
SOME ECONOMIC INDICATORS OF PRODUCTION OF COW'S MILK IN THE REPUBLIC OF SERBIA

Robert Radišić¹, Zorica Sredojević², Predrag Perišić³

*Corresponding author E-mail: zokas@agrif.bg.ac.rs

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ABSTRACT

The subject of this research is cattle breeding with a focus on the production of cow's milk in the Republic of Serbia. The main goal is to analyze the state and trends of cow's milk production in Serbia during the last ten years in relation to production in Europe, the European Union and the world. Data from the SORS, FAO databases, etc. were used. In Serbia, 908,102 head of cattle are raised on 177,552 family farms, ie, an average of 5.11 head of cattle per farm. The number of cattle has dropped by more than 200,000 head over the last decade. In the total milk production in Serbia, cow's milk accounts for 96.84%. The average milk yield of cows in Serbia is far below the European average. The highest average amount of milk is recorded in the Belgrade region, where 5,335 liters per milking head are produced in one year. The quality of cow's milk in Serbia is far below EU standards, which is a key restriction on exports.

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Introduction

Cattle breeding are the most important branch of livestock production and represents an indicator of the development of the entire agricultural and food sector, both in the world and in the Republic of Serbia. The harmonization of livestock with field production contributes to achieving greater stability of production on the farm, and in general, the overall agriculture of the country. In Serbia, 908,102 head of cattle are raised on 177,552 family farms, that is, an average of 5.11 head of cattle are raised per farm. On 89,753 farms, 190,914 heads are raised, and on average 2.17 heads per farm, while

1 Robert Radišić, Ph.D. student, University of Belgrade, Faculty of Agriculture; scientific researcher, Institute for Science Application in Agriculture, Bulevar despota Stefana 68, 11000 Belgrade, Serbia, Phone: +381 11 27 51 622, E-mail: rradistic@ipn.bg.ac.rs, ORCID ID (<https://orcid.org/0000-0002-7161-1269>)

2 Zorica Sredojević, Ph.D., Full Professor, University of Belgrade, Faculty of Agriculture, Nemanjina 6, 11080, Zemun, Serbia, Phone: +381 11 44 13 297, E-mail: zokas@agrif.bg.ac.rs, ORCID ID (<https://orcid.org/0000-0001-7224-1573>)

3 Predrag Perišić Ph.D., Associate Professor, University of Belgrade, Faculty of Agriculture, Nemanjina 6, 11080, Zemun, Serbia, Phone: +381 11 44 13 172, E-mail: perisicp@agrif.bg.ac.rs

717,188 head of cattle are raised on 87,799 farms, i.e. 8.16 heads per farm. Farms with an average of 7 head of cattle make up 40% of the total number of farms where cattle are raised.

In the structure of agricultural farms by regions of Serbia, farms where livestock is represented, in the region of Šumadija and Western Serbia they occupy 79.10%, while in the region of Vojvodina; this share is somewhat smaller, 72.90% (SORS, 2019). One of the most important livestock products of the Republic of Serbia is cow's milk, and the largest quantities are produced in the region of Šumadija and Western Serbia, exactly where the largest number of dairy cows is raised.

According to Kitsopanidis (2000), farms with less than 5,000 liters of milk per cow per year are not sustainable, while farms with 5,000-6,000 liters per cow are sustainable but not competitive, and farms with over 6,000 liters of milk per cow are both sustainable and competitive.

MacDonald et al. (2007) have determined a gross income of 4,051.50 euros per head of cow, and in the structure the value of milk is 87.80%, while the share of meat sales is much smaller (6.70%), and different types of support represent the smallest part of the total gross income, only 5.50%.

Of the represented breeds of cattle bred in Serbia, the largest share is the Simmental breed, the so-called "Serbian Simmental". A large number of high-quality cattle of this breed have been imported during the last decade from Germany and Austria, so that the Simetal breed makes up about 80% of the total number of cattle in the country. The share of crossbreeds, whose origin is from Simmental with other breeds of cattle, mainly with bush, is about 5%, while pure autochthonous breeds (bush and podolska) have a little more than 1,000 heads. Recently, there is a decreasing trend in Serbia in the number of producers who raise 1-3 head of dairy cows (Perišić et al., 2012).

Stankov (2015) states that farms, on which there are small farms (1-9 head of dairy cows), are relatively acceptable in terms of profitability, due to the engagement of family members. However, such farms have a low yield rate, about 36%. Due to insufficient animal productivity and small volume of final sales of products, the economic efficiency of small farms is not satisfactory. Animal nutrition has a great impact on the profitability of family farms. In the total cost of keeping dairy cows, the largest share is made up of food costs and ranges from 45 to 60% (Glavić et al., 2017).

