Scientific Papers. Series D. Animal Science. Vol. LXVII, No. 2, 2024
ISSN 2285-5750; ISSN CD-ROM 2285-5769; ISSN Online 2393-2260; ISSN-L 2285-5750

RESEARCH ON THE INCIDENCE OF MASTITIS AND ITS INFLUENCE ON MILK PRODUCTION IN A HERD OF CATTLE

Vasile MACIUC

"Ion Ionescu de la Brad" Iasi University of Life Sciences, 3 Mihail Sadoveanu Alley, 700490, Iaşi, Romania

Corresponding author emails: vmaciuc@uaiasi.ro, vmaciuc@yahoo.fr

Abstract

The purpose of this work was to study the incidence of mastitis and its influence on quantitative and qualitative milk production. The biological material was represented by two groups of lactating cows: healthy cows (40 heads) and sick cows (9 heads). The obtained data were systematized and processed statistically. In the conducted study, three types of mastitis were highlighted: serous, catarrhal and purulent. The percentage of 18% of cases of mastitis in total population studied, the catarrhal form predominated with 8%, the serous form with 6% and the purulent one with 4%. Average milk production was 4526.05 kg in healthy cows, compared to sick cows in which milk production was 2251.44 kg and the statistically significant difference for p<0.01 it was of 2274.61 kg of milk. Fat and protein content in sick cows case was also reduced, respectively 2.68% for fat and 2.58% for protein. Improving the rearing system, maintaining hygiene in the barn and especially respecting the hygiene of the udder are some of the measures that must be adopted to be able to avoid such unpleasant situations.

Key words*: cows, incidence, mastitis, milk, quantity, quality.*

INTRODUCTION

Inflammatory diseases of the udder occur in cows following microtraumas and/or neglect of hygiene rules during milking. Mastitis is an inflammation of the udder, as a result of a bacterial infection and it can alter a teat, a quarter or the entire udder. The symptoms of the disease are: temperature rise; the appearance of edema; redness of the udder; purulent and bloody discharge of milk from the teats (Berry et al., 2002; Dohoo et al., 2011; Hayes et al., 2001).

There are two types of mastitis in cows: caused by environmental microbes and contagious, caused by Streptococcus agalactiae and Staphylococcus aureus. Both forms cause productive and economic losses. Depending on the manifestation, mastitis is divided into clinical and subclinical form, the latter being symptomless. Detection of mastitis can be done based on external signs and clinical studies. The more highly productive females are, the greater the pressure of infectious agents on the female genital system and the mammary gland (Barkema et al., 1998; Maciuc et al., 2017; Maciuc & Radu-Rusu, 2018; Vidu et al., 2015).

Clinical mastitis can reach an incidence between 13% and 40%, and the economic repercussions can exceed $1000/year in certain countries. Annually, in the United States of America, losses due to cow mastitis exceed 2 billion dollars. At the level of our country, financial losses can reach 200 euros/year/cow with mastitis (Lago et al., 2011a; Lago et al., 2011b; Makovec & Ruegg, 2003; Onaciu et al, 2019; Pantoja et al., 2003).

Ensuring a clean and dry environment is essential for mastitis control because not only milking is a key point but also the times when females can come into contact with moisture, mud and dung so all staff involved in cows care have responsibilities related to reducing the risk of production of mastitis. The evacuation of manure, the type of bedding and keeping the rest areas clean have a major impact on the hygiene of the cows and especially the udders. The study by Barkema et al. (1998) demonstrated that farms where the NCS in the tank is high are deficient in terms of hygiene compared to those where this aspect is well managed. For example, 31% of farms where NCS was greater than 250,000 cells/ml were characterized by a dirty milking parlor compared to 15% of herds where tank NCS was below 150,000 cells/ml. Farms where NCS was greater than 250,000 cells/ml also had more shelters containing more than

10% dung, shelters cleaned less frequently (1.6 vs. 2.2 times per day) and poorer litter use in shelter (Maciuc et al., 2015; Roberson, 2003; Rodrigues et al., 2005; Schutz et al., 2014; Steenveld et al., 2011). Hence, the need for studies on the incidence of mastitis and their influence on milk production in dairy cow farm.

