The Milk Contamination and the Training of Handlers about the Hygienic Handling of Milk

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ABSTRACT

Background: This study was performed in the markets of Elobeid City- North Kordofan State-Sudan, to study the relation between the milk contamination and the training of handlers about the hygienic handling of milk during the period from October 2012 to October 2015. Methodology: The study covered all the places for the boiled milk sale found in the markets of Elobeid City which are 84 places. Data were collected from all milk handlers who were 87 by observation-check list. The data were analyzed manually and the results presented in tables showed for the percentages. Eighty four milk samples were collected from the offering containers of boiled milk, and examined for the presence of coliform bacteria. Results: Only 22.62% of milk handlers were trained about hygienic handling of milk. Most milk samples (77.38%) were contaminated by the coliforms bacteria. The study confirmed that the lack of training of milk handlers about hygienic handling of milk, and handling of milk by handlers who are unaware the diseases that are transmitted by contaminated milk were contributed the presence of coliform bacteria in milk by 59.52% and 53.57% respectively. Conclusion: This study concluded that there was a relation between the milk contamination by coliform bacteria and the training of handlers about the hygienic handling of milk, where the training of handlers reduces the presence of coliform in the milk. This study recommended the health authorities to make health education and training for handlers about hygienic handling of milk prior the licensing.

Introduction

The following aspects are important concerning to education and training: Education and training of food handlers are vital elements of food safety programmes; All employees must know and understand the basic principles of food safety and their own responsibility in this respect; Refresher courses should be given periodically; Education and training programmes must also be extended to management, cleaners and other personnel involved with food handling (1).
Food handlers should therefore receive suitable training in the basic principles of food safety. Examples of outline curricula for training courses for food handlers personnel are types of foodborne illness, Food preparation – cooking and serving, Survival of microorganisms because of insufficient heating, Procedures for preventing foodborne illness, Killing of bacteria, parasites and viruses (2). Training of food handlers regarding the hazards confronting their products, safe handling and preparation of food and good hygiene practice, as practicable under local street-vending conditions, is an essential part of any strategy to improve the safety and quality of street-vended food. This should, ideally, be done in conjunction with licensing, but ongoing education and training sessions at intervals are strongly suggested. The low level of education of most vendors makes training difficult (3).

Staff must be trained, supervised to ensure the continuous implementation of good hygiene practices. The law, and the industry guides to good hygiene practice, require every person working in food handling areas to maintain high standards of cleanliness. Training is consider the key to food safety (4). If people are not familiar with what good practices are, they are likely to make more than just one error (5).

**Personal Hygiene and Training:** The food handler can often be a major source of contamination. There are several good hygienic practices that he or she should observe. Hands should be washed regularly with soap in clean water, but especially before starting to handle food, after going to the toilet or changing a baby, and after handling raw food, food waste or chemicals. In all these activities the hands may become contaminated with pathogens or toxic chemical residues that can then be transferred to the food. It is easier to keep hands clean if finger nails are kept short and jewellery such as rings are removed as dirt can become lodged under these and may be difficult to remove. Food handlers should avoid coughing into their hands or touching their hair, nose or mouth while handling food without washing their hands afterwards. If food handlers are suffering from an illness that includes symptoms such as jaundice, diarrhoea, vomiting, fever, sore throat, skin rash or skin lesions such as boils or cuts, they should report this to their supervisor before starting work. It may then be necessary for them to be assigned temporarily to some other task which does not involve handling food (5). Also Steven (6) mentioned that, food employees shall keep their fingernails trimmed, filed, and maintained so the edges and surfaces are cleanable and not rough.
Hygiene Indicator Organisms:

“Hygiene indicator organisms” refers to the selected surrogate markers. The main objective of using bacteria as indicators is to reflect the hygienic quality of food (7).

The presence of indicator bacteria in ready-to-eat food, although not inherently a hazard, can be indicative of poor practice that may be one or more of the following:

Poor quality of raw materials or food components; undercooking; Cross-contamination; poor cleaning; poor temperature and time control. Indicator bacteria may be associated with an increased likelihood of the presence of pathogens. Indicator organisms are useful in the assessment of food product safety because they tend to be present in higher numbers than most pathogens and are relatively quick and easy to identify (8). The common indicators are Coliforms and \textit{E. coli} (9).

Coliforms:

The coliform bacteria are defined as: bacteria that, in the presence of bile salts or other equivalent selective agents, can grow and produce acid and gas from lactose when incubated at 35 or 37°C (10). Coliforms are Gram-negative, rod-shaped, facultatively anaerobic bacteria. They are also known as the 'coli-aerogenes' group. The coliform group includes species from the genera \textit{Escherichia}, \textit{Klebsiella}, \textit{Enterobacter} and \textit{Citrobacter}, and includes \textit{E. coli} (9).

