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# SENSORY EVALUATION OF LAMB'S MEAT ACCORDING TO CONVENTIONAL AND ORGANIC BREEDING SYSTEMS

*** Tatjana KALEVSKA [1], Ljupce KOCOSKI [2], Elena JOSHEVSKA[2], Viktorija STAMATOVSKA[1], Aleksandar SAVEVSKI[1]**

[1]*Faculty of Technology and Technical Sciences,University St.Kliment Ohridski Petre Prlicko 42, Veles, R.Macedonia,*
[2]*Faculty of Biotechnical Sciences, University St.Kliment Ohridski, Partizanska b.b, Bitola, R.Macedonia*
tkalevska@gmail.com
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**Abstract:** *The purpose of this paper is to determine the sensory properties of lamb meat according to conventional and organic breeding systems. The research was carried out on 120 lambs, out of which 60 were reared in a conventional and 60 in an organic system. During the research done by the heat treatment of lamb meat at a temperature of 175°, a significantly greater ($p<0.05$) weight loss of the meat from the conventional system as compared to organic system was found. The shrinkage during thermal processing of meat from organic system is of 31.45±0.97%, being of 2.59% smaller than the meat shrinkage from conventional system 34.04±0.78%. The overall acceptability score for sensory attributes (smell, juiciness, taste, aroma, texture and softness) was significantly ($p < 0.01$) higher for meat from group I and II from the organic system, as compared to meat from group I and II from conventional system. The results showed that the breeding system had a significant effect in lamb's sensory profile.*

*Keywords: sensory properties, lambs meat, oragnic and conventional systems, weight loss, thermal processing*

## 1. Introduction

Lately, because of concern for their own health, saving the environment and respecting animal welfare, the consumers' habits and requests are changed, and they prefer meat produced in organic system, which has better nutritive and sensory quality is safe for consuming, and which shall be widely accepted from domestic and foreign consumers [1].

The quality of the lamb must be acceptable for the consumers, who are on the top of the lamb production chain.

The factors that affect the acceptability of the meat are divided in sensory (look, taste, smell, aroma, tenderness, juiciness, texture), health correctness of meat, stability of the product, nutritional value, suitability for use and awareness about the product.

During thermal processing of the meat, loss of the weight of meat is occurring as a result of loss of certain amount of water, fat and soluble substances. The loss of weight which occurs during thermal processing of the meat is very significant, because it affects the look, the taste and the nutritional value of the meat [2].

The loss of weight during thermal processing show specific variations, depending on several factors, especially

the method and time of thermal processing, temperature, size, i.e. surface of the piece and the nutritional composition of the meat. According to [3], the meat freezing-point, storing and thawing causes specific biochemical and histological changes that manifest in bigger are smaller loss of tissue liquids (juices) while thawing. The inability of meat to bind the juice released while thawing the ice crystals is a result of protein denaturation. The average weight loss of meat after completed dry thermal processing (roasting) at $175^0$C temperature is 20-23%, while bigger weight loss occurs at higher roasting temperature, up to $222^0$C [3]. In their research, [4] determine weight loss of meat during thermal processing, wherein he stated weight loss of meat from 24.01% when it's boiled, that is 31.46% when it's roasted. During the thermal processing of the meat [5] stated bigger weight loss of the meat from conventional group, from 24.54%, that is 13.41% of the meat from organic system, as a result of meat chemical composition.

The sensory attributes of meat depend on the breed, the type, the sex, and the age of animals, as well as the meat storing and thermal processing conditions [6]. The most important factors which impact the acceptability of the lamb are: taste, smell, juiciness and tenderness of the meat [7]. The consumers request tender, soft meat, with specific taste and smell [8].

The smell of the meat is one of the most important factors that determine the acceptability of meat by the consumers. The smell of the meat is less pronounced in younger animals compared to older ones [9].

The meat aroma is one of the most important factors in determination of acceptability of the meat by the consumers. The basic meat aroma comes from meat components which are soluble and insoluble in water, like: sugars, amino acids and nucleotides. The specific meat aroma in different species is conditioned by the proportion of different fatty acids [10].

The textural attributes of the meat, like softness, tenderness and juiciness of the meat, which depend on the breed, the specie, the sex, the age, etc, are important sensory characteristics [6].