MATERIALS AND METHODS

The analyzed biological material was represented by two groups of cows in lactation wich belonging to the Holstein Friesian breed, respectively from healthy cows (40 heads) and sick cows (9 heads), so 49 heads in total. In our study we considered several objectives such as: the study of the technological flow on the farm, the milking technology on the farm, incidence of diseases on the farm, incidence of mastitis in the analyzed herd, the study of the quantitative and qualitative productive performances according to the health status of cows, the symptomatology, treatment and prevention actions of mastitis in the farm.

The data resulting from observations and direct determinations on the farm as well as from the primary data of the farm, but also from the records of the Official Production Control (COP) carried out by the Cattle Breeders Association, were systematized and statistically processed using the following computer programs: SAVC (Statistics Analysis of Variance and Covariance) respectively SPSS 16.00 for WINDOWS. Statistics are written with Latin letters: arithmetic mean ($\overline{X}$), variance (s^2), standard deviation (s), and parameters with Greek letters: theoretical mean (μ), variance ($ó^2$) and standard deviation (ó) [3; 8; 10].

For this purpose, the computer program SAVC was used to determine the arithmetic mean ($\overline{X}$), the error of the arithmetic mean ($\pm s_{\bar{x}}$), the standard deviation (s), the Fisher test and Tukey, and SPSS 16.00 for WINDOWS to determine the frequency, Chi-Square Tests, ANOVA Test, Significance test p. and confidence interval (C.I.)

The statistical test is a decision method that helps us to validate or invalidate with a certain degree of certainty a statistical hypothesis:

- hypothesis H_0 (or null hypothesis): the data are not related, they are independent/the compared values do not differ from each other;
- hypothesis H_1 (or alternative hypothesis): the data are related to each other, are dependent/the compared values differ from each other.

The result p of the test, given as a number between 0 and 1, represents the probability of making an error if we reject the hypothesis H_0. If p is lower than the significance threshold α chosen - usually α= 0.05 - we reject the hypothesis H_0 and accept as true the hypothesis H_1 (Cucu et al., 2004; Maciuc et al., 2015; Maciuc & Radu-Rusu, 2018).

The interpretation of p values is done in most statistical tests as follows:

- $p < 0.05$, the relationship is statistically significant (S, 95% confidence);
- $p < 0.01$, the relationship is statistically significant (S, 99% confidence);
- $p < 0.001$, the statistical link is highly significant (HS, confidence 99.9%);
- $p > 0.05$, the relationship is statistically insignificant (NS).

The ANOVA test compares the means of several samples at the same time.

H_0: m1 = m2 = m3 = m4 (for 4 samples)

H_1: at least two means differ significantly

The result is a number p which is interpreted in the same way as the other tests:

- If p>0.05, H0 is not rejected, the difference is insignificant at the 95% significance threshold;
- If p<0.05, H0 is rejected with a significance threshold of 95%. At least two means differ significantly;
- If p<0.01, H0 is rejected with a significance threshold of 99%. At least two means differ significantly;
- If p<0.001, H0 is rejected with a significance threshold of 99.9%. At least two means differ highly significantly.

The Fischer test (F) is used to verify the equality of dispersions of two normally distributed independent variables. The null hypothesis is H_0: σ12=σ22

The Tukey test is the most commonly used multiple comparison procedure, also called the honest significant difference test, usually used in conjunction with ANOVA statistical models.

When the null hypothesis of the F-test in the analysis of variance is rejected, it is of interest to determine what led to this rejection: which means cannot be considered equal. Multiple comparison techniques also appear, because

sequences of comparisons of two means cannot be controlled, as far as the significance threshold is concerned. The Tukey method simultaneously tests all differences between pairs of means to determine if at least one is significantly different from zero.
The Tukey-Kramer test is very similar to the Kramer method for equal groups, but the denominator differs slightly. The formula for calculating Q using Tukey-Kramer is:

$$Q = \frac{M_i - M_j}{\sqrt{MS_{int\ ra} * \left(\frac{\frac{1}{n_i} + \frac{1}{n_j}}{2} \right)}}$$

Where: n_i and n_j represent the number of subjects in the compared groups, and M_i and M_j are the averages of these groups.
The number of degrees of freedom is established similar to the Tukey method. The first degree of freedom is k (the number of groups of the experiment) and the second is N-k (df for intragroup dispersion).

