Invited paper

FEATURES AND POSSIBILITIES FOR OPTIMIZING FARM MILK PRODUCTION IN SERBIA

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Abstract

Milk production in Serbia is organized on farms of different capacities that mutually vary in relation to agro-ecological, zootechnical and production conditions. The aim of this paper is to present a part of the most important results that have been obtained so far, in the implementation of the project "Optimization of technological procedures and zootehnical resources on farms with the goal to upgrade sustainability of milk production". The results that are presented relate to the most important features of farm cow milk production in Serbia, as well as the possibility for optimization of the most important technological procedures and zootechnical resources on which milk production is based. The structure of dairy farms in Serbia, in terms of size and number of animals, is not satisfactory, because the predominated types are small and medium scale farms. However, there are numerous possibilities for optimization of farm and zootechnical conditions and resources in order to improve the sustainability of milk production. These possibilities can be divided into optimizing selection and breeding methods, optimizing nutrition manners and physical form of forage and complete meals in the nutrition of dairy cows, optimizing housing conditions, welfare and health care in order to improve the sustainability of milk production, as well as optimizing milking and handling the milk after milking.

Key words: *animal housing, animal welfare, breeding method, dairy farm, nutrition*

Introduction

Milk production in Serbia has a long tradition and represents one of the most important branches of livestock production with a great impact on the economic development of a particular geographic area. Milk production in Serbia is organized on farms of different capacities that mutually vary in relation to agro-ecological, zootechnical and production conditions. According to the research performed by Bogdanović et al., 2012, and Bogdanović et al., 2014, the largest number of cattle farms in Serbia are small capacity farms and they keep up to 10 cows, while the number of medium, and especially large farms, is significantly lower. Despite the available natural resources, farm fragmentation leads to large heterogeneity in their exploitation, and therefore in achieved production results, which significantly affects the unevenness in the quantity and quality of produced and supplied raw milk.

Researches of very complex farming systems for milk production require significant engagement of different resources, so researches of this type, as a rule, are very complex in terms of research activities that must be implemented, they are long lasting and rather expensive. This imposes the requirement for them to be financed from public funds i.e. from the budget of the Republic of Serbia, through the relevant Ministry of Education, Science and Technological Development.

The aim of this paper is to present a part of the most important results that have been obtained so far, in the implementation of the project "Optimization of technological procedures and zootehnical resources on farms with the goal to upgrade sustainability of milk production" which is funded by Ministry of education, science and technological development of the Republic of Serbia. The results that are presented relate to the most important features of farm cow milk production in Serbia, as well as the possibility for optimization of the most important technological procedures and zootechnical resources on which milk production is based.

State of the art of dairy cattle production sector in Serbia

Cattle production has traditionally been one of the most important branches of livestock production. Since the first official Simmental (SM) cattle imports in the second half of the nineteenth century until today it has passed through various stages of development. However, despite several decades of development, the current state of livestock production is not completely satisfactory. Generally speaking, the production of milk and meat is carried on with a significantly reduced number of cattle and is, generally, intended to meet the needs of the domestic market, which has relatively low purchasing power. A negative trend has been visible for more than two decades in the numbers of cattle, and all forecasts indicate that this tendency will continue in the future. The situation is further aggravated by the existence of a large number of non-commercial operators, mostly elderly households, with poor equipment and motivation. In the presence of these, it is not possible to organize a modern and efficient production sector, or to make long-term production plans (Perišić et al., 2006).

Based on the surveys that were performed by Bogdanović et al. 2012 and 2014, it was found that about 59% of farms that are primarily registered for livestock production and which are commercially engaged in milk production have a size of up to 20 ha (of which about 11% of the farms have a size up to 5 ha, about 25% of the farms have a size from 5 to 10 ha, about 14% of the farms have a size from 10 to 15 ha, and about 9% of the farms have a size of 15 to 20 ha), about 20% of the farms have a size of 20-50 ha, about 6.5% of the farms have a size between 50 and 100 ha, about 2.5% of the farms have a size from 100 to 200 ha, while about 6% of the farms that engage in commercial milk production have a size of more than 200 ha. Some 6% of surveyed farmers did not respond to this question.

