OKU Fen Bilimleri Enstitüsü Dergisi
5(3): 1872-1889, 2022

OKU Journal of The Institute of Science and Technology, 5(3): 1872-1889, 2022

Osmaniye Korkut Ata Üniversitesi Fen Bilimleri Enstitüsü Dergisi

Osmaniye Korkut Ata University Journal of the Institute of Science and Technology

Organic and Ecological Production of Chicken Meat and Eggs: A Review of the Regulatory Harmonization Between the EU and Republic of Serbia

Milena MİLOJEVİĆ[1*], Aleksandra MİLOŠEVİĆ[2], Tugay AYASAN[3], Sladjana ZARİĆ[4], Sevda INAN[5]

[1]Academy of Vocational Studies Šabac, Serbia
[2]Faculty of Law, University of Belgrade, Serbia
[3]Osmaniye Korkut Ata University, Kadirli Faculty of Applied Sciences, Department of Organic Agricultural Management, Osmaniye, Turkey
[4]Faculty of Agriculture, University of Belgrade, Serbia
[5]Namık Kemal University, Tekirdağ, Turkey

[1]https://orcid.org/0000-0001-6997-1532
[2]https://orcid.org/0000-0003-3231-5616
[3]https://orcid.org/0000-0001-7397-6483
[4]https://orcid.org/0000-0002-0941-8142
[5]https://orcid.org/0000-0001-8138-5851
*Corresponding author: milena.n.milojevic23@gmail.com

Review Article

Article History:
Received: 31.01.2022
Accepted: 26.04.2022
Published online: 12.12.2022

Keywords:
Organic
Chicken meat
Organic egg

ABSTRACT

The interest in organic livestock and products produced from animals has incr considerably in recent years; Studies on this subject have been concentrated. I review, organic and ecological production of chicken meat and eggs has examined: the review of legislative harmony between the EU and the Reput Serbia. Pure (autochthonous) breeds and their crossbreeds in organic produ have lately become the research subject of a growing number of authors. principles of organic livestock production, among other things, refer to dor animals welfare which inherently includes their health preservation an production of high quality animal products with the aim of setting up organizing ecologically acceptable production. Organic products are tasty, safe and have high nutritive values.

Tavuk Eti ve Yumurtalarının Organik ve Ekolojik Üretimi: AB ile Sırbistan Cumhuriyeti Arasındaki Mevzuat Uyumunun Gözden Geçirilmesi

Derleme

Makale Tarihçesi:
Geliş tarihi: 31.01.2022
Kabul tarihi: 26.04.2022
Online Yayınlanma: 12.12.2022

Anahtar Kelimeler:
Organik
Tavuk eti
Organik yumurta

ÖZ

Organik hayvancılık ve hayvanlardan üretilen ürünlere olan ilgi son yıllarda oldukça artış göstermiş olup; bu konu ile ilgili çalışmalar yoğunlaşmıştır. Bu derlemede tavuk eti ve yumurtalarının organik ve ekolojik üretimi: AB ile Sırbistan Cumhuriyeti arasındaki mevzuat uyumunun gözden geçirilmesi üzerinde durulmuştur. Organik üretimde saf (otokton) ırklar ve onların melezleri son zamanlarda artan sayıda yazarın araştırma konusu haline gelmiştir. Organik hayvancılık üretiminin temel ilkeleri, diğer şeylerin yanı sıra, ekolojik olarak kabul edilebilir üretimin kurulması ve organize edilmesi amacıyla evcil hayvanların sağlığının korunmasını ve yüksek kaliteli hayvansal ürünlerin üretimini içeren evcil hayvan refahına atıfta bulunmaktadır. Organik ürünler lezzetlidir, sağlık açısından güvenlidir ve yüksek besin değerlerine sahiptir.

To Cite: Milojevic M., Milosevic A., Ayasan T., Zaric S., İnan S. Organic and Ecological Production of Chicken Meat and Eggs: A Review of the Regulatory Harmonization Between the EU and Republic of Serbia. Osmaniye Korkut Ata Üniversitesi Fen Bilimleri Enstitüsü Dergisi 2022; 5(3): 1872-1889.

1.Introduction

In ecological forms of production, which also include the methods of organic agriculture, the existing knowledge of agronomy must be supplemented with biological and ecological expertise in order to protect the agroecosystem and ecosystem (environment) through this type of production. Fundamentally, organic (biological, ecological) production is based on the principles of agroecology. Namely, "organic production", as a part of sustainable development, is based on the application of agroecological and agroeconomic principles, and it includes production, processing, product storage, distribution and sale, together with the production control and product certification. More specifically, organic production is a part of sustainable technology of agricultural production in which scientific findings are used to understand the laws of nature. Also, in the long run, organic production is set up on the principle of human health and environmental protection.

The main negative effects that follow conventional (intensive) production are the soil and biodiversity erosion, animal products made from animals bred in chronic stress conditions, the presence of antibiotics residues and plant protection products. For this reason, contemporary organic production is developed on the ecological principles to which economical production with agroecosystem and ecosystem preservation are inherent. It means the production of quality, safe, controlled and certified food that meets the needs of contemporary consumers, and contributes to the rational resource usage and environmental protection. According to the definition given by FAO (http://www.fao.org), "organic agriculture" is a process of sustainable development of rural areas in accordance with disposable resources, tradition and biodegradable potential of the habitat, and it represents a complete and whole farmer production, crop and animal husbandry alike, which also covers the preservation and renewal of natural resources and return to traditional values and knowledge. In other words, self-sustainable organic agriculture represents, among other things, an attempt to identify the methods which should enable the production of organic food with the reduction of negative effects of intensive agricultural production.

Organic agricultural production is an entirely controlled production cycle from the aspect of IFOAM legal regulations (International Federation of Organic Agriculture Movements, 1996). According to these, the production conditions must be adjusted to the specific requirements of each country in which the production takes place in accordance with the existing laws. In order to set up organic agricultural production in an area, precisely defined requirements must be met, such as: the isolation of land plots, animal farms and processing facilities from potential sources of contamination; a suitable quality of water for irrigation; a harmonized development of plant and animal production and the competence of qualified persons and producers who are obliged to continually improve and update their knowledge and skills.

