Appreciation of the Mammary Gland Health Status Based on the Quality Traits of Milk Obtained from Friesian - Black Spotted Breed

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Abstract

One of the main objectives in dairy cows exploitation is to guarantee food security and safety of the population, a desideratum achieved through better milk quality and better control of production in all aspects imposed by the health and welfare of animals from which milk is obtained. The purpose of this sciencific paper is to highlight the status of mammary gland health in a population of Friesian- Black Spotted breed based on the main traits of milk quality, with particular reference to somatic cell counts as the main indicator of subclinical mastitis. The research was conducted in 2014 within the farm S.C. "Modern Farm" S.R.L., located in Jucu village. The individual analysis of Holstein Friesian milked cows was performed, the main indicators of milk production were analysed both quantitatively, based on production obtained daily, and especially qualitatively, based on seven controls with individual sampling from all milked cows at the date of control. Qualitative analysis of 1,391 milk samples highlighted the fact that the somatic cell count in milk obtained from cattle included in this study recorded an average value of 390.54 ± 11.16 cells/ml x 10^3 with the variability between controls of 314.94 ± 28.93 and 482.36 ± 91.12 cells/ml x 10^3. Regarding the fat content, the average values was 4.19%, 3.63% for protein content, a pH value of 6.56 and the values of urea was 20.09 mg/dl. Individual analysis also revealed some cows with subclinical mastitis, which were milked separately, verified and monitored supplementarily in order to reestablish udder health and to prevent the occurrence of clinical mastitis, which can compromise the mammary gland.

Keywords: *Friesian breed, mammary gland health, milk quality*

INTRODUCTION

Currently, there is a growing concern among farmers to produce milk that does not just satisfy the quantity desideratum, but above all qualitatively aspects taking into account especially the direct consequences of mammary gland disorders on the profitability of the farm and animal welfare.

Animal health, stable hygiene, personal hygiene, milking area, storage and cooling of milk immediately after milking are all important factors in quality management of raw milk.

Mastitis has been ranked as one of the top diseases for dairy cattle along with reproductive problems, and lameness (Wells *et al.,* 1998), caused by over 100 organisms from a broad phylogenetic spectrum (Rinaldi *et al.,* 2010). Both acute and chronic mastitis results in a dramatic increase in somatic cell count (SCC) in milk (Rinaldi *et al.,* 2010), which plays a protective role against infectious disease (Kehrli and Shuster, 1994).

It is generally accepted that milk production and composition are affected during intramammary infection. Thus, milk quantity is affected negatively, due to physical damage of the epithelial cells (Petrovski and Stefanov, 2006) and, concerning composition, this is associated with altered protein quality, change in fatty acid

composition, lactose, ion and mineral concentration, increased enzymatic activity, and a higher pH of raw milk (Auldist *et al.,* 1996; Coulon *et al.,* 2002; Ogola *et al.,* 2007). These changes in milk composition also lead to quality problems in final dairy products, such as pasteurized milk, yogurt and cheese (Karimi and Taban, 2014).

Quantitative and qualitative monitoring of raw milk is an absolutely crucial factor in the work of improving the productive performance of dairy cows and is also very important for every farmer who would like to achieve economic efficiency at the farm level (Onaciu *et al.,* 2014, Popescu, 2009).

MATERIALS AND METHODS

Based on the studies performed, in this scientific paper we analysed, both quantitatively and especially qualitatively, the main indicators of milk production of Holstein Friesian milked cows bred on the SC "Modern Farm" in Jucu village, to highlight the status of mammary gland health in this population and establish quality, conformity of raw milk and its adequacy for processing.

The methodology consisted in data acquisition concerning daily production obtained and milk quality from control register and analysis bulletins for the year 2014, issued by Floresti, Cluj county.

The main milk quality indicators, such as fat, protein, lactose, pH, urea and somatic cell, were analyzed for 1,391 milk samples, obtained from the seven controls with individual sampling from all milked cows at the date of control. The amount of milk achieved per animal and at the farm level was determined based on a monthly average effective, and quantity of milk obtained and destinated for commercialization or consumption on the farm.

Interpretation of the data obtained was done at the group level, calculating through statistical methods the average and its elements. The data were statistically processed and were interpreted in accordance with the specialised literature.

The animals are kept in stable in a loose housing system with individual space for rest and a 2x12, Italian type fishbone milking parlour.

RESULTS AND DISCUSSION

The main components of milk, such as fat, protein, lactose, and urea, along with somatic cell count are important parameters in appreciation of the mammary gland health status and nutritional aspects of dairy cows.

All the data collected after the analysis of 1,391 milk samples recorded between the 20th of February 2014 and the 14th of November 2014 were used to describe lactation, and milk quality characteristics; to describe milk urea and their link to protein or energy nutrition and to investigate the relationship between somatic cell count and mammary gland health status.