RESULTS AND DISCUSSIONS

The exploitation system of cows in the studied farm is that of free stables one, with the capacity to raise 50 dairy cows (Figure 1).
The cow shelter has the appearance of the letter "L", extended over 526 m^2. The height regime of the shelter is of the "ground floor" type, with dimensions of 32.87 x 14.03 m in plan, in length and 9.75 x 6.65 m, in width. This positioning allows ensuring a favorable microclimate for housing and exploitation of dairy cows.
The floor is made of road concrete, with a thickness of 15 cm and of ballast with a thickness of 10 cm. Inside, the stands are arranged frontally in two rows (Figure 1) and are 2.20 m long and 1.2 m wide.
The stands have a floor made of rubber carpets, 2 cm thick, placed directly on the reinforced concrete. The rubber bedding had superficial striations with an anti-slip role, which ensure a complete draining of liquids (under and above the bedding). The floor of the stand has a drainage slope in the first two thirds of 1% and in the last third of 2%.
The movement alley is located in front of the feed front and between the rows of resting beds, it is 3.00 m wide and has a drainage slope (2%) for liquid manure. The alley has margins that keep vehicles on the traffic side. The feeding front is individualized and equipped with a continuous metal frame, set back 10-20 cm from the edge of the manger. It presents pillars at intervals of one or two stands, reinforced by stand separating bars.

Figure 1 The livelihood system applied in the studied farm (original photo)

The feed lane is used by the farmer to distribute forage. It is 4 m wide, and the floor is made of reinforced concrete (10 cm thick), with a wear layer of rolled cement (2 cm thick). At a height of 10-15 cm, between the floor and the wall plinths are made.
The manure is removed with a scraper plow that works in the area of their movement.
The farm has a fodder park on an area of 110.01 m^2 which is supplied with bales of alfalfa and of hay and with corn silos. Feeding of the cows is done with a technological trailer.
The milking parlor is equipped with a fish-type installation (2 x 4), located near the dairy, a space intended for taking over and cooling the milk. From here, the quantitative and qualitative evaluation of the milk is done, then it is delivered to the processing company.
The cases of diseases found in the farm under study were mastitis and laminitis.
From the group of mastitis, the most frequent were:
- serous mastitis manifested by swelling of the affected part of the udder; low productive level; the milk from the affected quarter has a more liquid consistency and often changed in color. The local temperature is increased and after

milking the edema decreases. The lymph nodes are enlarged;

- catarrhal mastitis in which the general condition of the animal is normal. Production drops insignificantly. If the catarrh persists in the galactophorous ducts, casein clots are observed in the milk at the beginning of milking. If the glandular acini (alveoli) are affected, clots appear at the end of milking. The local temperature is increased. On palpation at the base of the teats it can be detected induration of the size of a pea;

- purulent mastitis is manifested by the depressed condition of the cow; limps and does not chew the cud. Body temperature exceeds 40°C. There is no milk in the affected quarter. The lymph nodes are enlarged.

From the pododermatitis group, the following persisted:

- aseptic pododermatitis manifested by serous, serous-hemorrhagic or serous-fibrous inflammation of the hoof skin;

- purulent pododermatitis is a purulent inflammatory process of the base of the hoof skin of an individual. It develops as a complication after aseptic pododermatitis and also occurs with cracks, wounds, folds of the horn of the hoof wall.

Table 1 and Figure 2 show the cases of disease found on the farm, the incidence of diseases and mastitis in the herd of cows studied and we note that the percentage of healthy cows in herd was only 53%.

From the laminitis group, the aseptic form represented 17% of the total followed by the purulent form 12%. From the group of mastitis, the catarrhal form predominated, with 8%, then the serous form, with 6% and the purulent form, with 4%.