The average size of farms in the first group with up to 20 ha is about 10.15 ha, the average size of the farms in the group between 20 to 50 ha is about 29.8 ha, farms in the group from 50 to 100 ha have an average size of about 66.4 ha, while in the group of farms with a size from 100 to 200 ha the average size is about 131 ha.

The most common cattle breeds are SM and HF. The SM breed exists mainly in central Serbia, while HF is more prevalent in Vojvodina, i.e. in north region of Serbia. However, due to its greater robustness the SM breed is gradually increasing in Vojvodina.

The usual way of managing cows in milk production is in free stalls, rarely in tied-up systems. Stables with the free system are open or semi-open with appropriate outlets, while keeping the cows in pasture is seldom practiced.

The average number of cows varies considerably from farm to farm. About 55% of farms have up to 15 cows and heifers (of which about 26% of farms have up to 5 cows, about 19% of farms have 5 to 10 cows and 10% of farms have 10 to 15 cows), about 15% of farms have 15 to 30 cows, about 5% of farms have 30 to 100 cows, about 5% of farms have 100 to 200 cows, while about 3% of the farms have more than 200 cows in the production. A total of 17% of surveyed farmers did not answer this question.

Even though the results of this study cannot be generalized to all the farms that continuously or occasionally supply milk to the dairies, of which there are, according to various estimates, around 149,000, they indicate that there are still significant potentials for optimization and improvement of milk production both in terms of farmers, and in terms of optimum utilization of available farm resources. This certainly includes optimization of breeding and selection programs, optimization of cow nutrition in lactation period, as well as optimization of the conditions of keeping and care of animals.

Possibilities for optimization of most important technological procedures and zootechnical resources in milk production

Cow milk production in Serbia is mainly organized in semi-intensive and intensive production systems, while extensive systems are less common and mainly associated with undeveloped or mountainous areas. Common to all farmers who are engaged in specialized livestock production, compared to the average farmers engaged in mixed agricultural production, is a higher level of technological knowledge, greater openness to technological production improvements, larger farm areas and larger number of animals that are kept on the farm.

Numerous analyzes of the situation and the level of milk production on farms with dairy cows confirm that there is still a need for continuous organization and implementation of planned activities to improve milk production, primarily by improving the breeding composition of cattle. All estimates indicate that the number of cattle, especially cows, will decrease also in the period to come and the only answer to that is continuous improvement of the genetic potential of cattle intended for milk production. The main reason for this assumption is the constant closing down of a large number of small, mainly elderly households, as well as the reorientation of small farms and households to some other types of agricultural production. Intensive and sustainable milk production require, primarily, improving the genetic potential of milk production cattle. In accordance with the characteristics of the area (climate conditions, forage quality, breeders habits, altitude) the method that imposes for improving both domestic Simmental, and Holstein, is growing in pure breed with performing strict selection and application of artificial insemination with bull semen that is highly rated for their milk properties (Perišić et al, 2011a and 2011b). The goal of the breeding should be improving milk production traits, without compromising fattening traits, while retaining the resistance, regular fertility, good health and longevity. This type of breeding should contribute to the improvement of milk performance traits, from the average level which is currently, with the majority of milk producers, in the interval from 3,000 to 4,000 kg, to the average production level of the entire population of 5,000 kg and more. At the same time, feeding conditions, housing and care have to be improved in order for the improved cattle to fully express their genetic potential. It should be mentioned that the Simmental breed kept in the mountainous area of

some European countries (e.g., Austria, Germany) has an average milk production of 6,500-7,000 kg with over 4% fat, and quite often there are herds with an average of more than 8,000 kg of milk per cow. It is from these countries that bull semen should be imported in order to improve the genetic potentials for milk yield of our Simmental herds (Perišić et al, 2011a and 2011b).