The compositional properties of milk analysis results on seven controls (C1-C7) are presented in Tab. 1.

The chemical characteristics of 1,391 samples showed considerable variations from one control to another. The amount of total fat and protein was found to be within the range of (3.80±0.05)% to (4.49±0.07)%, and (3.44±0.03)% to (3.95±0.04)%, respectively. Regarding the content of urea and somatic cells, in all tested milk samples, the lowest value was found in the first control, with an average of 12.01±0.52 mg/dl and in the seventh control with 314.94±28.93

Tab. 1. Milk composition, milk urea and somatic cell count

Traits	Date of control	No. of samples	Fat (g/100g)	Protein (g/100g)	Lactose (g/100g)	pH	Urea mg/dl	SCC/ml X 10^3
C 1	20.02.2014	185	4.20± 0.05	3.67±0.03	4.82±0.02	6.54±0.01	12.01±0.52	338.78±28.72
C 2	04.04.2014	190	3.92±0.05	3.56±0.04	4.80±0.01	6.61±0.00	15.44±0.47	342.34±29.85
C 3	18.05.2014	224	4.32±0.06	3.54±0.03	4.80±0.01	6.56±0.01	19.53±0.41	389.31±24.99
C 4	30.06.2014	223	4.08±0.04	3.44±0.03	4.72±0.01	6.52±0.01	21.31±0.60	482.36±91.12
C 5	14.08.2014	218	3.80±0.05	3.46±0.03	4.75±0.01	6.59±0.00	31.43±0.59	447.40±29.17
C 6	30.09.2014	173	4.55±0.05	3.79±0.03	4.65±0.01	6.58±0.00	23.31±0.42	398.24±33.30
C 7	14.11.2014	178	4.49±0.07	3.95±0.04	4.62±0.02	6.53±0.00	17.63±0.37	314.94±28.93

cell/mlx10^3, while the highest was in the fifth control (31.43±0.59) mg/dl for urea, and in the fourth control (482.36±91.12) cell/mlx10^3 for the somatic cells.

As concerns the season, it was observed that in the autumn and winter fat and protein recorded the highest values, while the somatic cell count recorded the lowest values (Tab. 2).

Regarding the concentration of milk urea, it was found that it varies among cows, across control periods and seasons of the year.

There is a strong correlation between milk quality parameters and nutrition (especially protein and energy nutrition). Thus, milk urea nitrogen, which indicates the amount of urea found in milk, and which is highly correlated (0.88 to 0.98) with blood urea nitrogen (Biswajit Roy *et al.,* 2011), can be one of the useful tools (Peterson *et al.,* 2004) to detect when major inadequacies in protein or energy nutrition are occurring at the rumen level.

The normal value of blood urea nitrogen in cows is 15 mg/dl (Roseler *et al.,* 1993) and milk urea nitrogen concentration for individual cows ranges from 8 to 25 mg/dl, while the optimum concentration for a herd ranges from 12 to 17 mg/dl (Roseler *et al.,* 1993; Baker *et al.,* 1995; Hwang *et al.,* 2000; Baset *et al.,* 2010). Tab. 3 presents how to interpret milk urea and protein results and which aspects of the diet, referring to energy and protein, must be reviewed.

Tab. 2. Effect of season on milk composition, milk urea and somatic cell count

Traits	No. of samples	Fat (g/100g)	Protein (g/100g)	Lactose (g/100g)	pH	Urea mg/dl	SCC/ml X 10^3
Spring	414	4.13±0.04	3.55±0.02	4.80±0.01	6.59±0.00	17.65±0.32	367.34±19.30
Summer	441	3.94±0.03	3.45±0.02	4.74±0.01	6.56±0.00	26.36±0.49	464.29±21.07
Autumn	351	4.52±0.04	3.87±0.02	4.63±0.01	6.55±0.00	20.43±0.32	355.92±22.10
Winter	185	4.20± 0.05	3.67±0.03	4.82±0.02	6.54±0.01	12.01±0.52	338.78±28.72

Tab. 3. Interpreting basic fodders ration based on stage of lactation, milk urea and milk protein percentage