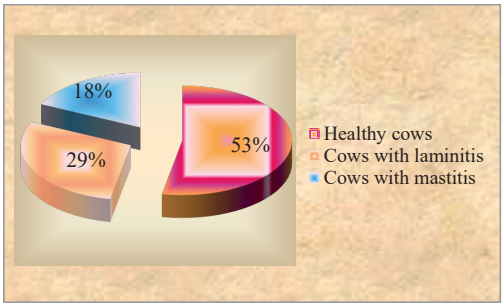

Figure 2. Graphical representation of diseases in the studied herd

Table 1. Incidence of diseases in the farm

Total herd (head)	Healthy cows		Cows with laminitis				Cows with mastitis					
	heads	%	aseptic		purulent		serous		catarrhal		purulent	
			head	%	head	%	head	%	head	%	head	%
49	26	53	8	17	6	12	3	6	4	8	2	4

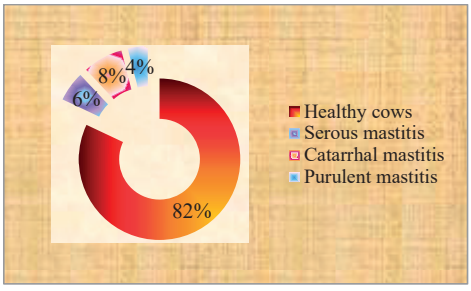

Figure 3 The incidence of mastitis in the studied farm

In the studied farm, three types of mastitis were encountered: serous, catarrhal and purulent. From Table 2 and Figure 3 it is highlighted that from total herd, 18% are cases of mastitis, of which the catarrhal form predominated, with 8%, then the serous form, with 6% and the purulent one, with 4%.

Table 2. The incidence of mastitis in the studied farm

Total herd (heads)	Healthy cows		Cows with mastitis					
	heads	%	serous		catarrhal		purulent	
			heads	%	heads	%	heads	%
49	40	82	3	6	4	8	2	4

The productive level for the groups of healthy and sick cows was analyzed during a single lactation (total and normal), the mean values of the analyzed indicators being presented in

Tables 3 and 4. The monitored characters were: the duration of lactation (days), the amount of milk (kg) age of first calving (months) and service period (days). Regarding the milk quality, two characters were analyzed, fat and protein (percentage and quantity). The duration of lactation character recorded in first total lactation, for healthy cows, an average of 473.48 days with variations between 366 days and a maximum of 713 days. For the group of sick cows, the duration of lactation was on average 268.44 days, with variations between 195 days and 328 days, significantly reduced lactation for $p< 0.01$, C.I. = 95%, compared to healthy cows. In normal first lactation, the group of healthy cows recorded an average duration of lactation of 304.65 days, but in sick cows, the mean was only 265.33 days, with variations between 195 and 305 days.

Table 3. Statistics of milk production in the herd studied with healthy animals

Lactation	Traits	n	$\overline{X}$	$\pm s_{\bar{x}}$	s	V%	Minim	Maxim
First total lactation	Length of lactation (days)	40	473.48	12.44	78.70	16.62	366	713
	Milk production (kg)	40	5766.18	192.63	1118.29	19.12	3375	7919
	Fat, %	40	4.05	0.04	0.29	7.37	3.38	4.71
	Fat (kg)	40	234.23	8.65	54.72	23.36	114.08	345.2
	Protein, %	40	3.63	0.02	0.12	3.51	3.45	4.00
	Protein (kg)	40	209.48	7.16	45.28	19.62	122.18	306.78
First standard lactation	Length of lactation (days)	40	304.65	0.17	1.12	0.36	300	305.00
	Milk production (kg)	40	4526.05	153.15	968.64	19.40	1879	8207
	Fat, %	40	4.06	0.05	0.32	7.91	3.6	4.9
	Fat (kg)	40	183.77	6.94	43.88	19.88	80.8	344.69
	Protein, %	40	3.17	0.02	0.17	5.42	3.00	3.83
	Protein (kg)	40	142.98	4.65	29.44	19.59	63.89	251.95
	A.F.C. (months)	40	26.43	0.19	1.24	4.68	23.55	29.00
	S.P. (days)	40	68.7	2.18	13.81	20.10	25.00	89.00