Artificial insemination of cattle, import of breeding heads, application of selection, as well as crossing of domestic autochthonous breeds with noble breeds of cattle have significantly contributed to the change of the racial composition of cattle in Serbia. According to Popović (2014), the average capacity of cattle production of 5.1 head of cattle of all categories per farm indicates that cattle breeding in Serbia are dominant on small family farms. At the same time, milk production takes place on farms with an average capacity of 2.8 head of dairy cows. Perišić et al., (2002) found that there were statistically very significant effects of age at first fertilization on milk yield and 4% MCM in standard lactations, a significant

effect on milk fat yield and a negligible effect on milk fat content in standard lactations. Selection for maternal fertility is increasingly important for greater inclusion in the total breeding / breeding value. If there are major problems in reproduction, in addition to the immediate consequences on the production of milk and milk fat, there are also difficulties in the normal realization of the overhaul of the herd, which is reflected in the economy of production (Pantelić et al., 2009; *cit.* Pantelić et al., 2015; Miletić et al., 2020).

The highest average amount of milk per head of milk is recorded in the Belgrade region, where 5,335 liters of cow's milk, 200 liters of sheep's milk and 345 liters of goat's milk are produced in one year. In accordance with the structure of milk production, the production of dairy products on farms is mostly based on cow's milk products. Therefore, the subject of this research is cattle breeding with a focus on the production of cow's milk. The main goal of the research is to based on selected parameters, determine the state and trends of cow's milk production in Serbia during the last ten-year period in relation to the production in Europe, the European Union and the world.

Materials and Methods

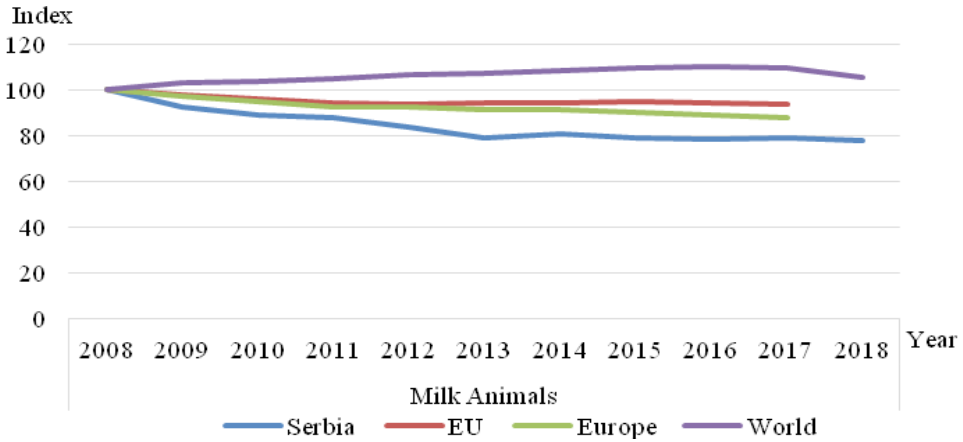
For this research, data and publications of official statistics published in statistical yearbooks, bulletins and other materials of the Republic Statistical Office of the Republic of Serbia, relevant publications of the FAO database, as well as other available domestic and foreign sources on the Internet were used. Data from the Expert Reports, Institute of Animal Husbandry of Belgrade were used as an additional source of data. When considering the situation and trends in cow's milk production in Serbia, the selected parameters were compared with the parameters of milk production in the European Union and the world. Agriculture and the food industry in the EU are protected by trade barriers and receive substantial financial support through a specific and dedicated policy (Andrei et al., 2020). It can influenced on production structures and their evolution (Popescu et al., 2018).

Results and Discussions

According to FAO data (2020), in the world cattle are mostly raised in the United States (35.50%), followed by Asia (33.40%), a slightly lower share in Africa (17.80%), and the lowest share in Europe (10.50%). The number of dairy cattle in the period 2008-2017 gradually increased in the world, so that in 2017 it was higher by 10% compared to 2008, with a slight decrease in 2018. In Europe and the European Union, it had a similar trend, with in 2018 the number decreased by 8% in the EU compared to 2008 and in Europe decreased by 10% (Figure 1).