Stage of lactation	Milk protein %	Milk urea mg/dl	Energy nutrition	Protein nutrition
First 100 days of lactation	< 3.10	< 20	Low	Low
	< 3.10	20-30	Low	Sufficient
	< 3.10	> 30	Low	Excess
	3.10-3.50	< 20	Sufficient	Low
	3.10-3.50	20-30	Sufficient	Sufficient
	3.10-3.50	> 30	Sufficient	Excess
	> 3.50	< 20	Excess	Low
	> 3.50	20-30	Excess	Sufficient
	> 3.50	> 30	Excess	Excess
Mid to late lactation	< 3.20	< 20	Low	Low
(> 100 days)	< 3.20	20-30	Low	Sufficient
	< 3.20	> 30	Low	Excess
	3.20-3.80	< 20	Sufficient	Low
	3.20-3.80	20-30	Sufficient	Sufficient
	3.20-3.80	> 30	Sufficient	Excess
	> 3.80	< 20	Excess	Low
	> 3.80	20-30	Excess	Sufficient
	> 3.80	> 30	Excess	Excess

Source: http://danutrition.ro/

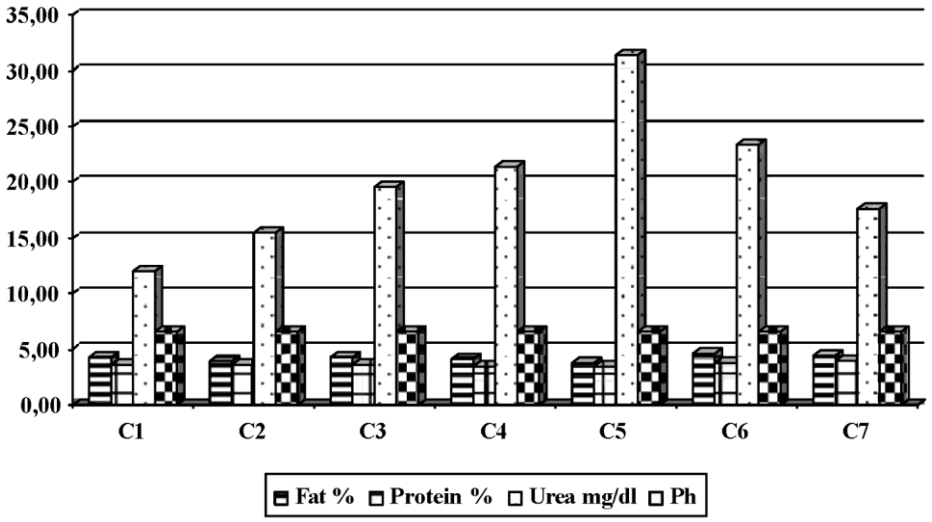

Fig. 1. Milk quality parameters related to the efficiency and quality of dairy cattle nutrition

The feed ration in the case of Holstein Friesian milked cows bred on the SC "Modern Farm" in Jucu is based on corn silage, hay and concentrates.

Interpreting milk urea results and milk protein percentage, obtained from all seven controls (Tab. 1), according to the data in Tab. 3, we can conclude that the basic fodder ration, referring to energy and protein, is in most cases well structured (Fig. 1).

Somatic cells are an important component of milk used in the assessment of quality aspects, hygiene and mastitis control, and which can be used to monitor the level or occurrence of subclinical mastitis in herds or individual cows (Sharma *et al.,* 2011). According to Sharma (2011), high cell-count milk is associated with a decrease in lactose, α- lactalbumin, fat in milk and affects the activity of yogurt fermentation and cheese production.

In order to analyse the status of mammary gland health based on somatic cell count, all 1,391 samples obtained from seven controls were grouped into four classes, as follows: under 100 cell/ml X 10^3, between 101 and 300 cell/ml X 10^3, between 301 and 400 cell/ml X 10^3 and over 400 cell/ml X 10^3 (Tab. 4).

In Table 4, it can be seen that in the first control (C1) of 185 heads examined, even if they were grown and exploited under the same conditions, 58 heads (31%) show an exceptional udder quality, 50 heads (27%) a good quality, 10 heads (5%) a low quality, while 67 heads (36%) are suspected of subclinical and other by clinical mastitis, i.e. animals which had been identified and marked after which they entered advanced surveillance procedure and treatment. These situations regarding udder health assessment are also valid for the C2, C6 and C7 with fluctuations of 3-4% between udder quality groups.

Noteworthy is the increase in the number of animals with udder health problems in the C3 control from May to 40%, along with a decrease of animals from the group with under 100 cell/ml x10^3 by 12% compared with C1 and by 17% compared to C2. In addition, animals with udder health problems were highlighted at the C4 and C5 controls, making up a percentage of 42%, and 40%, respectively of the overall analysed population.

Analyzing all seven controls, with an average effective of 196 heads, it was found that the number of animals covered in the first two groups, totalling an average effective of 100 heads, represents 52% and the percentage of animals with udder health problems is about 36%. Concerning the season, it was observed that in the spring and summer the number of animals suspected of clinical or subclinical mastitis was the highest, while the lowest values were recorded in the winter season (Tab. 5).