Apart from this, one should have in mind that the size of the farm, together with applied farm management, can have a significant impact on the expression of, primarily, production traits of cows. In general, the tendency is that farms that raise more livestock achieve not only higher average milk yield, but have less manifested problems in the reproduction of animals. The results of the research by Kučević et al. 2011, indicate, however, that this trend is maintained only up to a certain farm size, i.e. number of livestock in the herd, after which there is a stagnation, and even decrease in production. In this regard, it is extremely important that every farmer independently estimates the optimal size of his herd in relation to the availability of necessary resources for milk production.

During the implementation of any program for the improvement of milk yield one should pay attention that the quality of milk and dairy products directly depends on its protein composition. The variability of kappa-casein (κ-CN) , as one of the four casein proteins in milk, is of particular importance in the selection of cattle. The research of Đedović et al., 2012 (unpublished results), conducted on the genotypes of Simmental breed cows, the crossbreed obtained by crossbreeding the Simmental with Red Holsteins and cows of the indigenous breed of Buša, showed that there are differences in the frequency of κ-CN. Genotype frequencies κ-CN for Simmental breed were: 42.8%; 47.6% and 9.6% for AA, AB and BB genotype, for crossbreeds: 75.0%; 25.0% and 0.0% and for Buša individuals: 41.7%; 50.0% and 8.3%, respectively. The frequencies of alleles A and B, for observed breeds, estimated on the basis of genotypic frequencies, were 0.667 and 0.333 for Simmental breed, 0.875 and 0.125 for crossbreeds and 0.667 and 0.333 for the indigenous cattle breed Buša, respectively. The research showed that the genotype κ-CN, statistically, significantly affects milk yield and highly significantly milk fat yield, but it does not affect the milk fat content of tested animals.

The research established the dominance of allelic A variant with all covered breeds, which particularly applies to crossbreeds obtained by crossbreeding Simmental and Red Holstein. The frequency of desirable B allelic variant κ-CN was lower and the same with cows of Simmental breed and Buša cows. Through identification of populations and cattle breeds with an increased proportion of B allelic variants κ-CN and their inclusion in selection programs, the opportunity to increase the frequency of favourable alleles would be gained, and thus the technological quality of cattle milk would be improved, which would increase the economic value of livestock production. Conducted research provides a starting point for further determination of breeders for keeping breeds and producing milk of a certain quality and quantity according to the needs of the dairy industry.

It is well known that the costs of cattle feeding in milk production can amount to 65-75% of total production costs. Therefore, all farmers involved in this survey pay special attention to proper feeding of all categories of cattle. All the farmers involved in this analysis adapt feeding to the physiological status of the animal, paying particular attention to milk yield and to reproductive status. About 92% of farmers prepare their own livestock feed, while 55% of farmers buy ready-made concentrates from animal feed manufacturers. Farmers that prepare their own feed, mainly produce the entire amount of forage and one part of the concentrated feed. In terms of forage, farmers prepare hay from clover or alfalfa, corn silage and, increasingly, haylage. When it comes to concentrated feed, farmers usually produce feeds such as corn, soybean or sunflower, while they only purchase

additives or necessary premixes. About 78% of surveyed farmers buy the vitamin and mineral supplements required in cattle diets.

What is, in the researches by various authors, more frequently expressed as a possibility for additional optimization of nutrition programs on dairy farms is to solve the problem of forage crumbling and primarily whole-plant corn silage and alfalfa haylage, as well as total mixed ration (TMR), for nutrition of cows in lactation. Based on the research by Stojanović et al. 2011a, 2011b and 2011c, and with the use of "Penn State Particle Separator" system of four sieves, various deviations were defined from the optimum predicted values of distribution of certain fractions of particles for both forage and TMR. The more uneven the crumbling of forage was, the more the fragmentation of TMR varied. The authors of these researches point out that the results indicate the importance of optimization of the physical form of forage during its preparation, in order to achieve the desired physical effectiveness of the entire meal. The optimum physical efficiency of forage can be achieved using various methods and procedures both during the grinding of the mass and during preparation of whole-plant corn silage, and alfalfa haylage.

