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HAZARD ANALYSIS CRITICAL CONTROL POINTS OF FARMYARD PRODUCTION OF *WARA* – A POPULAR NIGERIAN CATTLE MILK FOOD

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ABSTRACT

Hazard Analysis Critical Control Points of the production methods of farmyard-processed Nigerian *wara* were determined using survey studies and oral interviews. Low to moderate sources of microbial hazards included boiling of fresh cowmilk containing *Calotropis procera* extracts, transfering of moulded *wara* into boiled cowmilk whey, included addition of crushed *Calotropis procera* leaves and stem to fresh cowmilk and transporting *wara* to market for sale and packaging of *wara* for sale. High sources of microbial hazards were manual milking of several cows to obtain fresh milk samples, and collection of milk samples from different cows in same containers. Significant preventive control of the identified microbial hazards for *wara* were- keeping of cows in hygienic farmyards, non-milking of mastitic / ill cows, proper hygiene by food handlers, usage of clean processing materials, wholesome water samples and hygienic processing conditions. There is need for effective HACCP for quality control and assurance of farmyard-produced Nigerian *wara*.
Keywords: Cattle milk, food quality control, HACCP, local cheeses, *wara*

INTRODUCTION

Hazard Analysis Critical Control Point (HACCP) is a risk-based preventive approach system designed to identify, evaluate and control the potential food safety hazards, by providing precise process-control measures for each step of an entire food manufacturing process (FDA, 2001), to increase levels of food safety assurance (Beekhuis-Gibbon *et al*., 2011). The United States Department of Agriculture (USDA) regulates the HACCP for meat and poultry industry while the Food and Drug Administration (FDA) regulates the HACCP in seafood, juice and egg industries. Particularly, FDA (2007) developed hazards and controls guides for the dairy industry, as well as the unhygienic and contaminated cheese products, which have most times been responsible for outbreaks of food poisoning. Food illnesses caused by , *Staphylococcus aureus*, *Salmonella* serovars, *Yersinia*, *Mycobacterium bovis*, *Bacillus cereus*, *Brucella* spp., *Campylobacter* spp., *Coxiella burnetii*, *E. coli*., *Shigella* spp., *Streptococ-*

cus spp. *Toxoplasma* spp. and yeasts have been associated with the consumption of dairy products (Gadaga *et al.*, 2000; El-Baradei *et al.*, 2007; Abdel All and Dardir, 2009; Aïssi *et al.*,2009; Dadie *et al.*, 2010; De Jonghe *et al.*, 2010; Jaros *et al.*, 2012; Njage *et al.*, 2013).

Increasing demand for milk and dairy products affords great opportunity and potential for the small-scale processed milk producers and for the development of milk production and processing industry. Whereas, the needs and demand for dairy products in sub-Saharan Africa is under-estimated in spite of the fact that dairy products like *wara / warakanshi* (a Nigerian indigenous, unripened soft cheese produced from cow milk) is highly essential, especially with the high rates of poverty, malnutrition and infant mortality. For tropical cheeses, little information is available on their microbial safety (Pacheco and Galindo, 2010) in addition, there is very little scientific information available on cheeses produced in Africa, since the processing methods is a traditional art passed from generation to generation through observation and practical experiences. The Egyptian domiati has been reported as the most popular scientifically well documented African soft cheese (Raheem ,2006). African soft cheese have different names in African countries, namely *amasi* (Zimbabwe), *aoules* (Algeria), *ayib* (Ethiopia), *fromage* (Madagascar), *gybna beyda* (Sudan), *karish* and *laban rayeb* (Egypt), *kule naoto* (Kenya), *mashanza* (Congo), *mudaffara* (Sudan), *wagashi* (Benin, Mali), *warangashi* (Benin), *wara / warakanshi* (Nigeria) etc. (Raheem, 2006; Aïssi *et al.*, 2009; Gonfa *et al.*, 2001; Mathara *et al.*, 2004; Mufandaedza *et al.*, 2006; Adetunji and Chen, 2009).

