MICROBIOLOGY

DETERMINATION OF HAZARD ANALYSIS CRITICAL CONTROL POINT OF FERMENTED MILK (*NONO*) USING *STAPHYLOCOCCUS AUREUS* AS INDICATOR

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Abstract
A component of hazard analysis critical control point (HACCP) was used to investigate the hazards associated with milk processing from the source to the market, using *Staphylococcus aureus* as indicator. The aerobic plate count for milk samples at different stages of processing (milking, fermentation, transportation and market) were determined. Contamination of milker's hand and milk contact surfaces during the processing was also investigated for evidence of bacteria load.Adulterated fermented milk at the point of retail was found to produce a high yield of *Staphylococcus aureus* with an average count of $141.8x10^7$ cfu/ml. Fresh milk and unadulterated fermented milk yielded a colony count of 109.5 cfu/ml and $65.1x10^7$ cfu/ml respectively. The calabashes used for collecting and transporting the milk samples and the milkers' hands yielded $210x10^2$ cfu/cm^2, $192.6x10^2$ cfu/cm^2 and $154.9x10^2$ cfu/cm^2 respectively. These findings suggest that contamination of milk occurs during processing at the point of collection, transportation, adulteration and retail. Good sanitary measures are therefore advocated in order to obtain wholesome milk at point of consumption.
Key words: HACCP, Milk, Fermented Milk, *Staphylococcus aureus,* Sokoto.

Introduction

One method that has been used in developed countries to ensure the safety of food from the time of preparation to the time of consumption is Hazard Analysis critical control point (HACCP) (Frazier and Westhoft, 1978). HACCP was first used in United State of America by industry, the army and National Aeronautics and space administration (NASA) in the 1960s, to produce the safest food possible for the space program (Frazier and Westhoft, 1978). It was incorporated into red meat and poultry slaughter establishments in 1985, and today it has since been applied by large industrial concerns, cottage industries and even in domestic food preparation (Adams and Moss, 1995). The main aim of HACCP is to ensure food safety by anticipating food borne hazards and instituting appropriate control to prevent their occurrence (Cross, 1996). The principle of the system is the identification of points in the food processing chain at which hazard can be identified and controlled, establishing acceptable limits for hazard and determining methods for routinely monitoring and controlling the processes (Cross, 1996).

One of the most important foods of animal origin produced and consumed among inhabitants of Sokoto State is "nono", a locally fermented often times unpasteurized milk product. It is used as a local staple gruel known as "fura da nono". This unpasteurized milk may contain varying numbers of organisms, depending upon the system of animal management, milking processing, cleaning and handling of milk utensils (Umoh, 1988). Among the contributing factors for contamination of "nono" with bacteria are milker's hand, contaminated surfaces of equipments or utensils used during milking or milking process (Robert, 1982). HACCP can be estimated based on the cfu of some common organisms to estimate the degree of contamination.

The application of HACCP in fermented milk processing in Sokoto using the isolation of *Staphylococcus aureus* from the milk samples is reported in this paper.

Materials and Methods

Samples were collected from households involved in processing and retailing of milk. In all, milk from twenty households were followed up from the point of milking to the market. Processing of milk usually involves collection of fresh milk, fermentation, transportation, adulteration and marketing.

At each step of the process, 100ml of sample were obtained in sterile Bijou bottles and swab samples were also obtained as described by Speck (1976) of which sterile cotton tipped swab placed into a test tube containing 5ml normal saline diluent with screw–capped was used to obtained swab from milkers' hand and milk contact surfaces of containers. All samples were transported on ice pack to the laboratory for bacterial analysis.

A ten fold serial dilutions of the samples (milk and swabs) were made (10^{-2} to 10^{-7}) in sterile normal saline, cultured and incubated at 37^{0}C for 24 hours; for bacteriological analysis. Sterile media plates of nutrient agar and mannitol salt agar were used for ioation of *Staphylococcus aureus*. Formed colonies were counted using colony counter (Gallenkamp, England). The presence of *Staphylococcus aureus* was confirmed using the standard biochemical test as described by Cowan and Steel (1993). That is by gram staining techniques, catalase and coagulase tests.

