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Prevalence and Risk Factors of Bovine Mastitis on Conventional Dairy Farms in Northwestern Algeria

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ABSTRACT

Background: Algeria's dairy sector is experiencing various obstacles, such as a high frequency of diseases in dairy farms, particularly mastitis. Nonetheless, there has been a scarcity of research on mastitis occurrence, notably in Algeria's Western area. As a result, the purpose of this study was to investigate the prevalence of mastitis and its associated risk factors in Algeria's northwest area.

Methods: The study included 130 dairy cows from 17 farms. The California mastitis test (CMT) and visual inspection were used to determine the prevalence of subclinical and clinical mastitis.

Result: The total cow-level prevalence was 68.50% (89/130), with clinical cases accounting for 3.10% (4/130) and subclinical cases accounting for 65.40% (85/130). The quarter-level prevalence of mastitis was 35.19% (183/520), with 3.08% (16/520) clinical cases and 32.11% (167/520) subclinical cases. The study found that parity, lactation stage and age were all significant intrinsic risk factors for mastitis (P<0.05). Additionally, cow cleanliness level, cleaning solution, wiping udder after washing and dry cow treatment were significant extrinsic risk factors linked with mastitis (P<0.05). Given the high prevalence of mastitis in this region, regular screening and treatment are crucial to minimize the risk of mastitis and enhance cow health.

Key words: Clinical mastitis, Northwestern Algeria, Prevalence, Risk factors, Subclinical mastitis.

INTRODUCTION

Despite worldwide efforts and numerous management programs, mastitis remains a serious problem for the dairy sector in terms of economic effect. It is anticipated to cost roughly 72 billion dollars every year (Bradley, 2002; Kumar *et al*., 2014). Cow mastitis is a complicated and multifaceted illness caused mostly by a variety of pathogens categorized as infectious and environmental (Radostits, 2007; Kumar *et al*., 2014). The disease is caused by the interplay of animals, pathogens, the environment and management variables.

Mastitis can appear clinically or subclinically. Atypical milk production, udder oedema and systemic symptoms such as fever, lethargy and anorexia define clinical cases (Eraskine, 2001). Subclinical mastitis, on the other hand, is difficult to detect since there are no visible changes in milk or udder appearance, but it can have a substantial impact on dairy producers by lowering milk production, changing milk quality and limiting reproductive activity (Ghallache *et al*., 2021).

Subclinical mastitis infections are especially problematic in dairy farming since 90-95% of animals do not exhibit clinical signs, although milking output might be decreased by 5-20%, according to Juozaitiene *et al*. (2006). Algeria consumes 5 billion liters of milk per year, whereas domestic output is roughly 3.5 billion liters. To compensate for the gap, the country imports 1.5 to 2 billion liters of milk powder, which cost US$1.50 billion in 2021 (Demmad, 2021). Mastitis was the first prevalent disease identified in dairy farms in Algeria's northwest area (Meskini *et al*., 2021a).

Mastitis is a serious impediment to the growth of the dairy sector in Algeria, particularly in the west, where information on the frequency of bovine mastitis is limited. As a result, the goal of this study is to give insight into the existing status of mastitis, both clinical and subclinical, at dairy farms in Algeria's northwestern region. We are seeking a better knowledge of the disease's occurrence in the region by performing this study and identifying the main risk factors that contribute to mastitis development and recurrence. This data may then be used to develop more effective mastitis prevention and control techniques, ultimately enhancing the health and productivity of the region's dairy cattle.

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MATERIALS AND METHODS

Study area and sample size

Cross-sectional research was undertaken in the provinces of Sidi bel abbes, Oran, Mascara and Mostaganem in Algeria's northwestern area, which are key producers to milk

production in western Algeria. The research comprised 17 dairy farms ranging in herd size from 5 to 15 cows. The study included 130 lactating cows of various breeds, principally Holstein, Red Holstein and Montbeliarde, who were handled in both semi-intensive and traditional farming systems. The research was carried out from January 2021 to May 2022 with the goal of evaluating the prevalence of bovine mastitis and identifying risk factors. The farms were chosen based on the owners' willingness to participate in the study and all lactating dairy cows present on the farms were included in the analysis without exception.

Study methodology

Field survey

A pre-designed questionnaire was used in the study to collect information about the dairy farms and animals involved. The questionnaire was split into two sections. The first section intended to gather general information regarding farm management techniques and risk factors. The second section was more thorough, focusing on the farmers' cleanliness and prophylactic methods. This section's data included information regarding milking hygiene methods and preventative measures, including dry cow treatment. The questionnaire was carefully designed to offer a thorough knowledge of the elements that may contribute to the prevalence of bovine mastitis in the research region.