Soft *wara* cheese produced in Nigeria at local farms, mostly by the nomadic Fulani women involves the use of local ingredients which may be a source of microbial contamination. The plant rennet used as coagulant in the production of *wara* cheese is commonly obtained from native Sodom apple plant (*Calotropis procera*) extract (Adetunji and Chen, 2009). Reported cases of food poisoning outbreaks resulting from consumption of contaminated cheese (Cauteren *et al.*, 2009; Sangoyomi *et al.*, 2010) call for effective quality control of the processing methods of the farmyard-processed Nigerian *wara* as majority of people consume wara without further heat processing (boiling /frying) In line with this, it is very important to determine and report the hazards and critical control points of indigenous farmyard production of wara a popular processed cow milk product in Nigeria. This study investigated the hazards and critical control points in the traditional processing of *wara*.

MATERIALS AND METHODS

Information on farmyard production of *wara* were obtained from indigenous Fulani female producers at four locations namely; Ibadan and Oyo (Oyo State), Iwo in Osun Stae and Ilorin in Kwara State. Verbal informed consents were obtained from the *wara* producers and their husbands, while video recordings and pictures of the entire production process were taken and questions also asked during the production of *wara* samples. The study was conducted in between April and August, 2013.

RESULTS

The indigenous farmyard processing method of *wara* from cow milk in Nigeria is as presented in Fig. 1 and Plates 1-14, while the Hazard Analysis Critical Points and Hazard Analysis Control Measures for farmyard processing of *wara* are presented in Fig. 1.

Lactating dairy cows feeding the calf** [þ ©]

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Manual milking of cows to obtain fresh milk samples*** [þ © §]

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Collection of milk samples from different cows into same containers*** [þ © §]

↓

^Addition of little water to ready-to-boil fresh cow milk*** [þ © §]

↓

Crushing of *Calotropis* leaves and stems** [þ © §]

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Addition of crushed *Calotropis* leaves and stem to fresh cow milk** [þ © §]

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Mixing of crushed *Calotropis* leaves and stem extracts with fresh cow milk** [þ © §]

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^Addition of little water to ready-to-boil fresh cow milk containing *Calotropis* leaves/stem extracts**[þ © §]

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Boiling of fresh cow milk containing *Calotropis* extracts* [þ © §]

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Removal of oil film (layer) on boiling cow milk* [þ © §]

↓

Removal of fire woods for gentle heating of boiling cow milk

↓

Gentle heating of boiling cow milk

↓

Foaming of boiling cow milk

↓

Filling local moulds with boiled cow milk** [þ © §]

↓

Draining of whey from boiled cow milk** [þ © §]

↓

Transfer of moulded *wara* into boiled cow milk whey* [þ © §]

↓

Transporting *wara* to market for sale** [þ © §]

↓

Packaging of *wara* for sale** [þ © §]

Fig. 1: Farmyard-produced *wara* cheese process flow diagram / Hazard Critical Points / Hazard Analysis

Control Measures of farmyard-produced *wara* processing

Keys: ^ = processing methods that slightly vary among *wara* producers; [*] = sources of microbial hazards; * = low source of microbial hazard; ** = moderate source of microbial hazard; *** = high source of microbial hazard; [þ] = preventive measure for controlling the identified microbial hazard; [©] = control measure for the identified microbial hazard; [§] = special process measure for controlling the identified microbial hazard.

