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Bacteriological Quality of Fresh Cow Milk From Dairy Farms in Parts of Kaduna State, Nigeria

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Abstract

The study was carried out to determine the bacteriological quality of farm fresh raw cow milk with emphasis on the detection of Staphylococcus species. A total of 592 quarter milk samples, 30 bulk milk samples and 27 swab samples of the hands of milk men were examined from 12 dairy farms in Kaduna and Zaria. The bacteriological quality of the milk samples were determined by both the California Mastitis Test and the Total Viable Staphylococcal Count. The prevalence of subclinical mastitis from positive California Mastitis Test (³+) was 24.5%. The mean Staphylococcal count was 4.2 log10 cfu/ml. The number of suspected Staphylococcal isolates that were Gram positive and catalase positive were 103, which were then biochemically screened down clearly to 51, with their identities confirmed using the Microbat Microgen Kit. Among the Staphylococcal species, Staphylococcus aureus showed the highest population of phenotypic identity with 38%. This organism is important from public health point of view as they have been associated with the onset of food poisoning in human beings.

Keywords: Milk, Diary Farms, Staphylococcus Species, Zaria.

1. Introduction

Milk is an aqueous colloidal suspension of proteins, fats &carbohydrate that contains numerous vitamins and minerals [1]. It has been described as a nearly perfect food because it contains the essential nutrient required by the body in appropriate proportions.

Milk has a distinct physical, chemical and biological characteristic which justifies its high quality for consumption [2]. These characteristics present a favorable environment for the multiplication of various bacteria and an efficient vehicle for transmission of diseases to humans [3].

The dairy industry in Nigeria (like in other developing countries) is facing a major problem of low demand for raw milk; this is partly because of public health concerns over its safety and quality as they are produced mostly in unhygienic conditions [4].

Dairy foods are frequently contaminated with staphylococci (Imami et al 2007). Staphylococcal food bone infection/ intoxication is one of the common forms of bacterial food bone diseases in many countries [5].

The number of bacteria present in a milk sample is of importance. Milk from cows infected with mastitis generally has higher total bacterial counts and somatic cell counts than milk from uninfected cows therefore bacteria counts (and somatic cell counts) are used by dairy farmers and milk processors as indicators of milk quality [6]

2. Materials and Methods

2.1 Determination of the Bacteriological Quality of Milk Samples

This was achieved through the California mastitis test as well as by the total viable bacterial/Staphylococcal count test.

2.2 California Mastitis Test

In order to study the quality of milk, the California mastitis test was carried out on milk samples of composite milk using the CMT kit.

Five ml of each composite and bulk milk samples were collected, each sample was mixed with the reagent and the test carried out according to the manufacturer's instruction. The criteria used for scoring were:
0 (negative), +1 (weak positive) +2 (distinct positive) and + 3 (strong positive) [10].

In this study, CMT score of 0 was regarded or grouped as having originated from cows free of subclinical mastitis and better quality milk, while CMT result of ≥ + 1 was taken as evidence of subclinical mastitis and low quality milk.

2.3 Isolation and Phenotypic Characterization of Isolates.
The milk samples that showed positive reaction to CMT were taken for bacteriological culture in the laboratory.

2.4 Isolation of Staphylococcus species from milk samples:
One ml of the raw milk sample was added in to 9ml of peptone water (Pre enrichment). It was homogenized and incubated at 37oC for 24 h. Thereafter, 0.1ml of this pre- enriched sample was cultured on to Baird-Parker agar (a selective medium for Staphylococcus species) and incubated at 37oC for another 24h and observed for Staphylococcal colonies (Creamy, greyish, white or yellow colonies). These presumed colonies of Staphylococcus species were subjected to Gram reaction and catalase production test to get isolates that were Gram and catalase positive.

2.5 Isolation of Staphylococcus Species from Swab of Milkers Hands
The inoculate from each swab stick was also inoculated on to well prepared, sterilized mannitol salt agar by rubbing/ streaking the swabs on to the surface of the agar plates and then incubated at 37oC for 24 h and observed for typical colonies of Staphylococcus (Cheesbrough, 2009).