The juiciness of the lamb is more pronounced and depends on the ability to retain the natural water. This ability decreases with aging of the lamb and directly affects the decrease of meat juiciness [11].

## 2. Materials and methods

### 2.1 *Source of lamb's meat*

The experimental part of the research is performed on a sheep farm in property of ZK Kicevo-AD Kicevo located in Cer, 30 km (18.6 miles) from Kicevo, Republic of Macedonia, certificated for organic production. The lambs bred on that farm are traditionally exported to Italy for Easter, and belong to the first category, with average slaughter weight from 7.0 to 12.0 kg. The experimental part of the research began in the middle of January, and ended on the $75^{th}$ day of lamb breeding.

The research includes 120 lambs, 60 of them are bred in organic system, and the other 60 are bred in conventional system.

In the conventional system of breeding two groups are formed, each one with 30 lambs. Lambs in group I are crossbreeds from domestic breed refined with Virtemberg, and the lambs in group II are crossbreeds from domestic breed refined with East Friesian. The lambs from both groups in the conventional system are bred on traditional way, the breast-feeding was interrupted at the $30^{th}$ day and they were fed with conventional commercial fodder,

alfalfa hay and *ad libitum* water until the end of breeding.

In the organic system of breeding two groups are formed, each one with 30 lambs. The lambs in group I are crossbreeds from domestic breed refined with Virtemberg, and the lambs in group II are crossbreeds from domestic breed refined with east Friesian, certificated for organic production and bred according to the rules for equivalence with EU/Reg. 834/2007, according to which with the respect of animal's welfare, they were weaned at the 45$^{th}$ day and fed with concentrated fodder from organic and certificated food, produced in own mill.

The lambs from the conventional and the organic system are bred in special, physically separated and marked parts of the farm, with lot of straw on the floor.

**2.2** ***Measuring, marking and lambs feeding***

The formation of the groups and the selection of the lambs is done shortly after the partus. Right after the measuring, each lamb is marked with numbers inflicted with paint, and on the second control weight measuring on the 15$^{th}$day the lambs are marked with earmarks provided from the authorized veterinary station. In the first ten days of breeding, the lambs from the conventional and the organic system of breeding were constantly with their mothers, just breast fed, while after the tenth day the lambs were separated from their mother for few hours during the day in order to adjust to concentrated food. The chemical composition of organic and conventional fodder for lambs, are presented in (Table 1).

**Table 1**

**Chemical composition of fodder lambs in conventional and organic system**

| ***Index*** | ***Conventional fodder*** | ***Organic fodder*** |
|---|---|---|
| **Moisture (%)** | 15.44 | 14.98 |
| **Dry matters (%)** | 84.56 | 85.02 |
| **Crude proteins (%)** | 14.86 | 14.76 |
| **Crude fats (%)** | 1.21 | 1.20 |
| **Crude fiber (%)** | 3.63 | 3.96 |
| **Total ash (%)** | 4.92 | 3.81 |
| **Nitrogen free extracts (%)** | 59.94 | 61.29 |

**2.3** ***Statistical data processing*** **-** For the calculation of basic statistical indicators the software package Tools (Data Analysis) was used. Results were presented as the mean value % of total peak areas of three repeated analyses. The statistical significance of the effect considered was evaluated by means of the variance analysis at the level of 0.05 and 0.01. The variations between each mean value were also tested by applying the t-test.

**2.4** ***Samlpes of lamb meat and panels***

Samples of lamb shoulder and thigh from group I and II from organic system and from group I and II from conventional system, which after 24 hours cooling are wrapped into polyethylene foil and frozen to -18$^0$C, are taken for examining the weight loss that is determining the shrinkage during thermal processing of the meat.

