Detection of bovine mastitis using the California Mastitis Test under field conditions in Algeria

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Keywords

Dairy cattle, mammary gland diseases, diagnostic techniques, livestock management, Algeria

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Summary

Background: Mastitis is a major cause of economic loss for the dairy industry. It frequently affects postpartum dairy cows that are permanently housed, irrespective of breed, age category and udder conformation. *Aim*: This study set out to evaluate the prevalence and annual incidence of clinical and subclinical mastitis in dairy farms in the mountainous region between Bejaia and Tizi Ouzou provinces. *Methods*: The trial was conducted under field conditions to demonstrate the value of the California Mastitis Test (CMT) for the early diagnosis of subclinical bovine mastitis. Four hundred cows from thirty-two small dairy farms, of different breeds and age groups, were screened using the CMT after a preliminary clinical examination. Screening took place from January 2019 to February 2020. *Results*: Two hundred and nineteen cows screened had at least one affected quarter, representing an overall prevalence of 54.75%. There were far more cases of subclinical mastitis (35.5%) than of clinical mastitis (17.25%). The CMT allowed for early diagnosis, otherwise two thirds of cases would have gone unnoticed. *Conclusions*: Early detection has the potential to improve veterinary healthcare, as well as reduce economic losses.

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■ INTRODUCTION

Bovine mastitis is a multi-etiologic disease (Boufaida et al., 2012; Birhanu et al., 2017). It is the inflammation of the mammary gland that occurs in response to damage caused by different aggressive agents. These include microorganisms, such as bacteria, fungi, viruses and their toxins, chemicals, extreme temperatures, various traumas, etc. (Birhamu et al., 2017). Mastitis of infectious origin is the most prevalent. Over 130 different causal agents have been isolated from mastitis milk samples. *Staphylococcus aureus* (Abebe et al., 2016), Streptococci and members of Enterobacteriaceae are among the most common etiological agents in cows and other mammals (Quinn et al., 1999; Birhamu et al., 2017).

Mastitis is a major cause of economic loss for the dairy sector and represents a huge challenge to the industry worldwide (Erskine, 1992; Michira et al., 2023). It reduces milk production, both quantitatively and qualitatively (contaminated milk is discarded), requires costly veterinary treatment and may lead to early culling (Quinn et al., 1999; Michira et al., 2023).

In most cases, mastitis is associated with intramammary bacterial infections. As in other species, such as sheep, goats and camels (Barka et al., 2023), it is subdivided into clinical mastitis (CM), which can be detected visibly (udder inflammation, milk quality) and subclinical mastitis (SCM), when there are no visual signs of inflammation.

Both forms of mastitis reduce milk yield and quality. The use of antibiotics to treat mastitis contributes to antibiotic resistance to molecules commonly used in public health (Ngotho et al., 2022). Clinical mastitis also has implications for animal welfare (Lundberg, 2015).

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In Algeria, the dairy sector is an important part of the agricultural economy. Its development represents a huge challenge for the national agricultural policy. An in-depth understanding of dairy farming is a prerequisite to effective sectoral development (Fartas et al., 2017).

Many authors have conducted epidemiological and bacteriological studies, particularly in north-central and northeastern Algeria (Bouaziz ,2005; Saidi et al., 2010; Bouzid et al., 2011; Akkou et al, 2016, Saidani et al., 2018). However, most research focuses on the prevalence of infection, the identification of bacterial agents and their sensitivity to antibiotics. Studies that identify and quantify the risk factors associated with mastitis are less common (measuring Odds ratio) (Saidani et al., 2018).

In field conditions, cows with mastitis are often missed in the clinical evaluation (Patiño, 2008). Yet, they could be diagnosed using field and laboratory tests, such as the California Mastitis Test (Al -Edany et al., 2012: Li et al., 2018). This would reduce the risk of undiagnosed infected cows spreading mastitis pathogens to their environment.

The objectives of this one-year study were to evaluate the prevalence and annual incidence of clinical and subclinical mastitis in dairy farms in Bejaia and Tizi Ouzou provinces, using clinical examinations in parallel to the California Mastitis Test, under field conditions.