Lactating cows were allowed to feed their young for some time (about five minutes) to induce lactation (Fig. 1; Plate 2), before forcing them away from the udders, after which the lactating cows were manually milked by pressing the udders with fingers to obtain fresh cow milk samples (Fig. 1; Plates 3a & 3b). Milk samples (Plate 4a) were usually collected from as many lactating cows as possible and deposited in a big container until enough quantities were obtained (Plate 4b). *Calotropis* leaves and / (or) stems were then crushed (Fig. 1; Plates 5a & 5b) and added to the fresh cow milk sample by mixing (Fig. 1). There were three major methods of adding the *Calotropis* leaves and stems to the fresh milk samples. First, the *Calotropis* leaves or stems could be partially crushed and the extract squeezed directly into the raw milk (Plates 6a & 6b) for a period of about 3-5 minutes before boiling. Second, *Calotropis* leaves or stems could be partially mashed and added directly to the fresh milk and left until when boiled or thirdly, the *Calotropis* leaves or stems could be partially crushed and the extract squeezed into about 100 ml of water, which would then be added to the fresh milk before boiling. In some cases, prior to boiling, there was addition of little water to the ready-to-boil fresh cow milk already containing *Calotropis* extract (Fig. 1; Plates 7a & 7b). Boiling of milk took between 30 and 40 min.

Boiling cow milk was gently stirred once or twice prior to formation of oil film (layer), which was scooped from the boiling cow milk (Fig. 1; Plate 8c). About seven minutes after the milk started to boil, there was removal of burning fire woods, leaving smouldering fire woods for gentle heating of the cow milk (Fig. 1; Plates 9a & 9b) for about 20 minutes. Gently boiling cow milk (Fig. 1; Plate 10) was stirred intermittently and then left until the boiling cow milk coagulated and separated into curds and whey, and about five minutes after, the cooking pot was removed from fire. Local, basket moulds (Plate 11a) of various shapes and sizes were immediately filled with the boiled cow milk (Fig. 1; Plate 11b) and the whey completely allowed to drain (Fig. 1; Plate 12). The whey was discarded. Moulded *wara* having the shape of the mould were then transferred into boiled cow milk whey for transportation to the market for sale (Fig. 1; Plate 13).

Wara were usually packaged for buyers in transparent polyethylene bags (Fig. 1; Plate 14). Post-production home preparations of bought *wara* samples can include re-boiling with or without addition of table salt, frying with vegetable / palm oil or direct addition of *wara* into stews, sauces and other prepared dishes. The Hazard Analysis Critical Points and Control Measures of farmyard-produced *wara*, are indicated in Fig. 1.

In this study, there were three identified types of sources of microbial hazards in the traditional processing of *wara*. Low sources of microbial hazards included boiling of fresh cow milk containing *Calotropis* extracts, removal of oil film (layer) from boiling cow milk and transferring of moulded *wara* into boiled cow milk whey. Identified moderate sources of microbial hazards included cows feeding the young prior to milking, addition of crushed *Calotropis* leaves and stem to fresh cow milk, mixing of crushed *Calotropis* extracts with fresh cow milk, draining of whey from boiled cow milk, transporting *wara* to market for sale and packaging of *wara* for sale. Identified high sources of microbial hazards were manual milking of several cows to obtain fresh milk samples, collection of milk samples from different cows in same containers, addition of little water to ready-to-boil fresh cow milk and filling local moulds with boiled cow milk (Fig. 1).

1. *Lactating cows feeding the young* [**]

Udders of lactating cows were not usually cleaned after the young had been fed before milking for *wara* production. There is therefore, strong likelihood of transmission of microbial pathogens through the udders.

Plate 1: Resting cows

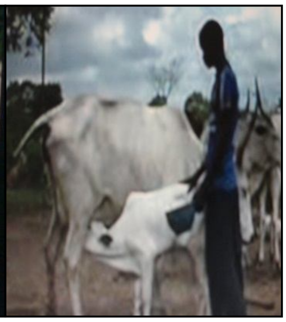

Plate 2: Adult cow feeding the young

Plates 3a & 3b: Manual milking of cow

Plates 4a & 4b: Fresh cow milk samples

Plates 5a & 5b: Crushing of *Calotropis* leaves and stem

Plates 6a & 6b: Adding and mixing crushed *Calotropis* leaves and stem into fresh cow milk

Plates 7a & 7b: Ready-to-boil fresh cow milk containing Calotropis and stem extracts