Meat defrostration is performed at room temperature from 18 do 20$^0$C. The shrinkage from the meat thawing is determined on the basis of difference between meat weight before freezing and

after thawing. All the samples are measured and registered before roasting.
The thermal processing of the meat (roasting) is performed in professional oven at $175^0$C to reaching temperature from $80^0$C ±1 in depth of the samples. After roasting, the meat is left to cool at room temperature, and measurements of roasted meat weight are performed afterwards.
The weight loss of the meat that is the shrinkage during thermal processing is determined on the basis of the difference between meat weight before and after roasting.
The evaluation of the sensory attributes of lamb from both systems is conducted by 38 different evaluators. The meat samples are encrypted with letters: A,B,C and D. The evaluation of the sensory attributes of lamb is conducted with the scoring method, [12]. Coefficient of relevance is determined for each attribute of the meat: smell, juiciness, taste, softness, texture and aroma. The sensory attributes are evaluated with grades 1-5, which multiple with the coefficient of relevance, and their sum is expressed in (%) and indicates the percentage of maximum possible quality. Mean value, or weighted overall evaluation of meat quality is obtained by dividing the maximum possible quality with the sum of coefficient of relevance ($\Sigma$=20).

## 3. Results and discussion

Examination of evaluation results during thermal processing of lambs meat from bought breeding systems are shown in Table 2.

**Table 2**

**Weight loss during thermal processing of lambs meat according to breeding system**

| *System* | *Weight before frozen (kg)* | *Thawing shrinkage (%)* | *Weight before roasting (kg)* | *Weight after roasting (kg)* | *Roasting shrinkage (kg)* | *Roasting shrinkage (%)* |
|---|---|---|---|---|---|---|
| O (I) | 4.754±0.74 | 2.34±0.63[a] | 4.645±0.83 | 3.242±0.79 | 1.403±0.81 | 30.20±1.09[a] |
| O(II) | 4.709±0.76 | 2.49±0.71[b] | 4.595±0.80 | 3.150±0.93 | 1.445±0.66 | 31.45±0.97[b] |
| C(I) | 4.728±0.81 | 2.78±0.71[a] | 4.600±0.69 | 3.095±0.55 | 1.505±0.66 | 32.71±0.84[a] |
| C(II) | 4.773±0.89 | 2.99±0.74[b] | 4.635±0.74 | 3.057±0.67 | 1.578±0.75 | 34.04±0.78[b] |

*O(I)- Organic system I group, O(II)-Organic system II group, C(I)-Conventional system I group, C(II)-Conventional system II group,
[a,b,] Means in a column not having a common superscript letter are different ($p<0.05$)

Biggest meat thawing shrinkage is determined in meat from C (II) in amount of 2.99 ±0.74 %, and 2.78% in meat from C (I). The meat thawing shrinkage in the meat from O (I) is 2.49±0.71%, or 2.34% in meat from O (II). The bigger meat thawing shrinkage in lamb from conventional system is due to different chemical composition of meat, or bigger amount of water compared to the meat from organic system which is released during meat thawing, i.e. during thawing the ice crystals.
From the research results it can be concluded that weight loss during thermal processing, that is the shrinkage during thermal processing of frozen and thawed meat from O (I) is 30.20±1.09%, and it is 2.51% smaller than the weight loss from C (I) (32.71±0.84%). The shrinkage during thermal processing of meat from O (II) is 31.45±0.97%, and it is 2.59% smaller than the meat shrinkage from C (II)

(34.04±0.78%). The ascertained difference in thermal processing shrinkage between the meat from O (I) and C (I) is significant ($p<0.05$). The weight loss during roasting determined in lamb from conventional system compared to the ones from the organic system are bigger, and derive from breeding system and way of feeding the lamb, which is the reason for different chemical composition of the lamb from organic and conventional system. It is obvious that the bigger weight loss of meat from conventional system during thermal processing is due to bigger content of water and fat in the meat, which are released during thermal processing of the meat.

Our results are in accordance to ascertainment that the weight loss of meat during thermal processing indicates specific variations depending on the impact of various factors, especially the method and time of thermal processing, the temperature, the size, i.e. the area of piece and the meat composition, the freezing-point, the meat storing and thawing, which cause bigger or smaller loss of tissue liquids (juices) [3].