AFC: age of the first calving; SP: service period

Table 4. Statistics of milk production in the herd studied with sick animals

Lactation	Traits	n	$\overline{X}$	$\pm s_{\bar{x}}$	s	V%	Min	Max
First total lactation	Length of lactation (days)	9	268.44	16.66	50.00	18.62	195	328
	Milk production (kg)	9	2331.89	100.80	302.40	12.96	1865	2684
	Fat, %	9	2.82	0.10	0.31	11.31	2.33	3.28
	Fat (kg)	9	65.74	4.02	12.06	18.35	47.86	88.04
	Protein, %	9	2.55	0.14	0.43	16.94	2.04	3.3
	Protein (kg)	9	60.72	5.24	15.73	21.91	41.96	87.48
First standard lactation	Length of lactation (days)	9	265.33	15.50	46.51	17.53	195	305
	Milk production (kg)	9	2251.44	159.47	478.42	17.25	1604	2956
	Fat, %	9	2.68	0.07	0.23	8.79	2.33	2.98
	Fat (kg)	9	59.99	4.27	12.82	19.38	44.27	80.58
	Protein, %	9	2.59	0.16	0.50	19.53	2.04	3.28
	Protein (kg)	9	57.62	4.93	14.81	21.70	36.89	80.85
	A.F.C. (months)	9	26	0.38	1.16	4.46	23.99	27.5
	S.P. (days)	9	105.22	1.70	5.11	4.86	96	110

The average production of milk per total lactation for the group of healthy cows (Table 3) was 5766.18 kg of milk in the first total lactation (variations being between 3375 and 7919 kg),

and for the group of sick cows (Table 4), the average production of milk was 2331.89 kg in first total lactation and 2251.44 kg of milk in first standard lactation (305 days) with variations between 1604 kg and 2956 kg. The variability of the milk quantity character, for both groups of cows, healthy and sick, had average values (17-19%).

Statistically, the differences in the mean values for the milk quantity trait in the Fisher test was very significant, and the Tukey Test shows us a very significant difference of the means between the two lots of 2274.61 kg of milk (C.I = 95%).

Regarding the fat percentage and protein percentage traits for the group of healthy cows, the average values were 4.05-4.06% for fat % and 3.63-3.17%, for protein %. In the group with sick cows, the average of traits had values between 2.68 - 2.82%, and for proteins, the average values were within the limits of 2.55-2.59%.

About the quantity of proteins, the mean of the group with healthy cows was between 142.98-209.48 kg, compared to the mean values of 57.62-60.72 kg for sick cows.

In parallel with the analysis of the productive level, emphasis was also placed on two reproductive indicators, namely the age of the first calving (AFC) and the service period (SP).

Thus, in the group of healthy cows, the mean of AFC was 26.43 months (with variations between 23.55 and 29 months), compared to 26.00 months (with variations between 23.99 and 27.5 months), in sick cows.

The duration of the SP was 68.7 days in healthy cows (with variations between 25 and 89 days), compared to 105.22 days in sick cows, with variations between 96 and 110 days.

In Tables 5 and 6 we present the main indicators for milk quality in the two batches of cows studied, respectively healthy cows and sick cows.

Table 5. Statistics for qualitative indicators of milk production in healthy cows

Traits	n	$\overline{X}$	$\pm s_{\bar{x}}$	s	V%	Minim	Maxim
NSC (ml x 1000)	40	286.65	10.977	69.426	24.22	140	430
Fat, %	40	3.94	0.012	0.075	2.157	3.37	3.84
Protein, %	40	3.38	0.015	0.095	2.809	3.25	3.61
Lactose, %	40	4.11	0.038	0.241	5.874	3.88	4.58
SUT, %	40	11.93	0.233	1.472	15.293	9.9	14.3
Urea (mg/dl)	40	13.5	0.184	1.166	8.638	12.25	16
Caseink, %	40	29.82	0.22	1.389	4.659	24.37	32.3
Daily milk production (kg)	40	14.57	0.268	1.693	11.617	10.8	18.3

Table 6. Statistics for qualitative indicators of milk production in sick cows

Traits	n	$\overline{X}$	$\pm s_{\bar{x}}$	s	V%	Minim	Maxim
NSC (ml x 1000)	9	568.44	38.738	116.214	20.444	420	793
Fat, %	9	3.45	0.091	0.274	8.699	2.76	3.65
Protein, %	9	2.91	0.123	0.368	12.627	2.3	3.28
Lactose, %	9	4.53	0.046	0.137	3.012	4.26	4.7
SUT, %	9	9.98	0.019	0.057	0.638	8.93	10.06
Urea (mg/dl)	9	10.88	0.224	0.671	6.165	10	11.86
Casein, %	9	26.78	0.156	0.468	1.628	28.1	29.3
Daily milk production (kg)	9	7.88	0.467	1.401	17.773	5.65	9.58