Plates 8a, 8b: Boiling fresh cow milk containing Calotropis extracts

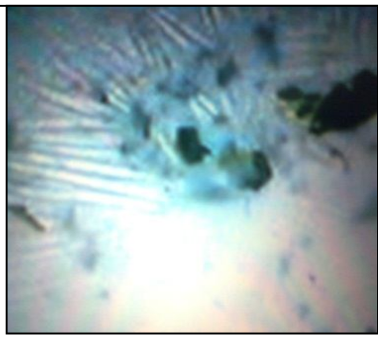

Plate 8c: Oil film (layer) on boiling cow milk

Plate 9a: Removal of fire woods for gentle heating of boiling cow milk

Plate 9b: Gentle heating of boiling cow milk

Plate 10: Foaming of boiling cow milk

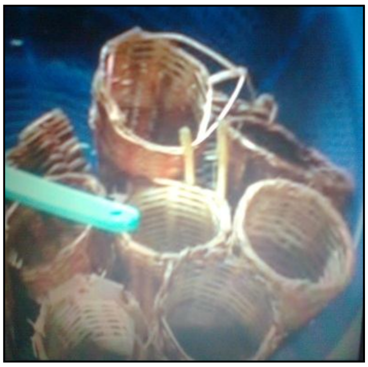

Plate 11a: Local moulds for *wara*

Plate 11b: Filling local moulds with boiled cow milk

Plate 12: Drained boiled cow milk

2. *Manual milking of several cows to obtain fresh milk samples* [***]

Manual milking with bare hands (which were mostly unwashed / not properly washed), vessels used for collection of milk samples and milk collection method can introduce microbial pathogens into fresh milk samples. Also, cows usually resting with ventral sides down in the farmyards (Plate 1); would contribute to contamination of the cow milk samples during milking through the udders.

3. *Collection of fresh milk samples by manual milking of several cows* [***]

Pooling of fresh milk samples collected from different lactating cows in same containers until enough quantity for *wara* production was obtained is a critical point, since milk from infected cows (such as mastitic cows) or milk samples containing toxin -producing microbes can be added to wholesome milk samples, which can eventually cause contamination of the milk sample for *wara* production.

4. *Addition of crushed Calotropis leaves and stems to fresh cow milk samples* [**]

Crushing and hand-mixing of *Calotropis* leaves / stems' extracts (1 ml)with the liquid milk (50 ml) and removal of spent *Calotropis* leaves / stems can also contaminate the fresh cow milk during *wara* production. *Calotropis* leaves and stems, even after being rinsed in water can still contain pathogenic microorganisms that can be introduced into the milk sample during the addition (mixing) of *Calotropis* extract as a coagulant. The *wara* producers can also contaminate the milk during addition of *Calotropis* extract if their hands are contaminated.

5. *Water samples* [***]

Water supply used in the farmyard production of *wara* were mostly stream or well water samples; therefore, lack of potable water is a critical control point in *wara* production, since such water samples were used for mixing cow milk and *Calotropis* leaves and stems, and for cleaning the processing items and vessels.

6. *Boiling of fresh cow milk* [*]

Most of the microbial pathogens can be eliminated or reduced to safety levels during boiling, which can be taken as a type of pasteurisation; however, it is possible that certain toxins produced by some microbial contaminants may survive the boiling effect. Stirring spoons and wooden stirrers can also be a source of minimal microbial contamination during the removal of the foamy portion of the boiling milk.

7. *Moulding of boiled cow milk and draining of whey* [**]

Local woven basket moulds were usually cleaned before and after usage by rinsing with water, while some quantities of water added to the whey before transferring moulded *wara* samples into whey were usually stream, stored rain or well water samples, and pathogenic water-borne microorganisms can thereby, be introduced into the freshly prepared *wara* samples.

8. *Transportation of wara to the market* [**]

It could take between 30 minutes to 2 hours after production for the *wara* to be taken to the market; while it could take between one to two days for a batch of produced *wara* to be sold at the market; therefore, it can take about two days for any likely introduced microbial pathogens or contaminants in the prepared *wara* to either increase in microbial loads or to release toxins into the *wara* samples.

