

Bovine mastitis: Prevalence and economic losses

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ABSTRACT

Objective: To determine the prevalence of mastitis and estimate the economic losses caused by the disease in dual-purpose livestock units in Cuajinicuilapa, Guerrero, Mexico.

Design/Methodology/Approach: A total of 261 cows were sampled, encompassing 1,025 mammary quarters. The California Mastitis Test (CMT) was used for diagnosing mastitis, and economic losses were estimated based on milk production loss according to the severity of the disease.

Results: The overall prevalence was 42.9%, with 40.2% corresponding to subclinical mastitis and 2.7% to clinical mastitis. Among the quarters sampled, 80% tested negative, 17.5% showed subclinical mastitis, 0.7% presented clinical mastitis, and 1.8% were classified as blind quarters. Economic losses associated with mastitis ranged from USD 0.248 to USD 1.253 per day.

Study Limitations/Implications: The lack of record-keeping in the Livestock Production Units (LPU) studied hindered the estimation of additional costs related to the presence of mastitis.

Findings/Conclusions: The prevalence of mastitis in dual-purpose LPUs in Cuajinicuilapa, Guerrero, was lower compared to other regions of the country. Subclinical mastitis was more frequent, leading to economic losses across all herds due to reduced income from milk sales. These losses often go unnoticed by producers, given the asymptomatic nature of subclinical cases.

Keywords: Subclinical mastitis, clinical mastitis, prevalence, milk production.

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INTRODUCTION

Bovine mastitis is a multifactorial disease whose manifestation depends primarily on pathogens, the efficacy of the cow's udder immune defenses, environmental risk, and the interaction of factors such as breed, poor hygiene, and inadequate milking practices. These aspects collectively contribute to a decrease in both milk production and quality (Pérez *et al.*, 2019a; Ruiz *et al.*, 2016). This disease is considered the most significant challenge facing the global dairy industry in terms of economic losses. Losses of up to 35 billion pesos have been reported (Acosta *et al.*, 2017), attributed to reduced milk yield, treatment costs, discarded milk due to antibiotic contamination, and recovery time for affected animals (Vissio *et al.*, 2015). Mastitis manifests in both clinical and subclinical

forms, with the latter being the most frequent and economically impactful (Fernández *et al.*, 2012). This pathology can be diagnosed through the measurement of inflammatory components and pathogenic agents present in milk (Ruiz-García & Sandoval-Monzón, 2018). Various diagnostic methods are available, with the most common being the California Mastitis Test (CMT) and Somatic Cell Count (SCC), both of which are conducted in the field prior to each milking session (Tommasoni *et al.*, 2023). Diagnosis is critical, as somatic cells in milk, comprising approximately 75% leukocytes and 25% epithelial cells (Ruiz-García & Sandoval-Monzón, 2018), representing the udder's first line of defense against mastitis-causing pathogens (Pereyra *et al.*, 2014). Consequently, elevated SCC levels serve the primary indirect indicator of subclinical mastitis. In Mexico, studies on the prevalence and economic impact of this disease are limited, and the findings vary across geographic regions. In Sonora, a prevalence of 65.80% was identified (Pinelli-Saavedra *et al.*, 2022). In Veracruz, mastitis prevalence was reported at 40.52% (León-García *et al.*, 2021), while in the central region of Yucatán, it reached 53% (Pech *et al.*, 2007). However, there are areas such as the Costa Chica region of Guerrero specifically the municipality of Cuajinicuilapa where no studies have been conducted on mastitis prevalence. This municipality ranks fifth in milk production within the state and first in the Costa Chica region, with a total output of 4,704,560 liters (SIAP, 2024), making it one of the main economic activities for small-scale producers in the area. The closest studies have been conducted in the Tierra Caliente region, where a clinical mastitis prevalence of 20.50% was reported (Olivares-Pérez *et al.*, 2015), and in Marquelia, Guerrero, where subclinical mastitis prevalence reached 45.9% (Muñoz *et al.*, 2012). Given that no data exists for Cuajinicuilapa on the prevalence or economic losses associated with this disease, the present study aimed to determine the prevalence of bovine mastitis and the associated economic losses in a region where milk production holds considerable socioeconomic importance (SIAP, 2023).