2.6 Total Staphylococcal Count
The colonies of suspected Staphylococcus species growing on the plates after the incubation were counted and then recorded as the total bacterial/ Staphylococcal count. For all the colonies, smear preparation and Gram staining was performed to guide the way in the characterization of staphylococcus, which showed typical Gram positive bacteria and coccus in clusters.

2.7 Storage of Isolates
Nutrient agar slants were prepared in Bijou bottles and the isolates were then inoculated on to the nutrient agar slants and stored in a refrigerator at 4oC for further analysis and characterization.

2.8 Biochemical and Serological Characterization of the Isolates. (Phenotypic Characterization)
The phenotypic characterization of all the isolates was carried out using biochemical and serological tests.

2.9 Biochemcial Tests:
The following biochemical tests were performed in order to further confirm the identity of the Staphylococcus isolates: Catalase positive, Coagulase positive or negative, positive Thermonuclease production, Haemolytic reaction on blood agar, positive Voges Paskauer, positive Sugar fermentation/utilization, positive Mannitol fermentation and Clumping factor/protein A production positive tests.

2.10 Confirmation of Isolates Using the MicrogenTM Kit:
The test was carried out according to the instruction of the kit manufacturer (Oxoid Ltd, Basinstoke, UK). Four pure colonies from a 24 h culture were picked and emulsified in a 3ml of suspending medium to a homogenous suspension using a sterile inoculating loop. With a sterile Pasteur pipette, 10ml of the bacterial suspension was added to the wells of each test strip and incubated at 37oC for 24 h. After incubation, the result was read and recorded on to the MicrogenTM organism I.D. report form provided in the kit. Interpretations of the result was aided by a colour chart provided in the kit. Results were analyzed using computer aided software for identification.

3. Results
3.1 California Mastitis Test (CMT)
Out of the 592 quarter milk samples screened for mastitis (8 samples were omitted due to blind teats) 145 were CMT positive, giving a prevalence of 24.5%. Between farms, the prevalence of subclinical mastitis ranged from 15.0 - 61.0%. (Table 4.9).

Out of the 30 bulk milk samples obtained from 30 herds sampled, 19 (63.0%) were negative to CMT, Five (16.7 %) were weakly positive and distinctly positive respectively, while only one (3.3%) was strongly positive to California mastitis test (Table 4.10).

3.2 Total Staphylococcal Count from Milk and Dairy Workers
The mean total Staphylococcus count (log10 cfu/ml) was shown in Table 4.11. The mean total staphylococcal count ranged from 1.43±0.1 – 6.03±0.20 (log10cfu/ml). The highest mean count (6.03±0.20 log10 cfu/ml) was recorded in the LMDF in Zaria. Significant differences existed between the counts at $p \leq 0.05$ for all locations. The average mean total staphylococcal count (log10 cfu/ml) was 4.26±0.45.

Table 4.12 showed the association between CMT and staphylococcal count at different sampling points. Spearman's correlation analysis was used to compare the relationship between CMT and staphylococcal count at different sampling points; moderate to high relationship was observed between CMT and staphylococcal count. The highest association between CMT and staphylococcal count was recorded in swab sample ($r = 0.71$) while the least association was recorded in the bulk sample ($r=0.27$).

3.3 Phenotypic Characterization of Staphylococcus Species
Biochemical characterization of the isolates were further confirmed using the Microgen staph I.D kit. A representation of the result of twenty (20) out of the fifty (50) isolates identified with the kit was shown in Table 4.13. From the test, 19 (38.0%) were identified as Staphylococcus aureus, 9 (18.0%) were Staphylococcus chromogens, 2 (4.0%) were Staphylococcus

hyicus, another 2 (4.0%) were Staphylococcus epidermidis. Only one (1) (2.0%) was Staphylococcus cohnii, 4(8.0%) were Staphylococcus xylosus and then 4(8.0%) were identified as Staphylococcus intermedius. Table 4.14 and 4.15 showed the distribution of the identified organisms on farm to farm basis.