9. *Packaging of wara for sale* [**]
Wara were normally packaged in small transparent polyethylene bags after purchase at the market, except in special cases, when large quantities of *wara* were needed that they could be sold into containers brought by the buyers. It is also important to note that most times, the polyethylene bags used for *wara* package were not prepared to standard and therefore could be difficult to open; so, most times, the sellers blew air from their mouth into the bags to force-open them; thereby, likely introducing saliva, oral microbial flora etc. into the bags. A number of buyers eat market *wara* without any post-production home preparations, and in such case, any microbial pathogens or contaminants in the market *wara* can be eaten directly.

Fig. 1, which is the suggested flow diagram for hazard analysis control measures for farmyard processing of *wara*, highlighted the preventive, control and special process measures for controlling identified microbial hazards during *wara* production:

- *Pre-manual milking* [þ © §]
Microbial contamination due to the lactating cows resting on contaminated farmyard floors can be prevented or controlled by cementing the farmyard floors and washing and sanitizing regularly, while the lactating cows' udders and areas around the udders can be properly cleaned, at least by brush-washing with soap and water, prior to milking.

- *Manual milking* [þ © §]
Proper personal hygiene and handling by food handlers, i.e., food handlers can wash and disinfect hands before milking or wear disposable gloves before milking, while special process can be usage of handy, easy-to-use sterilisable milking equipment.

- *Milking of several lactating cows to obtain fresh milk samples* [þ © §]
Collection of milk samples from different lactating cows to obtain enough quantities for *wara* production cannot be prevented or controlled, since a single lactating cow cannot produce adequate quantity of fresh milk samples for *wara* production. However, mastitic or ill cows should not be milked for *wara* production.

- *Milking vessels and milk collection containers* [þ © §]
Milking vessels and containers can be thoroughly washed before and after each use, and also rinsed with hot boiled water or briefly boiled in clean cooking pots.

- *Addition of little water to ready-to-boil fresh cow milk* [þ © §]
Water samples used for *wara* processing can be boiled well water, and treated borehole water can be fetched and stored for use.

- *Crushing and addition of Calotropis leaves and stems to ready-to-boil fresh cow milk* [þ © §]
Calotropis leaves and stems must be properly rinsed with water before crushing. Proper personal hygiene and handling are a must, i.e., washing and disinfecting hands before crushing the *Calotropis* leaves and stems. Also, grinding stone is better for crushing the *Calotropis* leaves and stems, instead of wood surfaces, since the grinding stone can be properly washed and also surface-sterilised by repeated rinsing with clean, hot water.

- *Mixing of crushed Calotropis leaves and stem extracts with ready-to-boil fresh cow milk* [þ © §]
Proper personal hygiene and handling, i.e., food handlers can wash and disinfect hands or wear disposable gloves to mixing crushed

Calotropis leaves and stem extracts with ready-to-boil fresh cow milk.

- *Removal of oil film (layer) from boiling cow milk* [ꞵ © §]
The stirring spoon must be properly washed with soap and rinsed with clean, hot water before and after use. Stainless stirring spoons are better than plastic spoons for proper disinfection with hot water.

- *Filling of local basket type moulds with boiled cow milk* [ꞵ © §]
Moulds / containers must be properly brushed-washed before and after use with soap and rinsed with clean, hot water.

- *Draining of whey from boiled cow milk* [ꞵ © §]
Instead of leaving moulding *wara* uncovered in a shallow bowl during draining of the whey, they must be covered with stainless tray that can be properly washed before and after use with soap and rinsed with clean, hot water.

- Transferring moulded *wara* into boiled cow milk whey [ꞵ © §]
Water added to the whey before transferring of moulded *wara* must be wholesome or adequately boiled.

- *Transporting wara to the market for sale* [ꞵ © §]
Freshly prepared *wara* must be kept and transported to the market in clean, covered containers, especially stainless steel containers.