In developed countries, where the aggressive use of available chemicals has led to the deterioration of water, air and soil quality in contemporary agriculture, establishing organic production is almost impossible, which causes a great lack of organic products. Hence, less developed countries whose

agroecosystem is still preserved, have an opportunity to increase their export of organic products. Organic products are tasty, safe, have high nutritive values, are rich in minerals, especially potassium and iron, and also contain a higher level of magnesium, phosphorus and vitamin C. As in conventional agricultural production, organic products can be fresh or processed, which depends on production methods. Organic products take up only 1% of the total world food market, but the demand for them is continually growing on the global level, and their participation in the world trade flows is getting more and more significant.

The Republic of Serbia and The Republic of Srpska (Bosnia and Herzegovina), like many other countries in the world, fulfill all the requirements for the organized development of high quality, safe, certified food that meets the consumers' needs and corresponds to export increase, making ecological and economic profit without jeopardizing the environment. As for the current state of legistation in the Republic of Serbia, our normative framework is completely harmonized with the EU directives. Enacted and implemented laws and regulations strictly follow the principle of "ecological welfare", facilitating the export of final organic products to the EU and third country markets. This is the reason why organic production is described as a controlled way of production from field to table - it prevents a potential deterioration of ecosystem and human health. For countries in the region, this is a very important type of production, since they have always been agricultural countries with significant natural resources and a long production tradition. Contemporary tendencies and the awareness of the necessity of ecological production and environmental protection have given rise to organic production as an alternative for conventional production. The contemporary scientific findings and technological advances make possible the successful application of organic production in all forms of agriculture, including livestock breeding. Also, the fact that one of the most important characteristics of organic production is the principle of plant and animal production unity should never be overlooked. These are the very principles the legislator was guided by when regulating the area of organic production, having as a goal the setting up of organic production as a complete system of managing and producing food based on ecological procedures, high degree of biological diversity, preservation of natural resources and high standards of animal welfare (Organic production law - Official Gazette of RS, no. 30/2010 and 17/2019).

The objective of this paper is to show the results of organic production of poultry meat and eggs in suitable ecological conditions that have been reached so far. In organic production pure (autochthonous) breeds and their crossbreeds have lately become the research subject of a growing number of authors. Basic principles of organic livestock production, among other things, refer to domestic animals welfare which inherently includes their health preservation and the production of high quality animal products with the aim of setting up and organizing ecologically acceptable production.

2.The Results of Organic Poultry Meat and Egg Production

Based on references, it is noticeable that, pure (autochthonous) breeds and their hen crossbreeds (more rarely hybrids) have lately become a subject of research for a certain number of authors in the field of organic poultry production, especially in the European Union countries. Besides, it can be said that a slightly stronger emphasis was put on organic poultry meat production, and weaker on egg production by laying hens according to organic principles. This contradicts Hovi et al. (2003), who state that it is much easier to organize organic egg production than organic meat production in the countries where free-range system is used, due to a more demanding choice of breed (hybrid) with specific performances such as slower growth and movement in free nature.

2.1.The Results of Organic Egg Production

The research conducted by Sorensen and Kjaer (2000), which deals with the potential of traditional breed for organic egg production in Germany, proved to be interesting. The authors examined two breeds at the same time (White Leghorn and New Hampshire), their crossbreeds that were inclined towards a greater egg carrying capability and a line hybrid ISA Brown, and the organically produced eggs (the floor housing system) were most commonly sold in Denmark. The research (comparison) was carried out in experimental organic production conditions. From 18^{th} to 43^{rd} week of age, the highest egg production was found in ISA Brown. Still, within this time period of rearing laying hens, the mortality caused by cannibalism was several times higher in ISA Brown (16%) compared to other traditional breeds and crossbreeds (0.0-1.1%). Although ISA Brown reared in this housing system were the most productive, the poultry welfare was dramatically endangered. It follows that it was difficult to achieve high egg production and simultaneously preserve the health of laying hens. On these grounds, the authors argued that, the attempt to find alternative breeds/hybrids, i.e. to create 'organic hens', was still not finalized. Grobbelaar (2008) and Grobbelaar et al. (2010) came to similar conclusions, especially regarding mortality. They examined certain productive parameters in three South African autochthonous breeds, Leghorn and Naked Neck, during a production cycle (52 weeks). There were significant differences between the examined breeds ($P<0.05$), especially regarding mortality, which was almost twice as small in autochthonous breeds compared to Leghorn and Naked Neck. In addition, the authors found out that, an average body mass of 16-week-old Naked Necks was 1.10 kg, and of 20-week-old Naked Necks it was 1.40 kg. The full maturity was reached at 155 days, while Leghorn laying hens weighed on average 1.17 kg at 17 weeks, and 1.70 kg at 76 weeks, reaching the full maturity at 149 days. However, unlike mortality, the egg carrying capacity and egg mass in Naked Neck and Leghorn, compared to native South African breeds were higher and statistically significant ($P<0.05$). During the production cycle (52 weeks), 138.9 and 279.5 eggs were produced per housed Naked Neck and Leghorn, respectively. The average egg mass was 55.10 g (Naked Neck) and 60.50 g (Leghorn).

As in the majority of European countries and the world, domestic (autochthonous) breeds are also reared in the Republic of Serbia in quite large quantities, mostly in rural households in semi-extensive or extensive systems. These breeds are: Sombor Kaporka, Svrljig Black, Naked Neck and Banat Naked Neck. In addition, there are foreign pure breeds: Rode Island Red, Naked Neck, White Leghorn and New Hampshire. The characteristics of these breeds in Serbia are relatively little observed and determined. Modest research on determining the productivity of these breeds was done by Mašić et al. (1970), Žigić et al. (1970), Marinković et al. (1972), Apostolov (1976), Apostolov and Apostolov (1976), while Milošević et al. (2005), Pavlovski et al. (2009), Mitrović et al. (2011b) conducted somewhat larger research, primarily in order to determine fattening and slaughter characteristics of these breeds reared in different systems. In addition, these authors found statistically significant positive coefficients of phenotype correlation ($P<0.001$) between egg and chicken masses. A negative correlation coefficient was found between the egg mass and the percentage of chicken in the White Naked egg. This turned out positive in Svrljig Black and the correlation coefficient did not seem to be statistically significant ($P>0.001$).