■ MATERIAL AND METHODS

Place of study

The study was carried out on 32 dairy farms in the Bejaia and Tizi Ouzou provinces around the Akfadou Forest. The Forest is located about 160 km east of Algiers, the capital, and 20 km from the Mediterranean Sea. The area is administratively dependent on the departments of Béjaia and Tizi-Ouzou (Figure 1). The forest massif covers an area of some 11,000 ha and constitutes 18% of the deciduous oak forest in Algeria.

In general, the land is fairly mountainous (slopes of 15% to 45%), particularly in the southeast. Altitudes in Akfadou vary from 800 m to 1,646 m. It has a humid Mediterranean climate with a temperate variant (Messaoudène, 1991).

The livestock farms in this region depend on natural resources, at least partially. Traditional forest grazing is still practiced in North African countries. Cattle, sheep and goats forage for all or part of their food rations. Thus, herds graze alternately in forests, collective pastures, on fallow land and stubble, depending on the season (Karmouni 1997).

Clinical examination of the udder

The clinical diagnosis of mastitis is important at the individual and herd level in order to establish the epidemiological model of mastitis on a farm. Clinical mastitis can be detected by simply examining the udder and milk. Early detection followed by appropriate treatment improves recovery rates (Angoujard, 2015).

Subclinical mastitis (Ismail, 2017) cannot be detected clinically, since it does not cause changes in the milk or udder and infected animals do not present any general signs associated with the disease.

Udders can be examined during milking, once a day or ideally at each milking, as well as at other times (during the dry period, after calving, etc.). Obviously, the examination is less easy on farms with milking robots. It involves checking the udder, as well as retro-mammary lymph nodes and vessels. First, udder conformation can be observed from a distance. In cases of poorly formed, blocked or oversized

