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Pathological assessment of clinical mastitis among sahel goats in Maiduguri, Northeastern Nigeria: An abattoir survey

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ABSTRACT

Mastitis imposes a great economic loses in terms of decreased milk yield, increased cost of veterinary services and great risk to the public in terms of microbial spread amongst raw milk consumers. This study tends to investigate clinical mastitis after culling in sahel goats. 105 goats presented for slaughter in Maiduguri abattoir northeastern Nigeria were examined for gross lesion of mastitis followed by CMT screening to identify positive animals. Sixty-six (66) animals were positive for CMT with a prevalence of 63%. *Staphylococcus aureus* was the frequent isolate (80%, 53/66) followed by *Streptococcus spp* (20%, 13/66) with no *E.coli* isolated. Mean length values of gland-to-abdomen of the CMT +3 animals is significantly higher ($p<0.05$) than that of the CMT negative, +1 and +2 groups. Gross lesions examined were lacerations, papillomatous growth, gangrene and abscess which served as predisposing factor to mastitis. Vacuolation of alveolar epithelia, fibroplasia in interstitial and inter-alveolar fibrosis are found to be the causes of significant increase in the glandular length of the udder. Clinical mastitis is prevalent in sahel goats and one of the major reasons of culling in farm animals. Early screening is therefore advocated to improve herd health and prevent spread among farm animals and to humans.

KEYWORDS: Clinical Mastitis, Prevalence, Papillomatous, fibroplasia, Staphylococcus, Streptococcus.

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INTRODUCTION

Inflammatory condition of the mammary gland is characterized generally by changes in the physico-chemical properties of the milk, decrease quality and quantity of milk as well as bacteriological alterations in the udder (Mishra A. S., 2018). It is one of the most devastating disease affecting the dairy industry worldwide (Sharma, 2010). Clinical mastitis (CM) has been found to affect goat population of up to 17% as reported by Ameh et al (1993). Economic loses have been reported in terms of decreased milk yield, increased cost of veterinary services, increased rate of early culling, great risk to the public in terms of microbial spread amongst raw milk consumers (Thompson-Crispi, 2014). Clinical signs of swollen udder, bruises, variation in the teat length in addition to the change in milk quality have been reported in CM (Yoksa et al 2024). In most cases of CM the common bacterial isolates are *Streptococcus, Staphylococcus* and *Escherichia coli* however other isolates of bacteria such as *Pseudomonas aeruginosa*, have been incriminated in CM (Jabbar 2020; Ejeh 2024). In dairy goats *Staphylococci* has been the most common reported pathogen in CM (Virdis, 2010). Staphylococcus aureus, a coagulase positive has been reported to be the most prevalent in clinical mastitis in goats (Mishara 2014; Ejeh 2024). *Streptococci spp* are second to *Staphylococcus* and are frequently present in both subclinical and clinical mastitis (Bergonier, 2003).

Mastitis tends to have a devastating effect on production by reduction in the quality and quantity of milk. This cross-sectional study tends to determine the prevalence of clinical mastitis among lactating goats at slaughter using California mastitis test (CMT), bacterial culture. gross and histopathology.

MATERIALS AND METHODS

Study animals/area: 105 lactating goats presented for slaughter between the months of February and March 2023 were clinically screened for gross signs of mastitis.

Sample collection: Udder was disinfected, and 2 to 3 squirts of milk were allowed to drop to obtain a fresh sample. Somatic cell count was determined using California mastitis test (CMT) paddle and reagent by collecting milk from the two sides of the mammary gland and processed according to the method described by Gelasakis, 2016, Mishra, 2018 and Mbindyo, 2014. Briefly milk was collected and mixed with equal amount of reagent (BOVI-VET, KRUUSE, Denmark) and mixed by gentle movement of the hand. After 10 seconds the results are read as Negative, +1, +2, +3 based on the intensity of gel formation. The paddle is the washed and the procedure repeated for another animal. Tissue samples were collected from the glands of the positive animals after slaughter and preserved in 5% Formalin followed by processing in accordance with the standard laboratory procedure for histopathology.

Microbial Assessment of milk: Milk sample was collected aseptically and inoculated by direct streaking onto 5% sheep blood agar, mannitol salt agar, and eosin methylene blue agar and incubated at 37 °C for 48hrs for growth. Morphologic characterizations are in accordance to reports of Quinn, 2011 and Yoksa, 2024.