MATERIALS AND METHODS

The study was conducted in eight localities within the municipality of Cuajinicuilapa, Guerrero, Mexico: El Pitayo, San Nicolás, Montecillos, El Quizá, Comaltepec, Buenos Aires, and El Júcaro (Figure 1). A total of 15 Livestock Production Units (LPUs) were studied, selected based on convenience and their willingness to participate in the study. All lactating cows from each herd were included, resulting in the sampling of 261 cows and a total of 1,025 mammary quarters.

The study was conducted during the rainy season (June to September). Each Livestock Production Unit (LPU) was visited during milking hours, between six and seven in the morning. A questionnaire was administered to each producer, which included data on each lactating cow (identification, breed, age, number of calvings, physiological status, origin, economic value, and date of last calving), as well as information on the LPU (location, land area, herd composition, feeding, health management, equipment, external inputs, labor, and costs). For sample collection, each teat of the cow's udder was disinfected with a 0.5% iodine-based solution. Immediately after, each quarter was stripped and subjected to the California Mastitis Test (CMT). The reading and interpretation of the test were carried out

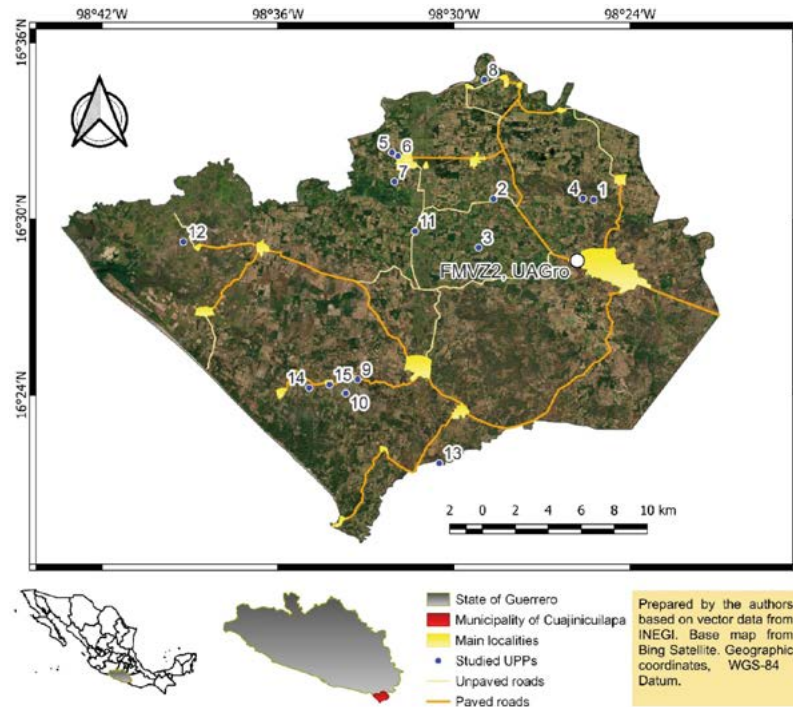


Figure 1. Location of the studied LPU.

according to the criteria described by Bedolla *et al.* (2007). To estimate the economic losses caused by clinical and subclinical mastitis, the method proposed by Fort (1985) was used, as described below:

$$X = \frac{100 \times N \times P}{100 \times N - (aA + bB + cC + dD + eE)}$$

Where: X = The ideal herd milk production (in the absence of mastitis), P = Total herd production (liters), N = Number of quarters sampled, $a = 0.103$ (Milk production reduction factor for quarters with grade 1 mastitis), $b = 0.159$ (Reduction factor for grade 2 mastitis), $c = 0.228$ (Reduction factor for grade 3 mastitis), $d = 0.058$ (Reduction factor for quarters with traces), $e = 0.515$ (Reduction factor for quarters with clinical mastitis); A = Number of quarters with grade 1 mastitis, B = Number of quarters with grade 2 mastitis, C = Number of quarters with grade 3 mastitis, D = Number of quarters with traces, and E = Number of quarters with clinical mastitis. Once X is calculated, the volume of milk lost due to mastitis is obtained by subtracting P . The economic data are expressed in U.S. dollars, using the average exchange rate for 2021, which was 20.27 Mexican pesos per dollar (Government of Mexico, 2021).