Over the last decade, the number of cattle in Serbia has dropped by more than 200,000. Compared to the average during the period 2008-2017, in 2018 the total number of cattle was lower by 6.50%. Observing by regions, out of the total number of cattle in the Republic of Serbia, the largest number of cattle is bred in the Region of Šumadija and Western Serbia, i.e. 46.70% (SORS, 2019).

Figure 1. Dynamics of number of milking animals in the world, Europe, the EU and the Republic of Serbia, 2008-2018

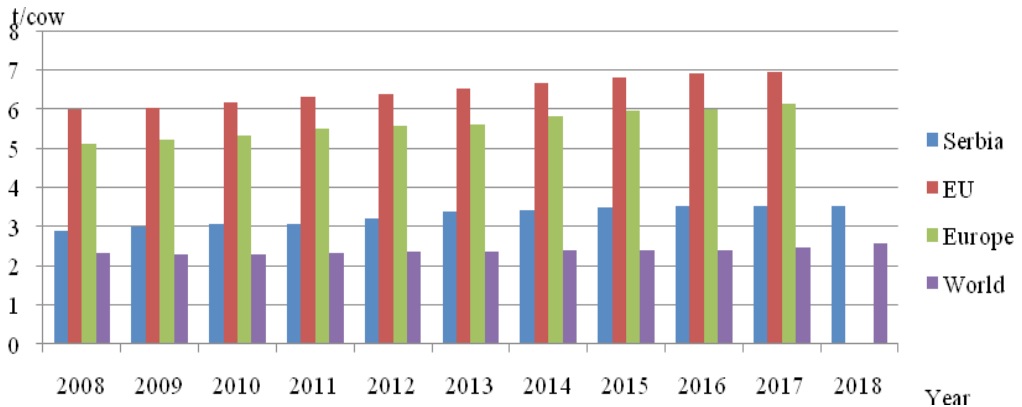


Source: FAO, 2020

Assessments of type and physical development are very important indicators of the productive abilities of cows, their ability to consume sufficient amounts of food, provide technologically quality milk, reduce energy consumption in production and stay in operation as long as possible (Pantelić et al., 2011; Pantić & Milojević, 2019).

The average annual milk production in the world during the period 2008-2018 ranged from 2.2 tons to 2.4 tons per head of dairy cow (Figure 2). Significantly more favorable results have been recorded in Europe and the European Union. In the European Union, from 6 tons per head in 2008, the average milk production improved to 6.9 tons of milk per head in 2017. A similar trend of production was recorded in Europe, with an average production of 5.1 tons per head in 2008 with an increase to up to 6 tons of milk per head in 2017

Figure 2. Average milk production per cow in the world, Europe, the EU and the Republic of Serbia, 2008-2018



Source: FAO, 2020

Compared to the average in Europe and the European Union, milk production per dairy cow in Serbia is significantly lower, and during the analyzed period ranged from 2.8 tons in 2008 to 3.3 tons in 2017. Observing the index of average milk production in the world during the analyzed period, a significant increase in 2018 (about 18%) compared to 2008 was observed, with slight oscillations by individual years. A similar trend is in Europe and the European Union with a growth of 8-10% in 2018 compared to 2008.

Farms that specialize in one of the branches of animal husbandry make up 14.30% of the total number of farms where livestock is raised (SORS, 2019). Territorially, the largest number of farms specialized in animal husbandry is located in the region of Šumadija and Western Serbia, and the smallest is in the Belgrade region, which is consistent with the total number of farms where livestock is raised.

The average milk yield of cows in the Republic of Serbia is far below the European average. According to the SORS (2019), the total number of musk deer in the Republic of Serbia is declining. On the other hand, the number of heads from which milk is delivered to dairies is constant.

In the structure of farms in Serbia where cattle are raised, farms with up to three heads make up about 50%, while the share of farms with 20 or more heads is only 3.20% (Table 1).

Table 1. Number and the structure of holding in Serbia according to the number of cattle in the Republic of Serbia

Interval of cattle number	Average number of cattle on the holding	Number of holdings	Share in the total number (%)
0	0	434,476	76.96
1-2	1.52	56,046	9.93
3-9	4.88	53,552	9.49
10-19	13.19	13,006	2.30
20-29	23.61	3,503	0.62
30-49	37.33	2,379	0.42
50-99	64.79	1,226	0.22
≥ 100	320.81	350	0.06
Total:		564,538	100.00

Source: Statistical Office of the Republic of Serbia, 2019

The total standard output from farms where livestock production takes place is 3.8 billion euros (SORS, 2019).

