

MILK PRODUCTION AND QUALITY OF HOLSTEIN-FRIESIAN DAIRY COWS ON THE MALESHEVO FARM OF NORTH MACEDONIA**PROIZVODNJA I KVALITETA MLIJEKA HOLSTEINSKO-FRIZIJSKE MLIJEČNE KRAVE NA FARMI MALEŠEVO U SJEVERNOJ MAKEDONIJI****G. Cilev, F. Fejzula, S. Stojanovski, M. Ristevski**

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SUMMARY

The study aimed milk production and quality of Holstein-Friesian dairy cows on the Maleshevo farm in North Macedonia. In 2023, 30 lactating cows with an average body weight of 552.3 kg were monitored on the AD Maleshevo dairy farm in Berovo, which has a capacity of 200 cows. The nutrition was compound with ration from corn silage, lucerne hay, meadow hay, (dry) brewery by-product, (dry) sugar beet by-product, and concentrate like a mixture. Milk production over the 305 days lactation period averaged 8,997.5 kg with a mean daily yield of 29.50 kg. The average chemical composition of milk was 3.99% fat, 3.11% protein; 4.04% lactose, 8.39% nonfat dry matter and 12.38% total dry matter. The total somatic cells count was 185.000 cells/ml, while the total number of microorganisms was 236.000/ml. As a general conclusion, we can highlight the fact that the cow's milk obtained in the Maleshevo farm in terms of the two investigated parameters (chemical composition and total number of somatic cells) fulfills the stipulated criteria for extra class and is of excellent quality, while in terms of the total number of microorganisms belongs to the first class of quality and it is necessary to take a set of hygiene measures in order to improve its microbiological composition.

Key words: Holstein-Friesian, nutrition, milk production, chemical composition, somatic cells, microorganisms

INTRODUCTION

Cattle breeding is important branch of the animal husbandry. In some European countries, like Denmark, Netherlands, Finland it contributes more than 50-60% of the agricultural production. It is same in the Republic of North Macedonia where cattle products provide good results giving the best part of the milk (80%) and meat (50%) products, both as fresh

and secondary products. This, gathered with the fact that there are 296.634 cattle, 133.838 (45.12%) belonging to the Holstein-Friesian cows (Official data from the Unit for Animal identification at the Ministry of agriculture, forestry and water management of the Republic of North Macedonia), makes it the major branch in the meat and milk production.

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Milk production in R. North Macedonia is generally achieved by breeding Holstein-Friesian dairy cattle that have genes for high production that measure 8-10 tons of standard milk and one calf in a 365-day reproduction cycle (Trajkovski and Bunevski, 1999). But the big production can be achieved only by controlling the paragenetic factors (nutrition, management, animal welfare, animal health) that are specific and can differ quite from the ones used in our general practice (Kitanovski et al., 1998).

One of the major paragenetic factors in milk production is the nutrition. Without adequate nutrition considering all of the ingredients needed by the cows, the high milk production is not possible. Although a lot has been done on these issues through the years, the science can only give the numbers in part on what a successful ration is about (Grubic and Adamovic, 2003). We consider that the key to economic production of milk is creating and testing models of comparative rations for dairy cattle, with the help of the modern science of ruminants' nutrition (Sretenovic et al., 2007).

The purpose of this paper is to stress the importance of the milk production and quality in Holstein-Friesian dairy cows in conditions found in Maleshevo farm of North Macedonia.

MATERIALS AND METHODS

The research has been done on a commercial dairy cattle farm AD „Maleshevo” from Berovo with capacity of 200 cows. The study included 30 lactating cows (under milking control) with average body weight 552.3 kg. The cows have been fed with rations made of corn silage, lucerne hay, meadow hay, brewery by-product (dry), sugar beet by-product (dry) and concentrate like a mixture. All the forage and mixture samples were analyzed according to AOAC (1980) analysis by the method of Weende.

The results of the chemical composition of milk (% of milk fat, % of proteins, % lactose, % of defatted dry matter and % of total dry matter), the total number of somatic cells and the total number of microorganisms in milk were analyzed (Regulations for the storage of raw milk - Article 9 and Article 13, Official Gazette of the RM, No. 151/2011).