Statistical analysis

Data obtained from this study were presented in descriptive tables. Mean of values of variables were further summarized as ± standard deviation and comparison of multiple mean value were subjected to analysis of variance (ANOVA) using computer software (SPSS® statistic version 21, IBM computer, USA). Values were considered significant at $p \leq 0.05$.

RESULTS

Prevalence of Mastitis by California Mastitis Test (CMT).

Table 1 presents the frequency of occurrence of mastitis in the survey. The total prevalence of mastitis based on CMT was 66 (63%) while 39 (37%) were negative. The degree of CMT positivity of the milk sample are +1 26 (25%) mild, +2 28 (27%) moderate and +3 12 (11%) respectively.

Table 1: Prevalence of mastitis diagnosed by California mastitis test (CMT)

N=105	Prevalence	
CMT Positivity	**Total No of Samples**	**Percentage (%)**
+1	26	25
+2	28	27
+3	12	11
Total	66	63

Frequency of bacterial isolation from CMT positive milk samples.

Table 2 presents the isolation frequency of bacterial organism from CMT positive milk samples. All the 66 CMT positive samples yielded growth on their specific culture media. *Staphylococci species* has the highest isolation rate of 53 (80%), *Streptococcus Spp* 13 (20%) and *E. coli 0* (0%) respectively.

Table 2: Frequency of bacterial isolation from CMT positive milk samples

Isolates	Frequency	Percentage (%)
Staphylococcus Species	53	80
Streptococcus species	13	20
E. coli	0	0
Total	66	100

Mean body condition score, age, mammary circumference and mammary longitudinal length.

Table 3 presents the mean values of body condition score (BCS), age, mammary circumference, gland to ground length, and gland to abdomen measurements in the surveyed animals, grouped into CMT –ve, CMT 1+, CMT 2+ and CMT 3+ respectively. No significant difference ($p>0.05$) was observed in the mean values of BCS, age, mammary circumference of the animals (n=105) surveyed. The mean values of gland-to-abdomen of the CMT +3 animals is significantly higher ($p<0.05$) than that of the CMT negative, +1 and +2 groups.

Table 3: Mean values of BCS, age, mammary circumference, and mammary longitudinal length

	CMT Positivity			
Variables	**Negative**	**+1 (Slight)**	**+2 (Moderate)**	**+ 3 (Severe)**
BCS	2.7±0.7[a]	2.8±0.4[a]	2.6±0.5[a]	2.9±0.3[a]
Age	3.0±0.7[a]	2.9±0.7[a]	3.0±0.[9a]	2.8±0.6[a]
Gland mid- Circumference	27.8±6.8[a]	28.0±7.6[a]	28.4±6.8[a]	28.8±6.4[a]
Gland longitudinal length	16.4±1.3[a]	16.4±1.5[a]	16.3±1.1[a]	15.3±2.6[b]

[a, b] Values with different superscript across rows are significant ($p<0.05$)

Frequency of occurrence of gross lesion of mastitis.

Table 4. presents the frequency of occurrence of gross lesions of mastitis in the animals surveyed. Out of the 105 animals examined, 19 (18.1%) had no visible gross lesions, 10 (9.5%) had shrunken and gangrenous mammary gland, 40 (38%) of the examined animals had suspended mammary gland as represented by increased in the longitudinal length of the gland, 25 (23.8%) had laceration, 7 (6.7%) had abscess and 2 (1.9%) of the presented cases had watery milk and papillomatous growth each.

Table 4: Frequency of occurrence of gross lesions

Lesions	**No. of Cases (%)**
Laceration	25 (23.8%)
Papillomatous growth	2 (1.9%)
Gangrene	10 (9.5%)
Enlarged udder	40 (38.1%)
Abscess	7 (6.7%)
Watery milk	2 (1.9%)
No visible lesion	19 (18.1%)

Gross lesion score of animals with clinical mastitis examined

The gross lesions observed are presented in table 5. Lacerations, papillomatous growth, gangrenous gland, suspended mammary gland, abscess and watery milk are the observable lesions. CMT 3+ group has the highest percentage of lesions. Lacerations was 13 (52%), 7 (28%) and 5 (20%) in CMT 3+, 2+ and 1+ groups respectively; suspended mammary gland was 31 (77.5%), 9 (22.5%) and 0 (0%) in CMT 3+, 2+ and 1+ respectively; papillomatous growth was 0 (0%), 0 (0%) and 2 (100%) in CMT 3+, 2+, and 1+ groups. Cases of abscessation was 5 (71%), 2 (29%) and 0 (0%) in CMT 3+, 2+ and 1+ groups respectively, while watery milk was 0 (0%), 2 (100%) and 0 (0%) in CMT 3+, 2+ and 1+ groups.