Small economic power farms make up the majority in all regions of the Republic of Serbia and their share ranges from 61.80% in the region of Vojvodina, to 81.90% in the region of Southern and Eastern Serbia. In the total milk production in Serbia, cow's milk makes 96.84%, then goat's milk 2.20, and a smaller share makes sheep's milk, 0.96% (Table 2).

Table 2. Average annual milk production in the Republic of Serbia, 2008-2018

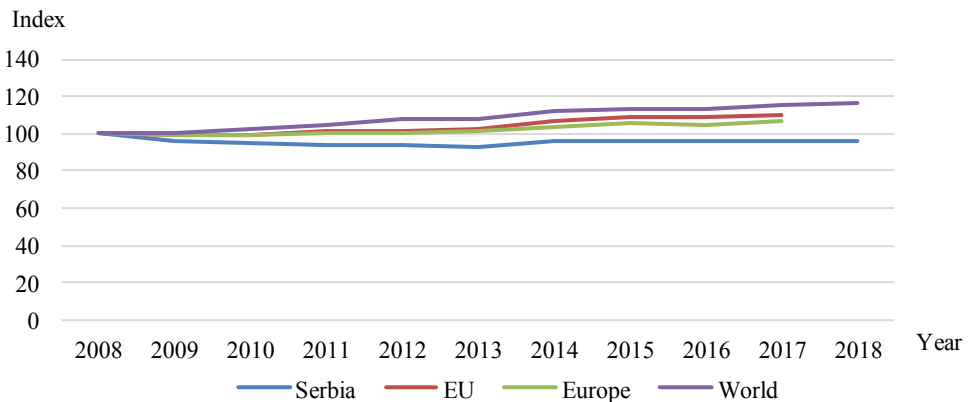
Animal origin of milk	Average annual milk production (mill. litres)	Share (%)
Cow's milk	1,493.18	96.84
Sheep's milk	14.82	0.96
Goat's milk	33.91	2.20
Total:	1,541.91	100.00

Source: Statistical Office of the Republic of Serbia, 2019

Milk production in developed countries is based on large family farms. This is a consequence of the fact that, in the development of cattle production, during the last decades, there has been a decrease in the number of producers, and an increase in the number of heads on existing farms on family farms. The biggest problem for small producers in the new member states was the harmonization with EU standards. The chance can be found in organic farming (Popescu & Andrei, 2011; Vasile et al., 2015).

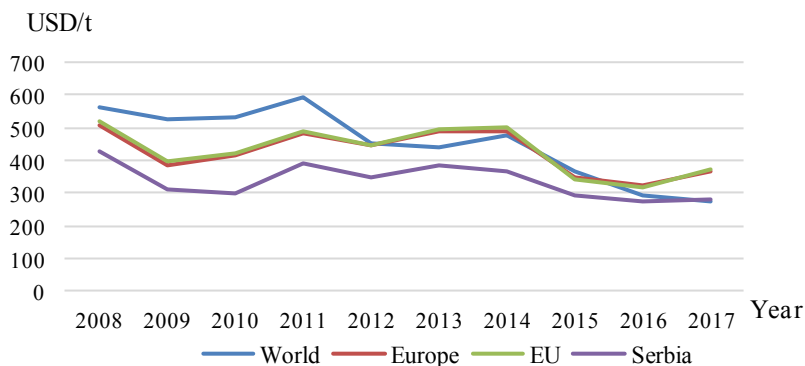
The average production of cow's milk in Serbia decreased by 8% less in 2013 compared to 2008 and then stagnated over the next three years with a slight increase of 2% in 2018 compared to 2013. Indices of average milk production per year were calculated on the basis of data from the FAO database (Figure 3).

Figure 3. Indexes of average cow's milk production in the world and the Republic of Serbia, 2008-2018



Source: FAO, 2020

The average price of production of one ton of milk in Republika of Serbia decreased in 2018 compared to 2008, both in the world and in Europe and the European Union (Figure 4).

Figure 4. Average production prices per ton of milk in the world, Europe, the EU and the Republic of Serbia, 2008-2017

Source: FAO, 2019

Observing the production of cow's milk by regions of the Republic of Serbia, the dominant place is occupied by the region of Šumadija and Western Serbia during the entire period 2007-2018, with a share of 46.60% in the total production of cow's milk in 2018 (Table 3).