Concerning the quantitaty of milk production, in 2014, a production of 16,656.68 hl was found, of which 13,065.08 hl was delivered to processing, 2,515 hl to milk dispensers, and 1,076.60 hl was used on the farm (Tab. 6), returning an average per day of 22.6 l/head/year, 25.37 l/head/total lactation and 27.04 l/head/normal lactation.

Tab. 4. Status of somatic cell count of milk in Holstein Friesian cows

Traits	SCC/ml X 10^3											
	≤ 100 cell			101-300 cell			301- 400 cell			> 400 cell		
	Livestock			Livestock			Livestock			Livestock		
	No. heads	%	$X \pm s_x$	No. heads	%	$X \pm s_x$	No. heads	%	$X \pm s_x$	No. heads	%	$X \pm s_x$
C 1	58	31	52.12±3.04	50	27	182.94±8.44	10	5	342.70±9.86	67	36	807.60±47.88
C 2	69	36	50.49±3.19	46	24	193.20±8.83	11	6	348.73±9.65	64	34	831.95±54.20
C 3	42	19	60.67±3.89	77	34	200.74±5.97	16	7	346.94±6.48	89	40	797.77±37.48
C 4	34	15	52.44±3.66	48	22	182.98±7.65	48	22	355.17±7.78	93	42	810.47±36.52
C 5	52	24	57.48±3.51	48	22	194.19±9.00	31	14	353.62±8.60	87	40	834.17±35.68
C 6	43	25	47.79±3.59	36	21	178.64±10.33	31	18	345.71±6.65	63	36	852.55±52.49
C 7	57	32	51.12±3.00	51	29	189.80±9.52	30	17	344.70±9.71	40	22	842.98±54.13
Average	50	26	52.95±1.29	50	26	190.19±3.14	25	12	348.17±3.00	71	36	823.16±16.47

Tab. 5. The effect of season on somatic cell count and the incidence of clinical mastitis

Traits	SCC/ml X 10^3							
	≤ 100 cell		101-300 cell		301- 400 cell		> 400 cell	
	No. heads	$\bar{X} \pm s_{\bar{x}}$	No. heads	$\bar{X} \pm s_{\bar{x}}$	No. heads	$\bar{X} \pm s_{\bar{x}}$	No. heads	$\bar{X} \pm s_{\bar{x}}$
Spring	111	54.34±2.50	123	197.92±4.97	27	347.67±5.38	153	812.69±31.62
Summer	86	55.49±2.57	96	188.58±5.90	79	354.36±5.71	180	821.93±25.51
Autumn	100	49.69±2.30	87	185.18±7.02	61	345.39±5.40	103	848.43±37.71
Winter	58	52.12±3.04	50	182.94±8.44	10	342.70±9.86	67	807.60±47.88

Tab. 6. The monthly and annual analysis of total milk production produced in the farm

Months	Average milked cows (head)	Quantity of milk/farm (hl)	Milk for processing (hl)	Milk delivered to dispensers (hl)	Farm consumption (hl)	Fat content (%)	Average milk production (litres/head/day)
January	190	1323.54	1023.54	211	89	4.2	22.5
February	200	1404.95	1113.65	201.8	89.5	4.2	25.1
March	215	1483.05	1181.55	209.5	92	4.1	22.3
April	218	1525.7	1220	211.7	94	3.95	23.3
May	220	1486.73	1185.23	209	92.5	3.9	21.8
June	222	1501.6	1201.1	210.5	90	3.9	22.5
July	225	1497.9	1196.4	212	89.5	3.9	21.5
August	224	1404.28	1104.28	210	90	3.9	20.2
September	173	1297.6	997.8	211.8	88	4.1	25.0
October	175	1262.18	963.68	210	88.5	4.2	23.3
November	178	1235.65	937.45	211.2	87	4.2	23.1
December	185	1233.5	940.4	206.5	86.6	4.2	21.5
Total Farm	202	16656.68	13065.08	2515	1076.60	4.06	22.6

The analysis of distribution analysis of age of first calving, the calving interval and service period places about 45% of cows within normal values, while the other females show higher than normal values. At the farm level, the age of first calving is at 28 months, the calving interval has a mean value of 405 days, and the service period is of 119 days.

CONCLUSION

The main factors contributing to profit in dairy farms are nutrition, quantity and quality of milk and cattle reproduction, which are closely correlated.

The major factor affecting somatic cell count in the herd and in individual cows is the presence of intramammary infections, leading to a decrease in both the quality and the quantity of the milk obtained.

By analysing individuals, cows with subclinical mastitis have been identified, they were milked separately, verified and monitored supplementarily in order to remediate udder health and also to prevent clinical mastitis, which can compromise mammary gland.

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