		Mean ± SEM				
Variables	**N**	**LMDF-Kaduna**	**SHDF-Kaduna**	**SHDF-Zaria**	**LMDF-Zaria**	**LOS**
pH	12	6.71±0.03b	6.81±0.02a	6.72±0.05b	6.73±0.06b	0.001**
Acidity	12	0.15±.004	0.15±.004	0.16±.003	0.17±.003	0.0005**
a, b= Means with different superscript in the same row differ significantly (*p<0.05; 0.05**p<0.01) SE						

Table 4.5: Mean values of the Chemical Properties of Fresh Milk Samples

Key:

SEM - Standard Error of Mean
N - Number of Samples Tested
LOS - Level of significance
LMDF - Large Mechanized Dairy Farm
SHDF - Small Holder Dairy Farm

	Farm Location	Acidity	pH
LMDF Kaduna	X1	0.14±0.01b	6.78±0.01
	X2	0.15±0.01ab	6.64±0.00
SHDF Kaduna	X3	0.15±0.01ab	6.52±0.01
	X4	0.15±0.01ab	6.64±0.01
	X5	0.16±0.01ab	6.96±0.02
	X6	0.16±0.01ab	6.75±0.01
SHDF Zaria	Y1	0.16±0.01ab	6.41±0.01
	Y2	0.17±0.01a	6.83±0.01
	Y3	0.17±0.01a	6.97±0.01
	Y4	0.16±0.01ab	6.72±0.01
LMDF Zaria	Y5	0.15±0.01ab	6.78±0.03
	Y6	0.14±0.01b	6.84±0.01
	P value	7.76	0.53
	LOS	0.001**	0.67ns

Table 4.6: Mean (±SEM) Acidity and pH of Fresh Cow Milk from Different Farms in Kaduna and Zaria

Means with different superscript in the same column differ significantly (*p<0.05; **p<0.01)

Key:

SEM - Standard Error of Mean
LOS - Level of significance
ns - not significant
LMDF - Large Mechanized Dairy Farm
SHDF - Small Holder Dairy Farm

	Proximate parameters (%)								
	Farm Location	Moisture	Ash	Protein	fat	Carbohydrate	Crude fibre	lactose	Total solids
LMDF Kaduna	X1	86.43±0.01h	0.88±0.01ab	4.50±0.01b	4.06±0.01i	4.23±0.01f	0.28±0.01e	4.72±0.01d	13.41±0.01e
	X2	86.62±0.01f	0.86±0.00ab	4.32±0.00c	4.15±0.01j	4.41±0.01e	0.23±0.01f	4.58±0.01f	13.32±0.01f
SHDF Kaduna	X3	87.34±0.01d	0.84±0.01c	3.43±0.01g	4.42±0.01e	5.35±0.01d	0.16±0.01gh	4.43±0.01g	12.84±0.00h
	X4	87.45±0.01c	0.85±0.01c	3.37±0.01h	4.38±0.01f	5.68±0.01c	0.14±0.01h	4.34±0.01i	13.46±0.01c
	X5	87.28±0.01de	0.86±0.01bc	3.24±0.01i	5.61±0.01a	5.57±0.01c	0.34±0.01d	5.16±0.01b	12.75±0.00i
SHDF Zaria	X6	86.52±0.01g	0.85±0.00c	3.06±0.01j	4.34±0.01g	5.42±0.01d	0.42±0.01b	4.20±0.01j	13.82±0.01a
	Y1	87.24±0.01e	0.85±0.01c	3.41±0.01g	5.62±0.01a	6.61±0.01a	0.45±0.01a	4.40±0.01h	12.64±0.01j
	Y2	86.30±0.00j	0.86±0.01bc	3.38±0.01h	4.24±0.01h	5.40±0.01d	0.39±0.01c	4.61±0.01e	13.28±0.01g
	Y3	87.94±0.04a	0.86±0.01bc	3.52±0.01e	5.51±0.01b	5.32±0.01d	0.26±0.01e	5.35±0.01a	12.51±0.01k
	Y4	87.52±0.01b	0.84±0.01c	3.49±0.01f	4.90±0.01d	6.24±0.01b	0.17±0.01g	4.72±0.01d	13.42±0.01de
LMDF Zaria	Y5	86.40±0.01ih	0.89±0.01a	4.62±0.01a	4.03±0.01k	4.51±0.01e	0.26±0.01e	4.83±0.01c	13.53±0.01b
	Y6	86.36±0.01ij	0.88±0.01ab	3.81±0.01d	5.41±0.01c	4.47±0.01e	0.28±0.01e	4.63±0.01e	13.44±0.01dc
	Pvalue	3.13	17.09	60.96	4.00	39.20	3.35	1.21	3.45
	LOS	0.001**	0.001**	0.001**	0.001**	0.001**	0.001**	0.001**	0.001**