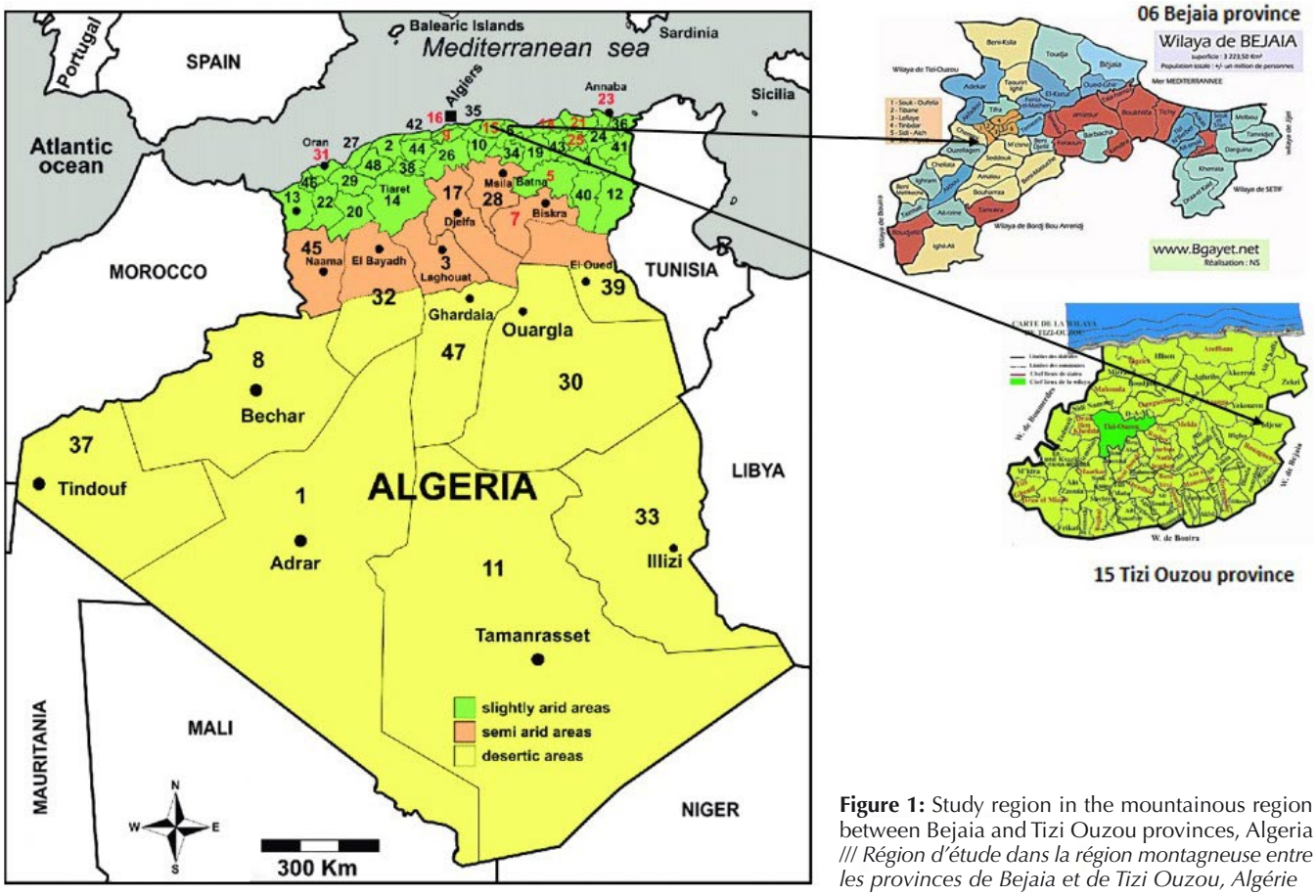

Figure 1: Study region in the mountainous region between Bejaia and Tizi Ouzou provinces, Algeria /// *Région d'étude dans la région montagneuse entre les provinces de Bejaia et de Tizi Ouzou, Algérie*

udders, teats are more exposed to the environment, which increases the risk of mastitis (Durel et al., 2011). The different quarters should be compared to detect an abnormality in terms of symmetry (atrophy, hypertrophy), size, colour (congestion, hematoma) or skin growths (warts). By examining the teats, possible damage induced by the milking method or milking machine can be detected. The type of injury determines the protocol (treatment required and restrictions). Vascular type injuries, such as petechiae, redness, oedema, cracking, etc., indicate recent damage and heal quicky. On the contrary, it may take 20 to 60 days for cows to recover from hyperkeratotic type lesions (Durel et al., 2011). Hyperkeratosis is a proliferation of the skin, which often involves the formation of a white ring around the end of the teat. It is a physiological skin reaction to an irritation (due to the use of a poorly adjusted milking machine), which eliminates part of the keratinized layer of skin inside the teat canal (Angoujard, 2015).

Examining milk secretions

This consists of evaluating the quality (colour, odour, consistency, viscosity and homogeneity) and quantity of the milk secretions. Healthy milk is white and homogeneous. It may become yellow during the colostrum phase or at the end of lactation when it is rich in fat or when production is low (Durel et al., 2004). In cases of hemolactation or hematoma, the colour of the secretion may range from pink to bright red. Mastitis changes the milk's appearance. The colour may vary from yellow (also associated with the presence of bubbles, like "beer" or "cider" in the case of enterobacterial mastitis), to dark red (in the case of gangrenous mastitis).

The characteristic smell of fresh milk is altered during mastitis. It has a bittersweet smell when caused by anaerobic bacteria, a spicy fruity smell when caused by enterobacteria and a nauseous "rotten egg" smell when caused by pyogenic bacteria.

Mastitis alters the natural homogeneity of milk, causing pus or lumps (clots, etc.), which are especially visible when fore stripping is practiced to stimulate milk let down. We used a black-bottomed bowl to examine samples because lumps are easier to see against a dark background. The amount of milk produced depends on udder health, as well as on the animal's general condition. Both clinical and subclinical mastitis reduce milk production. The decrease in yield is greater during acute infections than during subclinical infections. When milk production resumes, it is an important sign of clinical recovery (Angoujard, 2015).

The California Mastitis Test

The CMT is based on the action of a detergent (10% Teepol solution) and a dye (Bromocresol powder). The detergent causes the lysis of the milk cells by destroying their cell walls. The DNA is released, forming a network of very long filaments, which reduce hydrodynamic flows, trap fat globules and increase the milk's viscosity until it flocculates. The higher the cell concentration, the greater the amount of DNA released and the greater the flocculation (Table I).

The dye changes colour depending on the pH. Healthy milk has a pH between 6.5 and 6.7 (Durel et al 2004). In cases of mastitis, it becomes more alkaline, approaching pH 7. The dye is colourless to grey at a pH ranging from 5.2 to 6.8. It turns violet when the pH is greater than 6.8, in the presence of mastitis.

