
PRODUCTION OF PORK IN THE REPUBLIC OF NORTH MACEDONIA AND THE OTHER FORMER YUGOSLAV COUNTRIES

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Abstract: With the growth of the global population, the demand for food rises, coupled with changes in dietary habits, improvements in living standards, and the development of the meat processing industry. These factors have led to the creation of pig breeds that contain more meat and significantly less subcutaneous fat. Consequently, in commercial fattening practices in countries with advanced pig production, meat breeds of pigs and their hybrids are predominant. This research focuses on pork production in the Republic of Macedonia and other former Yugoslav countries from 2012 to 2022. Data for this study was sourced from the Food and Agriculture Organization of the United Nations (FAO) website. Pork production holds the largest share of overall meat production in the Republic of Serbia, the Republic of Croatia, and the Republic of North Macedonia. During the period from 2012 to 2022, the Republic of Serbia was the largest pork producer among the former Yugoslav countries, with an average production of 304,999.91 tons, followed by the Republic of Croatia with 109,540.27 tons, the Republic of Slovenia with 30,277.64 tons, the Republic of North Macedonia with 12,396.36 tons, the Federation of Bosnia and Herzegovina with 9,373.75 tons, and the Republic of Montenegro as the smallest producer with 3,247.01 tons. The average pork production in the Republic of Serbia during this period was 2.78 times higher than that of the Republic of Croatia, 10.07 times higher than that of the Republic of Slovenia, 24.60 times higher than that of the Republic of Macedonia, 32.54 times higher than that of the Federation of Bosnia and Herzegovina, and 93.93 times higher than that of the Republic of Montenegro. The former Yugoslav countries need to implement measures to enhance the health and welfare of fattening pigs, emphasize biosecurity measures to prevent the spread of African swine fever, continuously improve the genetic potential of fattening pigs, and provide ongoing education for producers.

Keywords: pork, fattening, breeding, production, farms, measures

1. INTRODUCTION

Animal husbandry is a significant indicator of a country's agricultural development, with milk, meat, and eggs being crucial inputs in the food industry.

According to Idonea Yeoman et al. (2023) food production has become a primary concern for national economies, especially after the economic crises triggered by the COVID-19 pandemic, the war in Ukraine, the 2008 global economic crisis, and the increasing number of hungry people worldwide. Pork is the most consumed red meat globally, as noted by Hoa et al. (2019), and is the most used raw material in the meat processing industry (Jokanović, 2013).

Pigs were first domesticated in the Middle East around 8,500 BC and were brought to Northern Europe by 4,500 BC (Mateos et al., 2024). Significant morphological changes occurred during domestication, with modern pig breeds now storing up to 70% of their muscle mass in the rear of their bodies, which has substantial economic importance. Over the past 200 years, pig farming systems have evolved rapidly, transitioning from small, extensive systems in rural areas to intensive, industrialized systems to feed growing urban populations (Mateos et al., 2024). The high reproductive capacity of pigs, the relatively short production process, and the low food consumption per kilogram of growth make pig farming particularly important in animal husbandry.

According to Article 95 of the Law on the Quality of Agricultural Products ("Official Gazette of the Republic of Macedonia" No. 140/10), pigs for slaughter marketed in the Republic of Macedonia are classified by age and weight into the following categories:

- **Category I:** Pigs of both sexes with a cleaned carcass weight of 5 to 25 kg.
- **Category II:** Fattened pigs and castrates with a hot half-carcass weight of 50 to 120 kg for scalded pigs, or 37 to 100 kg for skinned pigs. Male pigs should be castrated within the first week of life or at least 30 days before slaughter if not.
- **Category III:**
 - Light fattened pigs of both sexes and castrates with a hot half-carcass weight of 20 to 49 kg for scalded pigs or 37 kg for skinned pigs.
 - Heavy fattened pigs and castrates with a hot half-carcass weight of 121 to 180 kg for scalded pigs or 101 to 153 kg for skinned pigs.