Table 5: Gross lesion score based on CMT positivity

	CMT Positivity		
Lesion	**+1 (%)***	**+2 (%)***	**+3 (%)***
Laceration	5 (20)	7 (28)	13 (52)
Papillomatous Growth	2 (100)	0 (0)	0 (0)
Gangrene	0 (0)	3 (30)	7 (70)
Pendulous gland	0 (0)	9 (22.5)	31 (77.5)
Purulent exudate	0 (0)	2 (29)	5 (71)
Watery Milk	0 (0)	2 (100)	0 (0)
Aggregate Gross Lesions	7 (8)	23 (26.7)	56 (65.1)

*Values presented are proportions (%) of lesions grouped into CMT 1+, CMT 2+ and CMT **3+**

Gross lesion of mammary gland of animals examined.

Figure 1 present photographs of some lesions observed among the animals examined. Pendulous mammary gland (Fig 1A), papillomatous growth (Fig 1B), swollen mammary gland with purulent discharge (Fig.1C) and Shrunken and gangrenous mammary gland (Fig 1D).

Fig. 1 A, an enlarged and pendulous mammary gland.

Fig 1 B, papillomatous growth on teat of mammary gland (red arrows).

Fig. 1C, swollen mammary gland (black arrow) with purulent exudation (arrow).

Fig. 1D, shrunken firm mammary gland (red arrow) with gangrenous lesion (black arrow).

Histopathological findings of mammary glands with mastitis

Figure 2 presents the photomicrograph of the mammary gland section stained with H&E. Lactiferous ducts, mild inter-alveolar oedema (Fig 2A), vacuolation of alveolar epithelia, mild fibroplasia in interstitial space, Ballooning degeration and fat necrosis (Fig 2B), massive leukocytic infiltration, interstitial and inter-alveolar fibrosis, destruction and desquamation of alveolar epithelia (Fig 2C) and infiltration of inflammatory cell, neutrophils, macrophages and few plasma cell (Fig. 2D).

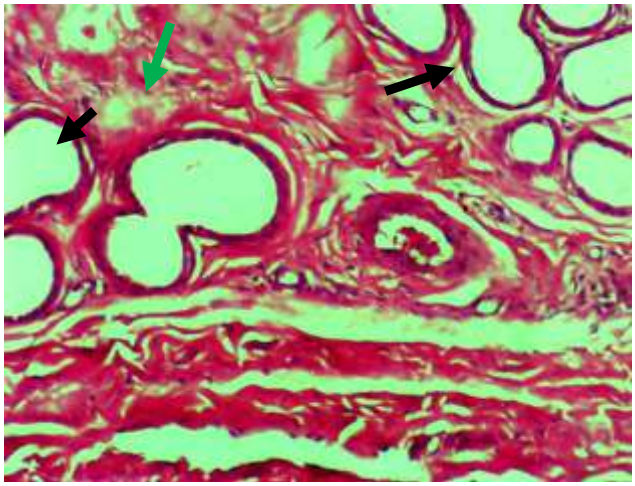

Fig. 2A, Lacteferous ducts (black arrows), mild inter-alveolar oedema (green arrow) H & E x40

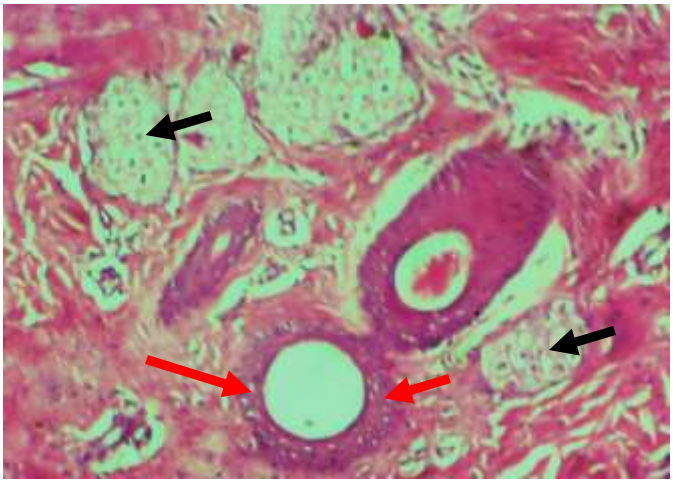

Fig 2B, Vacuolation of alveolar epithelia (red arrows, mild fibroplasia in interstitial space, Ballooning degeration and fat necrosis (black arrows) H & E x 100