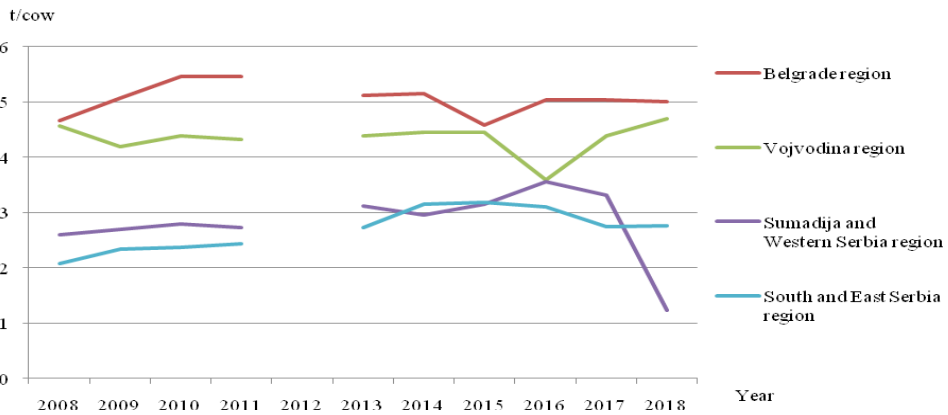
Table 3. Quantities of produced cow's milk by years in the Republic of Serbia, by regions and average per head, 2007-2018

Year	Cow's milk (total, mil. lit.)					Average milk yield of cows in Serbia (t)
	Republic of Serbia	Belgrade Region	Region of Vojvodina	Region of Šumadija and Western Serbia	Region of Southern and Eastern Serbia	
2007	1,571.00	128,00	388,00	747,00	308,00	2.69
2008	1,561.00	126,00	393,00	742,00	299,00	2.88
2009	1,505.00	137,00	356,00	728,00	284,00	3.00
2010	1,485.00	131,00	351,00	721,00	282,00	3.08
2011	1,462.00	131,00	337,00	714,00	280,00	3.06
2012	1,465.00	3.22
2013	1,451.00	123,00	360,00	670,00	298,00	3.38
2014	1,492.00	134,00	379,00	680,00	299,00	3.41
2015	1,501.00	119,00	357,00	723,00	302,00	3.49
2016	1,504.00	106,00	352,00	732,00	314,00	3.53
2017	1,506.00	106,00	434,00	695,00	270,00	3.51
2018	1,493.00	100,00	428,00	697,00	268,00	3.53
Index	100.00	6.70	28.67	46.68	17.95	-

Source: Statistical Office of the Republic of Serbia, 2019

The second place in terms of the amount of cow’s milk production belongs to the region of Vojvodina (28.67%), then to the region of Southern and Western Serbia (17.95%), and finally to the Belgrade region (6.70%). During the period from 2007 to 2018, the average annual production of cow’s milk ranged from 670 to 750 million liters with significant oscillations over the years. The largest quantities of milk were produced in 2007 and 2008, and the least in 2013 and 2014 during the analyzed period (Figure 5).

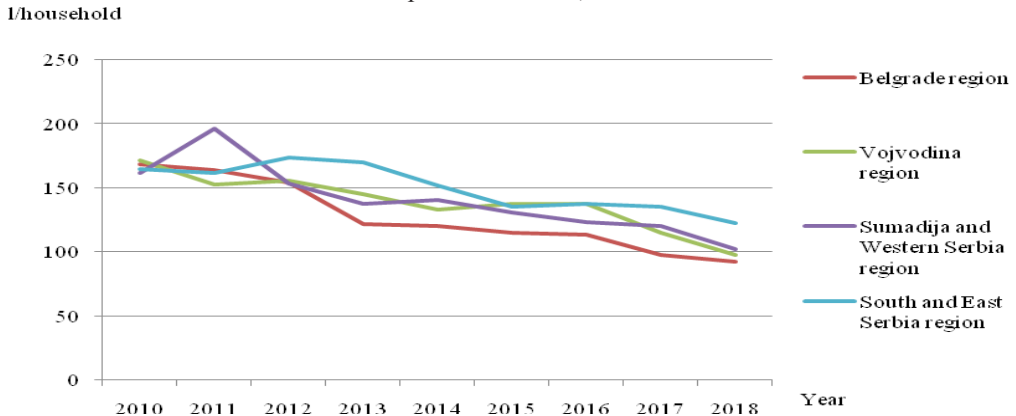
Figure 5. Average production of milk per cow by regions of the Republic of Serbia, 2008-2018



Source: Statistical Office of the Republic of Serbia, 2019

The average consumption of milk in households in Serbia during the analyzed period shows a declining trend. For example, in 2010, the average consumption was about 170 liters per household in all regions, and in 2018 it dropped to 90 liters in the Belgrade region, to 100 liters in the regions of Vojvodina, Sumadija and Western Serbia, and 130 liters in the Eastern and Southern Serbia (Figure 6).