- Excluded breeding pigs, including breeding pigs regardless of the hot half-carcass weight and boars over 64 kg that have been skinned.
- **Category IV:** Young fattened boars, including uncastrated male pigs with a hot half-carcass weight of 50 to 80 kg for boars or 37 to 64 kg for skinned pigs. This category also includes monorchids (with one testicle) and cryptorchids (with hidden testicles).
- **Category V:** Other pigs not covered by Categories I-IV.

The evaluation and classification of slaughtered pig carcasses are carried out in slaughterhouse facilities, based on age and carcass weight. Carcasses are assessed for meatiness (percentage of meat in the carcass) and conformation, with the following meatiness classes: S, E, U, R, O, P.

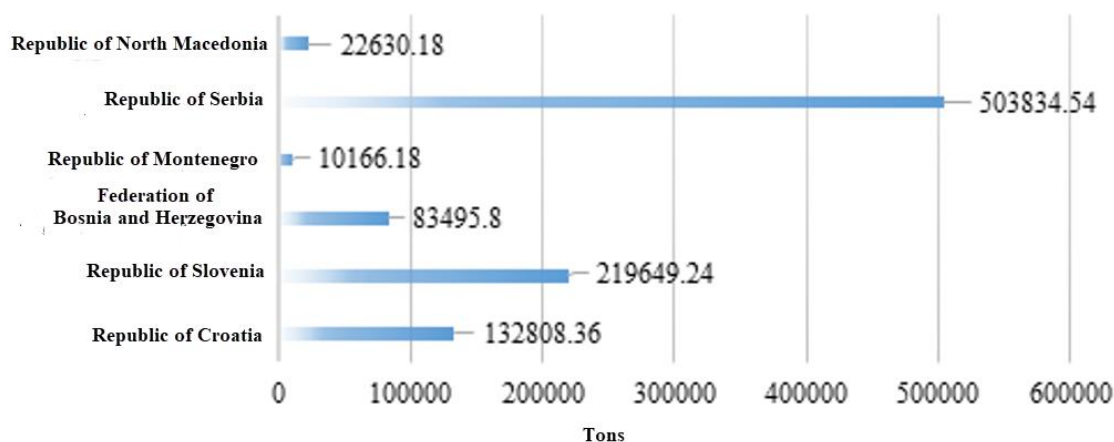
2. MATERIAL AND METHODS

The analysis utilized official data from the Food and Agriculture Organization of the United Nations (FAO) website, covering the period from 2012 to 2022. Pork production in the Republic of North Macedonia during this time frame was examined and compared to that of other former Yugoslav republics. Various statistical methods were employed for the quantitative analysis of the data. These included determining the arithmetic mean (\bar{x}) to establish average values, identifying the variation interval (the minimum and maximum values for a given area within the analyzed period), calculating the standard deviation (SD) and the coefficient of variation (CV), and computing the average rate of change (%) to show the percentage increase or decrease. The analyzed data is presented in graphs and tables.