Data were recorded in Microsoft Excel, and descriptive statistics were obtained. The prevalence (P) of mastitis was calculated by dividing the number of positive cases at the time (N) by the total population studied (T) (Fajardo-Gutiérrez, 2017).

$$P = \frac{N}{T(100)}$$

RESULTS AND DISCUSSION

During the study, a total of 261 lactating cows were recorded —242 crossbred with Swiss breeds and 19 with Zebu. The average number of lactating cows per herd was 23.3, ranging from seven to 37 cows. In 14 herds, milking was performed manually, while only one used mechanical milking. In general, the producers and their families carried out most of the activities within the Livestock Production Unit (LPU); only four out of the 15 producers had a permanent employee.

Feeding was primarily based on grazing, with occasional supplementation of corn stover and commercial mineral salts. Reproductive management was conducted through the rotation of breeding bulls. Health management included vaccination against paralytic bovine rabies and blackleg, as well as deworming for gastrointestinal parasites and administration of B-complex vitamins. In 93.3% of the herds, no sanitary practices were implemented during the milking process, and none of the studied herds used any diagnostic method for mastitis control. Out of the 261 cows sampled, 112 tested positive for either subclinical or clinical mastitis, representing a mastitis prevalence of 42.9%. Among the cows diagnosed with some form of mastitis, 104 were crossbred with Swiss breeds and eight with zebu breeds. The highest prevalence was observed in LPU 8, where 100% of the cows were diagnosed with subclinical mastitis, while LPU 9 had the lowest prevalence, at 15% (Table 1).

Table 1. Number of lactating cows per production unit, herd-level mastitis prevalence, and cows with mastitis by breed cross.

LPU	Total number of cows	Prevalence %	Mastitis according to caste (N°)	
			Swiss/bred cows	Caste cows/zebu
1	12	67	7	1
2	7	71	4	1
3	13	46	6	-
4	24	67	16	-
5	12	42	3	2
6	19	32	6	-
7	11	55	6	-
8	7	100	6	1
9	20	15	3	-
10	37	43	15	1
11	20	30	6	-
12	31	23	7	-
13	17	71	10	2
14	12	50	6	-
15	19	16	3	-
Total	261	42.9	104	8

When determining quarter-level prevalence (Figure 2), it was observed that, out of the 1,025 mammary quarters sampled, 80% tested negative. Subclinical mastitis was found in 17.5% of the quarters, while clinical mastitis was present in 0.7%. Additionally, 1.8% of the quarters were classified as blind.

All 15 herds studied experienced economic losses attributable to the presence of clinical or subclinical mastitis. The LPUs with the highest milk losses corresponded to herds with the greatest incidence of subclinical mastitis. These losses ranged from 3.07 to 3.63 liters of milk per day, representing USD 1.074 to 1.253, based on the price per liter paid to the producer (Table 2).

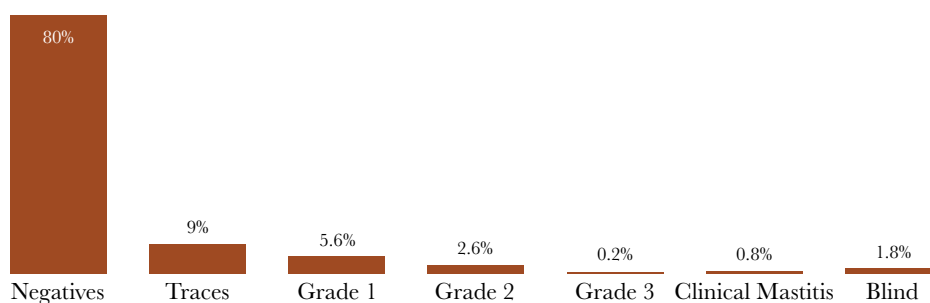


Figure 2. Prevalence of mastitis in sampled cows in the municipality of Cuajinicuilapa, Guerrero, Mexico.