Figure 6. Average cow milk consumption per household by regions of the Republic of Serbia, 2010-2018



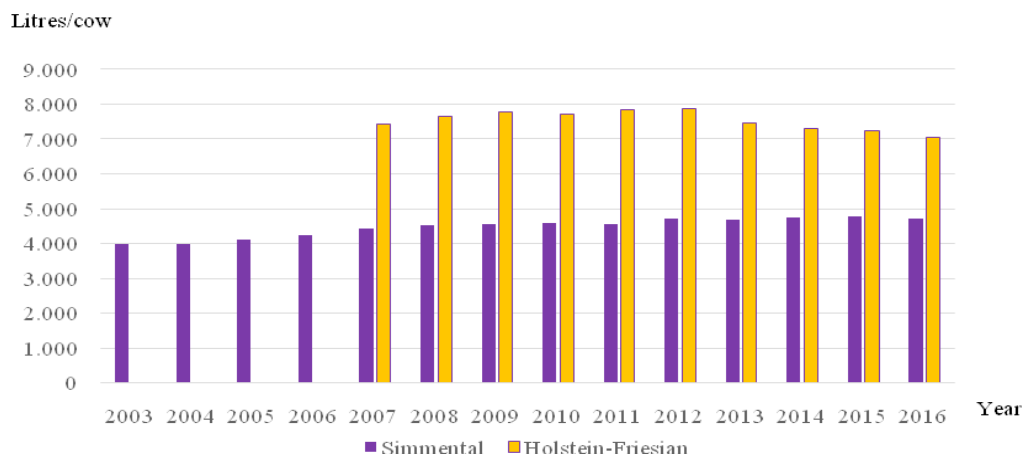
Source: Statistical Office of the Republic of Serbia, 2019

The average milk yield of Holstein-Friesian cows is lower than in Croatia (7,633 kg) and Slovenia (7,535 kg). In Austria, the average milk yield of Holstein cows is 8.809 kg with 4.07% milk fat and 3.30% milk protein (according to ICAR, Recording Guidelines-International Agreement of Recording Practices, 2016, *cit.* Mičić et al., 2019).

According to World Holstein Frisian Federation (Annual Statistics Report, 2016, *cit.* Mičić et al., 2019), HF populations in Israel and the USA with a yield of more than 11,000 kg have the highest milk production in the world, and the highest in Europe in Denmark, Germany and the Czech Republic (9-10,000 kg).

Based on the data from the Report of experts made on the basis of the survey and the results of control work conducted within the breeding program, by experts from the Institute of Animal Husbandry in Belgrade, during the period 2003-2016, the average milk yield of Bimetallic cows ranged from 4,000 to 4,800 liters, and Holstein-Friesian breeds from 7,200 to 7,900 liters per head of dairy cow (Figure 7).

Figure 7. Milk yield for Simmental (2003-2016) and Holstein-Friesian (2007-2016) cows in the Republic of Serbia



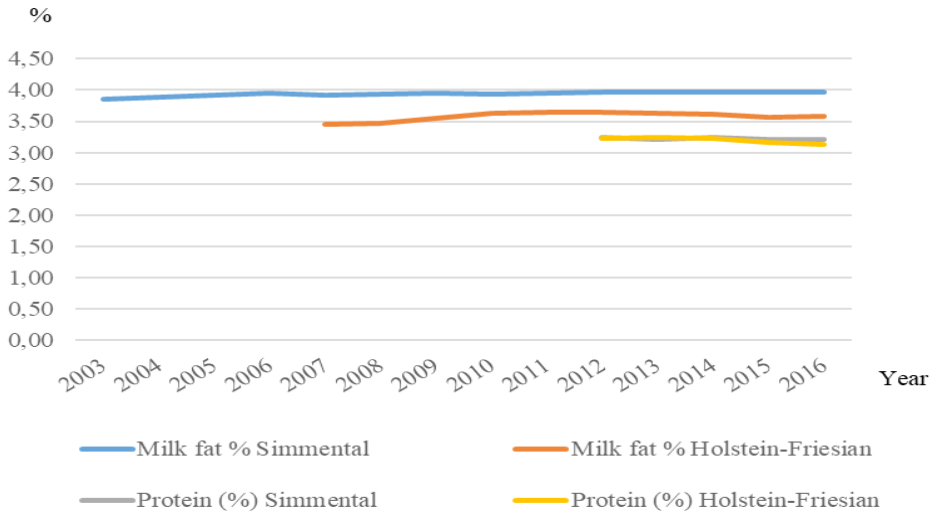
Source: Expert reports and results of control work carried out within the breeding program in 2016, Surveyed by Institute for Animal Husbandry