3. RESULTS AND DISCUSSION

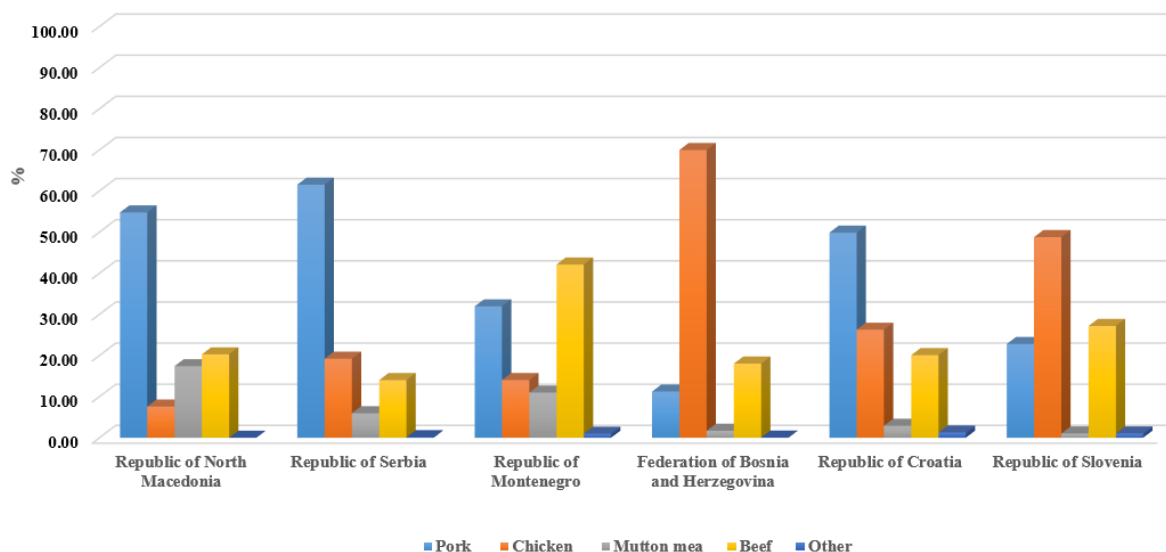
Graph 1 illustrates the average meat production in the countries of the former Yugoslavia for the period from 2012 to 2022. The Republic of Serbia is the largest producer, with an average production of 503,834.54 tons. It is followed by the Republic of Croatia, which produces 219,649.24 tons, the Republic of Slovenia with 132,808.36 tons, the Federation of Bosnia and Herzegovina with 83,495.8 tons, and the Republic of Macedonia with 22,630.18 tons. The smallest producer is the Republic of Montenegro, with an average meat production of 10,166.18 tons.

Graph 1. Overview of the average meat production for the period from 2012 to 2022 in the countries of the former Yugoslavia



Based on the analyzed data for the period from 2012 to 2022, it can be determined that the production of pork occupies the largest share of the total production (Graph 2). In the Republic of Serbia, pork production accounts for 61.54% of the total meat production, in the Republic of Macedonia it accounts for 54.78%, followed by the Republic of Croatia with 49.87%, the Republic of Montenegro 31.94%, the Republic of Slovenia with 22.80% and the Federation of Bosnia and Herzegovina with 11.27%.

Graph 2. Overview of the percentage representation of different types of meat, produced in the period from 2012 to 2022 in the countries of the former Yugoslavia



(source: FAOSTAT database)

From Table 1, it can be concluded that the largest producer of pork from 2012 to 2022 is the Republic of Serbia, with an average production of 304,999.91 tons. It is followed by the Republic of Croatia with 109,540.27 tons, the Republic of Slovenia with 30,277.64 tons, the Republic of North Macedonia with 12,396.36 tons, the Federation of Bosnia and Herzegovina with 9,373.75 tons, and the Republic of Montenegro, the smallest producer, with 3,247.01 tons. When comparing the average pork production of the Republic of Serbia with other former Yugoslav countries, it is evident that Serbia produces 2.78 times more pork than Croatia, 10.07 times more than Slovenia, 24.60 times more than North Macedonia, 32.54 times more than Bosnia and Herzegovina, and 93.93 times more than Montenegro.

The Republic of North Macedonia shows the highest trend of increase, with an average rate of change of 2.44%. Serbia has a much smaller trend of an average increase of 0.4%, while the other countries show a trend of decrease in the average rate of change: Montenegro at -1.4%, Croatia at -1.22%, Slovenia at -3.02%, and Bosnia and Herzegovina at -6.66%.

In North Macedonia, the lowest pork production was in 2013, with 8,845 tons, and the highest was in 2021, with 15,578 tons. However, there was a 13.38% decrease in pork production in 2022 compared to 2021, primarily due to the outbreak of African swine fever. The first case was confirmed in January 2022 in the Eastern region of North Macedonia, leading to a significant number of pigs being euthanized, both the infected ones, and the others- as a preventive measure. It is crucial for both large and small traditional farms to adhere to biosecurity measures to prevent the spread of disease.