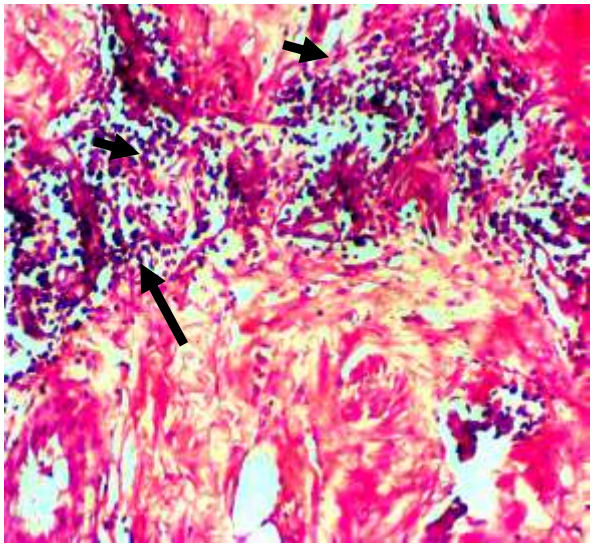

Fig. 2C, Massive leukocytic infiltration, interstitial and inter-alveolar fibrosis, destruction and desquamation of alveolar epithelia (arrow). H & E x 40

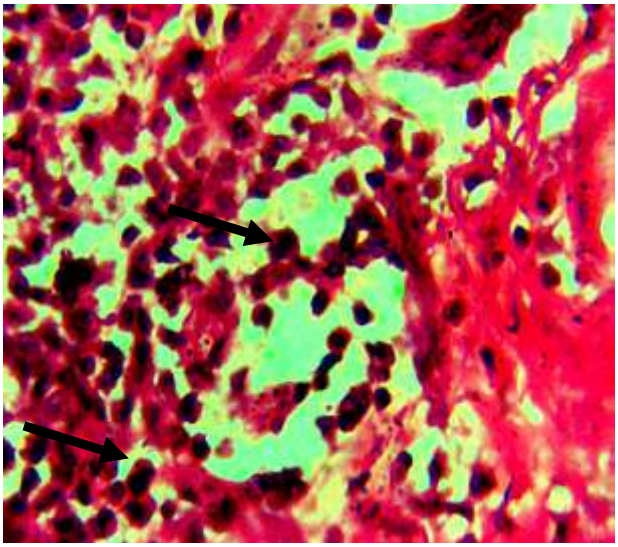

Fig. 2D, Infiltration of inflammatory cell, neutrophils, macrophages and few plasma cell (black arrow). H & E x400

DISCUSSION

The findings of this study presented the endemicity of clinical mastitis among sahel goats to have prevalence of 63% in Maiduguri (Northeastern Nigeria). The prevalence found is higher in comparison to the previous reports of Ameh et al 1993 possible due to increase in population of goats. The prevalence of clinical mastitis found in this study agrees with the prevalence of clinical mastitis 63% reported by Udoh *et al.,* 2019 in Zaria Kaduna State, 61% by El-Shymaa *et al.,* 2018 in Egypt and 61% by Mbindyo *et al.,* 2014 in Tanzania. Danmallam and Pimenov, 2019 who reported a lower prevalence of 43.33% in Bauchi, Plateau and Edo States. Mastitis is one of the diseases that necessitate early culling in lactating goats and hence the increase prevalence in the abattoir. Of the 66 CMT positive samples majority are of the CMT +1 category (tested for culture and identification of specific microbial organism. All sample 66 (100%) samples yielded growth of organism on specific media. This finding re-echoes the sensitivity and specificity of CMT as a screening test for mastitis (Danmallam and Pimenov, 2019; Mahlangu *et al.,* 2018). The bacteriological isolation rate in this study indicates that *Staphylococcus aureus* were the common organisms isolated with a frequency of (80%), followed by *Streptococcus species* (20%) and no culture yielded growth of *E. coli.* This finding has reiterated the fact that *Staphylococcus aureus* is the major etiological agent in CM of goats as reported by Ameh, 1993, Menzies, 2021 and Ejeh 2024. Pirzada *et al.,* 2016 and Udoh *et al.,* 2019 also reported a high prevalence of *S. Aureus* in goats. Such high prevalences could be due to reinfection of the mammary gland by the organism through teat lesions transferable during suckling and milking. Low prevalence of Streptococcus organisms was observed in comparison with reports of Yoksa et al 2024 on subclinical mastitis in the same area. Body condition score, mammary circumference and age are not associated with the prevalence of CM and this agrees with the earlier