The composition of raw milk and hygienic correctness are factors on which its purchase price depends. In most industrialized countries, milk quality is defined by the level of somatic cells in the raw milk tank (Eduardo, 2014). High levels of somatic cells indicate poor milk quality, which further leads to adverse effects, such as lower selling (purchase) price of milk, and thus unfavorable business results, as well as other consequences for dairy products and health in general people.

In essence, the main parameters for determining the price of raw milk are the content of protein and fat in it. According to the same Report (above), of the Institute of Animal Husbandry in Belgrade, during 2003-2016, in the content of raw milk of Simetalac cows, the fat content was 4.50-5.00%, and protein 3.20-3.30%, while in the milk of

Holstein-Friesian cows, the protein content was the same as in the Simmental breed and the fat content was slightly in the range of 3.50-3.60% (Figure 8).

Figure 8. Percentage of fat and protein in the milk of Simmental and Holstein-Friesian cow breeds in the Republic of Serbia, 2003-2016



Source: Expert reports and results of control work carried out within the breeding program in 2016, Surveyed by Institute for Animal Husbandry

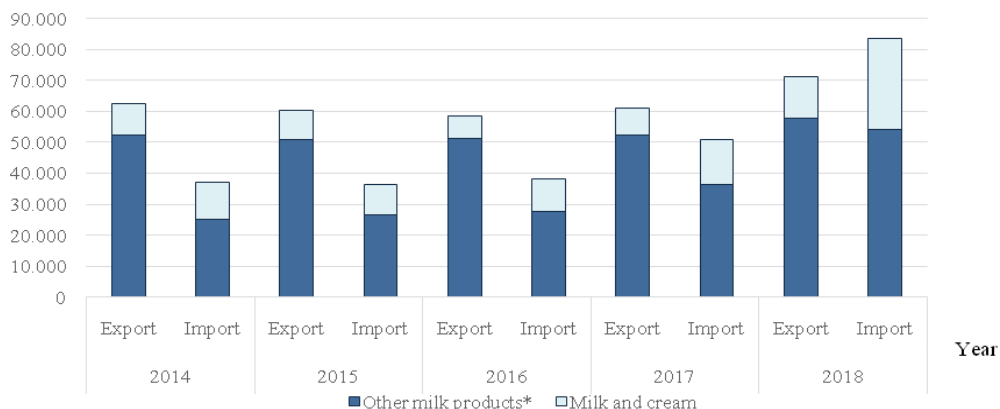
According to the standards in the European Union, the quality of milk is determined according to the following parameters: extra class contains less than 30,000 bacteria / ml and less than 300,000 somatic cells / ml; Class I contains 30-10,000 bacteria / ml and 300-400.00 somatic cells / ml; Class II has 100-300,000 bacteria / ml and 400-750.00 somatic cells / ml; and Class III contain more than 300,000 bacteria / ml and more than 750.00 somatic cells / ml (Mandić et al., 2006).

However, in Serbia, the limits of the stated parameters of milk are somewhat lower, as follows: for the extra class it is less than 100,000 bacteria / ml; for class I is 100-400,000 bacteria / ml; for class II it is 400-1,000,000 bacteria / ml; for class III it is more than 1,000,000 bacteria / ml, and for all classes up to 400,000 somatic cells / ml (Mandić et al., 2006). Therefore, milk that is considered an extra quality in Serbia, in the EU satisfies the quality of class III, which is a limiting factor for the export of milk from Serbia to the EU. According to expert estimates, a large number of Serbian producers do not meet the standard of extra milk class according to EU standards.

Of the total milk produced in Serbia, about 54% is placed on the market through dairies, which meet business requirements in terms of food safety, while the rest of the milk is consumed or processed on farms and thus placed through green markets. Given that the right to milk premiums is exercised only for quantities delivered to dairies (at least 3,000 liters of cow's milk per quarter), it can be expected that the share of placements through dairies will increase in the future.

According to the data from the Report of the Ministry of Agriculture, Forestry and Water Management, Figure 9 shows the value of exports and imports of cow's milk and dairy products in millions of euros per year in the period 2014-2018.

