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QUALITY EVALUATION OF LAMB'S MEAT ACCORDING TO BREEDING SYSTEMS

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The aim of this research was conducted to determine the differences between lamb's meat reared in organic and conventional systems. The research was carried out on 120 lambs. out of which 60 were reared in a conventional and 60 in an organic system. Compared to the conventional breeding system. which was used as a control in this research. it was found out that the meat from the organic system has the most favorable ratio and content of fatty acids. which is due to the breeding system and the way of nutrition. The differences in the average content of water. proteins. fat. carbohydrates and minerals between groups from the organic and conventional system. are statistically significant ($p < 0.05$). Based on the results obtained in this research. it can be concluded that lamb's meat from organic breeding systems have higher meat quality traits compared to conventional.

Key words: breeding; lambs; lamb's meat; oragnic and conventional system; quality

ОЦЕНА НА КВАЛИТЕТОТ НА ЈАГНЕШКОТО МЕСО ВО ЗАВИСНОСТ ОД НАЧИНОТ НА ОДГЛЕДУВАЊЕ

Целта на ова истражување беше да се утврдат разликите во јагнешкото месо од јагнињa одгледувани на органски и конвенционален начин. Истражувањето беше спроведено на 120 јагнињa. од кои 60 беа одгледувани на конвенционален и 60 на органски начин. Во споредба со конвенционалниот начин на одгледување. кој беше искористен како контрола во ова истражување. утврдено е дека месото на јагнињата од органскиот начин на одгледување има најповолен сооднос и содржина на масни киселини. што се должи на начинот на одгледување и начинот на исхрана. Разликите во просечната содржина на вода. протеини. масти. јаглехидрати и минерални материи помеѓу групите од органски и конвенционален начин на одгледување се статистички значајни ($p < 0.05$). Врз основа на добиените резултати од ова истражување. може да се заклучи дека јагнешко месо произведено на органскиот начин на одгледување има повисок квалитет од месото произведено на конвенционален начин.

Клучни зборови: одгледување; јагнињa; јагнешко месо; органски и конвенционален начин; квалитет

INTRODUCTION

Sheep production systems in Macedonia are quite diverse and determined by specific environmental conditions and tradition. which affect the choice of breed. housing system. nutrition. age. way of slaughter and processing of carcasses. From the total ten genotypes. Ovchepolian sheep mainly used for milk production represents population with greatest significance for sheep breeding in the country (Pacinovski et al.. 2006). Domestic Merinolandrace sheep and domestic East-Friesian sheep are farmed under an extensive production system and are used only for meat production (Kalevska. 2014). Today. there are many different systems of lamb breeding. which are conditioned by natural and economic factors. as well as the tradition in some countries or regions. Osamu et al.. (2005)

point that there is no general model of breeding that could be applied in any farm under any conditions.

In the conventional breeding system. Prevalent way is the traditional with technology of early interruption of the breast-feeding of the lambs aged 25–30 days and intensive feeding with concentrated fodder and hay if desired. until specific age or weight is reached (Benoit et al.. 2003). The main objective of this way of breeding is intensifying the animal husbandry through achieving solid fattening performances with early interruption of the breast-feeding of the lambs and obtaining bigger amount of milk per sheep.

Compared to the conventional. the organic animal husbandry is based on respecting the standards and legal regulations during control of each phase of the production cycle. which contributes for respecting the welfare of animals and production of safe products from animals (Sylvander et al.. 2002). According to EU Regulative 834/2007. the organic system for meat production is performed under defined standards that do not allow presence of antibiotics. coccidiostats. medical products. growth stimulators. genetic modifications, hormones and other chemical substances. in the whole product cycle.

In the sheep meat industry it is favorable to have animals that produce heavy carcasses. with good conformation. high proportion of muscles and adequate amounts of fat (Sousa et al.. 2009). but which also present higher yields in prime cuts. hence. a carcass with a higher commercial value (Cezar et al.. 2007).

