Original Scientific paper
10.7251/AGREN2402115B
UDC 636.2:637.1

RELATIONSHIP BETWEEN CERTAIN ANIMAL WELFAR PARAMETERS AND THE PHYSICO-CHEMICAL AND MICROBIOLOGICAL QUALITY OF MILK

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ABSTRACT

In Algeria, dairy farms face a major problem related to poor management of animal welfare, which leads to a decline in milk production in terms of quality and quantity. The objective of this study was to verify whether there is a link between animal welfare parameters and milk quality. The experiment was carried out at two dairy farms in the wilaya of Chlef on a staff of 30 dairy cows of Prim Holstein and Montbéliard breed. These females were followed after calving by sampling milk and evaluating mastication index, rumen filling, dung consistency and udder cleanliness at day 7 and day 14. Milk samples were transported in a cooler for physicochemical analysis by measuring fat, total dry extract, degreased dry matter, pH, titratable acidity, density, conductivity and acidity of fat. The isolation of coliforms was carried out to verify the hygienic quality of milk. The results showed that with a cleanliness score equal to (2,33 ; 2,4) during the cold and hot season respectively the hygienic quality of the milk was unsatisfactory with a conductivity of (7,75 ; 7,40) and number of coliform was (8,01- 8,86) $\times 10^3$ UFC respectively with a $p>0,05$. The observed fluctuation in fat, total dry extract and degreased dry matter during the first and second week of the parturition at the rate of [(33,04; 24,14); (125; 120); (88,43; 85,76)] g/l with $p<0,05$ respectively was caused by subclinical mastitis thus excluding the dietary cause. Because the index of mastication, the filling of the rumen and the consistency of dung were in the range of the usual values at the rate of (52,82) m/min; (3); (3,4) respectively as well as the acidity of the fat at the rate of (0,48; 0,55) respectively with a $p>0,05$. In conclusion, the origin of subclinical mastitis was the poor hygienic condition of the udder, which led to contamination of the milk by coliform bacteria, resulting in a decrease in the physicochemical quality of the milk.

Key words: *conductivity, milk quality, season, subclinical mastitis.*

INTRODUCTION

Production diseases in high-producing dairy cows occur primarily in early lactation. This diversion in metabolism promotes the development of associated pathologies (metritis, mastitis, fertility disorders, etc.) thus decreasing the performance of animals. So the economic impact of these diseases is not negligible especially to achieve the goal of one calf per cow per year. Calving is considered a state of stress (ill-being) for the dairy cow and is related to an energy balance that is at its lowest level the week following the share, thus, biologically speaking this situation will generate a response from this organism to be able to live in better conditions. (Bouhroum et al., 2013). Stress reactions consume energy and weaken the body on several levels, threatening animal welfare and production and reproduction. (Bouhroum et al., 2014) To increase milk production in Algeria it is necessary to ensure well-being around calving by playing on the comfort level of the calving area, the psychological, physiological, behavioral and health level. (Bouhroum et al., 2022) We noticed in the field that the breeder is a main stressor, because he does not control well the management of animal welfare, for him the animal is used for his product and for his work force. The animal is considered in this materialistic conception as a being without sensitivity, which can therefore be subjected to any constraint without suffering. (Fraser, 2011) The objective of the study is to assess the welfare of dairy cows using peripheral indicators and in parallel to analyze the hygienic and physicochemical quality of milk to deduce the relationship between them.

MATERIAL AND METHODS

Our study was carried out during the month of July 2023 until May 2024, at the level of two dairy farms in the wilaya of Chlef on a staff of 30 cows of Prim Holstein and Montbéliard breed. These cows were followed at day 7 and day 14 after calving in order to collecte milk for physicochemical and microbiological analysis and to determine certain animal welfare parameters such as:

- Mastication index based on the method of (Denwood et al., 2018).
- Dung consistency based on the method (Guedon., 2017).
- Rumen filling using the method of (Burfeind et al., 2010).
- Udder cleanliness scoring was done using a scoring grid from Lensink et al., in (2012), cows with score 1 are considered “very clean” while cows with score 5 are considered “very dirty”.