Table 4.7: Mean values (± SEM) of the Proximate Composition of Fresh Milk Samples

Means with different superscript in the same column differ significantly (*p<0.05; **p<0.01)
Significant differences in means were separated using Turkey HSD test

Key:
SD - Standard Error of Mean
LOS - Level of significance
LMDF - Large Mechanized Dairy Farm
SHDF - Small Holder Dairy Farm

Farm Management type/location					
Parameters	LMDF Kaduna	SHDF Kaduna	SHDF Zaria	LMDF Zaria	LOS
Moisture	86.53±0.04b	86.38±0.01b	87.15±0.11a	87.25±0.18a	0.0004**
Ash	0.87±0.01b	0.89±0.01a	0.85±0.01c	0.85±0.01c	0.0001**
Protein	4.41±0.04a	4.22±0.18ab	3.27±0.04b	3.45±0.06b	0.0001**
Fat	4.11±0.02c	4.72±0.31b	4.69±0.16b	5.08±0.17a	0.02*
Carbohydrate	4.32±0.04d	4.49±0.01bc	5.50±0.04a	5.89±0.17b	0.0001**
Crude fibre	0.26±0.01	0.27±0.01	0.27±0.04	0.32±0.03	0.51
Lactose	4.65±0.08b	4.73±0.11a	4.53±0.11b	4.77±0.11a	0.03*
Total solid	13.37±0.02b	13.49±0.02a	13.22±0.13b	12.96±0.12c	0.03*

Table 4.8: Mean values (± SEM) of the Proximate Composition of Fresh Milk Samples from Different Points in Kaduna and Zaria

Means with different superscript in the same row differ significantly (*p<0.05; **p<0.01)
Significant differences in means were separated using Turkey HSD test

Key:
SEM - Standard Error of Mean
LOS - Level of Significance
LMDF - Large Mechanized Dairy Farm
SHDF - Small Holder Dairy Farm

CMT Reactions								
Farm magt system/location	Farms	No of samples	-	+	++	+++	∑(CMT≥+)	Prevalence (%)
LMDF	X1	98	80	8	6	4	18	18.0
Kaduna	X2	60	49	6	3	2	11	18.3
SHDF	X3	39	26	13	0	0	13	33.3
Kaduna	X4	40	28	8	4	0	12	30.0
	X5	18	7	5	5	1	11	61.0
	X6	60	51	4	4	1	9	15.0
SHDF	Y1	40	28	6	2	4	12	30.0
Zaria	Y2	40	33	5	2	0	7	18.0
	Y3	37	17	14	3	3	20	54.0
	Y4	40	31	3	3	3	9	23.0
LMDF	Y5	80	68	4	7	1	12	15.0
Zaria	Y6	40	29	3	5	3	11	28.0
Total	-	592	447	79	44	22	145	24.5
%	-	-	75.5	13.4	7.4	3.7	24.5	

Table 4.9: California Mastitis Test of Quarter Milk Samples

Key
- = Negative
+ = Weak positive
++ = Distinct positive
+++ = Strong positive
LMDF = Large mechanized dairy farm
SHDF = Small holder dairy farm

	Farm	Herd No		CMT Scores		
			-	+	++	+++
LMDF Kaduna	x_1	5	3	1	1	0
	x_2	3	2	0	1	0
SHDF Kaduna	x_3	2	1	1	0	0
	x_4	2	1	0	1	0
	x_5	1	0	0	1	0
	x_6	3	3	0	0	0
SHDF Zaria	y_1	2	1	0	0	1
	y_2	2	2	0	0	0
	y_3	2	1	1	0	0
	y_4	2	1	1	0	0
LMDF Zaria	y_5	4	4	0	0	0
	y_6	2	0	1	1	0
	Total	30	19(63)	5(16.7)	5(16.7)	1(3.3)