Statistical analysis

We conducted a simple random sampling technique to select dairy cows for the study, with the help and guidance of veterinary practitioners from the target region.

Herds of beef cattle, fattening cattle and non-pubescent or non-pregnant females were excluded from the sampling. Once a farm was selected, all the dairy cows on the farm were included in the sample.

Data generated during sample collection and from the face-to-face questionnaire were entered into Microsoft Excel 2013 spreadsheets and analysed using the R program version 4.3.1 (R Core Team, 2023).

The desired sample size for the study was calculated using the formula given by Thursfield (2007): N=

Where N = the total number of dairy cows = the sample size, p_{exp} indicates expected prevalence and d is desired precision. Z=1.96 is the z value that corresponds to the 5% risk shown in the standard normal distribution table: N (0, 1).

Given that there were no previous studies on subclinical mastitis in the study region, the expected prevalence was set at 50%. A large sample size was required to optimize precision, as in Debela and Birhamu (2020).

A total of 384 lactating cows with 1,536 teat quarters were required for the study. However, we included 400 dairy cows to improve accuracy (Saidani et al., 2018).

We conducted a univariate analysis of the effect of different factors possibly associated with the disease, using chi-square.

The dependent variable was the cow mastitis status (0 = negative and 1 = positive). The binary nature of this variable justified the use of logistic regression (Ricco, 2017; Saidani et al., 2018) to identify the factors that significantly influence the occurrence of bovine mastitis.

Farm herd size was extremely heterogeneous, ranging from 2 to 55 head of cows per farm. This complicated the use of a mixed effect model, but was preferable to the use of clustered data (farms).

Only variables with p value < 0.20 were included and evaluated with a stepwise model selection, which allowed us to choose the final logistic regression model (Ruegg, 2012).

We tested the associations between the dependent and independent variables. A $p < 0.05$ level was considered as statistically significant.

Table I: CMT Reading Grid (Kit Instructions) /// *Grille de lecture pour l'interprétation du test CMT (selon les instructions du kit)*

Score	Meaning	Description of the reaction	Interpretation (cells/ml)
0	Negative	The mixture is liquid, homogeneous and fluid	0 – 200 000
1	Traces	The mixture becomes slightly viscous. Viscosity is reversible and tends to disappear	200 000 – 400 000
2	Weakly positive	The mixture becomes viscous, with no gel formation in centre and viscosity tends to persist	400 000 – 1 500 000
3	Clearly positive	The mixture thickens immediately with the formation of a gel in the centre of the glass during rotation movements. Liquid may persist	800 000 – 5 000 000
4	Strongly positive	The mixture forms a gel in the centre that adheres to the bottom of the glass. There is no liquid left.	> 5 000 000

■ RESULTS AND DISCUSSION

At the farm level, our study revealed that 84.37% of the 32 herds observed had at least one cow with subclinical or clinical mastitis (Table II). Similarly, 219 cows had at least one infected quarter, which represents a prevalence of 54.75%.

At the quarter level, only 22% of quarters were affected (352/1600). Our findings revealed a 54.75% prevalence of bovine mastitis (Table II). In comparison, Bouzid et al. (2011) recorded a 44.8% prevalence and Ait Kaki et al. (2019) reported an overall prevalence of 26%. This disparity could be explained by the multifactorial nature of mastitis. Even when the same region is considered, its occurrence depends on various factors linked to the animals, the environment and breeding management. The accuracy of the estimated prevalence also depends on the number of animals screened, i.e. sample size (Thursfield, 2007).

Table II shows the preponderance of subclinical mastitis (35.5%), for which CMT is considered the best screening method (Ruegg and Reiman 2002; Traore et al., 2004). The prevalence of clinical mastitis was similar to that recorded by Saidani et al (2018) in the same region, which indicates that the epidemiological situation is stable.

The prevalence of subclinical bovine mastitis is 3 to 4 times higher than for clinical mastitis, with few exceptions. In Ethiopia, for example, according to Sarba and Tola (2017), the prevalence of clinical and subclinical mastitis were 9.9% and 31.8%, respectively.