Mašić et al. (1970) found a bigger mass in the eggs originating from White Rock (61.18 g) than New Hampshire (58.36 g). A similar egg mass in New Hampshire, on average 58.29 g, was found by Žigić et al. (1970), while the egg shape index was about 72.89%. A significantly lower egg mass (56.89 g) was found in White Rock by Marinković et al. (1972) and Apostolov (1976). Apostolov and Apostolov (1976) found that, in White Rock, a relative chicken mass in relation to the total egg mass was around 66%. Mitrović et al. (2011b) examined the incubation values of eggs originating from two breeds, i.e. hen class (Svrljig Black and White Naked Neck) that are reared in extensive systems in the rural areas of Serbia. The chicken hatchability was 1.98% higher in White Naked Neck than in Svrljig Black. The average egg mass was also statistically significantly higher ($P<0.01$) in White Naked Neck (61.27 g) than in Svrljig Black (57.67 g), as well as one-day-old chicken mass (41.13 g - White Naked Neck and 39.47 g - Svrljig Black), whereas the relative proportion of chicken mass in the total egg mass was 1.27% higher in Svrljig Black (67.16% - Svrljig Black and 68.43%, White Naked Neck). But the difference was not statistically confirmed.

In addition to the mentioned authors, the productivity and quality of eggs of autochthonous hen populations reared in extensive conditions were researched by Pavlovski (1990), Mašić and Pavlovski (1994), Supić et al. (1997), Tolimir et al. (1997). Mašić and Pavlovski (1994) came to the conclusion that different housing systems of laying hens had small effect on egg quality, when feeding was equal in each system. However, Pavlovski (1990) brought up a suggestion to research the quality of eggs that had demonstrated a persuasive advantage of the extensive system over the battery system, with the quality being expressed in Haugh-units. Since the participation of auchthonous hen populations was much higher in the extensive keeping system, the question whether autochthonous hens lay better quality eggs than culture breeds or industrial laying hen hybrids was still open. An exquisite addition to this debate was given by Tolimir et al. (1997), who examined external and internal parameters of

certain egg populations of East Serbia autochthonous breeds. Generally, the mentioned authors argue that the examined parameters of external and internal egg quality were significantly different in autochthonous hens in comparison to the bibliography data related to hybrid laying hens in industrial production ($P<0.05$). On top of that, it is emphasized that, further research should show whether there are genetic differences between individual flocks of autochthoous hens in the observed or other circumstances.

Supić et al. (1997) described external and physiological characteristics of autochthonous poultry breeds in Vojvodina (Naked Neck and Sombor Kaporka), based on their own and other authors' data. The authors showed a current number of domestic hens included in the control flock. The control flock consisted of 235 hens and 29 roosters (total 264 heads) of Naked Neck, and 36 hens and 4 roosters (total 40 heads) of Sombor Kaporka. The control of productive and reproductive characteristics was carried out in both breeds. Three flocks of each breed underwent the control. The productive characteristics of Naked Neck, depending on the flock, were as follows: age in the control group from 39 to 52 weeks; egg production per laying hen from 30.41 (30.11 breeding eggs) to 62.00 (59 for setting) pieces; the average intensity of egg carrying capacity was from 43.44% to 44.14%; the hatchability of laid eggs was from 63.16% to 82.22%. More favourable productive characteristics were found in Sombor Kaporka flocks: the control group age from 30 to 68 weeks; egg production per laying hen from 40 (35 for setting) to 70 pieces; egg carrying capacity from 45.86% to 57.14%, and the hatchability of laid eggs between 75.12% and 81.35%.

The productive and reproductive characteristics of pure breeds (Rhode Island Red, Barred Plymouth Rock, White Leghorn, White Rock and New Hampshire) and hybrids (Ross 308, Cobb 500 and Ross SL 2000) were researched by many researches (Vieira et al. 2005; Almeida et al. 2006; Đermanović, 2010. In 2 studies by Islam et al. (2002), in which four hen breeds were observed (White Rock, WR; White Leghorn, WL; Barred Plymouth Rock, BPR; Rhode Island Red, RIR), the highest fertilization (fertility) of eggs was found in WLH (95.08%), and the lowest in RIR (88.16%) and the differences were statistically important ($P<0.01$). The chicken hatchability out of the number of fertile eggs was approximately similar, ranging from 88.50% (BPR) to 92.27% (WR) and the differences were not important. In addition, the authors found the largest average egg mass in WLH (59.48 g), the smallest in BPR (58.04 g), and the differences were also not important ($P>0.05$). However, the percentage of chicken in egg mass was significantly higher ($P<0.01$) in BPR (67.21%) than in RIR (65.96%), WR (65.46%) and WLH (65.17%). Statistically very significant ($P<0.001$) positive coefficients of phenotype correlation were found between egg mass and (normal) chicken mass, while negative coefficients of correlation were found between egg mass and chicken percentage, but these were not significant. However, Farooq et al. (2001) found a significantly lower average egg mass (53.94 g) and chicken mass (35.32 g) in Rhode Island Red breed reared in a farm, while chicken in egg mass was 65.94%. The average egg length was 5.57 cm and width 4.19 cm (length/width = 1.33). The statistically important correlation ($P<0.05$) was found Between egg mass, length and width, like

between egg and one-day-old chicken masses (r= 0.496). In the same breed (RIR), Witt and Schwalbach (2004) found an average egg mass 67.8 g (heavy) and 47.8 g (middle), hatched chicken egg 40.9 g and 33.8 g, and the chicken percentage in egg mass 70.76% and 70.56%. In the other hen breed (New Hampshire), egg mass was 58.3 g (heavy) and 48.7 g (middle), chicken mass was 40.0 g and 34.6 g, while chicken percentage was 72.04% and 71.05%.