Table 4.10: California Mastitis Test of Bulk Milk Samples

Key: LMDF = Large Mechanized Dairy Farm, SHDF = Small Holder Dairy Farm. No in brackets represent percentage

		Mean (± SEM)	
Location	N	Total staphyloccal count (log10cfu/ml)	Mean colony count (log10cfu/ml)
LMDF Kaduna	30	4.00±0.12c	
SHDF Kaduna	47	5.87±0.01b	
SHDF Zaria	51	5.97±0.01b	4.26±0.45
LMDF Zaria	23	6.03±0.20a	
Bulk milk samples	8	2.23±0.15d	
Dairy Workers	4	1.43±0.15e	

Table 4.11: Mean (± SEM) Total Staphylococcal Count of Milk Samples

Means with different superscript in the same column differ significantly (*p<0.05; **p<0.01)

Key:

SEM - Standard Error Mean
N - Number of CMT positive milk samples tested
cfu - Colony Forming Units
LMDF - Large Mechanized Dairy Farm
SHDF - Small Holder Dairy Farm

Farm Location	CMT	Staphylococcal Count
LMDF kaduna	1.00	0.33*
	0.33*	1.00
LMDF Zaria	1.00	0.57**
	0.57**	1.00
SHDF Kaduna	1.00	0.44*
	0.44**	1.00
LMDF Zaria	1.00	0.68**
	0.68**	1.00
Bulk Samples	1.00	0.27*
	0.27*	1.00
Swab Samples	1.00	0.71**
	0.71**	1.00

Table 4.12: Correlation Between CMT and Staphylococcal Count at Different Sampling Points

Significance difference exist at (*p<0.05; **p<0.01)

Key:

CMT - California Mastitis Test
LMDF - Large Mechanized Dairy Farm
SHDF - Small Holder Dairy Farm

Isolate No	Octal code	Identity	% Probability
1.	77766	*Staphylococcus aureus*	99.64
2.	36666	*S. chromogenes*	99.98
3.	12446	*S. intermedius*	99.86
4.	12466	*S. intermedus*	99.86
5.	76676	*S. hyicus*	99.49
6.	26740	*S. xylosus*	96.64
7.	77746	*S. aureus*	98.08
8.	36666	*S. chromogene*	99.98
9.	72466	*S. aureus*	99.64
10.	77762	*S. aureus*	97.85
11.	377772	*S. haemolyticus*	96.65
12.	47672	*S. hyicus*	99.94
13.	76676	*S. hyicus*	99.49
14.	36667	*S. chromogenes*	99.95
15.	76662	*S. aureus*	99.26
16.	76652	*S. hyicus*	99.99
17.	67764	*S. aureus*	100.00
18.	26146	*S. xylosus*	99.80
19.	30266	*S. epidermidius*	99.83
20.	23606	*S. cohnii*	75.21

Table 4.13: Representative Phenotypic Identification of Staphylococcus Species Using the Microgen Staphylococcal Identification Kit from Milk Samples and Dairy Workers

Isolate	Frequency	Percentage
Staphylococcus aureus	19	38
S. chromogenes	09	18
S. haemolyticus	02	4
S. hyicus	09	18
S. epidermidis	02	4
S. cohnii	01	2
S. xylosus	04	8
S. intermedius	04	8
Total	50	100

Table 4.14: Frequency of Occurrence of Staphylococcus Species Isolated from Mastitis Milk Samples and Dairy Workers