Consumer preferences for a specific carcass weight are very diverse. so in countries of southern Europe consumers prefer light lamb carcasses: 8 kg in Portugal (Santos et al.. 2007). 9 kg in Italy (Cifuni et al.. 2000). 11 kg in Spain (Ripoll et al.. 2008). while in countries of Northern Europe heavier carcasses from 16 to 23 kg prevail (Beriain et al.. 2000).

Around 80 % of Macedonian lambs are exported to European countries. Italy. which is known and traditional buyer of Macedonian lambs. shows special interest. Besides Italy. Greece. Bosnia. Croatia. Montenegro and occasionally the countries from Middle East are also importers of the Macedonian lamb (Joshevska et al.. 2014).

The objective of this research is to determine the differences in the chemical. fatty acid and tissue composition of the lamb obtained from lambs bred in organic and conventional system.

MATERIAL AND METHODS

Source of lamb's meat

The experimental part of the research is performed on a sheep farm in property of ZK "Kičevo" AD Kičevo located in Cer. 30 km (18.6 miles) from Kičevo. 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 75th 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 Merino breed refined with Virtemberg. and the lambs in group II are crossbreeds from domestic Merino 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 30th day and they were fed with conventional commercial fodder (20% corn. 20% wheat. 30% barley. 28% peas. 1% premix. 0.6% feed chalk and 0.4% salt). 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 45th 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.

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 15thday. 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 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
*NFE	59.94	61.29

*Nitrogen –free extractive substances

Carcass tissue composition

For determining the tissue composition in lamb. that is the percentage share of muscle. bone and fat tissue a method of dissection of the lumbar section (*loin)* has been used. This method encloses the lumbar region of *m. longissimus dorsi* with lumbar vertebrae. the 13th back vertebrae and part of the 13th rib. obtained by dissecting the left half. The lumbar section is taken from 12 lambs. 6 from each group. separately from the organic and the conventional breeding system.

Physicochemical and statistical analyses

Samples from *m.longissimus dorsi* are taken for chemical analysis of lamb meat. For examining the chemical composition of the meat following accredited methods have been used:

Method for determining water content (ISO 1442:1997). total fat content (ISO 1443:1973). protein content (ISO 937:1978). carbohydrates content (SOP 449). mineral content (SOP 197).

The intramuscular fatty acid analysis was performed on a slice of the *longissimus dorsi* muscle obtained from each right half-carcass between the 1st and 3rd lumbar vertebra. Total lipids were extracted in duplicate (Folch. 1957). Fatty acids in the lamb meat are examined by the method AOAC 996.06 GC (FID). The total content of saturated. unsaturated and polyunsaturated fatty acids are shown in percentage (%).

Data obtained in this study were analyzed by descriptive and analytical statistical parameters: mean value (±). standard deviation (Sd) by using MS Excel and analysis of variance ANOVA. 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.

RESULTS AND DISCUSSION

Carcass tissue composition is one of the factors that determine meat quality. From the obtained results (Table 2). we can conclude that the average content of muscle tissue in lambs from O(I) is for 2.22% significantly higher than the one from C(I). while the content of fat tissue is statistically significantly higher for 1.71 % in lambs from C(I). compared O(I). The content of muscle tissue in lambs from O(II) is for 3.12% higher than the C(II). The average content of fat tissue is for 2.19 % smaller in the lambs from O(II). compared with the lambs from C(II). The absolute weighs of all tissues increased in order. heavier carcasses. only the percentage fat increased. the percentages of muscle and bone decreasing progressively (Tribe. 1964). These differences indicate that breed and breed system has an impact on the tissue composition of lamb's meat. because they are statistically significant ($p < 0.05$).

The tissue composition of the carcass would be the most correct manner of classifying and paying of marketed carcasses. since the body composition of animals of all species varies as a result of growth. nutrition and their genetics. and the percentage of muscle in the bodies of the animals ranges from 35 to 50 kg/100 kg body weight (Gomes et al.. 2011).