Clinical inspection

The udder was inspected and physically examined for symptoms of mastitis such as changes in size, consistency, lesions, fibrosis, pain, heat, redness and swelling. Moreover, milk quality was visually assessed using a black-bottomed bowl to detect any anomalies such as clots, flakes, or blood. A clinical case of mastitis was judged positive if one or more of these indications were present in any quarter or the entire udder. This method offered a thorough assessment of the occurrence and severity of mastitis.

California mastitis test (CMT)

The first step in screening for subclinical mastitis was a thorough washing of the udders with a biocide solution and water, followed by individual wiping as recommended by Quinn *et al*. (1999). A total of 504 teats were tested by taking 2 mL of milk from each quarter (Fig 1) and combining it with an equivalent quantity of commercial CMT reagent (RAIDEX GmbH, Germany) as shown in Fig 2. The viscosity of the resultant mixture was graded on a scale of 0 to 4, with scores of 0 and 1 categorized as negative and trace, respectively and scores of 2, 3 and 4 classifieds as positive. A cow was judged to have subclinical mastitis if at least one quarter tested positive with a score of 2 or above.

Data analysis

The number of cows or quarters that tested positive for mastitis was divided by the total number of cows or quarters examined to establish the overall prevalence of mastitis.

The study's information was recorded in a Microsoft Excel spreadsheet and analyzed with the statistical program SPSS version 21. To examine the link between mastitis infection and other risk factors, the Chi-square (2) test was performed. A p-value less than 0.05 ($p<0.05$) was judged statistically significant, showing a significant relationship between mastitis infection and the particular risk factor under consideration.

RESULTS AND DISCUSSION

The goal of our study was to investigate the frequency of bovine mastitis in dairy cows and identify potential risk factors.

Mastitis prevalence

Cow level

According to the results shown in Table 1, we discovered a significant incidence of mastitis at the cow level, with a rate



Fig 1: Milk sampling from each quarter.



Fig 2: Addition of CMT reagent.

Table 1: Prevalence of clinical and subclinical mastitis at a cow and quarter levels.

Form of mastitis	Total examined cows	Total affected cows (%)	Total examined quarters	Total affected quarters (%)
Clinical	130	04 (3.1%)	520	16 (3.08%)
Subclinical	130	85 (65.4%)	520	167 (32.12%)
Total	130	89 (68.5%)	520	183 (35.19%)

of 68.5%, using both clinical inspections of the udder and the California Mastitis test (CMT). The prevalence rate contrasts from that reported by Hocine *et al*. (2021) in Algeria and Belay *et al*. (2022) in Ethiopia, where the prevalence rates were 41.66% and 17.1%, respectively. Our findings, however, are consistent with prior research in Ethiopia, such as studies by Abebe *et al*. (2016) and Melesse and Minyahil (2019), which found prevalence rates of 64.3% and 73%, respectively, as well as Maalaoui *et al*. (2021) in Tunisia, who reported a prevalence rate of 60.3%. These discrepancies may be attributable to regional, environmental and agroecological variables, changes in farm management, husbandry methods, production systems and the investigators' research methodology or equipment. Mastitis is also a complicated illness involving the combination of animal risk factors and causative agents, and its incidence varies (Radostits *et al*., 2007).

In our study, 65.4% of dairy cows had subclinical mastitis. This number is comparable to other studies done in Algeria (Fartas *et al*., 2017; Meskini *et al*., 2021b; Ghallache *et al*., 2021), which showed prevalence rates of 61.6%, 62.8% and 66.4%, respectively. Nonetheless, the prevalence rate in our research was greater than that discove red by KAKI *et al*. (2019) in Bejaia (26%) and Ferroudj *et al*. (2021) in Algeria's Dry land area (12.9%). The prevalence rate in our study was also lower than the findings of Boufaida *et al*. (2012) in Algeria's Est area (79%) and Ouakli *et al*. (2022) in Blida province (71%).

In this study, the prevalence of clinical mastitis at the cow level was 3.1%, which is similar with the findings of Abebe *et al*. (2016) in Ethiopia (3.4%) but higher than the prevalence reported by Belay *et al*. (2022) of 1.9%. It is crucial to note, however, that the prevalence of subclinical mastitis was significantly greater than that of clinical mastitis. This disparity might be attributed to a failure to pay attention to subclinical mastitis when treating clinical infections (Lakew *et al*., 2019). Subclinical mastitis is 15-40 times more common than clinical mastitis, lasts longer, has a large economic burden and frequently precedes clinical mastitis, according to Seegers *et al*. (2003). According to Erskine (2003), the udder's defensive mechanism tends to reduce the degree of infection and it has been hypothesized that the risk of subclinical mastitis is higher than that of clinical mastitis.