Miclea and Zahan (2006) determined the effect of egg weight on hen weight and hen percentage in egg weight of Ross SL 2000 crossbred parents reared between 35^{th} and 49^{th} weeks. Chickens with mass 38.11 g were hatched out of small eggs (average mass 54.59 g), chickens whose mass was 40.74 g were hatched out of middle eggs (58.89 g) , and 43.18 g chickens were hatched out of large eggs (63.10 g). Therefore, the largest egg mass loss during the incubation period was in large eggs, i.e. the largest proportion of chicken in egg mass was in small eggs (69.81%), followed by middle eggs (69.17%) and the smallest proportion was in large eggs (68.43%). Similar results were found by Luquetti et al. (2004), Vieira et al. (2005), Almeida et al. (2006), Wolanski et al. (2007), Đermanović (2010) in broiler hybrid parents Ross 308 and Cobb 500. The largest relative proportion of chicken in egg mass was found in 27-week-old parents (74.63%), and the smallest in 60-week-old parent flock (65.58%). Phenotype correlation between observed indicators of examined hybrids was similar to that in pure breeds that were found by Islam et al. (2002) and Farooq et al. (2001). Namely, a positive phenotype correlation was found between parents age, egg mass and chicken mass, while a negative correlation with different significance tresholds was found between egg mass and chicken percentage in egg mass.

Đermanović et al. (2012) examined the mean values, variability and difference significance between the observed parameters of the analyzed chicken breeds in their study. The researchers used New Hampshire and SK-Sombor Bodywork breeds. They found that there was no significant difference between the breeds in terms of egg mass and egg shape index, whereas egg length and width promoted a statistical difference ($P<0.05$). The same researchers also stated that there was no statistical difference in egg mass and shape index values in both fertile and infertile eggs. Detailed results of comparative studies of productive and reproductive traits of Sombor Kaporka and New Hampshire widely bred in the Republic of Serbia are given by Đermanović et al. 2012 and Mitrović et al. 2014. Both breeds were reared in a free range i.e. semi-extensive housing system. Essentially, the authors observed the carrying capacity (egg production) in a certain time period (60 days), egg mass, external egg characteristics (length, width and egg shape index), mass of the chickens laid in a natural – traditional way and a relative proportion of chicken in egg mass. In addition, coefficients of phenotype correlation and the relation intensity were found between the majority of observed indicators. They reported that New Hampshire and Sombor Kaporka breeds showed satisfactory productivity and reproductive performance while kept in semi-coverage housing system, and both breeds could be used successfully in organic poultry production (Đermanović et al. 2012; Mitrović et al. 2014). Besides, the authors emphasized that better incubation results are achieved during natural laying (under the

clucking hen) than in artificial egg incubation, especially regarding the hatchability percentage of fertilized eggs and relative chicken proportion in egg mass (chicken %).

Đermanović et al. (2013) and Đermanović and Mitrović (2013) examined phenotype variability of external quality characteristics of breeding eggs (egg mass, length, width and egg shape index) of Partridge Italian and Leghorn reared in the semi-intensive system. The eggs of Partridge Italian, compared to Leghorn eggs, had greater mass (62.25 g- 61.01 g), greater length (55.72 mm-55.19 mm) and width (42.15 mm-41.99 mm), while the egg shape index (width/length x 100) was insignificantly higher in Leghorn eggs (76.08%-75.65%), but the differences were not significant ($P>0.05$). Senčić and Butko (2006) researched 2 groups of hybrid hens - Lohmann Brown. The first group was conventionally (intensively) reared, i.e. in cages (550 cm^2/laying hen). The other group was reared in a free-range system, so it had a permanent access to the pasture. There were seating bars, feeding, water troughs and nests in the hennery. The population density of the hennery was 7 hens per m^2 of the floor, while the pasture size per hen was 15 m^2. The production of eggs in both groups of hens lasted 52 weeks. Free range hens, compared to those kept in cages, laid lower number of eggs (266:295), daily consumed more food (129g: 115g), had higher mortality (6.80%: 5.50%) and lower body mass at the end of production (1.95kg: 2.10kg). The eggs laid by free range hens had significantly ($P<0.01$) higher mass (62.59g: 60.50g), had thicker shell (0.36mm: 0.34mm) and more intensive yolk colour.

According to Rizzi and Chiericato (2005), a study was conducted with two domestic breeds of Rovigo (ER), Robusta Maculata (RM) and Ermellinata, which were grown following organic production principles using Hy Line Brown (HLB) and Hy Line White (HLW) hybrid lines. In the study, egg mass and quality were determined in 30 and 42 weeks old laying hens. The age of laying hens of all observed lines had a highly significant ($P<0.01$) effect on the egg mass increase, yolk color, relation between yolk and whites and decrease in the percentage of whites. The mentioned authors observed the chemical composition of yolk in the same lines and breeds.. The genotype had an important effect on the content of proteins, fats and ash in an egg. The greatest influence on protein and low fat content was found in RM and HLW. In HLW, egg yolk had a significantly higher ash content compared to other genotypes. Also, the genotype had a highly significant ($P<0.01$) effect on the cholesterol level in autochthonous breeds RM and ER.

Fatty acids profile in the yolk was influenced by genotype. In other words, the capability of laying hens to build fatty acids into yolk was genetically defined. Other authors' papers also showed that fat metabolism was influenced by laying hens' age and genotype besides nutrition. This is very important because eggs are present in human nutrition (Bean and Leeson, 2003). The expressed productive characteristics and determined egg quality of the laying hens reared in the free-range and cage housing systems are given in tables (Table 1 and 2). Based on the results, the authors argued that laying hens in the free range housing system, in comparison to those in the cage system, carried lower number of eggs (266-295), daily consumed more food (129-115 g), spent more food per kg of egg mass (2.83-2.35 kg), had higher mortality (6.80- 5.50 %) and smaller body mass at the end of production cycle

(1.95-2.10 kg). The eggs from the free-range system compared to the eggs from the cage system had a significantly bigger mass (62.40-60.50 g), a thicker shell (0.36-0.34 mm) and more intense yolk color (12.00- 10.00 Roche).

Table 1. Egg quality in free range and cage hen housing system (Senčić and Butko, 2006)

Characteristics	Free range system		Cage system		Significance
		S		S	
Egg mass (g)	62.40	3.10	60.50	3.40	**
Egg shell thickness (mm)	0.36	0.02	0.34	0.02	**
Yolk index (%)	45.40	3.05	45.50	3.05	Ns
Whites index (%)	76.70	21.00	76.40	21.00	Ns
Yolk colour (1-15)	12.00	0.75	10.00	0.75	**
Haugh units	75.50	4.30	72.00	4.30	Ns
Yolk pH	5.95	0.10	5.90	0.10	Ns
Whites pH	8.80	0.08	8.75	0.08	Ns
Total cholesterol in yolk (mg/g)	12.10	0.25	12.15	0.25	Ns

^{ns}P>0.05; **P<0.01.