In our study, the prevalence of clinical mastitis revealed by clinical examination was 17.25%. CMT revealed a subclinical mastitis rate of 35.5% (Table II). The prevalence of mastitis (Table II) was high (54.75%), indicating that over 50% of dairy cattle were infected. Our findings are in line with numerous authors, including Kossaibati and Esslemont (1997), Ouakli et al. (2022), Niar et al. (2000), Sischo et al. (1990), as well as Bouzid et al. (2011). The high rate of infection can be explained by the poor general hygiene of livestock facilities (Bouzid et al., 2011; Saidani et al., 2018; Farag et al., 2023). Prevalence may vary between and within regions due to livestock management and climatic conditions (Farag et al., 2023).

The number of infected quarters show that most cows only had one infected quarter. Blind or non-functional quarters were not considered. Pearson's X^2 test of homogeneity showed that this number is inversely proportional (p value < 2.2e-16) to the number of infected cows (Table II).

Table II shows the prevalence of mastitis in the different quarters. The posterior quarters were the most affected. The highest rate of infection was recorded in the right posterior quarter, with 157 infected quarters, equivalent to 44.60% of the total number of infected quarters. The left anterior quarter had the lowest prevalence (6.53%).

This could be due to the fact that cows tend to lie down on their right side because their rumen is on the left. Lying down increases the likelihood of contact between the teats and pathogens on the ground, especially just after milking when the teat sphincters have not yet closed. To avoid this phenomenon, we always recommend feeding hay after milking to keep the cows on their feet (Fartas et al., 2017).

In contrast, Escobar Diaz and Mercado Castilla (2008), presented slightly different results showing that the anterior quarters were more affected than the posterior ones.

Economic losses obviously rise in parallel with the increasing number of infected quarters. Actual loss varies depending on initial milk production (Lakew et al., 2019).

The prevalence of mastitis was also studied in relation to the time animals spent in the pasture. This factor was categorized into 3 groups: A) cows did not go out, B) cows spent less than 4 hours outside, C) cows spent over 4 hours in the pasture (Table III). It clearly appears that dairy cows that spend a long time outside are less vulnerable to

Table II: Prevalence (with confidence interval) of mastitis at farm, cow and quarter level /// *Prévalence (et intervalle de confiance) des mammites diagnostiquées au niveau de l'exploitation, de l'animal et du quartier*

Variables	No. of Negatives	No. of Positives	Prevalence and $C.I._{95\%}$	p-value
Prevalence at herd, cow and quarter level				
Farm	27	5	84.37% [71.79; 96.96]	**0.003406**
Cow	219	181	54.75% [49.87; 59.63]	0.1786
Quarter	352	1258	22% [19.97; 24.03]	**0.00003711**
Prevalence according to type of mastitis				
Clinical mastitis	331	69	(17.25%) [13.55; 20.95]	**0.000009075**
Subclinical mastitis	250	150	35.5% [32.76; 42.24]	
Number of infected quarters per affected cow				
One	275	125	31.25% [26.71; 35.79]	**< 2.2e-16**
Two	335	65	16.25% [12.63; 19.87]	
Three	381	19	4.75% [2.67; 6.83]	
Four	390	10	2.5% [0.97; 4.03]	
Total	1248	352	22% [19.97; 24.03]	
Side and position of infected quarter				
Anterior right	281	119	29.75 % [25.27; 34.23]	**2.84e-15**
Anterior left	377	23	5.75% [3.47; 8.03]	
Posterior right	243	157	35.68% [34.46; 44.04]	
Posterior left	347	53	13.25 % [9.93; 16.57]	

bovine mastitis. The incidence of bovine mastitis was lower in cows that spent over 4 hours outside compared to those that spent less time outside or were housed permanently. The same finding was established by Sarba and Tola (2017). The evidence shows that dairy cows that are permanently housed and never go outside are more likely to have mastitis. This may be due to the higher concentration of pathogens in livestock housing and a greater likelihood of teat lesions. In intensive systems, microbes are easily transmitted between animals or from the environment, which may partially explain why mastitis is more common. In contrast, animals that live outside may be less vulnerable because they are less stressed (Saidani et al., 2018).

Lastly, we were also interested in the relationship between the incidence of both clinical and subclinical bovine mastitis, and the lactation phase (Table III).

The distribution of mastitis cases according to the lactation stage indicates a high prevalence immediately after calving, after which the incidence decreases steadily until drying off (Table III).