Source	***S. aureus*, No isolated**	***S.chromogenes*, No isolated**	***S.intermedius* No isolated**	***S.hycius*, No isolated**	***S. xylosus*, No isolated**	***S.haemolyticus* ,Noisolated**	***S. epidermidis*, No isolated**	***S.cohnii*, No isolated**
LMDFK	2(4.0)	1(2.0)	1(2.0)	1(2.0)	1(2.0)	0(0.0)	0(0.0)	0(0.0)
SHDFK	4(8.0)	2(4.0)	0(0.0)	3(6.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
SHDFZ	5(10.0)	3(6.0)	1(2.0)	1(2.0)	1(2.0)	2(4.0)	0(0.0)	0(0.0)
LMDFZ	6(12.0)	2(4.)	1(2.0)	3(6.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
BMS	1(2.0)	1(2.0)	1(2.0)	1(2.0)	1(2.0)	0(0.0)	0(0.0)	0(0.0)
DW	1(2.0)	0(0.0)	0(0.0)	0(0.0)	1(2.0)	0(0.0)	2(4.0)	1(2.0)
Total	19 (38.0)	9 (18.0)	5 (10.0)	10 (20.6)	4 (8.0)	2 (4.0)	2 (4.0)	1 (2.0)

Table 4.15: Frequency of Occurrence of Staphylococcus Species(%) from Bovine Mastitic Milk on the Basis of Farm Locations

Key:

LMDFK - Large Mechanized Dairy Farm Kaduna
SHDFK - Small Holder Dairy Farm Kaduna
SHDFZ - Small Holder Dairy Farm Zaria
LMDFZ - LargeMechanizedDairyFarmZaria
BMS - Bulk Milk Sample
MH - Milkers Hands

4. Discussion

The overall prevalence of mastitis from CMT test in this study was 24.5%. This prevalence is appreciable and may be attributed to the general low level of hygiene observed in the clinical and farm inspection. However, this prevalence is lower compared to 30.5% reported by Umoh et al., 2007 for traditional dairy herds in Plateau State and 37.0% by Umoh et al., 1990 in a study carried out in Kaduna and Zaria which is the same study area with this study [8].

The difference could be due to the fact that while the other studies collected milk from nomadic Fulani herds only, the present study collected milk from both the traditional small holder farms and the large mechanized dairy farms, whose hygiene measures were higher. Also the sample collection for this study was carried out during the dry season (January to April). This is the period known to record low prevalence of organisms and also the period during which the pH of milk tends to be low, which inhibits the growth of most organisms [9].

However, the result is consistent with the 25.4% reported by Zouharova (2009) in Aydin, Turkey. The prevalence observed in individual farms showed the large mechanized dairy farms to have lower figures than their corresponding small holder dairy farms within the same sampling area. For instance, is was 18.0% and 18.3% in Kaduna large mechanized dairy farms but a prevalence of 30.0 – 61.0% was recorded for the small holder farms around Kaduna. This may be attributable to the fact that the large mechanized dairy farms adopted better farm management practices compared to the small holder dairy farms as evidenced in the outcome of farm inspection.

The prevalence of subclinical mastitis observed in the bulk milk samples, 16.7% and 3.3% were in conformity with the reported

15.9% of Strastkova *et al;* (2009) in Czech Republic in bulk tank milk and the 3.2% reported among nomadic herds by Umoh *et al;* (1990 a) [8]. The lower detection rate of mastitis in the bulk milk samples compared to the quarter milk was probably due to substantial dilution of contaminated milk and this helped to substantially reduce the likelihood of detection as reported by Strastkova *et al;* (2009).

The bacteriological quality of the fresh raw cow milk samples showed a high total staphylococcal count beyond the standard recommended by the American Public Health Association (APHA, 2001) which is Grade A raw milk ($<10^5$ cfu/ml) and Grade B (milk from local producers) ($<10^6$ cfu/ml). the counts for LMDF Kaduna ($\log_{10}$ 4.00 cfu/ml), SHDF Kaduna ($\log_{10}$ 5.87 cfu/ml), SHDF Zaria ($\log_{10}$ 5.97 cfu/ml) and LMDF Zaria ($\log_{10}$ 6.03 cfu/ml) were all too high, showing that the milk samples were contaminated with bacteria. Only the counts of the bulk milk samples ($\log_{10}$ 2.23 cfu/ml) and swab samples ($\log_{10}$ 1.43 cfu/ml) are within the standard range.