Table 2

Carcass tissue composition of lambs according to breeding systems (%)

System	Muscle tissue	Bone tissue	Fat tissue
O(I)	59.37[a]	14.36[a]	26.27[a]
O(II)	58.36[a]	15.02[a]	26.62[a]
C(I)	57.15[b]	14.87[b]	27.98[b]
C(II)	55.24[b]	15.95[c]	28.81[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.c]Means in a column not having a common superscript letter are different ($p < 0.05$)

The chemical composition of meet is one of the more important factors that determine the nutritional quality of the lamb meat. From the above stated (Table 3) it can be ascertained that the differences which emerge in the chemical composition of the meat between the groups in the same breeding system are significant ($p < 0.05$) and are due to the breed characteristics.

The lamb meat from the O(I) showed significantly higher content of protein (23.51%) and mineral compounds (1.32%) and lower fat content (1.34 %) in comparision with the lamb meat from the C(I). The determined differences in the average content of water. proteins. fat. carbohydrates and minerals between 1st and 2nd group from the organic and conventional system. are statistically significant ($p < 0.05$) and they come from the influence of many factors: lamb breeding technology applied in the organic system. way of feeding. composition of fodder. breed and age of slaughtering lambs.

Table 3

Chemical composition of lamb's meat (%)

System	Water	Proteins	Fat	Carbohydrates	Minerals
O(I)	73.97[a]	23.51[a]	1.34[a]	0.26[a]	1.32[a]
O(II)	74.72[a]	22.36[a]	1.48[a]	0.27[a]	1.17[b]
C(I)	74.65[b]	22.09[b]	1.81[b]	0.19[b]	1.26[b]
C(II)	75.63[b]	21.03[b]	1.97[c]	0.23[b]	1.14[c]

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 column not having a common superscript letter are different ($p < 0.05$)

The similar results were shown by Babiker et al. (1990). Sanz-Sampelayo et al. (1993). Arsenos et al. (2000). Pieniak-Lendzion et al. (2000). Morbidini et al. (2001).

The fat in sheep carcasses is divided into subcutaneous. intermuscular and intramuscular fat. The lipids in the subcutaneous and intermuscular fat are mostly made up of triglycerides but with basically phospholipids in intramuscular fat but the amount of triglycerides depends on the amount of marbling in the muscles (Jónsdóttir et al.. 2001). Lamb fat is solid and very saturated (Table 4).

Table 4

Fatty acids composition of lamb's meat (%). according to breeding systems

System	SFA	MUFA	PUFA
O(I)	37.43[a]	49.16[a]	13.35[a]
O(II)	39.62[a]	47.38[a]	12.97[a]
C(I)	43.61[b]	44.15[b]	12.17[c]
C(II)	45.31[b]	43.31[b]	11.21[c]

O(I) – Organic system I group. O(II) – Organic system II group. C(I) – Conventional system I group. C(II) – Conventional system II group. SFA – saturated fatty acids. MUFA – unsaturated fatty acids. PUFA – polyunsaturated fatty acids;

[a.b.c]Means in a column not having a common superscript letter are different ($p < 0.05$)

Most favorable proportions of the fatty acids are determined in the meat from the organic system that is lower content of saturated fatty acids (SFA) and higher content of unsaturated (MUFA) and polyunsaturated fatty acids (PUFA). During the analysis of the average content of fatty acids. the determined content of SFA in the meat from O(I) group is 6.18% lower that the content of C(I) group. The average content of SFA in O(II) is 5.72 % lower compared to C(II). The content of MUFA from O(I) and O(II) groups is significantly higher for 5.01% or 3.97% than the C(I) and C(II) groups. The average content of PUFA in the meat from O(I) significantly higher for 1.18% compared to the content of PUFA in C(I) group. and the 1.76% higher than the content of C(II)group.

From the presented data and determined differences it is found that the meat from the organic system has the most favorable ratio and content of fatty acids. which is due to the breeding system and the way of nutrition practiced in the organic system. as well as the composition of the fodder and the hay.

Our results are in accordance with the results obtaind from Angood et al. (2008). which reported that the fatty acids in the meat from the organic lambs have more favorable ratio compared to the meat from the conventional system. Similar results for organic breeding system were reported by Diaz et al. (2003), Casey et al. (1995), Sanudo et al. (2000), Demirel et al. (2006).

CONCLUSION

Based on the results obtained in this research. it can be concluded that lamb's meat from organic breeding systems have higher meat quality traits compared to conventional.