Milk samples were taken in sterile plastic bottles, in the amount of 50 ml per sample (AT method). The samples were taken from the collected morning milk.

The chemical composition of milk was determined using a Foss Milkoscan 4000 apparatus (according to the Instructions for the Operation of Infrared Spectrophotometry Instruments), manufactured by Foss Electric from Denmark. When determining the chemical composition of cow's milk, the content of the following components was measured: milk fat, proteins, lactose, defatted dry matter and total dry matter in milk was determined.

The total number of somatic cells was determined using a Foss Fossomatic 5000 apparatus, somatic cell enumeration (According to the Operating Instructions with Fluoro-Opto-Electronic Counters), manufactured by Foss Electric of Denmark.

The microbiological composition of the milk was determined using an apparatus, Bentley Bactocount IBC 50 – (Quantitative determination of the bacteriological quality of raw milk).

The analyses were performed in an authorized laboratory (PROANALYZ Laboratory-Strumica, North Macedonia).

The ration composition for nutrition of high dairy cows that were object in this research is given in Table 1.

RESULTS AND DISCUSSION

The results of the average content of milk produced on the cattle farm AD Maleshevo - Berovo is given in Table 2.

The results presented in Table 2 show that the average milk production was 28.00 kg in Group 1, 31.00 kg in Group 2, and the average milk production for both groups was 29.50 kg while the standard milk production for 305 days of lactation was 8,997.5 kg.

Our results on the total lactation in the period of 305 days are in the limits of 7420-8894 kg given by Sretenovic et al., (2007), but are above 5795-7190 kg and 7290 kg given by Palasevski et al. (1995) and Shokarovski et al. (2001) respectively, and much higher than 5849 kg in the first lactation of Holstein-Friesian cows in the Pelagonia region given by Kitanovski et al. (1998) and Trajkovski and Bunevski (1999).

Table 1 Composition of ration for nutrition of high dairy cows on the cattle farm AD Maleshevo - Berovo

Tablica 1. Sastav obroka za hranidbu visoko mliječnih krava na govedarskoj farmi AD Maleševo - Berovo

	Daily Dnevno	DMS Suhe tvari	NEL total Neto energija za laktaciju Ukupno	Total protein Ukupne bjelančevine	Digestible protein Probavljive bjelančevine	Undigestible protein Neprobavljive bjelančevine	Crude fibers Sirova vlakna	Acid detergent fibers Kisela deterdžentska vlakna	Neutral detergent fibers Neutralna deterdžentska vlakna
	kg	kg	MJ	g	%/g	%/g	g	%/g	%/g
Roughage feedstuffs Krmiva									
Corn silage Kukuruzna silaža	13	4.16	23.40	130.21	65.7/85.55	25.3/32.94	467.58	10/46.76	17.2/80.42
Brewery by-product (dry) Nusproizvod pivovare (suhi)	1.5	1.32	10.04	331.06	5.2/17.22	57.5/190.3	193.38	4.9/9.48	11/21.26
Lucerne hay Sijeno lucerne	4	3.60	17.32	354.96	48.8/173.2	33.3/118.2	1405.1	30.1/422.9	40.4/567.6
Meadow hay Livadno sijeno	4	3.56	18.80	239.94	20/47.99	56/134.36	1428	38.3/546.9	62.7/895.3
Sugar beet pulp by-product (dry) Nusproizvod pulpe šećerne repe (suhi)	1.5	1.27	10.14	119.60	5.2/6.22	61.6/73.7	319.38	32/102.2	41.1/131
Total roughage feedstuffs Ukupna količina hrane za životinje	24	13.91	79.70	1175.77	330.18	549.56	3813.44	1128.24	1695.58
Concentrate Koncentrat	9	7.83	68.31	1202.4	155.7	616.5	454.5	61.11	120.51
Total (roughage feedstuffs + concentrate) Ukupno (krmiva za životinje + koncentrat)	33	21.74	148.01	2378.17	485.88	1166.06	4267.94	1189.4	1816.1