Table 2. Estimated economic losses due to reduced milk production associated with mastitis in each production unit.

LPU	Milking cows	Liters of milk per LPU	Loss of milk production (liters) by type of mastitis				Economic Loss (\$/day) *	Estimated loss % of milk
			Grades 1, 2 and 3	Traces	Clinic	Total		
4	24	135.9	2.11	0.84	0.68	3.63	1.253	2.6
8	7	53.4	1.64	1.43	-	3.07	1.211	5.44
1	12	67	2.32	0.27	0.74	3.33	1.149	4.74
10	37	168.6	1.34	1.17	0.6	3.11	1.074	1.81
13	17	80.92	0.69	1.28	-	1.97	0.680	2.38
9	20	97.07	0.4	0.22	1.29	1.91	0.659	1.93
2	7	46.6	1.28	0.22	-	1.5	0.518	3.12
6	19	145.6	0.96	0.47	-	1.43	0.493	0.97
12	31	119.6	0.82	0.11	0.5	1.43	0.493	1.18
14	12	50.83	0.43	0.62	-	1.05	0.362	2.02
11	20	121.5	0.71	0.36	-	1.07	0.316	0.87
5	12	58.3	0.7	0.15	-	0.85	0.293	1.44
7	11	31.13	0.29	0.2	0.4	0.89	0.263	2.16
3	13	34.8	0.67	0.09	-	0.76	0.262	2.14
15	19	69.6	0.19	0.06	0.47	0.72	0.248	1.02

LPU: Livestock Production Unit.

* It was obtained by multiplying the volume of the loss (liters) by the price of milk paid to the producer (0.35 to 0.40 USD).

On the contrary, the herds with the lowest milk loss were those with the fewest cases of subclinical mastitis. Clinical mastitis was detected in seven of the studied LPU, in eight quarters and seven animals in total (Table 2).

The mastitis prevalence found in this study was 42.9%, which is lower than that reported in various studies (Pinelli-Saavedra *et al.*, 2022; Pérez-Morales *et al.*, 2022; León-García *et al.*, 2021; Aguilar *et al.*, 2014; Muñoz *et al.*, 2012), despite the fact that the study was conducted during the rainy season a period considered conducive to the presence of mastitis (Mora *et al.*, 2015; Pérez-Morales *et al.*, 2022). These results are similar to those reported by Muñoz *et al.* (2012) in Marquelia, Guerrero, who found a prevalence of 45.9%, although they did not specify the time of year. In the study by Pérez-Morales *et al.* (2022), no significant seasonal differences were reported when comparing mastitis prevalence in two different periods of the year in Sonora. The authors reported a higher prevalence during the rainy season (June-September), at 64.9%, compared to the present study. However, in winter (December-February), they reported a prevalence of 65.7%, without attributing this difference to any specific cause. Therefore, future studies in the Costa Chica region of Guerrero should consider at least two seasons to provide evidence of potential seasonal variations in mastitis prevalence. One of the predisposing factors associated with mastitis is breed. In the Costa Chica region, the American Swiss breed is most commonly used for crossbreeding and genetic improvement due to its dairy aptitude. Mora *et al.* (2015) stated that crossbreeding with American Swiss results in high susceptibility to mastitis, which could partly explain why, in this study, the highest number of subclinical mastitis cases occurred in cows crossbred with American Swiss (Table 2). It has been reported that the Holstein breed is more susceptible to subclinical mastitis than Jersey and American Swiss breeds (Santivañez-Ballón *et al.*, 2014), which contrasts with findings by Alvarado *et al.* (2019), who indicated that the Simmental breed is the most susceptible, followed by Brown Swiss and Holstein. Similarly, in the present study, crossbreeding with European breeds showed a higher proportion of subclinical mastitis. However, this study does not allow us to conclude that Swiss crosses are more susceptible, as a specific study with a larger sample of zebu-crossed animals is required. When analyzing mastitis prevalence by quarter, 80% tested negative and 17.5% tested positive. These results are very similar to those reported by Trujillo *et al.* (2011) in Antioquia, Colombia, where 19.9% of quarters tested positive for mastitis in seven herds. Compared to the present study, they found a slightly higher proportion of grade 1 and 2 cases, a lower proportion of grade 3 and trace cases, but a higher rate of clinical mastitis. In this study, no clear trend was observed that would attribute the presence of subclinical mastitis to a specific cause or factor. While climatic conditions, cow breed, and milking method may influence mastitis occurrence, it is evident that improved sanitary management during milking could reduce disease prevalence. Diagnostic testing can also help identify causative factors and guide better prevention strategies. Moreover, all LPU showed economic losses related to mastitis. These losses ranged from USD 0.248 to 1.253 per day, with estimated milk volume losses ranging from 0.87% to 5.44%. The highest losses occurred in four herds (1, 4, 8, and 10), and in three of these (1, 4, and 10), both clinical and subclinical mastitis were present. These four herds experienced milk