From the tables with the centralized results, we find that the mean value of the somatic cell count, the indicator that indicates the health of the udder and the quality of the milk, was 286.65 ml x 1000 in healthy cows compared to 568.44 ml x 1000 in sick cows, the difference between the two groups being highly significant for $p < 0.01$ and CI = 95%. Significant differences for p

< 0.05, C.I. = 95%, we also found in the fat and protein content of the milk, in the two groups of cows studied. Accordingly, I found at SUT respectively the casein from milk for healthy and sick cows.
In Figures 4 and 5 it is present the regression line for protein and lactose, respectively the number of somatic cells (NSC) and milk casein.

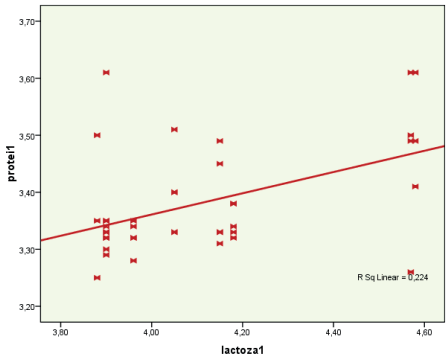

Figure 4. Regression line for protein and lactose

The upward evolution of the regression line indicates a positive evolution of the analyzed indicators, with a low intensity of 20-22% (0.20-0.22). A high protein content in milk will cause more lactose in milk and vice versa. Lactose is a type of natural sugar found in milk and milk products and it is a disaccharide consisting of two sugar molecules - glucose and galactose - which are linked by a beta-glycosidic bond.

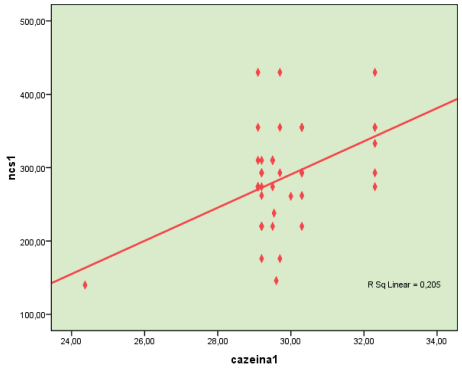

Figure 5. Regression line for NSC and casein

Casein is a complex protein found in milk. This is the protein with the highest presence in milk, representing 80% of the total proteins in its composition. Problems arise when for unknown reasons the immune system identifies casein as harmful. Thus, when it "identifies" the presence of casein in the body, the immune system activates specific antibodies, type E immunoglobulins or IgE, releasing histamine, a substance that causes tissue inflammation.
In Figure 4 we find that the number of somatic cells influences the casein content of milk by 0.20 or 20%. The evolution of the regression line is upward, and the connection between the two studied indicators is positive.

CONCLUSIONS

Following the study on the incidence of diseases and mastitis in a herd of cows and the influence on milk production, we can conclude:
1. Diseases and mastitis influence milk production both quantitatively and qualitatively, causing great problems in dairy farms. The EU regulations do not exclude from processing and consumption the milk of subclinical udders but the abnormal milk detected during the individual test milking done by the milker and the non-compliant milk (the merged one), i.e. the one whose NSC and NTG exceed 400,000/ml and 100,000/ml respectively, because it includes a large percentage of milk with mastitis.
2. Dry period allows the intramammary epithelium to regenerate so that when lactation begins again, milk production is optimal. It is required for the udder a rest period of at least 40 days to achieve optimal milk production. Therapy during the dry period reduces the risk of new "environmental" infections, especially in cows with a history of mastitis or high NSC.
3. Ensuring a optimal microclimate in the barn and in the pasture, a clean and dry bedding that limits the grafting of germs on the teats, correct milking regardless of the rearing system, the application of prophylactic procedures before and after milking, the isolation or exclusion of females with forms severe of mastitis, periodic screening of milking parlor parameters, periodic screening of milk quality, the application of targeted therapies on the pathogenic germ causing the disease, represent the main measures that must be adopted in dairy farms to prevent the spread of mastitis and the problems that arise due to this disease.