The objectives in the research are fundamental. and will give valuable contribution for bigger affirmation and stimulation of the organic production of lamb with bigger nutritional and sensory quality. safe for human's health. simultaneously taking care for sustainable development and protection of the environment. as well as respecting the welfare of the animals.

REFERENCES

[1] Angood. K. M.. J. D. Wood. G. R. Nute. F. M. Whittington. S. I. Hughes. P. R. Sheard**:** A comparison of organic and conventionally-produced lamb purchased from three major UK supermarkets: Price. eating quality and fatty acid composition. *Meat Sc*i..**78**. 176–184 (2008).

[2] AOAC No. 996.06. Fatty acids (free) in crude and refined oils. In: Horwitz. W. and Latimer. G. W. (Eds): *Official Methods of Analysis of AOAC. International. 17th. Edition. Arlington*. VA.. **41**. p. 12 (2006).

[3] Arsenos. G.. D. Zygoyjannis. D. Kofidis. N. Kotsaounis. C. Stamataris: The effects of breed slaughter weight and nutritional management on cholesterol content of lamb carcasses. *Small Rum. Res*.. **36**. 275–283 (2000).

[4] Babiker. S. A.. I. A. El Khider. S. A. Shafie: Chemical composition and quality attributes of goat meat and lamb. *Meat. Sci*.. **28**. 273–278 (1990).

[5] Benoit. M.. P. Veysset: Conversion of cattle and sheep suckler farming to organic farming: adaptation of the farming system and its economic consequences. *Livestock Production Science*. **80**. 141–152 (2003).

[6] Beriain. M. J.. A. Horcada. A. Purroy. G. lizaso. J. Chasco. J. A. Mendizabal: Characteristics of Lacha and rasa Arangonesa lambs slaughtered at three live weights. *J. Anim. Sci*. **78**. 3070–3077 (2000).

[7] Casey. N. H.. E. C.. Webb: Influence of dietary energy levels and form of diet on composition of fatty acids in subcutaneous adipose tissue of wethers. *Small Rum. Res*.. **18**. 125–132 (1995).

[8] Cezar. M. F.. W. H. Souza: Carcaças ovinas e caprinas: obtenção. avaliação e classificação. *Uberaba: Editora Agropecuária Tropical*. **1**. 231 (2007).

[9] Cifuni. G. F.. F. Napolitano. C. Pacelli. A. M. Riviezzi. A. Girolami: Effect of age at slaughter on carcass traits. fatty acid composition and lipid oxidation of Apulian lambs. *Small Rumin*. *Res*. **35**. 65–70 (2000).

[10] Demirel G.. H. Ozpinar. B. Nazli. O. Keser: Fatty acids of lamb meat from two breeds fed different forage: concentrate ratio. *Meat Science*. **72**. 229–235 (2006).

[11] Díaz M.T. S. Velasco. C. Pérez. S. Lauzurica. F. Huidobro. V. Cañeque: Physico-chemical characteristics of carcass and meat Manchego-breed suckling lambs slaughtered at different weights. *Meat Sci*.. **65** (4):1247–55 (2003).

[12] Folch J., M. Lees, G. H. S. Stanley: A simple method for the isolation and purification of total lipides from animal tissues. *The Journal of Biological Chemistry*. **226**. 497–509 (1957).

[13] Gomes. M. A. B.. G. V. Moraes. M. MatavelI. F.A.F Macedo. T. T. Carneiro. R. M. Rossi: Performance and carcass characteristics of lambs fed on diets supplemented with glycerin from biodiesel production. *Revista Brasileira de Zootecnia*. **40** (10). 2211–2219 (2011).

[14] ISO 1442: *Meat and meat products: Determination of total moisture content (Reference method)*. International Organization for Standardization. Geneva (1997).

[15] ISO 1443: *Meat and meat products: Determination of total fat content (Reference method)*. International Organization for Standardization. Geneva (1973).

[16] ISO 937: *Meat and meat products: Determination of total protein content (Reference method)*. International Organization for Standardization. Geneva (1978).