Table 2. Productive characteristics of laying hens in the free-range and cage housing system (Senčić and Butko, 2006)

Characteristics	Free range system	Cage system
Egg number per housed laying hen	266	295
Average egg mass (g)	62.40	60.50
Egg mass (kg)	16.60	17.84
Daily food consumption (g)	129.00	115.00
Food conversion (kg)	2.83	2.35
Mortality (%)	6.80	5.50
Body mass at the end of carrying (kg)	1.95	2.10

Upon regarding other analyzed indicators of egg quality (Haugh units whites index, whites pH, yolk index, yolk pH and total cholesterol in yolk), no important differences were found between free-range and cage housing system (P>0.05). The authors think that, the rentability of egg production in the free-range system would mostly depend on the production value on the market. However, this argument can be taken with a pinch of salt, because the chemical composition and nutritive egg value were not examined and they would have to be taken into account in order to grade in a more concrete way the quality of eggs produced by laying hens housed in a free-range system and to provide the economic justification of this type of production.

2.2. The Results of Organic Meat Production

Some authors compared different production systems, i.e. conventional (intensive) and organic production from the aspect of converting one into another, and consumer affordability of the products. Pandurević et al. (2014) gave, in a form of review, a comparison of conventional and organic poultry production through the analysis of chicken meat quality. They pointed out the fact that the conversion

from one type of production into another strongly influenced the animal welfare, economic, ecological and social circumstances in meat production. Consumers believe that, the quality of the food originating from organic production is superior to that of the food originating from conventional production (Lampkin, 1990). Consumers often argue that chicken meat is a healthier option compared to the meat of other animal species on the market (Harper and Makatouni, 2002; Castellini et al. 2008). According to Castellini et al. (2002b), natural requirements being met during chicken fattening and an increased chicken activity could contribute to lower fat content in chicken meat. Unlike developed countries, especially the EU member states, the Republic of Serbia and the Republic of Srpska (Bosnia and Herzegovina) only have a limited number of the published studies that directly deal with this subject, although in recent decades growing attention has been paid to the preservation of autochthonous poultry breeds and classes in order to keep and actively include them into the production of organic broiler meat in the semi-intensive, semi-extensive and extensive housing system. This is supported by the many studies (Pavlovski et al. 2009; Mitrović et al. 2011a). For instance, the aim of the research done by Pavlovski et al. (2009) was to determine the increase in body weight and carcass parameters of naked neck chicken grown in Serbia, and of the French hybrid of naked neck layer fattened in extensive systems until the 91st and until the 98th day of age respectively. Bogosavljević-Bošković et al. (2010) investigated the slaughtering parameters and chemical compound of broiler meat of hybrid Hybro G (fast growing) broiler fed in two house systems (free-range and wide-closed) until day 56.

The expressed fattening (Mitrović et al., 2011a) and slaughter (Mitrović et al., 2012) characteristics (results) of observed classes of hens were studied. As an addition to more detailed research on this subject, Mitrović et al. (2011a; 2012) simultaneously observed that carcass parameters of 2 domestic (native) classes (white class of Naked Neck and black class of Svrljig) fattened in a semi-intensive system, until the 84th day of broilers' age in order to produce organic meat. The chickens were kept in a closed facility on the floor with a bedding (around 8 heads/m^2) until the 28th day, after a period of free grass space was provided - paddock, around 4 m^2 per head. In both broiler classes and both genders (total 56 chickens) of 84 days of age, the following parameters were found: body mass at slaughter, carcass mass, proportion- contribution of breast, drumstick and head, back, thigh, wings, pelvis, neck, abdominal fat and giblets. Based on the results showed in the tables above, the authors argued that broiler chickens of both genders of white naked neck reared in the semi-intensive system at the end of fattening compared to Black Svrljig had important higher ($P<0.05$) proportion of thighs and drumsticks (34.20-33.93%), and lower proportion of back and pelvis (26.34-26.97%), while live body mass was insignificantly bigger (1587.07-1562.28 g) ($P>0.05$), the contribution of carcasses ready to grill was approximately equal (61.73-61.99%), and the found differences were not statistically confirmed ($P>0.05$). In addition to the genotype (breed, class), the gender significantly influenced the body mass, carcass contribution, proportion of thighs and drumsticks, wings, head, legs, giblets and abdominal fat. Namely, male chickens had bigger live mass, mass of processed carcasses, proportion

of pelvis, back, head, neck, thighs and drumsticks, legs and giblets, while female chicken had higher relative proportion of processed carcasses, breast, abdominal fat and wings.

Having analyzed carcass characteristics of 2 native classes (White Naked Neck and Black Svrljig) reared (kept) in a semi-intensive system and fattened until day 84, the authors (Mitrović et al., 2011a) argued that, both in the Republic of Serbia and in the surrounding countries had convincing results regarding observed indicators in both classes, and they could be used in the semi-intensive system i.e. in the production of good quality organic broiler meat, according to the organic livestock production law and standards of the EU. As a contribution to this type of research, the results obtained by Bogosavljević-Bošković et al. (2008) can be used. They examined the chemical composition of the chicken meat reared extensively in the poultry house and in the free-range system. Same authors analyzed the chemical composition of white meat (breast muscles) and dark meat (leg muscles) in two groups of broiler chickens. Both chicken groups were reared in a closed facility (poultry house) until day 28. From day 28 to 56, one group was reared extensively (in a closed facility), and the other one freely. The results showed that, free range was more favorable since there was a significantly higher protein content and lower fat content in white and dark chicken meat, therefore a higher fat content and comparably lower protein content was found in the meat of female in comparison to male chickens. Unlike domestic, a significant number of studies of foreign authors was conducted in order to find the most convenient breed, class or hybrid for organic (ecological) production of poultry (broiler) meat in a particular housing system – fattening (semi-intensive, semi-extensive, extensive) with provided suitable food and optimal duration of the fattening period. For example, Van Marle-Koster and Webb (2000) investigated the carcass parameters of six domestic lines (Naked Neck and one domestic line) until the 77^{th} day. In one study, a significantly lower mass (1670 g) was found in the Robusta macula (Italian strain) after 81 days of fattening (Castellini et al. 2002a).