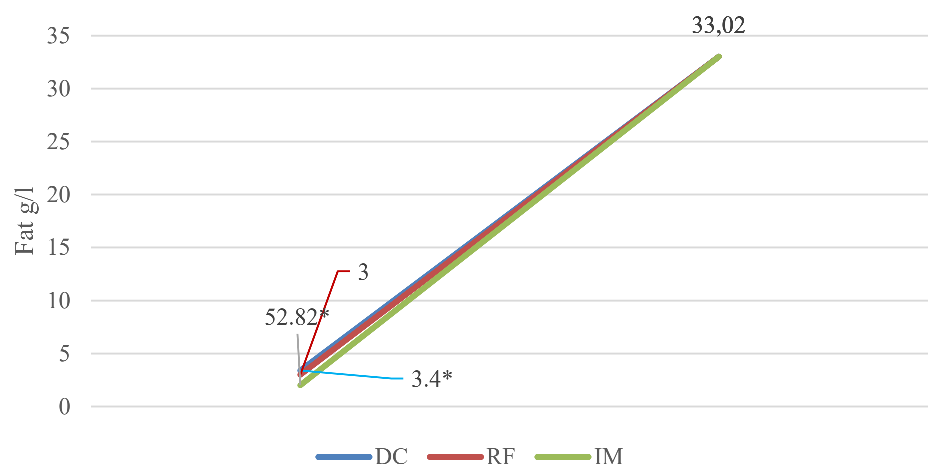
The pH of the milk was measured at 20°C with a pH meter type (HANNA Instruments), The acidity was measured by titrating with a NaOH solution. Ten ml of raw milk was taken and poured into a beaker to add three to four drops of phenolphthalein and the mixture was homogenized. The 0.1N NaOH solution was added by drip until the color turn to pink at room temperature to titrate. Density was determined at 35 to 20°C using a thermo lactodensimeter using the Maiworé et al., method in (2018). Fat was determined using an acido-butyrometric method called GERBER. (Koceir, 2010). The total dry extract content is the product of evaporation in a water bath at 70°C and drying of the sample (10 ml) in the oven for 3 hours at 105 ± 2°C. The degreased dry extract was obtained by the following formula : ESD (g/l) = EST-MG (EST = total dry extract; MG = fat). The electrical conductivity of the sampled milk was measured using a conductivity meter (EC 215, Hanna Instruments). Free acidity of fat was determined using the BDI method of (Evers, 2003). Isolation of coliforms was performed on desoxycholate agar. Statistical analysis was performed by the SPSS software using the student test.

RESULTS AND DISCUSSION

Milk fat

At the level of Table 1, the milk fat is high during the first week of post partum at a value of 33.04 g/l compared to the value of the second week of post partum at a value of 25.14 g/l with a $p<0.05$. By comparing our results with other studies on the same parameter using the same Gerber method. We can say that our results are lower than the result found by (Hamidi et al., 2020) who obtained a rate of (41 g/l), and that of (Zoghlami et al 2022). Our fat results in the first week range from 25.14 g/l (Tir et al., 2015) to 37g/l (Siboukeur et al., 2012). While those of the second week are very low compared to a good quality milk that must have a rate of 35g/ l of fat with a minimum tolerated limit of 27g/ L (Amroun and Hadjab, 2021). This difference in the results is probably related to the forage content and the nature of the fibres of the concentrates used in the dairy rations. A diet rich in cellulose that produces acetic acid promotes an increase in milk fat (Cauty and Perreau, 2009). But according to the acidity of the fat during the first week and the second week of the post partum which is equal to (0.486, 0.553) respectively with a $p>0.05$. It was noted that there is a de novo synthesis of carbon-number fatty acid between (10-12) according to (Deeth et al., 1975) at the level of the udder which means that the cause of the fall in fat is not food, because milk fatty acids come from two very distinct sources (food and from the mobilization of fat reserves) and the length of the carbon chain indicates their origin.

Figure 1:Fat according to dung consistency, rumen filling and mastication index



The mammary gland produces fatty acids with a carbon chain limited to 14 carbon atoms and this synthesis mainly uses acetate and butyrate as substrate. These two dietary compound will be extracted from the bloodstream and lengthened by sequential addition of two carbon atoms to form a variety of short and medium chain fatty acids (Enjalbert, 2016). This means that the origin of this decrease is not food and this is also confirmed by the parameters of animal welfare (IM, CB, RR) which is found in the standards at values of (52.82; 3.4; 3) respectively for a fat of 33.02 g/l. (Figure 1) Other factors can significantly influence milk fat such as lactation stage (Legarto et al., 2014), Total milk production follows an inverse evolution of milk fat concentration (Kaouche-Adjlane, 2019). Indeed our results showed a fall in fat around the third week of the post parum.

Total dry extract

We observe at the level of Table 1 that the total dry extract is higher during the 1st week of the post partum compared to the 2nd week at a value (124.93; 120.36) g/l respectively with a $p<0.05$ and it is found in the range of the usual value. This value is between (87.49 and 128) g/l indicated by (Tir et al., 2015; Siboukeur et al., 2012) respectively. This content means that the milk studied has not been diluted (Tir et al., 2015) effectively the density found in the milk sampled confirms this.