Figure 9. Foreign trade of milk and dairy products of the Republic of Serbia, 2014-2018 (000 euros)



*Other milk products: Powder milk, sour milk products, whey, buttery products, cheese and urda

Source: Report on the situation in Agriculture in the Republic of Serbia, Book II, Overview by Agricultural Markets (2018), Ministry of Agriculture, Forestry and Water Management of the Republic of Serbia

The value of exported milk and milk products from Serbia in 2018 is almost three times higher than the value of exported the same type of products in 2014. The value of imports of milk and milk products in the mentioned period ranged from 9-27 million euro and the value of imported products in the range of 50-57 million euro which confirms the surplus in foreign trade of these livestock products.

Conclusions

In the world, cattle are mostly raised in America (35.50%), followed by Asia (33.40%), a slightly smaller share in Africa (17.80%), and the smallest share is in Europe (10.50%). The number of cattle for milk in the period 2008-2017 gradually increased in the world so that in 2017 it was higher by 10% compared to 2008, with a slight decrease in 2018. In Europe and the European Union it had a similar trend, while in 2018 the number decreased by 8% in the EU compared to 2008, and in Europe it fell by 10% (FAO, 2020).

In Serbia, 908,102 head of cattle are raised on 177,552 family farms, that is, there is an average of 5.11 head of cattle per farm. On 89,753 farms, 190,914 head are raised, and on average 2.17 heads per farm, while 717,188 head of cattle are raised on 87,799 farms, i.e. 8.16 heads per farm. Over the last decade, the number of cattle in Serbia has dropped by more than 200,000. Farms with an average of 7 head of cattle make up 40% of the total number of farms where cattle are raised (SORS, 2019).

In the structure of agricultural farms by regions of the Republic of Serbia, farms where livestock is represented, in the region of Šumadija and Western Serbia they occupy 79.10%, while in the region of Vojvodina this share is somewhat smaller, 72.90%. Of the represented breeds of cattle bred in Serbia, the largest share is the Simmental breed, the so-called “Serbian Simmental”.

In the total milk production in Serbia, cow’s milk makes 96.84%, then goat’s milk 2.20%, and a smaller share is sheep’s milk, 0.96%. Cow’s milk production takes place on farms with an average number of head of 2.8 cows. The average milk yield of cows in the Republic of Serbia is far below the European average. Observing the production of cow’s milk by regions of the Republic of Serbia, the dominant place is occupied by the region of Šumadija and Western Serbia during the entire period 2007-2018, with a share of 46.60% in the total production of cow’s milk in 2018. The second place belongs to the region of Vojvodina (28.67%), then, on the third place is the region of Southern and Western Serbia (17.95%), and on the fourth place, the Belgrade region (6.70%). During the period from 2007 to 2018, the average annual production of cow’s milk ranged from 670 to 750 million liters with significant oscillations over the years. The largest quantities of milk were produced in 2007 and 2008, and the least in 2013 and 2014 during the analyzed period. The highest average amount of cow’s milk is recorded in the Belgrade region, where 5,335 liters per dairy cow are produced in one year.

Due to the still small number of quality breeding heads and lower production characteristics compared to countries with developed countries and EU member states, the non-competitiveness of our cow’s milk production is evident compared to the production in those countries. Also the quality of milk is a key problem that limits its export from Serbia to the EU. According to the allowed number of microorganisms, cow’s milk in Serbia is classified into: class I milk, class II milk and class III milk (The Official Gazette of Republic of Serbia No. 106/2017). In addition to these three classes, there is an extra class. Milk quality criteria in Serbia are far below the standards in the European Union. For milk that is considered extra quality in Serbia, in the EU it meets the criterion of the third III class.

The average consumption of milk in households in Serbia during the analyzed period shows a declining trend. Thus, in 2010, the average consumption was about 170 liters per household in all regions, and in 2018 it dropped to 90 liters in the Belgrade region, to 100 liters in the regions of Vojvodina, Šumadija and Western Serbia, and 130 liters in Eastern and Southern Serbia. Of the total milk produced in Serbia, about 54% is placed on the market through dairies, which meet business requirements in terms of food safety, while the rest of the milk is consumed or processed on farms and thus placed through green markets. Positive tendencies in the development of cow’s milk production in Serbia can be expected with the realization of favorable macroeconomic business conditions and more efficient fulfillment of requirements for quality standards. Achieving long-term stability of the market of milk and dairy products with better organization of sales channels is the basis of stability and sustainability of overall agricultural production in Serbia.

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Conflict of interests

The authors declare no conflict of interest.

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