REFERENCES

Barkema, H. W., Schukken, Y. H., Lam, T.J., Beoboer, M.L., Benedictus, G., & Brand, A. (1998). Management practices associated with low, medium and high somatic cell counts in bulk milk. *Journal of Dairy Science*, 81, 1917-1927.

Berry, E. A., & Hillerton, J.E. (2002). The effect of an intramammary teat seal on new intramammary infections. *Journal of Dairy Science*, 85, 2512-2520.

Cucu, G. I, Maciuc, V., & Maciuc, D. (2004). *Scientific research and elements of experimental technique in animal husbandry.* Iași, RO: Alfa Publishing House.

Dohoo, I. R., Smith, J., Andersen, S., Kelton, D.F., & Godden, S. (2011). Diagnosing intramammary infections: Evaluation of definitions based on a single milk sample. *J. Dairy Sci*., 94, 250-261.

Hayes, M. C., Ralyea, R. D., Murphy, S. C., Carey, N. R., Scarlett, J. M., & Boor, K. J. (2001). Identification and characterization of elevated microbial counts in bulk tank raw milk. *Journal of Dairy Science*, 84, 292-298.

Lago, A., Godden, S.M., Bey, R., Ruegg, P.L., & Leslie, K. (2011a). The selective treatment of clinical mastitis based on on-farm culture results: I. Effects on antibiotic use, milk withholding tine, and short-term clinical and bacteriological outcomes. *J. Dairy Sci.,* 94, 4441-4456.

Lago, A., Godden, S. M., Bey, R., Ruegg, P. L., & Leslie, K. (2011b). The selective treatment of clinical mastitis based on on-farm culture results: II. Effects on lactation performance, including clinical mastitis recurrence, somatic cell count, milk production and cow survival. *J. Dairy Sci.,* 94, 4457-4467

Maciuc, V., Creangă, Ș., Maciuc, D., & Vidu, L. (2015). A new software program for data management in dairy farms "ST26733". *International Conference "Agriculture for Life, Life for Agriculture". Agriculture and Agricultural Science Proceedings, 6*, 226–232.

Maciuc, V., Radu-Rusu, C.G., Popescu, C. E., & Radu-Rusu, R. M. (2017). Influence of season and cows farming system on milk physical, chemical and hygienic traits. *Romanian Biotechnological Letter*, 22 (6), 13096.

Maciuc, V., & Radu-Rusu, R.M. (2018). Assessment of Gray steppe cattle genetic and phenotypic traits as valuable resources in preserving biodiversity. *Environmental engineering and management Journal*, 17 (11), 2741-2748.

Makovec, J. A., & Ruegg, P.L. (2003). Characteristics of milk samples submitted for microbiological examination in Wisconsin from 1994 to 2001. *Journal of Dairy Science,* 86, 3466-3472.

Onaciu, G., Jurco, E., Jurco, S., Maciuc, V., & Ognean, L. (2019). Influence of varying milk urea nitrogen on chemical, hygienic and physical traits of cow milk. *Romanian Biotechnological Letter*, 24 (5), 866-873.

Pantoja, J. C. F., Hulland, C., & Ruegg, P.L. (2009). Somatic cell count across the dry period as a risk factor for the development of clinical mastitis in subsequent lactations. *Journal of Dairy Science*, 92, 139-148.

Roberson, J.R. (2003). Establishing treatment protocols for clinical mastitis. *Vet. Clin. North. Am. Food Anim. Pract*., 19, 223-234.

Rodrigues, A. C. O., Caraviello, D. Z., & Ruegg, P. L. (2005). Management of Wisconsin dairy herds enrolled in milk quality teams. *Journal of Dairy Science*, 88, 2660-2751.

Schutz, M. M., Maciuc, V., Gay, K., & Nennich, T. (2014). *Cattle husbandry in Eastern Europe and China*. Wageningen, ND: Wageningen Academic Publishers, EAAP 135.

Steenveld, W., van Werven, T., Barkema, H. W., & Hogeveen, H. (2011). Cow-specific treatment of clinical mastitis: An economic approach. *J. Dairy Sci.,* 94, 174-188.

Vidu, L., Chelmu, S. S., Băcilă, V., & Maciuc, V. (2015). The content of minerals and fatty acids in buffalo milk, depending on the rank of lactation. *Romanian Biotechnological Letter*, 20 (1), 10076-10084.