Table 2 Average content of milk produced on the cattle farm AD Maleshevo - Berovo, kg

Tablica 2. Prosječan sadržaj mlijeka proizvedenoga na govedarskoj farmi AD Maleševo - Berovo, kg

Groups Skupine	N	Measures of variation / Mjere varijacije				
		Average value Prosječna vrijednost (X)	Standard error Standarna pogrješka (Sx)	Standard deviation Standarna devijacija (Sd)	Coefficient of variation Koeficijent varijacije (Cv)	Interval of variation Interval varijacije (Iv)
		Milk, kg / Mlijeko, kg				
I group / I. skupina	15	28.00	0.43	2.33	8.33	24-34
II group / II. skupina	15	31.00	0.93	5.09	16.43	22-40
Both groups – Maleshevo farm Obje skupine – farma Maleševo	30	29.50	0.54	4.21	14.27	22-40

Table 3 Chemical composition of milk on cattle farm AD Maleshevo - Berovo, %

Tablica 3. Kemijski sastav mlijeka na govedarskoj farmi AD Maleševo - Berovo, %

Groups Skupine	N	Measures of variation / Mjere varijacije				
		Average value Prosječna vrednost (X)	Standard error Standarna pogrješka (Sx)	Standard deviation Standarna devijacija (Sd)	Coefficient of variation Koeficijent varijacije (Cv)	Interval of variation Interval varijacije (Iv)
		Milk fat, % / Mliječna mast, %				
I group / I. skupina	15	3.91	0.10	0.53	13.47	2.32-4.74
II group / II. skupina	15	4.07	0.09	0.47	11.59	2.81-5.20
Both groups – Maleshevo farm Obje skupine – farma Maleševo	30	3.99	0.06	0.50	12.59	2.32-5.20
Proteins, % / Bjelančevine, %						
I group / I. skupina	15	3.09	0.03	0.19	6.04	2.34-3.33
II group / II. skupina	15	3.14	0.02	0.11	3.41	2.84-3.31
Both groups – Maleshevo farm Obje skupine – farma Maleševo	30	3.11	0.02	0.15	4.91	2.34-3.33
Lactose, % / Laktoza, %						
I group / I. skupina	15	4.01	0.04	0.23	5.84	3.07-4.31
II group / II. skupina	15	4.07	0.02	0.14	3.42	3.71-4.31
Both groups – Maleshevo farm Obje skupine – farma Maleševo	30	4.04	0.02	0.19	4.78	3.07-4.31
Nonfat dry matter, % / Nemasna suha tvar, %						
I group / I. skupina	15	8.32	0.09	0.49	5.92	6.35-8.99
II group / II. skupina	15	8.46	0.05	0.28	3.34	7.58-8.88
Both groups – Maleshevo farm Obje skupine – farma Maleševo	30	8.39	0.05	0.40	4.82	6.35-8.99
Total dry matter, % / Ukupne suhe tvari, %						
I group / I. skupina	15	12.23	0.18	0.96	7.88	8.67-13.73
II group / II. skupina	15	12.53	0.12	0.63	5.06	10.39-13.52
Both groups – Maleshevo farm Obje skupine – farma Maleševo	30	12.38	0.11	0.82	6.64	8.67-13.73

It can be noted that the average milk production of the cows that were tested in our conditions related to that of some European countries (Arend, 1999) like Netherlands, Sweden, Italy, where it amounts to 8,000 kg (8,003, 8,504, and 8,134 kg, respectively) for the lactation period of 305 days of the tested black and white cows and Germany, Finland, and UK, where it measures more than 7,000 kg (7,438, 7,496 and 7,109, respectively), is in the limits of the genetic potential of the Holstein - Friesian cows.

Table 3 presents the results of the chemical composition of the milk on the farm tested.

According to the results shown in the Table 3, the average chemical content of the milk is 3.99% fats, 3.11% protein, 4.04% lactose, 8.39% non-fat dry matter, and 12.38% total dry matter.