Quarter level

Table 2 indicates that the total prevalence of mastitis in the quarters was 35.19%, which is comparable to the findings of Abebe *et al*. (2016) in Ethiopia (34.7%), Dinaol Belina *et al*. (2016) with (29.2%) and Elbably and Asmaa (2013) in Egypt (29.08%). The hindquarters were more impacted than the forequarters, particularly the right hindquarters, which is consistent with earlier study noted above. Zeryehun *et al*. (2013) ascribed the higher infection rates in these quarters to their high production capacity and greater risk of fecal and environmental contamination.

Mastitis risk factors

Intrinsic risk factors (animal risk factors)

As shown in Table 3, the findings revealed a substantial connection between the frequency of bovine mastitis and age and parity number ($p<0.05$).

Older cows showed a greater frequency of mastitis than younger cows, with cows aged 6-7 years having the greatest prevalence (87.50%) compared to cows aged 2 or 3 years (57.50%). In addition, mastitis was shown to be more prevalent in multiparous cows (76.47%) than in primiparous cows (63.33%), which is similar with earlier studies by Zeryehun *et al*. (2013) and Belay *et al*. (2022). The greater prevalence of mastitis in older cows in this research may be attributable to bigger teats and more relaxed sphincter muscles, making it easier for infectious agents to enter and grow in the udder (Radostits *et al*., 2007). According to Abebe *et al*. (2016), older cows with four or more parities are especially sensitive to mastitis due to their pendulous udders and mastitis history, which render the teats and udder more susceptible to damage and infection.

The research additionally showed that the stage of lactation had a significant effect on the prevalence of mastitis ($p< 0.05$), with a larger relative frequency in the late lactation stage (80.56%) compared to the early (67.21%) and mid-lactation phases (60.53%). This conclusion supports previous findings by Youssif *et al*. (2021) and Maalaoui *et al*. (2021). Mastitis is more common in late lactation due to recurrent and continuous exposure to infections with infectious germs during milking procedures or the removal of the teat "plug" (Youssif *et al*., 2021).

According to the findings of this study, no statistically significant correlation ($P>0.05$) was found between breed and mastitis or between milk output level and mastitis prevalence. This contrasts previous studies that demonstrated a substantial influence of these parameters on mastitis incidence, such as (Asmare and Kassa, 2017; Melesse and Minyahil, 2019) for milk output production and Moges *et al*. (2012) and Belay *et al*. (2022) for breed risk factors.

This lack of significance in our analysis might be related to breed sample variations. Our study used only imported breeds, whereas other studies used native and crossbred animals, which are known to be more resistant to mastitis infection. High-yielding cows are more prone to mastitis than low-yielding cows, according to (Radostits *et al*., 2007).

This might be due to the increased possibility of injuries developing in bigger udders, resulting in a higher risk of disease introduction. Also, the stress associated with excessive milk production may have an impact on the animal's defensive system.

Table 2: Prevalence of clinical and subclinical mastitis at quarter level.

Types of mastitis	Quarter level prevalence				Total
	Right front	Right hind	Left front	Left hind	
Clinical	04 (3.1%)	04 (3.1%)	03 (2.3%)	04 (3.1%)	16 (3.08%)
Subclinical	39 (30.0%)	46 (35.4%)	41 (31.5%)	42 (32.3%)	167 (32.12%)
Total	43 (33.8%)	50 (38.5%)	44 (33.1%)	46 (35.4%)	183 (35.19%)

Table 3: The prevalence of mastitis in milking cows based on intrinsic risk factors.

Risk factor	Category	Animals examined	Number of animals affected	Prevalence (%)	χ^2	P-value
Parity number	1 calf	41	24	58.54	21.897	0.000
	2 calves	51	39	76.47		
	3 calves	30	19	63.33		
	4 calves	5	4	80.00		
	5 calves	3	3	100.00		
Lactation stage	Early	56	37	67.21	16.299	0.000
	Mid	38	23	60.53		
	Late	36	29	80..56		
Age (year)	2-3	40	23	57.50	17.447	0.000
	4-5	82	59	71.95		
	6-7	8	7	87.50		
Breed	Prim 'Holstein	90	64	71.11	5.979	0.113
	Red 'Holstein	22	14	63.64		
	Montbeliarde	15	9	60.00		
	Others	2	2	100.00		
Milk production	1-10L	15	9	60.00	4.888	0.180
	11-20L	66	45	68.18		
	21-30L	47	33	70.21		
	30L+	2	2	100.00		

Early (1-3 months), Mid (4-7 months), Late (> 7 months).