Statistical Analysis

Total Aerobic plate counts (cfu/ml) for freshly obtained

milk and fermented milk samples were compared statistically using student t-test for significance difference at 95% confidence interval. Also compared was that of fermented milk and water adulterated fermented milk.

Results

The results of bacteriological analyses of samples from the twenty households involved in milking, milk processing and retailing of milk products are shown in tables I and II.

The mean total aerobic plate count (TAPC cfu/ml x 10^7) of $109.5x10^7$, $65.1x10^7$, and $141.8x10^7$ was obtained from freshly obtained milk , fermented milk and adulterated fermented milk respectively.

For milk contact surfaces mean total aerobic plate count (TAPC cfu/cm^2 x 10^2) of 154.85, 210.00, 192.55 and 157.45 was obtained from milker's hand, collecting utensils fermenting utensils, before addition of starter culture and retailing utensils respectively.

Statistically the difference in the mean count (cfu/ml) was significant between freshly obtained milk, and fermented milk and between fermented milk and water adulterated fermented milk ($P<0.05$).

Table 1: Total aerobic plate count (TAPC) of milk sample tested at different stages of processing

Samples(n=20)	Mean CFU/ml x10^7 ± S.D.	Range
FM	109.5 ± 46.86	(69-99)
FM-W	65.1 ± 21.01	(20-111)
FM+W	141.8 ± 60.16	(66-360)
FM	= Freshly obtained milk	
FM – W	= Fermented unadulterated milk	
FM + W	= Fermented adulterated milk. (i.e. water was added at this stage).	

Table 2: Total aerobic plate count (TAPC cfu/cm^2 x 10^2) of milk contact surface at different stages of processing

Samples(n=20)	Mean CFU/cm^2 x 102 ± S.D.	Range
MH	154.85 ± 68.78	(70-285)
CU	210.00 ± 106.80	(79-335)
FU	192.55 ± 123.80	(59-320)
RU	157.45 ± 78.50	(71-330)
MH	= Miller's hand	
CU	= Collecting utensils	
FU	= Fermenting utensils	
RU	= Retailing utensils	

Discussion

The locally fermented milk (nono) is largely consumed in the northern parts of Nigeria especially in Sokoto state. Little work has been done to ascertain the quality of "nono" produced in relation to public health (Akinyaju, 1989). But no work has been done to analyse the hazard associated with this product from source to market.

The result obtained $141.8x10^7$ mean value of adulterated fermented milk at point of retail shows a great increase when compared to WHO'S standard of $3.0x10^2$ CFU/ml for milk. This indicate that the adulterated fermented milk is unfit for consumption. Though the fermentation process reduces the bacterial load from $109.5x10^7$ CFU/ml to $65.1x10^7$ CFU/ml as expected but there was sudden increase to $141.8x10^7$ CFU/ml after addition of water as practisced. This further implies that the water used at this point is also contaminated.

The average bacterial count of $154.9x10^2$ CFU/cm^2 and $210x10^2$ CFU/cm^2 obtained from the milker's hands and collecting utensils respectively is an indication of poor sanitation and call for improved sanitary measures during milk processing to"nono". The counts obtained are greatly higher than WHO's standard of $1.5x10^2$ cfu/CM^2 for all food contact surfaces (Anon, 1992).

The cause of high bacterial contamination obtained from milk and as well as from the swab samples is attributed to the dairy animals, human handlers or milkers' hands and utensils. In addition, there are lack of pasteurization, addition of contaminated water and local starter culture and lack of proper education on hygienic milking practice and environment at which this product is being processed and sold. Schwabe (1969) has earlier pointed to these factors that was obtained at present in the study area.

This work has shown that milk processing to fermented milk (nono) can get contaminated at any stage or step of the process. With the growing increase in fermented milk products consumption, there is a need to introduce the HACCP concept, which can detect any hazard associated with the product at any stage in the production line. This concept is much safer as it monitor's a product from the time of production to the time of consumption, not only considering the hazards associated with the product at retail point.

It is recommended that health authorities in Sokoto State should include HACCP in milk inspection policies. However, further research work is needed to check their sources of water for bacterial pollutants. In addition, systematic identification of hazards associated with chains of all food production processes needs to be determined and control measures developed and monitor their effectiveness, so as to make HACCP a sound public health concept.

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