High temperatures (as a seasonal factor) in the form of heat stress can significantly reduce the daily milk production, and exceptionally stop lactation, which is especially the case with poorer dairy cows. The selection of high yielding cattle breeds with the aim of improving the genetic predisposition for higher milk production and the quantity of consumed food, has led to a decrease in productive and reproductive potentials in periods of increased outside temperature, because not enough attention has been given to the thermoregulatory abilities of animals. In the conditions of heat stress, there is first a reduction in milk production, which has particularly become important in recent years. High yielding dairy cows are most sensitive to heat in early lactation and milk production reduces significantly when body temperature is higher than 39 degrees Celsius. Dairy cows in early lactation are unlikely to cope with heat stress, which is why it has the greatest impact on milk production in the first 60 days of lactation (Joksimović-Todorović et al., 2011).

One of the major problems of modern intensive farm milk production is a growing presence of mycotoxins, as a result of significant climate changes, which has been validated in Serbia in the past few years. Due to the harmful effects on human and animal health, mycotoxins are today called the "silent killers", "invisible thieves" or "natural toxicants". The main mechanisms of toxicity are the inhibition of protein synthesis, DNA, RNA, lipid peroxidation, changes in the structure and function of the membrane and the initiation of programmed cell death. In addition to inadequate preparation and storage of feed, poor nutritional status of animals and housing conditions may, also, affect the increase in the sensitivity of animals to mycotoxins. In that sense, the use of different antioxidants can potentially be very important in the protection against mycotoxins. Selenium and vitamin E are the key ingredients that act as antioxidant protection and farmers should pay attention to this when preparing the meals for feeding the cattle (Joksimović-Todorović and Davidović, 2011).

Finally, it should be noted that for the success of any optimization program or improvement of production parameters on dairy farms it is essential that farmers are interested in this and ready to implement certain new solutions on their farms. In this regard, the oldest surveyed farmer was born in 1928, and the youngest in 1990. About 25% of surveyed farmers were born in the period from 1928 to 1952, while 50% of surveyed farmers were born in the period from 1952 to 1973. If we consider all the birth years, 50% of surveyed farmers were born until 1964 and 50% were born in the period from 1964 to 1990. It is the age of surveyed farmers, who are also the owners of their farms, that

provides some "space" for the acceptance of new technological solutions or optimization of existing technological processes. This is supported by the fact that 71% of all surveyed farmers have regular, and 23% occasional contact with agricultural advisory service. Also, over 86% of surveyed farmers intend to expand the existing farm production, mainly by increasing the number of animals, stricter selection of animals, as well as by improving the feeding conditions and manners, housing, care and milking. About 6.5% of farmers do not currently intend to expand their production. No less important is the fact that about 75% of surveyed farmers expect certain benefits from future EU membership, even though they are aware that they, also, can expect a lot more adjustments. On the other hand, about 19% of farmers do not expect any benefits from the potential Serbian EU membership.

Conclusion

Based on everything that has been mentioned, it can be concluded that the structure of dairy farms in Serbia, in terms of size and number of animals, is not satisfactory, because the predominated type are small and medium scale farms. As Serbia moves closer to EU, these farms will soon face even greater market pressure. On the other hand, family farms of larger capacity, but also many farms of medium capacity, can become competitive on the market only if they continuously improve and innovate their production. Commercial milk production of today is extremely demanding and based on continuous improvement of all available farm conditions, technological processes and zootechnical resources that are important for this type of production. The possibilities for optimization of farm and zootechnical conditions and resources in order to improve the sustainability of milk production can be divided into optimizing selection and breeding methods, optimizing nutrition manners and physical form of forage and complete meals in the nutrition of dairy cows, optimizing housing conditions, welfare and health care in order to improve the sustainability of milk production, as well as optimizing milking and handling the milk after milking. How many farm and zootechnical conditions and resources will be optimized or improved in order to increase the sustainability of milk production does not only depend on the obtained research results, but also on the system and the manner of their dissemination, and the willingness of farmers to innovate their production.

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