[17] Jónsdóttir Rósa. Guðjón Þorkelsson Helgi. Brekkunum Birna Mørkøre: Fatty Acid Composition of Faroese Lamb meat. *Project report to NORA* . 36–01, p. 3 (2001).

[18] Joshevska E., B. S. Rakipi, M. Stojanovskim K. Bojkovska, J. Tomovska, G. Dimitrovska: Specificity for the processing of Macedonian lamb meat for the Member State of European Union and third countries. *International Journal of Innovative Science, Engineering and Technology*. Vol. **1** (10). 451–467 (2014).

[19] Kalevska Tatijana: *Determination of differences of lamb meat from lambs reared in organic and conventional system.* Doctoral thesis. University St. Kliment Ohridski. Faculty of Biotechnical Sciences. 164 p., 2014.

[20] Morbidini. L.. D. M Sarti. P. Pollidori. A. Valigi: Carcass. meat and fat quality in Italian Merino derived lambs obtained with ''organic'' farming system. *Options Méditerraneénnes, Série A*. **46**. 29–31 (2001).

[21] Osamu S.. I. Kazuo. N. Yoshitaka: Breeds and breeding systems of dairy sheep in the Mediterranean countries. *Experimental Herbivora*. **29**. 39–48 (2005).

[22] Pacinovski N., M. Gilevski, E. Eftimova: Comparison of milk production ability between Awassi and East-Friesian sheep in Macedonia. *Macedonian Journal of Animal Sciences*. **3**. 65–72 (2006).

[23] Pieniak-Lendzion. K.. R. Niedziółka. W. Szeliga.: Charakterystyka wybranych cech jakościowych mięso kozioł-ków i tryczków [Characterization of selected meat quality traits of kids and ram lambs]. In: *Rocz. Nauk. Zoot*.. zesz. **5**. (suplement). 173–177 (2000).

[24] Ripoll. G.. M. Joy. F. Muñoz. P. Albertí: Meat and fat colour as a tool to trace grassfeeding systems in light lambs production. *Meat Sci*. **80**. 239–248 (2008).

[25] Rules of Equivalence with the EU Regulation (EC) 834/2007

[26] Sanz-Sampelayo. M. R., L. Lara, I. Prito, F. Gil Extremera, J. Boza: Body composition and energy metabolism of pre-ruminant kids and lambs. *Agric. Prod. Anim*. **8** (1). 5–15 (1993).

[27] Santos-Silava. J., R. J. B. Bessa, F. Santos-Silva: Effect of genotype, feeding system and slaughter weight on the quality of light lambs. II. Fatty acid composition of meat. *Livestock Prod. Sci*.. vol. **77**. 187–194 (2002).

[28] Santos. V. A. C., S. R. Silva. E. G. Mena, J. M. T Azevedo: Live weight and sex effects on carcass and meat quality of "Borrego terrincho–PDO" suckling lambs. *Meat Sci*. 77. 654–661 (2007).

[29] Sańudo. C., M. Alfonso, A. Sánchez, R. Delfa, A. Teixeira: Carcass and meat quality in light lambs from different fat classes in the EU carcass classification system. *Meat Science*. **56**. 89–94 (2000).

[30] Sousa W. H., Brito E. A., Medeiros A. N., Cartaxo F.Q., Cezar M. F., Cunha M.G.G.C.: Características morfométricas e de carcaça de cabritos e de cordeiros terminados em confinamento. *Rev. Bras. Zootec*.. **38**. 1340–1346 (2009).

[31] Standard Operating Procedure (SOP 449): Quantitative determination of carbohydrates with Dreywood's anthrone reagent

[32] Standard Operating Procedure (SOP 197): Quantitative determination of mineral content

[33] Sylvander. B., S. Bellon, J. Cabaret, Y. Gautronneau: Designing a Research Programme in Organic Farming in France: Systemic Approaches and Research in Partnership. *Proceedings of the 14th IFOAM Organic Word Congress,* 2002, p. 289.

[34] Tribe. D. E: Ed. of Tech. Can/. on Carcass Composition and Appraisal of Meat Animals. C.S.l.R.O.. Melbourne, 1964.