reports of Abba et al 2014. Significant difference was observed between CMT +1 to CMT +3 in the longitudinal length of mammary gland with those having CMT +3 being the highest possibly due to higher somatic cell counts, injury to the suspensory ligaments by the inflammatory processes hence the increase in glandular length. Abba et al 2014 also reported a significant longitudinal length of mammary gland with CM. The gross lesions observed in this study, were those of laceration 25 (23.8%), papillomatous growth 2 (1.9%), shrunken and gangrenous mammary gland 10 (9.5%), enlarged pendulous mammary gland 40 (38.1%), abscess 7(6.7%, watery milk 2(1.9%) and 19 (18.1%) of the cases of the mammary gland examined had no visible lesion. Lesions on the teat especially those caused by contagious ecthyma and papillomatous growth are predisposing factors for mastitis. (Arteche-Villasol, 2022). Abscess was found to be highest (71%) in CMT +3 when compared to CMT +2 (29%) and (0%) in CMT +1. Abba *et al.,* 2013 also reported suppurative inflammation in clinical mastitis in abattoir. Histopathological findings of CM in this study are vacuolation of alveolar epithelia, destruction and desquamation of alveolar epithelia ballooning degeneration and fat necrosis, suppurative inflammation characterized by massive infiltration of neutrophil and few macrophages in the inter-alveolar space, to infiltration of neutrophils, macrophages and few plasma cell., interstitial and inter-alveola fibrosis. Alawa et al (2000) also reported inflammation and replacement by fibrous connective tissues in CM. Inflammatory processes are responses to invading pathogens (Abba *et al*.,2013). Decrease production due to mastitis and the increase rate up culling contributed to the higher prevalence in clinical mastitis observed in study. This cross-sectional survey has provided insights into the type and nature of lesions associated with clinical mastitis in goat populace at both gross and histopathology level.

In conclusion teat lesions, papilloma, lacerations are the predisposing factors of CM in sahel goats and Staphylococcus and Streptococcus being the major pathogens hence the major reasons for culling.

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Conflict of Interest

No conflicting interest to declare.

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Authors Contributions.

DTY, DLM conceptualized the work, processed the samples and drafted the manuscript. BJ, NSY performed the survey and collected the samples. RHG, edited the manuscript. JJN Supervised the Microbiological work.