The frequency of mastitis is higher (27/43) in early lactation according to several studies (Elbers et al., 1998, Rahmouni Alami and Mazouz, 2003). This highlights the importance of prevention in early lactation and during the dry period. Indeed, animals are extremely sensitive in early lactation. Their reduced immunity a few days after calving increases their vulnerability. The consequent drop in circulating neutrophils and lymphocytes in the udder (Jasper et al., 1975; Oliver and Sordillo, 1988), make early lactation a risk period for mastitis (Bouzid et al., 2011).

We conducted a multivariate analysis using a binary logistic regression model (Table IV) to explore the risk factors of bovine mastitis diagnosed by the CMT. It revealed that the most influential intrinsic factors were breed, udder depth and lactation phase. The hygiene and the time spent outside constitute extrinsic risk factors.

Many researchers have studied multiple risk factors, such as advanced age, number of lactations, poor udder conformation and inadequate milking hygiene (Andersen et al., 2003; Andrews et al., 2003; Bouzid et al., 2011; Saidani et al., 2018, Ferroudj et al, 2021; Fesseha et al., 2021; Ngotho et al., 2022). Logistic regression (Saidani et al., 2018) has often been used to estimate the strength of the link between the exogenous variables (risk factors) and the response variable (bovine mastitis diagnosis). Various authors (Saidani et al., 2018; Farag et al, 2023; Rifatbegovi et al.; 2024) point out that good farming practices could significantly reduce the negative impact of environmental risk factors, such as clean bedding and adequate udder hygiene, a semi-extensive management system, suitable housing, etc. Careful selection could also improve genetic factors linked to bovine mastitis, such as breed and udder traits (Saidani et al., 2018).

■ CONCLUSION

More than half of the dairy cows examined were infected by clinical or subclinical mastitis. The clinical examination detected less than

Table III: Occurrence of mastitis according to some intrinsic and extrinsic risk factors /// *Fréquence des mammites en fonction des facteurs de risque intrinsèques et extrinsèques pris en compte dans l'étude*

Factors and levels	No. of Negatives	No. of Positives (%)	Significance level
Time spent outdoors			
Null	15	161 (91.48%)	**0.000131**
Less than 4 hours	6	5 (45.45%)	
More than 4 hours	160	53 (24.88%)	
Lactation phase			
Dry period	11	3 (21.42%)	0.02455
Post partum	16	27 (62.80)	
Advanced lactation	154	189 (53.35%)	
Breed			
Crossbred	56	60 (51.72%)	0.005725
Fleckvieh	11	5 (27.78%)	
Local breed	7	13 (72.22%)	
Montbeliarde	95	103 (52.02%)	
Prim'Holstein	12	38 (76%)	
Udder depth scores and bovine mastitis prevalence			
1 Above hock line	98	44 (30.98%)	5.64e-15
2 On hock line	53	58 (52.25%)	
3 Below hock line	30	116 (79.45%)	
Hygiene and bovine mastitis prevalence			
Good	136	67	2.2e-16
Average	41	50	
Poor	4	102	

Table IV: Final binary logistic regression model regarding bovine mastitis /// *Modèle final en régression logistique binomiale concernant la présence de mammite chez la vache laitière*

Level	Estimate	Standard error	z value	p-value	Odds Ratio
(Intercept)	-6.85	0.99	-6.9	4.59e-12***	0.001
Lactation rank	0.75	0.16	4.77	1.80e-06***	**2.13**
Hygiene					
Good	-	-	-	-	-
Acceptable	0.80	0.46	1.74	0.08	2.22
Inadequate	4.50	0.78	5.73	9.93e-09***	**89.62**
Udder depth score					
1 Above hock line	-	-	-	-	-
2 On hock line	2.49	0.70	4.94	7.69e-07***	**12.09**
3 Below hock line	2.99	0.61	4.94	7.69e-07***	**19.91**
Breed					
Crossbred	-	-	-	-	-
Local	-0.24	0.89	-0.27	0.78	0.78
Montbeliarde	0.25	0.50	0.50	0.62	1.28
Fleckvieh	-0.28	0.96	0.29	0.77	0.75
Prim'Holstein	1.61	0.64	2.51	0.012105*	5.02
Time of exercise					
More than 4 hours	-	-	-	-	-
Less than 4 hours	-0.29	1.17	0.25	0.81	0.75
Null	4.62	0.63	7.31	2.62e-13***	101.33

Significance levels /// *Niveaux de significativité* : 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

a third of the cases recorded. The California Mastitis Test made it possible to diagnose latent cases. The CMT is highly sensitive, as well as being cheap, convenient and rapid. As an effective method for the early detection of mastitis, it could help improve veterinary healthcare, optimize treatment and reduce economic losses.