- *Packaging of wara for sale* [ꞵ © §]
Proper personal hygiene and handling by food handlers (retailers and consumers) must be ensured, in addition, air from the retailers' mouth must not be blown into the small polyethylene bags used for packaging wara for sale

DISCUSSION

Production of local cheeses in African countries has been increasing, although there is very little scientific information available on such cheeses (Raheem, 2006) but in countries with intensive dairy industries, cheese provides an ideal vehicle for preserving the valuable nutrients of milk. In addition, cheese is an excellent source of protein, fat and minerals, such as calcium, iron, phosphorous, vitamins and essential amino acids (Adeniji and Keshinro, 2011; Shah, 2015), making it an important food in the diets of both the young and old. The lack of industrial production of traditional cheese varieties in Nigeria has resulted in the underutilization of the nutritional benefits of locally produced cheese. There is therefore, a clear need to improve on the production of farmyard wara and other African foods and beverages (Ogunshe and Olasugba, 2008; Ogunshe and Okereh, 2011). Farmyard production of *wara* also needs to be controlled, by the introduction of a systematic hazard analysis that is used to identify and control the critical control points (CCPs) at each step of the production process to ensure food safety and prevent food-borne illnesses (Riswadkar, 2000).

HACCP, which was originally developed as a *zero defects* program and considered to be synonymous with food safety, was aimed at assuring pathogen-free foods for the space program by the Pillsbury Company, the U.S. Army, and the National Aeronautics and Space Administration (NASA) in the 1960s and was also used in the food processing industry for low-acid canned food production in the 1970s. However, the HACCP system focuses on identifying and preventing hazards rather than relying on intermittent checks of manufacturing processes and random sampling (Riswadkar, 2000). HACCP is a straightforward and logical, science-based system that uses preventative action to address potential microbiological, chemical and physical hazards that are identified in the process, as well as ensuring that food safety hazards are controlled to prevent unsafe food from reaching the consumer (Bardic 2001). Since attention has been drawn to human health hazards due to potential presence of pathogenic bacteria from raw milk used in cheese production in dairy industries, it is then appropriate if HACCP is designed to be applicable as a quality control program for *wara* production, a very popular uncoloured (white/ cream), soft cheese produced from cow milk in Nigeria by the nomadic Fulani women.

Cheese making is the process of removing water, lactose and some minerals from milk to produce a concentrate of milk fat and protein, while the essential ingredients for cheese are milk, coagulant, starter cultures etc. Hazard identification is therefore, helpful in identifying potential microbiological, chemical and physical hazards that may occur during each processing step of *wara*. Although microbiological quality and safety of raw milk and soft cheese, as well as antagonistic activities against foodborne pathogens have been documented (Ortolani *et al.*, 2010), microbiological hazards include harmful microbial pathogens and toxins introduced during *wara* production (De Jonghe *et al.*, 2010; Sangoyomi *et al.*, 2010), as well as microbiological hazard from improper personal hygiene (Pacheco and Galindo, 2010). Likely chemical contaminants include toxins that may be from the vegetable rennet (*Calotropis*) added during *wara* processing, while physical contaminations can include foreign materials that could come from incorrect personal handling or processing environmental conditions (Zhao, 2003).

The goal of Critical Control Points (CCPs) is to ensure that food safety hazard can be prevented, controlled, reduced or eliminated; thus, CCPs should be established at the points in a process where lack of control is likely to result in a potential safety hazards (Taeymans, 2011). The health of cows (e.g., cows suffering from mastitis or inflammation of the udder) may affect milk composition considerably, and since the composition of milk is very important for the manufacture of dairy products, identification of raw, fresh cow milk as a CCP in *wara* production is therefore, very important, considering the fact that the milk samples are usually pooled from various milked lactating cows. It is also very important to report that cow udders are also CCPs. Cows are usually allowed to feed their young for a period before manually pressing the udders with fingers to milk the cows. Therefore, the person milking the cows can introduce microbial contaminations into the milk while pressing the udders, in addition to the fact that the young calf could have also introduced microbial contamination to the udder while feeding. Milking a cow with clean utensils should also be a must, while it would be of immense control if the milking vessels can be metal (stainless steel) containers, since they could be better sterilised with hot-heat, such as boiling them immediately before and after use.

