in fat and the sample of thigh is richer in moisture. Since the Kosovo state doesn't have yet any official regulations for the limits of these parameters, based on the literature we have used, we see that the first and the third sample exceed the value of the moisture because by 76,15 and 77,05 it should have up to 73 based on the reference values, while the second sample exceed the value of fat because by 11,72 it should have up to 5-6. Even though we have exceed values of fat in the second sample, we can't say that the quality of the meat is not good, but should pay attention more in the way of feeding the lamb.

Conclusion

At the end of the analysis, we have come to the conclusion that meat samples that we analyzed, in some cases they had exceeded the limits, especially in fat for the second sample. Because of the high percentage of fat, the meat is not of high quality because the ideal meat should have a 5-6 percent fat. Many factors may affect the nutritional content of the meat, some of many factors is animal welfare, stress before slaughter and the way of feeding. From the results obtained we can say that should pay attention more in the way of feeding lamb because the way of feeding can affect the percentage of fat.

REFERENCE

1. Cattle and sheep slaughter-Technical notes.
2. www.ams.usda.gov- Grading of slaughter lambs.
3. Anil M. H, Effect of slaughter method on carcass and meat characteristics in the meat of cattle and sheep.
4. Stenberg E, The effect of production system on carcass and meat quality in lambs, Skara, 2017.

5. Arnarson A, Lamb 101: Nutritional facts and health effects, March 26, 2019.
 6. Josef M, Health benefits of lamb meat and complete nutrition profile, August 15, 2018.
 7. Mrdovic B, Raseta M, Brankovic-Lazic I, Milijasevic M, Batlic B, Nastasijevic I, Pigs and cattle slaughter process hygiene in a large-scale and small-scale abattoir, A report from one country in Serbia.
 8. www.gerber-instruments.com, FOSS, FoodScan™ for meat.
- Mestani M, Teknologjia e përpunimit të mishit, 03.15.2017.