In a study, 2 slow-growing classes, Isa S 457 brown hairy and Isa J 957-white fed up to day 84, and fast-growing Hubbard JV-white and Ross 308-white were added (Grashorn, 2006). Faria et al. (2010) estimated the parameters of carcasses of male and female broilers of 2 classes slaughtered on different days reared in the semi-extensive system, while Castellini et al. (2002a) examined the effect of organic and conventional system on the contribution of carcasses and meat quality of male broiler chicken. In addition to these authors, interesting pieces of research were done by Lichovníková et al. (2009), who gave a comparative review of growth performance and carcass parameters results of two genotypes of male chickens (Isa Brown; slow-growing) and Ross 308 (fast-growing), fattened until 90^{th} day of age.

In a study, the fattening and carcass parameters of slow growing SG (Hubbard JA957) and fast growing FG (Hubbard F15) hybrids fed in paddock (O), until the 65^{th} day were investigated (Mikulski et al. 2011). The average mass in slow-growing hybrids (SG) reared in the facility and in paddock was equal (3.64 kg) and in facility and fast-growing (FG) was similar (O-4.40 kg, I – 4.41 kg). The authors argued that the system of keeping (fattening) had no influence on the final body mass in both

genotypes. However, at the end of the study, it was observed that, slow growing broilers had lower slaughter efficiency than fast growing broilers (P>0.05). Meat of the chickens from paddock (O) compared to chickens from the closed facility (I) was darker in breast and drumstick, had higher protein content in breast (O-24.73% I-23.79%) and drumstick (O-19.43%, I-19.01%), and a better ability of water binding. Similar research was conducted (Takahashi et al. 2006; Coelho et al. 2007; Larivière et al. 2009) in various genotypes, i.e. various age of broilers at slaughter.

However, based on the latest research, it can be said that Sirri et al. (2011) analyzed in much detail the production of organic poultry meat, in accordance with the EU regulations (European Commission, 1999) in Cobb 700 (FG), Naked Neck (MG) and Brown Classic Lohmann (SG). The fattening period lasted 81 days (FG and MG), i.e. 96 days in SG (Table 3).

On the grounds of the results shown in table 3, Sirri et al., (2011) argued that the choice of breed and hybrids (genotype) in organic poultry meat production strongly influenced the slaughter values, i.e. characteristics of meat (final body mass, processed carcass mass, slaughter yield, contribution and proportion of basic carcass parts, pH, color, cooling weight loss, boiling weight loss and collagen proportion) and chemical composition of breast and drumstick meat (moisture, protein, fat, ash and proportion of certain fatty acids). Finally, the authors gave a general statement that genotype had a significant effect on functional characteristics (organoleptic features) and nutritional value (chemical composition) of meat (P<0.05).

Table 3. Slaughter characteristics of fattened chickens of different genotypes (Sirri et al., 2011)

Parameters	**Genotypes**		
	FG	**MG**	**SG**
Body mass at the end of fattening (g)	5198	2642	1807
Processed carcass mass (g)	3550	1655	1029
Slaughter randman-ready to roast (%)	69.2	62.6	56.8
Breast proportion (%)	20.7	10.1	8.0
Proportion of thighs and drumsticks(%)	22.0	23.2	21.6
Wings proportion (%)	6.8	8.2	8.2

3. Conclusion

To sum up, in ecological forms of production which include organic agriculture, the existing agronomic knowledge must be supplemented with biological and ecological findings that make it possible for this type of production to protect agro-ecosystem and ecosystem. This is particularly emphasized by the positive law of the EU through regular harmonization of factual and legal framework, frequent changing and specifying of production areas, subjects and goals, in order to provide as complete as possible regulations and prevention of possible damage in livestock production (Commission Regulation (EC) No 889/2008).

Organic livestock is a development of this economic branch without disrupting relations in natural communities, without importing exotic animals and with limited application of products which follow

animal production including therapeutic agents. This type of production is not a classic extensive production (although it possesses certain characteristics of that system). It is rather intensive with the acceptance of limitations set by the habitat. The pollution is limited in the habitat itself which provides the preservation of the whole biological community, the satisfactory income and the possibility of developing additional activities such as tourism. Organic agriculture results in products of high values that are marked as organic food which increases the item price reduces consumer health risks and provides the entrance on all global markets. Accordingly, this production requires hiring more workforce, which is a very positive occurrence in the contemporary global trends of depopulating rural communities.

Fundamental principles of organic livestock production, among other things, are related to the welfare of domestic animals, which inherently means the preservation of their health, the production of animal products of high (ecological) quality with the aim of setting up and organizing ecologically acceptable production. Organic livestock production meets the needs of the ever-growing number of consumers who do not support conventional (intensive) production (Sundrum, 2001). In a significant number of countries, the consumers are ready to pay more for organic animal products, which means planned organization of livestock production which would preserve certain plant and animal breeds (biodiversity) and regional environment, with favorable economic consequences (Philips and Sorensen, 1993; Knauer, 1995; Mignolet et al., 1997). With the aim of boosting production and consumption of organic products, the European Commission has presented an action plan for the development of organic production whose final goal is to make at least one quarter of the EU agricultural land as organic. In this way, the EU strategy 'from field to table' is additionally supported, and this is all in accordance with the European Green deal and Common Agricultural Policy (COM2021/141 Final/2, COM/2019/640 Final).

Conflict of Interest

The authors declare no conflict of interest.

Author Contribution Statements

The authors declare that they have contributed equally to the article.

4. References

Almeida JG., Dahlke F., Maiorka A., Aria Filho DE., Oelke CA. Effect of broiler breeder age on hatching time, chick permanence time in hatcher and chick weight. Archives of Veterinary Science 2006; 11(1): 45-49.

Apostolov N. Comparative analysis of physical characteristics of eggs with whole and damaged shells in light and heavy type layers. Zbornik radova "Živinarski dani 1976", Oteševo, Macedonia 1976; 352-361.

Apostolov N., Apostolov D. Relation between egg shell deformation and hatchability of White Rock eggs. Zvornik radova "Živinarski dani 1976", Oteševo, Macedonia 1976; 392-397.