**Table 3**

**Sensory evaluation of lamb's meat**

| ***Sensory attributes*** | *Organic system* | | *Conventional system* | |
|---|---|---|---|---|
| | **I** | **II** | **I** | **I** |
| Intensity | 4.24±0.16[a] | 4.13±0.17[a] | 3.97±0.17[b] | 3.05±0.21[b] |
| Juiciness | 4.34 ±0.11 [a] | 3.91±0.13[b] | 3.87±0.16[b] | 3.55±0.17[c] |
| Taste | 4.26±0.15 | 4.05±0.16 | 4.10±0.15 | 3.03±0.18 |
| Aroma | 3.92±0.19[a] | 3.86±0.18[a] | 3.76±0.17[b] | 2.74±0.18[c] |
| Texture | 4.13± 0.12 [a] | 4.03±0.16 [a] | 3.74±0.16 [b] | 3.32±0.19[c] |
| Softness | 4.34± 0.12 | 4.50± 0.13 | 3.81±0.15 | 3.47±0.20 |
| **Overall acceptability score** | **4.29** | **4.08** | **3.92** | **3.31** |

*O(I)- Organic system I group, O(II)-Organic system II group, C(I)-Conventional system I group, C(II)-Conventional system II group,

[a,b,c] Means in a row not having a common superscript letter are different ($p<0.01$)

The results from the evaluation of sensory attributes of lamb from bought breeding group are represented in Table 3.

There are no significant differences in intensity and taste of lamb from organic system and from conventional system [13]. The meat smells from O (I) is normal and pleasant, evaluated with highest evaluation 4.24±0.16. The smell of the lamb from C (II) is more pronounced and unpleasant, evaluated with lowest evaluation 3.05±0.21. The determined differences between the smell of the meat from O (I) and C (II) are statistically significant ($p<0.01$). There are no determined significant differences in the smell of the meat between groups in the same breeding system.

The lamb from organic breeding system, compared to the lamb from conventional breeding system is more acceptable and desirable among the consumers, mostly because of meat juiciness [14]. Meat which has bigger ability to retain water is juicier. Meat juiciness of lamb from O (I) is evaluated with highest evaluation 4.34 ±0.11, and the juiciness of lamb from C (II) is evaluated with lowest evaluation 3.55±0.17. The determined difference in juiciness is significant ($p<0.01$).

The meat aroma is one of the most important factors of the acceptability of

meat among consumers. From the shown results, a large deviation in evaluation of meat aroma from both systems is ascertained, i.e. the aroma of the lamb from O (I) is evaluated with 3.92±0.19, and the meat aroma from C (II) is evaluated with 2.74±0.18. The determined difference in meat aroma is statistically significant ($p<0.01$).

Ascertainment that meat from younger animals has less pronounced aroma, which is more and more pronounced with aging because of increase of intramuscular tissue does not match with the results from this research, because the meat from both systems if from lambs of same age, [15]. The specific meat aroma from different breeds is a result of the different relation of fatty acids, especially unsaturated fatty acids which are more susceptible to oxidation. The way of feeding the lambs also impacts meat aroma [15]. The differences which occur in the evaluations of texture and softness of highest and lowest evaluated meat are statistically significant, and a consequence of breed characteristics. Our ascertainments match to [16] ascertainments.

From the results from the sensory evaluation it is ascertained that lamb from group I and II from the organic system has much better acceptability of sensory qualities that the meat from group I an II from the conventional system. The lamb from O (I) is evaluated with highest average evaluation 4.29, the meat from O (II) is evaluated with 4.08, the meat from C (I) is evaluated with 3.92, and the meat from C (II) is evaluated with lowest average evaluation 3.31. The general acceptability of lamb is highest evaluated in meat from O (I), and lowest evaluated in meat from C (II), and thereby it is ascertained that different sensory attributes of the meat derive from different breeding system and way of feeding, the composition of animal feed mixes, the chemical composition of the meat, as well as the breed characteristics of the lambs.

## 4. Conclusion

On the basis of the results from the evaluation of the sensory quality of thermal proceeded lamb from group I and II from the organic and the conventional system it is ascertained that the general acceptability of lamb, wherein all the sensory attributes (smell, juiciness, taste, aroma, texture and softness) are summed up, is highest evaluated in meat from group I and II from the organic system, compared to meat from group I and II from conventional system. Thereby, it can be ascertained that the determined differences in sensory attributes of the meat derive from the different breeding system that is the way of feeding which is practiced in the organic system, and the meat chemical composition. Also, there are differences in the sensory attributes due to breed characteristics of the lambs.

After performed thermal processing a significantly bigger ($p<0.05$) weight loss of lambs from conventional system compared to the weight loss of lamb from the organic system is determined.

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