Degreased dry matter

Table 1 shows that the degreased dry matter is identical during the first week and the second week of the post partum at a value (8.43; 85.76) g/l respectively, but without reaching the usual value. According to Souleymane et al. (2013), low-energy rations reduce the rate of degreased extract.

Table 1. Physicochemical parameters of milk during the first and second week of the parturition

	d7	d14	usual value	*p Value*
fat g/l	M= 33,04*	M= 25,14	37 (Siboukeur et al 2012)	0,003
the total dry extract g/l	M= 125*	M= 120	87,49 (Tir et al 2015) 128 (Siboukeur et al 2012)	0,031
the degreased dry matter g/l	M= 88,43	M= 85,76	94,47 (Debouz et al 2014)	0,12
pH	M=6,55*	M= 6,61	6,74 (Titaouine 2018)	0,03
titratable acidity	M= 16,55	M=16,79	16,8 (Titaouine 2018) 15-18 (Leymarios 2010)	0,18
density	M= 1,03	M=1,04*	1,03 (Titaouine 2018)	0,001
Free acidity of fat	M=0,48	M=0,55	0,42 (Acide Caprique : C10) 0,71 (acide Laurique : C12) (Deeth et al., 1975)	0,28

**=p<005, M= Mean*

pH

It is observed at the level of Table 1 that the pH is lower during the 1st week of the postpartum compared to the 2nd week at a value (6.55; 6.61) respectively with a $p<0.05$ and it is a value which is below the interval of the usual value. The pH determines whether the milk is fresh or fermented. (Koussou et al., 2007)

According to Ouadghiri (2009), there is a natural presence of lactic acid bacteria in the udders of cows, which may explain the pH drop during the first week of the parturition.

Titratable acidity

Table 1 shows that the titratable acidity is identical for the two weeks of the parturition at a value (16.55; 16.79) respectively with a $p>0.05$. The results obtained on acidity revealed values equal to the norm. This means that the refrigeration system at the farm level was correct because when the milk is not cooled immediately and the ambient temperature is high, it can acidify. (Debouz et al., 2014)

Density

We observe at the level of Table 1 that the density is higher during the 2nd week of the parturition compared to the first week at a value (1.04; 1.03) respectively with a $p<0.05$ and this is a value that lies within the range of the usual value. This can be explained by the fact that farmers did not use fraudulent milk wetting to increase their income. (Kouame-Sina et al 2010) and it can also be explained by the fall in fat (Debouz et al., 2014)

Electrical conductivity, coliform number, season and degree of cleanliness of the udder

Table 2 *presents the results* that the electrical conductivity of milk has a value of (7.75; 7.40) ms/cm during the cold and hot season respectively with a degree of cleanliness of the udder equal to (2.33; 2.4) respectively with a $p>0.05$.

Table 2. The conductivity of milk, the number of coliform and cleanliness of the udder during the cold and hot season

parameter / season	C E du lait (mS/cm)	Coliforme (UFC)	Propreté Mamelle
cold	M=7,75	$8,01\times10^3$	2,33
hot	M=7,40	$8,86\times10^3$	2.4
p value	p=0,58	p=0,48	p=0,50
Critical interval	CE > 7 mS/m (subclinical mastitis) (Mir et al 2018)	(5×10^2- 5×10^3) ufc/g (JORA 2017)	(0-1) (Lensink et al 2012)

**=p<005, M= Mean, CE=* electrical conductivity

Values that exceed the critical interval. This means that the udder has subclinical mastitis because the value of 11.20 mS/cm is considered a threshold for severe clinical mastitis. (Mir et al., 2018) It was also noted that the number of Coliform is identical during the cold and hot season at a rate of (8.01-8.86) respectively with $p>0.05$ by exceeding the microbiological limit (JORA, 2017). It can be said that there is no seasonal effect on the appearance of mastitis but there is a hygienic effect, According to Darej (2019), says that The production of quality milk does not require expensive facilities on the farm, neither ruinous transformations in the commercial and industrial system. It is essential that good hygiene practices are followed rigorously and continuously throughout the production process, especially when milking. According to Bouhroum et al. (2022) there is significant negligence in hygienic practices during milking.

CONCLUSIONS

The present study revealed that the hygienic quality of raw milk is unsatisfactory and that the milk are highly contaminated, revealing suspicious hygiene practices that even the best refrigeration conditions cannot hide. The results of the physico-chemical analyses are generally included in intervals close to the international standards for milk alone, fat, total dry extract and degreased dry matter are on average, low compared to the standard, and this fall is related to the environmental sub-clinical mastitis caused by coliform. These results confirm the importance of technical support for sustainability and the exhortation of the dairy sector in Algeria.

ACKNOWLEDGMENTS

The University of Chlef provided all the resources needed for this study, for which the author is grateful.

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