Bean LD., Leeson S. Long-term effects of feeding flaxseed on performance and egg fatty acid composition of brown and white hens. Poult. Sci. 2003; 82: 388-394.

Bogosavljević-Bošković S., Mitrović S., Petrović DM., Đoković R., Dosković V. Uticaj uzrasta i sistema držanja na odabrane parameter kvaliteta mesa pilića u tovu. Savremena poljoprivreda 2008; 57(3-4): 137-143.

Bogosavljević-Bošković S., Mitrović S., Đoković R., Dosković V., Đermanović V. Chemical composition of chicken meat produced in extensive indoor and free range rearing systems. African Journal of Biotechnology 2010; 9(53): 9069-9075.

Castellini C., Dal Bosco A., Mugnai C., Bernadini M. Performance and behavior of chickens with different growing rate reared according to the organic system. Italian Journal of Animal Science 2002a; 1: 291-300.

Castellini C., Mugnai C., Dal Bosco A. Effect of organic production system on broiler carcass and meat quality. Meat Science 2002b; 60: 219-225.

Castellini C., Berri C., Le Bihan-Duvan E., Martino G. Qualitative attributes and consumer perceprion of organic and free – range poultry meat. World´s Poultry Selence Journal 2008; 64: 500-512.

Coelho AAD., Savino VJM., Rosário MF., Silva MAN., Castihlo CJC., Spoto MHF. Carcteristicas de carcaca e da carne de genotipos de frangos caipiras. Brazilian Journal Food Tehnology 2007; 10 (1): 9-15.

Commission Regulation (EC) No 493/1999 of 5 March 1999 amending Regulation (EC) No 1484/95 laying down detailed rules for implementing the system of additional import duties and fixing additional import duties in the poultrymeat and egg sectors and for egg albumin, and repealing Regulation No 163/67/EEC, Official Journal L 59, 6.3.1999; 15–16

Commission Regulation (EC) No 889/2008 of 5 September 2008 laying down detailed rules for the implementation of Council Regulation (EC) No 834/2007 on organic production and labelling of organic products with regard to organic production, labelling and control, OJ L 250, 18.9.2008, p. 1–84

Communication from Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions the European Green Deal, Com/2019/640 Final, https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1576150542719&uri=COM%3A2019%3A640%3AFIN

Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and Committee of the Regions on an Action Plan for the Development of Organic Production, Com/2021/141 Final/2, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52021DC0141R%2801%29

Đermanović V. Fenotipska varijabilnost povezanost proizvoda – reproduktivnih osobina teških linijskih hibrida kokoši Cobb 500 I Ross 308. Doktorska disertacija, Poljoprivredni fakultet, Univerzitet u Beogradu, 2010.

Đermanović V., Đekić V., Mitrović S., Rajović M., Mitrović M., Pandurević T. Uporedni prikaz kvaliteta jaja za nasad Somborske karorke I Njuhempšir rasa kokoši gajenih u poluekstenzivnom sistemu. Zbornik Naučnih Radova 2012; 18(3-4): 123-129.

Đermanović V., Mitrović S., Đekić V., Mitrović M. Ocena kvaliteta priplodnih jaja leghorn rase kokoši gajene u polekstenzivnom sistemu. Zbornik Naučnih Radova 2013; 19(3-4): 173-178.

Đermanović V., Mitrović S. Phenotype vatiability of external quality traits of fertile eggs of partridge Italian bread in semi extensive breeding system. Biotehnology in Animal Husbandry 2013; 29 (3): 477-482.

Faria PB., Bressan MC., Souza XR. de, Rossato LV., Botega LMG., Gama LT. da. Carcass and parts yield of broilers reared under a semi – extensive system. Brazilian Journal of Poultry Science 2010; 12(3): 153-159.

Farooq M., Durrani FR., Aleem M., Chand N., Muqarrab AK. Egg traits and hatching performance of Desi, Fayumi and Rhode Island Red chickens. Pakistan Journal of Biological Sciences 2001; 4 (7): 909-911.

Grashorn MA. Fattening performance, carcass and mest quality of slow and fast growing broiler class under intensive and extensive feeding conditions. XII European Poultry Conference, Verona, 10 – 14 September 2006, paper no. 10236.

Grobbelaar JAN. Egg production potentials of four indigenous chicken breeds in Sount Africa. Magister thesis, Tshwane University of Technology, 2008.

Grobbelaar JAN., Sutherland B., Molalakgotla NM. Egg production potentials of certain indigenous chicken breeds from Sount Africa. Animal Genetic Resources 2010; 46: 25-30.

Harper GC., Makatouni A. Consumer perception of organic food production and farm animal welfare. British Food Journal 2002; 10: 287-299.

Hovi M., Sundrum A., Thamsborg SM. Animal health and welfare in organic livestock production in Europe: current state and future challenges. Livestock Production Science 2003; 80: 41-53.

Food and Agriculture Organization of the United Nations – FAO, http://www.fao.org

International Federation of Organic Agriculture Movements – IFOAM, http://www.ifoam.bio

Islam MS., Howlider MAR., Uddin MS., Kabir F., Alam J. Study on reproductive parameters of Barred Plymouth Rock, White Leghorn, Rhode Island Red and White Rock breed of cock. Online Journal of Biological Science 2002; 2(9): 605-607.

Knauer N. Ökologische Anforderungen in Agrarlandschaften. Agrarspectrum 1995; 24: 9-24.

Lampkin NH. Organic farming. Farming press. Ipswich, 1990.

Lariviére JM., Farnir F., Detllux J., Michaux C., Verleyen V., Leroy P. Performance, breast morphological and carcass trays in the Ardennaise chicken breed. International Journal of Poultry Science 2009; 8(5): 452-456.

Lichovniková M., Jandásek J., Jüzl M., Dračková E. The meat quality of layer males from free range in comprasion with fast growing chickens. Czech. J. Anim. Sci., 2009; 54(11): 490-497.

Luquetti BC., Gonzales E., Bruno LDG., Furlan RL., Macari M. Egg traits and physiological neonatal chick parameters from broiler breeder at different ages. Brazilian Journal of Poultry Science 2004; 6(1): 13-17.

Marinković V., Šrajber L., Žigić L., Mašić B. Examination of the effect of restricted feeding and simultaneous application of the vitamin-antibiotic additive on the reproductive performance of heavy type breeders. Zbornik radova, Živinarski dani 1972", Belgrade, Serbia. 347-353.

