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Microbiological Assessment of Cow Milk under Traditional Management Practices in Ado-Ekiti, Nigeria

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Abstract: Studies on the microbiological quality of milk obtained from traditionally managed cows in Ado-Ekiti were carried out. The samples were screened for total bacteria count, total Coliform, yeasts and moulds. Ten (10) bacterial species, comprising both gram negative and gram positive organisms were isolated, characterized and identified in thirteen out of fifteen milk samples in this study. *Bacillus cereus* recorded the highest percentage occurrence (46.7%) isolated from seven samples while *Cellulomenas flavigena*, *Escherichia coli* and *Micrococcus luteus* recorded the lowest percentage occurrence (6.7%) having being isolated from one sample each. Yeasts and moulds were not isolated in any sample. The isolation of the various microorganisms in the milk samples is of health significance. The results showed that 87% of the raw milk samples were of poor category thus indicating a deplorable state of hygiene and poor production condition during and after milking.

Key words: Cow milk, *Bacillus* species, *Escherichia coli*

INTRODUCTION

Milk is a complex fluid secretion, excluding colostrums, with a complex biological molecule from the normal milking (manual or mechanical) of the mammary gland of a healthy, normally-fed lactating animal (Jensen, 1995). A number of animal are used to produce milk for human consumption, although, the cow is by far the most important in commercial terms (Adams and Moss, 1995) with White Fulani (Bunaji) recognized as the principal producer (Adeneye, 1989). The Agro-pastoral (traditional) system of cattle production, especially in Nigeria, provides nourishment for stock only on range vegetation (Otchere, 1986) which is characterized by high incidence of diseases and parasitism together with the adverse effect of tropical climate. Milk, which is a nutritious food for man is also an excellent growth medium for microorganism at suitable temperature (Adams and Moss, 1995). If it is produced unhygienically and handled carelessly, it gets contaminated leading to early spoilage (Prajapati, 1995; Schmidt and Van Vleck, 1982). Three sources contribute to the microorganism found in milk: The udder interior, the teat exterior and its immediate surrounding and the milker with the milking equipment. The presence of bacteria in milk could pose a serious health problem or risk to milk consumers as they had been attributed to various food-borne illness or diseases of public importance (Adak *et al*., 2005). Thus, milk demands high standard of hygiene in its production and processing (Adams and Moss, 1995). Historically little attention was paid to pastoralism because its potential contribution to development was regarded as limited except in recent times when animal scientists begun collection on milk quality under pastoral practices.

The present study has been designed to determine the degree of contamination of the cow milk produced under traditional practice with a view to assess its sanitary level and production condition.

MATERIALS AND METHODS

Study site: The study was carried out at the Fulani settlements, Erinfun, along the Federal Polytechnic Road, Ado-Ekiti. Ado-Ekiti is located in Ekiti State of Nigeria on the Eastern part of Southwest of Nigeria, a typical rainforest belt. It is located within the tropics between latitude 7° 45' to 8° 5' north of the equator and longitude 4° 45' to 5° 45' east of the Greenwich meridian. The annual precipitation is about 1400 mm. The mean annual temperature is 27°C with two distinct seasons of rainy season (April-October) and dry season (November-March) (Diinat, 2005).

Animal management: All the cows used for this study were owned by pastoralists and were raised under the traditional management systems. The animals were kept in open yard constructed mainly from local materials. The pens were made from wooden bars and the floor was covered with sand. The pregnant animals were kept in separate yards. The cows were entirely fed on range vegetation. Supplementary food was

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uncommon. Routine grazing was carried out twice daily (morning and evening) on natural pasture comprising mainly guinea grass *(Panicum maximum)* and other forages (*Eleusine* sp., *Pennisetum* sp., *Asphilla africana* and *Tridax procumbens*). Milking of the cows is usually carried out manually by the owner before morning grazing into the collecting pail. The length of the lactation period ranged between 9 to 10 months.

Milk sampling: A total of fifteen (15) lactating cows were randomly sampled. Representative samples of the milk obtained from the cows were collected inside clean, sterilized, white plastic container with double-cap device of 120 mL capacity. The samples were carried in an ice box to the laboratory for microbial analysis.