Our results for the average content of fat, protein and lactose in the milk are in the limits of those reported by Djordevic et al. (2005) where the fat content in the milk is 3.34-3.81% depending on the diet and those of Gutic et al. (2001) where the milk protein is 3.56%. Our results are measurably higher than those of Bobos et al. (2001) where the control group of cows gave milk with average milk fat of 3.47%, 3.20% of protein, 8.27% of non-fat dry matter and 11.47% of total dry matter, while the tested group that were given the preparation Sel-Plex TM in the ration yielded better results of 3.59%, 3.38%, 9.04% and 12.61%, respectively. Our results were also higher than those of Adamovic et al. (2004), where the control group gave milk with average fat content of 3.29%, 2.90% of protein, 11.62% of dry matter, while the tested

group that were given buffer (mineral mixture of magnesium oxide, sodium bicarbonate, bentonite and organic zeolite) in the ration yielded better results of 3.58%, 3.03% and 11.99% respectively.

Sretenovic et al., (2007) in their research on the use of yeasts in combination with probiotics and enzymes in the diet of the dairy cow and its effect on the milk production gave results of 3.91% fat, 3.05% protein, 4.91% lactose and 11.65% of dry matter in the control group of cows, and 4.19%, 3.11%, 5.16% and 11.72% respectively in the tested group. Those results are similar to ours.

In Table 4 shows the results of the average total number of somatic cells in the milk obtained at the examined farm AD Maleshevo - Berovo, Maleshevo.

From the presented Table 4, it can be seen that the average content of total number of somatic cells in the milk ranges from 180.000/ml in the first group to 190.000/ml in the second group or the average for the both groups – the Maleshevo farm average content of total number of somatic cells in cow's milk is 185.000/ml.

Our found results in relation to the total number of somatic cells in the cow's milk at the examined farm AD Maleshevo - Berovo, as well as the average for the Maleshevo farm (185.000/ml) compared to those in the Regulation on the storage of raw milk - article 13 (Official Gazette of RM No. 151/2011) belongs to the extra class $\leq 400.000/ml$, which means that the cow's milk in the Maleshevo farm is of excellent quality.

Table 4 Average amount of total number of somatic cells (x1000/ml) in the milk on the cattle farm AD Maleshevo - Berovo, Maleshevo

Tablica 4. Prosječna količina ukupnoga broja somatskih stanica (x1000/ml) u mlijeku na govedarskoj farmi AD Maleševo - Berovo, Maleševo

Groups Skupine	N	Measures of variation / Mjere varijacije				
		Average value Prosječna vrijednost (X)	Standard error Standarna pogriješka (Sx)	Standard deviation Standarna devijacija (Sd)	Coefficient of variation Koeficijent varijacije (Cv)	Interval of variation Interval varijacije (Iv)
Total number of somatic cells (x1000/ml) in milk Ukupan broj somatskih stanica (x1000/ml) u mlijeku						
I group / I. skupina	15	180	15.26	59.08	32.82	104-328
II group / II. Skupina	15	190	16.03	62.06	32.66	137-337
Both groups – Maleshevo farm Obje skupine – farma Maleševo	30	185	15.64	60.57	32.73	104-337

Table 5 shows the results of the average content of total number of microorganisms in the milk obtained at the examined farm AD Maleshevo - Berovo, Maleshevo.

From the presented Table 5, it can be seen that the average content of total number of microorganisms in the milk ranges from 202.000/ml in the first group to 270.000/ml in the second group or the average for the both groups - Maleshevo farm average content of total number of microorganisms in cow's milk is 236.000/ml.

According to the results of microbiological analyzes in relation to the total number of microorganisms in the milk at the investigated farm AD Maleshevo - Berovo, as well as the average for the Maleshevo farm (236.000/ml), compared with those in the Regulation for the storage of raw milk - article 13 (Official Gazette of RM No. 151/2011) belongs to the first class from 100.001/ml - 700.000/ml, which means that for cow's milk from the Maleshevo farm, greater hygiene and hygiene measures should be proposed before, during and after milking as well as proper storage and cooling the milk, which would achieve the extra class and the milk would be of excellent quality.