Mašić B., Žigić L., Šrajber L., Marinković V. Investigation of periodically forced molting of White Rock and New Hampshire hens in a two-year laying. Veterinaria 1970; 58-65.

Mašić B., Pavlovski Z. Mala jata kokoši nosilja u različitim sistemima držanja. Naučni institut za stočarstvo, Beograd-Zemun, 1994.

Miclea V., Zahan M. Egg weight influence on the incubation of light hen breeds eggs. Buletin USAMV-CN 2006; 63: 107-110.

Mignolet C., Saintot D., Benoit M. Livestock farming system diversity and groundwater quality modeling at a regional scale. In: Sörems J. T. (Ed), Livestock Farming System. More than food Production. EAAP, 89,313/318, 1997.

Mikulski D., Celej J., Jankowski J., Majewska T., Mikulska M. Growth performance, carcass traits and meat quality of slower – growing and fast – growing chickens raised with and without outdoor access. Asian – Aust. J. Anim. Sci., 2011; 24(10): 1407-1416.

Milošević N., Perić L., Strugar V., Žigić D., Pavlovski Z. Rearing of fattening chickens on free range and extensively in chicken coop. Biotechnology in Animal Husbandry 2005; 21(5-6): 217-221.

Mitrović S., Ostojić Đ., Đermanović V., Pandurević T., Jež G. Carcass characteristics of Naked Neck male and female chickens fattened in semi-intensive system. 22 International Scientific-Expert Conference of Agriculture and Food Industry, Book of Abstracts, 35, September 28- October 1, Sarajevo, 2011a.

Mitrović S., Đermanović V., Pupovac S., Ostojić Đ., Rajović M. Incubation value of eggs domestic classs grown in chicken rural areas our country. Proceedings of Research Papers 2011b; 17(3-4): 149-155.

Mitrović S., Bogosavljević Bošković S., Đermanović V., Perić L., Jokić Ž., Pandurević T. Poluintenzivni tov golovrate kokoši, organska proizvodnja živinskog mesa. Zbornik radova, XVII Savetovanje biotehnologa sa međunarodnim učešćem, Čačak 2012; 17(19): 304-309.

Mitrović S., Đermanović V., Đekić V., Milivojević V., Simić D. Comparative studies on the reproductive and produktive traits of New Hampshire and Sombor Crested chicken breeds

reared in seni – extensivi production system. Proceedings of the International Symposium on Animal Science, Beograd – Zemun, Srbija, 61-67, 2014.

Organic production law - Official Gazette of RS, No. 30/2010 and 17/2019

Pandurević T., Mitrović S., Ristanovic B. Quality of chicken meat from conventional and organic production. Fifth International Scientific Agricultural Symposium "Agrosym 2014" Jahorina, October 23-26, 2014, Bosnia and Herzegovina.

Pavlovski Z., Mašić B. Mogućnost racionalizacije ekstenzivnog i poluintenzivnog sistema držanja živine sa aspekta proizvodnje prirodne i zdrave hrane. Poljoprivreda 1990; 384-349.

Pavlovski Z., Škrbić Z., Lukić M., Petričević V., Trenkovski S. The effect of genotype and housing system on production results of fattening chickens. Biotechnology in Animal Husbandry 2009; 25(3-4): 221-229.

Philips CJ., Sorensen JT. Sustainability in cattle production systems. J. Agric. Eviron. Ethies 1993; 6: 61-73.

Rizzi C., Chiericato GM. Organic farming production. Effect of age on the productive yield and egg quality of hens of two commercial hybrid lines and two local breeds. Italian Journal of Animal Science 2005; 4(sup3): 160-162.

Senčić Đ., Butko D. Proizvodnost nesilica i kvaliteta kokošijih jaja iz slobodnog držanja. Agriculture 2006; 12(2): s 48-51.

Sirri F., Castellini C., Biancji M., Petracci M., Meluzii A., Franchini A. Effect of fast-medium- and slow-growing strains on meat quality of chickens reared under the organic farming method. Animal 2011; 5(2): 312-319.

Sorensen PI., Kjaer JB. Noncommercial hen breed tested in organic system. Ecological animal husbandry in the Nordic countries. Proceeding of NJS-Seminar 2000; 303: 59-63.

Sundrum A. Organic livestock farming. A critical review. Livest. Prod. Sci. 2001; 67: 207-216.

Supić B., Milošević N., Konjević S., Perić Lidija, Mitrović S., Dimitrijević P., Savić D. Očuvanje autohtonih rasa živine u Vojvodini. Savremena poljoprivreda 1997; 46(3-4): 157-162.

Takahashi SE., Mendes A., Saldanha ESPB., Pizzolante CC., Pelicia K., Garcia RG. Efeito de sistema de criacao sorbe o desempenho e redimento de carcaca de frangos de cortetipo colonial. Arquivos Brasileiros de Medicina Veterinaria e Zootecnia 2006; 58(4): 624-632.

Tolimir N., Anokić N., Mitrović S., Milojković M., Mašić B. Spoljašnje i unutrašnje osobine jaja nekih populacija autohtonih kokoški istočne Srbije. Savremena poljoprivreda 1997; 46(3-4): 168-173.

Van Marle-Koster E., Webb CE. Carcass characteristics of South African native chicken lines. South African Journal of Animal Science 2000; 30(1): 53-56.

Vieira SL., Almedia JG., Lima AR., Conde ORA., Olmos AR. Hatching distribution of eggs varying in weight and breeder age. Brazilian Journl of Poultry Science 2005; 7(2): 73-78.

Witt F., Schwalbach LMJ. The effect of egg weight on the hatchability and growth performance of New Hampshire and Rhode Island Red chicken. South African Journal of Animal Science 2004; 34: 62-64.

Wolanski NJ., Renema RA., Robinson FE., Camey VL., Fancher BI. Relationships among egg characteristics, chick measurements, and early growth traits in ten broiler breeder class. Poultry Science 2007; 86: 1784-1792.

Žigić L., Šrajber L., Mašić B., Marinković V. The effect of forced molting on physical properties and inner quality of eggs layed by New Hampshire hens. Veterinaria 1970; 68-71.