losses of 3.11 to 3.63 liters per day, corresponding to daily economic losses ranging from USD 1.074 to 1.253. LPU 8 recorded the highest economic loss despite the absence of clinical mastitis, with more quarters affected by subclinical mastitis, resulting in a daily milk loss of 3.07 liters equivalent to USD 1.211 per day. These losses are lower than those reported by Calderón *et al.* (2012) in 15 dual-purpose herds in Córdoba, Colombia, where milk production losses ranged from 4.39% to 14.58%. In another study conducted in 19 herds in Argentina, economic losses from clinical mastitis were reported at USD 230.36 for cows and USD 178.09 for heifers, with a prevalence of 2.5 cases per 100 cows (Richardet *et al.*, 2016), adjusted to September 2021 prices using INPC data. These findings show that although clinical mastitis is less frequent, its economic impact is more severe due to the symptomatic nature of the condition. In the present study, clinical mastitis prevalence was 2.7%, with daily milk losses per herd ranging from USD 0.13 to 0.44, and a total milk loss across all herds of USD 1.61 excluding treatment costs. These comparisons indicate that losses vary depending on mastitis prevalence in the herd and the extent of glandular and systemic impact on the affected cow, ultimately influencing milk yield and resulting income losses. However, the selling price of milk must also be considered. In the present study, economic losses were higher than those reported in previous research, mainly due to the rising price of milk in recent years. From 2003 to 2019, the price increased from USD 0.23 to USD 0.39 per liter (SIAP, 2019), meaning that the economic impact of mastitis today is significantly greater. Although some herds experience greater losses due to subclinical mastitis-related milk reduction, the economic impact is not uniform. In this study, milk losses due to mastitis accounted for 0.87% to 5.44% of total herd production. Herds with the highest percentage losses were those producing less than 67 liters of milk per day, which could mean a greater impact on the income of the producer and their family. Therefore, it is essential to consider implementing a support program in these LPUs aimed at the diagnosis, prevention, and control of subclinical mastitis, as for some, the milk loss could represent nearly 6% of their total income.

CONCLUSIONS

The prevalence of mastitis in dual-purpose systems in Cuajinicuilapa, Guerrero, was lower (42.9%) than in other regions of the country, despite the absence of sanitary management during milking and the lack of diagnostic methods for mastitis control. Subclinical mastitis was more frequent, accounting for 40.2% of cases, and was present in all herds studied. The estimated milk reduction due to mastitis resulted in economic losses across all herds, caused by decreased income from milk sales losses that largely go unnoticed by producers, primarily because the condition manifests subclinically.

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