In North Macedonia, pig farms use modern technological solutions and breeding methods, and with ongoing investment, they achieve high standards of production efficiency and quality comparable to developed countries. Organized pig farms focus on biosecurity, disease prevention, health control, and promoting animal welfare principles. The Ministry of Agriculture, Forestry and Water Management of North Macedonia, in its National Strategy for Agriculture and Rural Development for 2021-2027, highlights the need to maintain and improve the genetic potential of the pig population and invest in farms for cost optimization, production expansion, meeting high environmental standards, and reducing climate impact. Larger farms can lower energy costs by investing in manure utilization and biomethane production. A major challenge is the threat of infectious diseases, particularly African swine fever, necessitating appropriate biosecurity measures.

The National Strategy for Agriculture and Rural Development for 2021-2027 also states the need to apply European-type instruments to mitigate the negative impacts of market price fluctuations by temporarily removing surplus pork from the market. To monitor pork markets, initiate necessary interventions, and promote domestic products in local and foreign markets, it is important to regulate the initial initiatives for producer associations, defining their market role and supporting the implementation of jointly defined priorities. Although the European minimum standards for

quality assessment of slaughter lines (SEUROP) are prescribed, they have not yet been applied in North Macedonia due to the need for institutional prerequisites and technical support.

The Strategy for Agriculture and Rural Development of the Republic of Serbia for the period 2014-2024 (Official Gazette of the Republic of Serbia, No. 85/2014) highlights that pig farming in Serbia, unlike other sub-sectors, is a highly intensive production system. This system relies on several key factors: the use of modern technical and technological solutions, breeding of highly productive pig breeds, adherence to strict technological standards for indoor facilities, equipping facilities with advanced feeding equipment, maintaining high animal hygiene standards, rigorous implementation of biosecurity measures, disease prevention, and pest control. Additionally, effective farm resource management and professional training of employees are emphasized.

Table 1. Overview of pork production in former Yugoslav countries from 2012 to 2022

	Republic of North Macedonia	Republic of Serbia	Republic of Montenegro	Federation of Bosnia and Herzegovina	Republic of Croatia	Republic of Slovenia	
2012	10598	293383	3780	15695	126900	35607	
2013	8845	302587	540	13013	106500	29569	
2014	9886	320363	2793	9663	95700	29709	
2015	10826	287801	3308	8534	94000	27317	
2016	12786	302914	3531.35	8523	98018	30724	
2017	13105	312377	3899.47	8771	104505	31438	
2018	12929	312834	3436.4	7296	113500	31290	
2019	13384	301590	3599	7749	120800	32210	
2020	14930	303530	4002	7621	110300	28950	
2021	15578	312167	3545.43	8364	122500	30030	
2022	13493	305453	3282.51	7882.21	112220	26210	
Average 2012-2022	12396.36	304999.91	3247.01	9373.75	109540.27	30277.64	
Variation interval	Min	8845	287801	540	7296	94000	26210
	Max	15578	320363	4002	15695	126900	35607
SD	2006.17	8832.32	911.96	2492.74	10531.11	2386.84	
CV (%)	16.18	2.90	28.09	26.59	9.61	7.88	
Average rate of change (%)	2.44	0.4	-1.4	-6.66	-1.22	-3.02	

(source: FAOSTAT database)

Despite these advancements, the current infrastructure and production methods result in pig production costs in Serbia being 25-30% higher than in the EU. Moreover, the productivity and quality of Serbian pig production have not yet reached the desired levels. (SEEDEV, 2020).