Rennet, a coagulating enzyme, is stirred into milk, and under certain acidic conditions, rennet separates casein (which is the major milk protein) from whey and causes the individual cells of casein to clump together (Hall, 2011). The semi-firm texture of *wara* is formed by addition of *Calotropis* as coagulant that causes the milk proteins to aggregate at a certain pH; then the whey (mostly water and lactose) begins to separate from the curds. The amount of *Calotropis* added to cow milk is however, very critical to the flavour, aroma and colour of the produced *wara*. Most cheese products are produced from milk samples that have been pasteurised; thus, boiling of fresh cow milk containing *Calotropis* extracts can be considered as a form of pasteurisation, which is one of the major CCPs in cheese-making process. High-Temperature-Short-Time (HTST) pasteurisation is widely used in industrial cheese production but combination of high, moderate and low temperatures is used in *wara* processing, and since the pathogenic microorganisms present in raw milk are assumed to be destroyed by pasteurisation, it can be deduced that in *wara* production, any form of microbial pathogen in raw cow milk would be destroyed during boiling.

Although the producers of *wara* could not fully ascertain any reason but stirring during cow milk boiling is taken in this study as a CCP because the producers indicated that stirring had to be non-vigorous, and it is likely that vigorous stirring may affect coagulation of the boiled milk. Removal of foamy portion of boiling milk with a plastic / metal scooping spoon is a likely CCP, since the spoons could have been contaminated by environmental dusts or water used in rinsing the spoon but effects of such likely microbes could be destroyed during boiling provided they are not toxigenic. Boiled water is also very important in this regard, since it can be used to clean and surface sterilise the stirring spoons before usage. Temperature at which the boiled milk samples are poured into moulds is critical because it can enhance the growth of microbial pathogens. It is therefore, appropriate that the boiled milk is scooped immediately into the moulds, while the milk is still on the fire but it is much safer that the moulds are properly rinsed with boiled water or boiled for a short period of time before use, since it takes some time for the whey to drain while the curds are setting.

Wara is a fresh, soft, moist curd cheese, which has been cut and drained of whey but never ripened, and is eaten in various forms either as normal cheese, a flavoured snack and meat substitute in sauces or as fried cake or sandwich filling (FAO, 1998) but toxins represent a big problem to the public health. It is therefore, very important that safety and quality must be ensured in every step of the traditional production of *wara* instead of focusing on the finished product. It is important that the *wara* producers should be able to cover their heads while working and need to wash their hands before working. Similarly, their state of health should also be of public health interest, since contamination, as an exposure of food products to hazards can cause illness or even death.

Wara is usually consumed unboiled after been bought but can be further processed at home after purchase into re-boiled or fried food product. The texture is however, harder when boiled or fried compared to the freshly -prepared *wara* and similarly, freshly-prepared *wara* becomes harder with increasing time after production. Since the majority of people consume freshly-prepared *wara* and considering the cautions raised about the significant foodborne bacteria associated with *wara*, due to microbial contaminations, which are usually encountered during processing, it is very important to access and report the hazards and critical control points of the cottage production of this highly popular processed cow milk food product.

CONCLUSION

There is the need for effective quality control of the processing methods of the locally processed Nigerian *wara*, a soft cheese produced from fresh cattle milk, which can be adequately effected through HACCP. Critical Control Points should focus on the processing points of *wara* where hazards can occur and control measures can be applied to prevent or eliminate food safety hazard or reduce it to the barest minimum or an acceptable level. In conclusion, measures that minimise the risk of food-borne illnesses in *wara* production should be a must, while the application of HACCP as advocated by WHO to a wide range of fermented foods should also be applicable to *wara*. Preventive measures to control hazards by eliminating or reducing occurrence of hazards to an acceptable level and HACCPs of farmyard production of *wara* with regards to the microbial contents and prevalence at the critical points are therefore, on-going in our laboratories.

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