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Conflicts of interest

The authors declare no conflict of interest.

Author contributions

KS: Design, writing and statistical analyses. FZ, AKM and DA: Revision of the first draft, diagnostic assistance as clinical researchers. ST: Methodological framework and revision of the latest draft.

Ethics approval statement

All the animal studies were conducted with the regard for animal welfare, and all animal rights issues were appropriately observed. Throughout the study, no animal suffered. Examinations and sampling of cattle were undertaken according to the guidelines of the Institutional Animal Care Committee of the Algerian Higher Education and Scientific Research (Agreement Number 45/DGLPAG/DVA.SDA.14).

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Résumé

Saidani K., Zeroual F., Metref A.K., Dahmani A., Tennah S., Détection de la mammite bovine par le test CMT dans les conditions de terrain en Algérie

Les mammites sont une cause majeure de perte économique pour l'industrie laitière. Elles affectent fréquemment les vaches laitières post-partum qui sont élevées en stabulation permanente, indépendamment de la race, de la catégorie d'âge et de la conformation de la mamelle. Cette étude a pour but d'évaluer la prévalence et l'incidence annuelle des mammites cliniques et subcliniques dans les élevages laitiers de la région montagneuse située entre les provinces de Bejaia et de Tizi Ouzou. L'essai a été mené dans des conditions de terrain pour démontrer l'intérêt du California Mastitis Test (CMT) pour le diagnostic précoce de la mammite bovine subclinique. Quatre cents vaches issues de trente-deux petites exploitations laitières, de races et de classes d'âge différentes, ont été dépistées à l'aide du CMT après un examen clinique préliminaire, sur une période de janvier 2019 à février 2020. Deux cent dix-neuf vaches dépistées avaient au moins un quartier atteint, soit une prévalence globale de 54,75 %, avec plus de cas de mammites subcliniques (35,5 %) que de mammites cliniques (17,25 %). Le CMT a permis un diagnostic précoce, sans quoi deux tiers des cas seraient passés inaperçus. La détection précoce peut ainsi améliorer les soins vétérinaires et réduire les pertes économiques.

Mots-clés : Bovin laitier, maladie des glandes mammaires, technique de diagnostic, conduite d'élevage, Algérie

Resumen

Saidani K., Zeroual F., Metref A.K., Dahmani A., Tennah S., Detección de mastitis bovina mediante la prueba CMT en condiciones de campo en Argelia

Las mastitis son una causa importante de pérdida económica para la industria lechera. Afectan a menudo en el postparto a las vacas lecheras que se crían en estabulación permanente, independientemente de la raza, de la franja de edad y de la conformación de la mama. Este estudio tiene como objetivo evaluar la prevalencia y la incidencia anual de las mastitis clínicas y subclínicas en la ganadería lechera de la región montañosa situada entre las provincias de Bujía y de Tizi Uzu. La prueba se llevó a cabo en condiciones de campo para demostrar la utilidad del California Mastitis Test (CMT) en el diagnóstico precoz de la mastitis bovina subclínica. Después de un examen clínico preliminar, se diagnosticaron con la ayuda del CMT 400 vacas provenientes de 32 pequeñas explotaciones lecheras, de razas y de franjas de edad diferentes, en el período que va de enero del 2019 a febrero del 2020. De las vacas diagnosticadas, 219 tenían al menos un cuarto de la mama afectado, es decir, había una prevalencia global del 54,75 %, con más casos de mastitis subclínicas (35,5 %) que de mastitis clínicas (17,25 %). El CMT permitió un diagnóstico precoz, sin el cual dos tercios de los casos habrían pasado desapercibidos. La detección precoz puede mejorar los tratamientos veterinarios y reducir las pérdidas económicas.

Palabras clave: Ganado de leche, enfermedades glándulas mamarias, Técnicas de diagnosis, manejo del ganado, Argelia