Abid *et al.,* 2009 reported that counts greater than 10^3 cfu/ml for raw milk indicates a serious fault in hygiene, the overall mean staphylococcal colony count of $\log_{10}$ 4.26 cfu/ml in this study therefore is relatively high and indicative of a milk that has suffered from bacterial contamination. The source of contamination in this study could be attributed to unsatisfactory condition of the housing for the cattle, poor sanitary procedures, and or secondary contamination from the skin, mammary gland and nasal cavity of the cows. Contamination could also be from the poor state of health of the milk animals (which could be habouring clinical or subclinical mastitis) and the bacterial causal agents from the udder may get into the milk.

The high level of association observed between CMT and staphylococcal count (table 12) is not surprising because according to the findings of Eldeeb and Hassan (1987) total bacterial count increase when milk tests positive for mastitis. In the same vein, bacteria that causes mastitis not only contaminate the milk but multiply and grow in the milk due to the fact that the milk is highly nutritious and serves as an excellent growing medium for a wide range of bacteria.

Mastitis has been reported as the most significant disease of the dairy industry, causing serious economic losses and species of staphylococcus especially *Staphylococcus aureus* was named as one of the most important causative agent all over the world. In the same vein, Hammed *et al.,* (2006) found in a study conducted in Egypt that 16% of all mastitis cases were caused by *Staphylococcus aureus*.

From the biochemical tests and the subsequent Microgen identification, *Staphylococcus aureus* was the most prevalent organism with 38%. This high detection rate may be due to its contagious nature, which has made it a major udder pathogen in many parts of the world, causing both subclinical and clinical mastitis [11]. This high percentage of *Staphylococcus aureus* agree with the result of Zubbeir and Elowni (2006) who got 34% from cattle in a similar study in Sudan.

The isolation of *Staphylococcus aureus* is of public health significance since it is a commonly recovered pathogen of food poisoning due to milk and milk products [11].

The other Staphylococcus species (CoNS) detected in this study included *Staphylococcus chromogenes* (18.0%) *Staphylococcus haemolyticus* (4.0%) *S. hyicus* (19.0%) *S. epidermidis* (4.0%) *S. cohnii* (2.0%) *S.xylosus* (8.0%) and *Staphylococcus intermedius* (8.0%).

This result agreed with that of Mahmmoud and Shamoon (2009) who isolated these similar bacteria from bovine mastitis in Iraq. It also agreed with the findings of Taponen *et al.,* (2006) who reported that among researches, isolation of *Staphylococcus chromogenes, Staphylococcus epidermidis* and *S. simulans* seem to be the most common coagulase negative staphyclococcus species (CNS) isolated from intra mammary infections inspite of some variations between herds, countries and methods [14].

Bovine CNS have traditionally been considered as skin flora opportunists and have also been isolated from the cow's environment [12]. *Staphylococcus chromogenes* was frequently isolated from the teat, skin and teat canal but also from extra mammary sites like nares, hair coat and vagina of cattle [13]. According to Matos *et al;* (1991) *Staphylococcus cohnii, S.saprophiticus* and *S. xylosus* were among the most common in the cow's environment such as in hay and beddings while Staphylococcus *haemolyticus* is an occasional pathogen of mastitis.

5. Conclusion

There was a high total Staphylococcal count (up to 6.03 ± 0.20 $\log_{10}$cfu/ml) which indicated a high level of milk contamination from unsatisfactory milking practices, this poses a health hazard of food borne infection to consumers through the food chain. The CMT value was about 25%, which is quite appreciable and this equally poses a threat of consumption of mastic milk from consumers and its attendant consequences. Different Staphylococcus species were isolated and identified from milk and dairy workers some of which include *Staphylococcus chromogenes* (18%), *S. intermedius* (8%), *S. haemolyticus* (4%) with *Staphylococcus aureus* being the most prevalent (38%). This is of public health significance because of its association with food poisoning in milk and milk products.

Recommendations

Dairy farmers should be educated by Government Agricultural Agencies and other stakeholders like Veterinary and Microbiology experts on the need to improve their level of hygiene in milk production and handling, through workshops, seminars and so on.

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