REFERENCES

1. Abba Y, Igbokwe IO, Adamu L, Buba I. 2013. Alterations in haematological and serum biochemical parameters of Sahel goats with clinical mastitis. IOSR J Agricult Vet Sci, 4(4), 74-7.
2. Abba, Y., Adamu, L., Igbokwe, I. O., Hassan, S. U., & Sule, D. (2014). Effect of clinical mastitis on the gross morphometry and histopathology of mammary glands of Sahel goats. *Int. J. Livestock Res*, *4*(1), 99-106.
3. Alawa, J. N. (2000). Chronic caprine mastitis in Nigerian goat breeds: microbiological flora and histopathological findings. *Small Ruminant Research, 35*(3), 203-207. doi:https://doi.org/10.1016/S0921-4488(99)00099-1
4. Ameh JA, A. P. (1993). Prevalence of clinical mastitis and intramammary infections. *Preventive Vet Med, 17*(1-2), 41-6. doi:https://doi.org/10.1016/0167-5877(93)90053-V
5. Arteche-Villasol, N. F.-E. (2022). Pathology of the Mammary Gland in Sheep and Goats,. *Journal of Comparative Pathology,, 193*, 37-49. doi:https://doi.org/10.1016/j.jcpa.2022.02.007.
6. Bergonier, D. C. (2003). Mastitis of dairy small ruminants. *Vet. Res, 34*, 689–716.
7. Danmallam FA, Pimenov NV (2019) Study on prevalence, clinical presentation, and associated bacterial pathogens of goat mastitis in Bauchi, Plateau, and Edo states, Nigeria, *Veterinary World*, 12(5): 638-645.
8. Ejeh, F. E.-D.-y. (2024). A Case Study of Clinical Mastitis in 2- Year-Old Sahel Goat in Nigeria and Its Implication on Public Health. *Asian Journal of Research in Animal and Veterinary Sciences, 7*(4), 397-401. doi:https://journalajravs.com/index.php/AJRAVS/article/view/322.
9. El-Shymaa, A. A. Mohammed, I. E. and Afaf, M. M. (2018). The prevalence of clinical mastitis in sheep and goats. *Zazazig Veterinary Journal,* 46(2): 96-104.
10. Gelasakis, A. A. (2016). Bacterial subclinical mastitis and its effect on milk yield in low-input dairy goat herds. *Journal of Dairy Science, 99*(5), 3698-3708. doi:doi.org/10.3168/jds.2015-10694.
11. Jabbar, A. S. (2020, Dec). Epidemiology and antibiogram of common mastitis-causing bacteria in Beetal goats. *Vet World. Dec;, 13*(12), 2596-2607. doi:doi: 10.14202/vetworld.2020.2596-2607

12. Mbindyo, C. G. (2014). A cross-sectional study on the prevalence of subclinical mastitis and antimicrobial susceptibility patterns of the bacterial isolates in milk samples of smallholder dairy goats in Kenya. *American Journal of Research Communication, 2*(8), 30-51.
13. Menzies, P. (2021). Udder Health for Dairy Goats. *Vet Clin North Am Food Anim Pract., 37*(1), 149-174. doi:doi: 10.1016/j.cvfa.2020.12.002. PMID: 33541696.
14. Mahlangu, P; Maina, N., Kagira, J. (2018). Prevalence, risk factors and antibiograms of bacteria isolated from milk of goats with subclinical mastitis in Thika East sub-county, Kenya. *Journal of veterinary Medicine,* 7:1-8.
15. Mishra, A. S. (2014). Isolation, characterization and therapeutic potential assessment of bacteriophages virulent to Staphylococcus aureus associated with goat mastitis. *Iran. J. Vet. Res., 15*(4), 320–325.
16. Mishra, A. S. (2018, Jan). Prevalence and bacterial etiology of subclinical mastitis in goats reared in organized farms. *Vet World. , 11*(1), 20-24. doi:doi: 10.14202/vetworld.2018.20-24.
17. Pirzada, M., Malhi, K. K., Kamboh, A. A., Rind, R. Abro, S. H., Lakho, S. A., Bhutto, R. K., and Huda, N. (2016). Prevalence of subclinical mastitis in dairy goats caused by bacterial species. *Journal of Animal Health and Production,* 9(6), 33-35.
18. Pretorius,
19. Quinn, P. M. (2011.). *Veterinary Microbiology and Microbial Disease. .* New Jersey, U.S.A:: Wiley-Blackwell, Hoboken; .
20. Sharma, N. M. (2010). Effect of Phyllanthus emblica on ceruloplasmin in bovine staphylococcal mastitis. *Indian J. Vet. Res., 19*(2), 19–24.
21. Thompson-Crispi, K. A. (2014). Bovine mastitis:Frontiers in immunogenetics. *Front. Immunol., 5*, 1–10.
22. Udoh, E. K., Kwaga, J. K. P., Umoh, J. U. and Raji, M. A. (2019). Occurrence of mastitis and methicillin resistant Staphylococcus aureus in goats in Zaria, Kaduna State, Nigeria. *Nigerian Veterinary Journal, 40(2):*164-177.
23. Virdis, S. S. (2010). Antibiotic resistance in Staphylococcus aureus and coagulase negative Staphylococci isolated from goats with subclinical mastitis. *Vet. Med. Int., 2010:517060.*
24. Yoksa DT, M. D. (2024). Subclinical mastitis of lactating Sahel goats from urban smallholder herds in Maiduguri, Nigeria: prevalence and intra-mammary infections. *Veterinaria,, 73*(2), 129-137.