The Strategic Plan for Agricultural Policy of the Republic of Croatia for 2023-2027, developed by the Ministry of Agriculture, emphasizes the importance of securing a sufficient supply of high-quality raw materials, particularly pork, to support the production of traditional products that have protected marks. The goal is not only to safeguard these marks, but also to enhance their value and provide manufacturers with a competitive edge in terms of placement, marketing, and achieving better prices for the protected products. The Republic of Croatia has a long tradition of intensive pig farming on medium and large farms, with a focus on maximizing facility capacity by housing the maximum number of pigs possible.

In the Republic of Slovenia, pig and poultry farming are advancing with new technologies, especially in breeding, which is organized under cooperative agriculture. This unified approach, mandated by leading organizations, helps in better market organization. However, the sector faces several challenges, including unstable agricultural markets with significant fluctuations post-COVID-19 pandemic, soaring energy prices, and frequent catastrophic weather events due to climate change—such as early vegetation phases, spring frosts, changes in precipitation, hailstorms,

and droughts. Additionally, soil degradation, the rise of diseases like African swine fever, and pests pose substantial threats to production potential.

There is also a shortage of skilled labor and a decreasing interest in agriculture, particularly in areas with challenging growing conditions. To address these issues, there is a focus on humane animal treatment and high standards of animal welfare, which exceed current legal regulations or common practices. Animal welfare improvements are implemented across four areas-nutrition, housing conditions, access, and care-affecting five livestock sectors: cattle, pigs, poultry, sheep, and goats. This approach aligns with the European Green Deal, aiming not only to enhance animal health but also to ensure the production of healthy and high-quality food.

In the Federation of Bosnia and Herzegovina, which is a relatively small pork producer, the strategy for agriculture and rural development for 2021-2027, prepared by the Federal Ministry of Agriculture, Water Management, and Forestry, emphasizes key actions for enhancing the pig farming sub-sector.

One of the primary goals is to improve genetic potential by investing in large farms and breeding centers to ensure a sufficient number of breeding herds. Continued direct payments to agricultural producers, along with additional support for young farmers and those expanding their operations, are also highlighted as essential measures.

Additionally, it is crucial to secure the production of animal feed and reduce its production costs by utilizing state-owned agricultural land. Advancing production technologies, applying quality standards, and meeting animal welfare requirements are also critical for the development of the sector.

Pig farming in Montenegro is currently underdeveloped, making it the smallest pork producer among the former Yugoslav countries. This production is primarily carried out by small farms with fewer than ten droves, which do not qualify for support.

Unlike other animal husbandry sectors such as cattle and sheep farming, pig farming is highly intensive. It relies on modern technical and technological solutions, the use of highly productive pig breeds and hybrids, and adherence to strict technological standards. Pig farming involves closed facilities equipped with advanced feeding systems, maintaining prescribed zoohygiene conditions, and rigorous biosecurity measures, including disease prevention, control, disinfection, and pest management.

To enhance this sector, the focus should be on creating added value and promoting domestic products. Increasing production efficiency, improving adherence to animal welfare and food safety standards, and enhancing the value of products through processing and traditional product production are essential goals for the growth of pig farming in Montenegro.

4. CONCLUSION

Based on the analyzed data for the period from 2012 to 2022, it can be concluded that pork production holds the largest share of total meat production in the Republic of North Macedonia, the Republic of Serbia, and the Republic of Croatia. In contrast, pig farming in the Republic of Montenegro is notably underdeveloped, while the Federation of Bosnia and Herzegovina needs to focus on improving the genetic potential of its pig breeds and adopting modern technological methods. In the remaining countries of the former Yugoslavia, pig farming for fattening employs modern technological solutions and breeding methods. Organized pig farms in these regions consistently prioritize biosecurity, disease prevention, health control, and the promotion of animal welfare principles. To advance the sector, it is essential to continually enhance genetic potential, adhere to animal welfare standards, and address the impacts of climate change. Ongoing training and education for producers, along with the application and improvement of meat quality standards, are crucial. Both large and small traditional farms must adhere to biosecurity measures to prevent the spread of African swine fever, which poses a significant threat to pig production.

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