Microbial analysis: One milliliter sample was aseptically transferred into 9 ml of distilled water and mixed. Subsequent serial dilutions up to 10^4 were made. The enumeration of the microorganisms of the sample was by the pour plate techniques using the method of Colins *et al.* (1995). After incubation, at 37°C for 24 h, the resultant bacterial colonies were counted. The discrete bacteria colonies were sub cultured on fresh acidified extract agar, incubated at 28±1°C for 72 h for yeasts and moulds. The sub-culturing was also performed on violet red bile lactose agar and incubated at 37°C for 24 h. The resultant colonies with up to 0.5 mm in diameter were identified as Coliform bacilli The cultural, morphological and biochemical characterization of the isolated organisms were done using the methods of Holt *et al.* (1994), Cowan and Steel (1993); Harrigan (1998), Olutiola *et al.* (2000) and Fawole and Oso (2001).

RESULTS

The total bacterial count in the fifteen milk samples in this study is presented in Table 1. The total bacterial count ranged from 0 to 96 (10^4 cfu/ml). Coliform organisms were found in three samples; M-6, M-8 and M-11. Ten bacteria species comprising both gram positive and gram negative organisms were isolated from thirteen of the fifteen milk samples. Bacterial genera isolated were one each for M-3, M-5, M-7 and M-15; two each for M-1, M-9, M-11 and M-14; three each for M-6, M-8 and M-10 while M-12 and M-13 had four genera as presented in Table 2. No organism was found in samples M-2 and M-4. *Streptococcus cremonis* was isolated from samples M-1, M-3, M-11, M-14 and M-15; *Bacillus cereus* was isolated from samples M-6, M-7, M-8, M-9, M-10, M-13 and M-14; *Lactobacillus brevis* was isolated from M-11, M-12 and M-13; *Citrobacter freundii* was isolated from M-6, M-8 and M-12; *Staphylococcus aureus* was isolated from M-5, M-10, M-12, and M-13; *Pseudomonas caryophilli* was isolated from M-1 and M-9; *Xanthomonas fragariae* was isolated from M-6 and M-8 while *Cellulomenas flavigena*, *Esherichia coli* and *Micrococcus luteus* was isolated from M-10, M-12 and M-13 respectively. *Bacillus cereus* recorded the highest percentage occurrence (46.7%) isolated from seven samples followed by *Streptococcus cremonis* (33.3%) isolated from five samples. *Cellulomenas flavigena*, *Escherichia coli* and *Micrococcus luteus* recorded the least percentage (6.7%) occurrence having being isolated from each from one sample (Table 3). Yeasts and moulds were not isolated in any milk sample.

Table 1: Total viable counts (10^4 cfu/ml) of the microorganisms in the fresh cow milk

Samples	TPC	TYMC	TCC
M-1	15	0	0
M-2	0	0	0
M-3	96	0	0
M-4	0	0	0
M-5	13	0	0
M-6	35	0	3
M-7	36	0	0
M-8	84	0	75
M-9	10	0	0
M-10	55	0	0
M-11	44	0	28
M-12	96	0	0
M-13	26	0	0
M-14	10	0	0
M-15	46	0	0

TPC = Total Plate Count, TYMC = Total Yeast and Mould Counts, TCC = Total Coliform Counts

Table 2: Microorganisms isolated from fresh cow milk

Sample	Bacteria
M-1	*Streptococcus cremonis*, *Pseudomonas caryophilli*
M-2	None
M-3	*Streptococcus cremonis*
M-4	None
M-5	*Staphylococcus aureus*
M-6	*Xanthomonas fragariae*, *Bacillus cereus*, *Citrobacter freundii*
M-7	*Bacillus cereus*
M-8	*Bacillus cereus* *Citrobacter freundii*, *Xanthomonas fragariae*
M-9	*Pseudomonas caryophilli*, *Bacillus subtilis*
M-10	*Staphylococcus aureus* *Bacillus cereus* *Cellulomenas flavigena*
M-11	*Streptococcus cremonis*, *Lactobacillus brevis*
M-12	*Citrobacter freundii*, *Staphylococcus aureus*, *Lactobacillus brevis* *Escherichia coli*
M-13	*Bacillus cereus* *Staphylococcus epidermidis*, *Lactobacillus brevis*, *Micrococcus luteus*
M-14	*Bacillus subtilis*, *Streptococcus cremonis*
M-15	*Streptococcus cremonis*