CONCLUSION

The results from the research done on Holstein-Friesian dairy cows in conditions found on the Maleshevo farm, North Macedonia, focused on the milk production and quality led us to the conclusion that:

- ✓ The milk production in the lactation period of 305 days with the use of a ration (corn silage, lucerne hay, meadow hay, brewery by-product (dry), sugar beet by-product (dry) and concentrate mixture) on the cattle dairy farm AD Maleshevo Berovo, was 8,997.5 kg standard milk and average daily milk production of 29.50 kg.
- ✓ The milk quality had the following chemical content: average percentage of milk fat of 3.99%, 3.11% protein, 4.04% lactose, 8.39% non-fat dry matter, and 12.38% total dry matter.
- ✓ The hygienic correctness of milk had the following content: average amount of total number of somatic cells is 185.000/ml and average amount of total number of microorganisms is 236.000/ml.

As a general conclusion, we can highlight the fact that the cow's milk obtained in the Maleshevo farm in terms of the two investigated parameters (chemical composition and content of total number of somatic cells) fulfills the stipulated criteria for extra class and is of excellent quality, while in terms of the total number of microorganisms belongs to the first class of quality and it is necessary to take a set of hygiene measures in order to improve its microbiological composition.

Table 5 Average amount of total number of microorganisms (x1000/ml) in the milk on the cattle farm AD Maleshevo - Berovo, Maleshevo

Tablica 5. Prosječna količina ukupnoga broja mikroorganizama (x1000/ml) u mlijeku na govedarskoj farmi AD Maleševo - Berovo, Maleševo

Groups Skupine	N	Measures of variations / Mjere varijacije				
		Average value Prosječna vrijednost (X)	Standard error Standarna pogrješka (Sx)	Standard deviation Standarna devijacija (Sd)	Coefficient of variation Koeficijent varijacije (Cv)	Interval of variation Interval varijacije (Iv)
Total number of microorganisms (x1000/ml) in milk Ukupan broj mikroorganizama (x1000/ml) u mlijeku						
I group / I. skupina	15	202	15.07	58.31	28.86	101-275
II group / II. Skupina	15	270	22.24	86.08	31.88	126-380
Both groups – Maleshevo farm Obje skupine – farma Maleševo	30	236	18.65	72.19	30.37	101-380

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SAŽETAK

Istraživanje je provedeno kako bi se utvrdila proizvodnja i kvaliteta mlijeka mliječnih krava holsteinsko-frizijske pasmine na farmi Maleševo u Sjevernoj Makedoniji. U 2023. godini na farmi mliječnih krava AD Maleševo iz Berova, kapaciteta 200 krava, kontrolirano je 30 krava prosječne tjelesne mase od 552,3 kg u laktaciji. Hranidba se sastojala od kukuruzne silaže, sijena lucerne, livadnoga sijena, (suhoga) nusproizvoda pivovare, (suhoga) nusproizvoda šećerne repe i koncentrata kao mješavine. Proizvodnja mlijeka u razdoblju laktacije od 305 dana iznosila je 8.997,5 kg standardnoga mlijeka, s prosječnim dnevnim sadržajem od 29,50 kg i sa sljedećim kemijskim sastavom: prosječan postotak mliječne masti iznosio je 3,99 %; bjelančevine - 3,11 %; laktoza - 4,04 %, nemasna suha tvar - 8,39 % i ukupna suha tvar - 12,38 %. Ukupan broj somatskih stanica u mlijeku bio je 185.000/ml, a ukupan broj mikroorganizama 236.000/ml. Kao opći zaključak iz ovih ispitivanja možemo istaknuti činjenicu da kravlje mlijeko dobiveno na farmi Maleševo ispunjava propisane kriterije za ekstra klasu i izvrsne je kvalitete u pogledu dvaju istraživanih parametara (kemijski sastav i ukupan broj somatskih stanica), dok u pogledu ukupnoga broja mikroorganizama pripada I. klasi kvalitete te je potrebno poduzeti niz higijenskih mjera kako bi se poboljšao njegov mikrobiološki sastav.

Ključne riječi: Holsteinsko-Frižijska pasmina, hranidba, proizvodnja mlijeka, kemijski sastav, somatske stanice, mikroorganizmi