Table 4: Prevalence of mastitis based on extrinsic risk factors the at cow level.

Risk factor	Category	Animals examined	Number of animals affected	Prevalence (%)	χ^2	P-value
Barn hygiene	Clean	10	7	70.00	4.733	0.094
	Mid	72	47	65.28		
	Poor	48	35	72.92		
Cow hygiene level	Clean	18	10	55.56	8.497	0.014
	Mid	68	49	72.06		
	Poor	44	30	68.18		
Milking machine hygiene	Clean	119	81	68.07	0.620	0.431
	Poor	11	8	72.73		
Cleaning solution	Biocide	7	3	42.86	21.119	0.000
	Soap	38	23	60.53		
	Water	85	63	74.12		
Wiping udder after cleaning	Yes	41	25	60.98	9.564	0.002
	No	89	64	71.91		
Feeding animals	Before milking	24	8	75.00	2.886	0.089
	After milking	106	71	66.98		
Previous mastitis history	Yes	30	21	70.00	0.061	0.804
	No	100	68	68.00		
Dry cow therapy	Yes	42	26	61.90	8.191	0.004
	No	88	63	71.59		

Extrinsic risk factors (management risk factors)

Data in Table 4 show that Cow cleanliness, particularly of the legs and udder, has been recognized as a risk factor for mastitis; Cows with low hygiene had a greater mastitis incidence (68.18%) than cows with good hygiene (55.56%), consistent with findings by Abebe *et al*. (2016) and Melesse and Minyahil, (2019).

According to Weigel *et al*. (2018), environmental conditions and herd management practices have a substantial influence on animal well-being and health, keeping the herd clean and comfortable helps lower the occurrence and severity of mastitis.

While using a biocide or soap to clean the udder (instead of using only water) was proven to have a substantial influence on lowering mastitis cases with rates of 42.86%, 60.53% and 74.12%, respectively. Farmers frequently refuse to use detergents for fear of affecting milk quality during milk control.

Wiping the udder after cleaning had a considerable influence on the incidence of mastitis 60.98% when this operation is performed versus 71.91% when it is not.

Whereas Idriss *et al*. (2013) claim that teat canals can be partially open for 1-2 hours after milking, feeding cows soon after milking is critical to prevent infections from readily infiltrating *via* the open teat canal. However, this study observed no significant influence on mastitis, which might be ascribed to the animals not standing for 1-2 hours due to a lack of acceptable quality and amount of feed (Asmare and Kassa, 2017).

This research reveals that previous mastitis history had no significant impact on mastitis incidence, in contrast to several studies such as Melesse and Minyahil (2019), who reported that previous udder infections were more likely to be re-infected than those with no previous exposure. This could be attributed to previously exposed cows retaining carriers and the limited efficacy of medications used to treat mastitis in the research area.

According to the findings of this study, treating dry cows had a favorable effect on lowering the prevalence of mastitis ($p<0.05$). As shown by Peterson-Wolfe *et al*. (2010), cows are most vulnerable to mastitis infections in the last seven to ten days of the dry season. As a result, it is advised that the early dry phase therapy be repeated two weeks before calving. Yet, because of fears about abortion, many farmers in the study declined to carry out systematic treatments during this time period.

CONCLUSION

The study found a high prevalence of mastitis, particularly subclinical mastitis, in the region, which can be attributed to a number of factors, including a lack of farmer awareness about the existence and diagnosis of subclinical mastitis, as well as insufficient farm management and hygiene practices. Efforts must be done to address and reduce the consequences of this problem. The study suggests educating farmers about the dangers of this disease and urging them to check for subclinical mastitis on a regular basis. Moreover, suitable management techniques for cows should be adopted during both the dry and lactation seasons, with clinical situations addressed with caution. It is thought that by doing so, the prevalence of mastitis in the region will be minimized.

According to the study findings, additional research is required to better understand the causes and prevention techniques of mastitis in the region. Future research should focus on identifying the mastitis-causing pathogens, as well as the specific management and hygiene practices that contribute to its high prevalence. Farmers must be taught on the importance of mastitis management, as well as how to diagnose and treat it. They should also be made aware of the negative impact of mastitis on cow health and milk production, as well as the need of maintaining correct hygiene and management procedures to reduce the risk of mastitis. Therefore, future research should focus on developing and implementing effective mastitis management strategies, as well as enhancing dairy cow health and production.

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Conflict of interest

The authors declare no conflict of interest.

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