Table 3: Types of microorganisms and their prevalence in the cow milk

Organisms	Percentage occurrence
Streptococcus cremonis	33.3%
Bacillus cereus	46.7%
Lactobacillus brevis	20%
Citrobacter freundii	20%
Staphylococcus *aureus*	26%
Xanthomonas fragariae	13.3%
Pseudomonas caryophilli	13.3%
Cellulomenas flavigena	6.7%
Escherichia coli	6.7%
Micrococcus luteus	6.7%

DISCUSSION

The identified bacterial species from the cow milk samples have been found in foods, environments and other places. According to Clarence *et al*. (2009), they may have entered the milk via cow, air, feedstuff, milk handling and through milking equipment. *Bacillus cereus* was present in seven milk samples. Its isolation and other bacteria species, *Streptococcus cremonis*, *Lactobacillus brevis*, *Citrobacter freundii*, *Xanthomonas fragariae*, *Cellulomenas flavigena* and *Micrococcus luteus* indicate a favourable environment that is capable of promoting their growth within the milk. Their presence is of health concern as some of them may be responsible for the various human ailments which may be dangerous to life.

Staphylococcus aureus was present in four milk samples. This organism may have entered the milk from nose where it is commonly found; hand, skin and clothing of handlers during milking processes (Hobbs and Golbert, 1982). Also, coughing, talking and sneezing may produce droplet which may settle on milk during milking.

Pseudomonas caryophilli was isolated from two samples. It belongs to a group of psychotropic bacteria that are capable of growing at 7°C or less. They grow at refrigerator temperature and cause spoilage, often resulting in off-flavours. The organism can be inactivated by pasteurization but may occur in milk from post-pasteurization contamination due to faulty heat or poor sanitary practices by the handlers. It is worthy of note that *Staphylococcus aureus* and *Pseudomonas caryophilli* are pathogenic organisms of public health problem or risk to milk consumers as they had been attributed to various food-borne illness or diseases of public importance (Adak *et al*., 2005).

Esherichia coli, a coliform organism was isolated form one sample. The Coliform result was a useful evidence of the extent of fecal contamination in milk. Its presence suggested unsanitary milk practices, poor herd hygiene, contaminated water, improperly washed and maintained milk utensils (CDFA, 2008). Most strains of *Esherichia coli* do not cause illness live in the intestinal tracks of healthy human and animals. *E. coli* 0157:H7 is found in the intestinal tracts feces of cattle and can be destroyed by pasteurization. *E. coli* 0157:H7 produces toxins that cause illness in humans with bloody diarrhea and abdominal cramps as symptoms. It can also result to hemolytic uremic symptom especially in young children which in some cases result to death (Jayarao *et al*., 2001 and 2006; Padbye and Doyle, 1999 and Steel *et al*., 1997).

It is more effective to exclude microorganisms than to try to control microbial growth once they enter milk. Future contamination of milk may be controlled by thorough washing of hands by the handlers, use of clean milk-handling equipment and provision of clean water to the animals. Heat treatment process (pasteurization) may also be applied to the milk to kill the pathogens to improve its keeping quality. Most importantly, consistence adherence to recommended milking procedures, and effective cleaning and sanitation practices will enhance the production of raw milk that meets the acceptable standards i.e milk with minimum bacteria population/count.

However, the presence of the possible pathogenic organisms in the analyzed fifteen cow milk should be of great concern to the producers, consumers and the concerned arms of Government since food poisoning by *Bacillus cereus* may also occur as a result of consuming contaminated milk.

Therefore, the time is now to educate the producers (pastoralists), who had been neglected by policy, on proper herd management and the need to maintain good sanitary practices during and after milking processes and the inherent health risk associated with consuming contaminated milk and milk products.

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