Coliforms are referred to as indicator microorganisms, since their presence is used to indicate the potential presence of pathogens in foods. Almost always, the presence of coliform organisms in dairy products is due to contamination from equipment that has not been properly cleaned and sanitized, or due to incorrect operation of the heat treatment process (11).

**Boiling of milk**

This is the easiest and most practicable method of making milk safe in every home. Boiling of milk destroys all microorganisms except the spore formers but it changes the nutritive value of milk, its flavors and palatability and appearance (12). The method followed in the houses for boiling the milk is putting it in container on flame and heating it until bubbling, then raised from the flame and let to cool spontaneously. And this method,
unfortunately, not consider enough for heating all parts of milk. Whereas what observed of bubbling, completes usually before reaching the milk to the boiling temperature (13).

The steps of correct method in milk boiling

- The heating must be indirect for milk by putting the milk container in boiling water bath, or using mineral container of tow walls, put the water between tow walls and heated to boiling for 5 – 10 minutes.
- The continuous and good turning for milk.
- Quick and immediate cooling after boiling.
- Covering the milk container and keeping it in cool place until it used (13).

Objective of this study:

The general objective of this study was to study the relation between the milk contamination and the training of handlers about the hygienic handling of milk in the markets of El-Obied City.

The specific objectives:

1. To detect the contamination of boiled milk by coliform bacteria.
2. To determine the extent of the training of handlers about the hygienic handling of milk.
3. To study the relation between the milk contamination and the training.

Materials & methods:

Study approach: Qualitative and quantitative approach.

Study type and design: Descriptive cross-sectional study.

Study variables: The variables of this study are the training of milk handlers about hygienic handling of milk and the existence of coliforms bacteria in boiled milk.

Study area: The area of this study was the markets of El Obied City. El- Obeid is the capital of North Kordofan State, its area has been estimated by 81 km$^2$ and the distance from Khartoum is about 332 mile. There are about 30 markets in El- Obied City which are distributed in all parts of the City. El Obeid is supplied by milk from the surrounding villages by Lorries.
Study population:

The populations for this study are vended boiled milk, the handlers of boiled milk in the markets of El-Obied City.

Sampling and milk sampling

Sampling: After the survey for all markets in Elobeid City, it was found that there were only (84) places that handle in the boiled milk. The sale points of boiled milk for this study were chosen by total coverage for the 84 places. The milk handlers who were 87 individuals were chosen by total coverage in each place and the simple random sample was used to select 84 of them for the variables concerned to the relationships, also the boiled milk offering utensils were chosen by total coverage which are 84 utensils, then the milk samples were collected from each offering utensils of the boiled milk.

- Milk sampling:

The steps for milk sampling were according to the following orders as mentioned by Ministry of Agriculture, Food and Fisheries (14):

- Identifing the sample containers with waterproof markings.
- Avoiding the contact with the rim or inside of the container with fingers, as this will contaminate the inside of the container and alter the results.
- Taking the sample only after milk has been properly mixed.
- Taking the sample from an area free from foam.
- Filling the container away from the utensil opening. The container could be dropped into the milk.
- Filling the container two thirds full. Never fill the container completely, leave some space to permit mixing of the sample in the laboratory.
- Securely close the sample container and put on ice immediately.
- The samples were transported in cooler boxes with ice to the laboratory and analyzed immediately.

Data collection: Data were collected by structured questionnaire observations from all the handlers of boiled milk at the markets that handle boiled milk in El-Obied City, and from the results of the laboratory analysis of collected milk samples. Boiled milk samples were collected in sterilized containers (100 ml) according to Harrigan (10) from the offering utensils at the sale points in the markets of El-Obied City, and were brought in ice box to the laboratory of veterinary research station in Elobeid City to laboratory analysis.

Data analysis:

The data of questionnaire was analyzed manually.

The results were presented in tables showing the percentages. The relations between variables were done according to El-Gassas (15) and Le (16) by McNemar's Chi-square ($X^2$) for the correlative percentages in the table (2x2) by the formula:
\[
X^2 = \frac{(B - C)^2}{B + C}
\]

Where:

\(B\) and \(C\) are cells in the table 2x2 (without the cells of the total) as in the following shape:

\[
\begin{array}{cc}
A & B \\
C & D
\end{array}
\]

The value of \(X^2\) obtained from this formula compared with the value of \(X^2\) obtained from the table of \(X^2\). The result have statistical significance when the calculated value is larger than the tabulated value under significance level (0.05). The null hypothesis is rejected at the 0.05 level when \(X^2 \geq 3.84\).

The milk samples was analyzed in the laboratory of veterinary research station in Eloheid City.

**Method of detection and enumeration of total coliforms**

Multiple tube system was used for samples examination, which is described as following:

- Ten fold serial dilutions of samples were made up to \(10^{-4}\) in sterile distilled water.
- 1 ml were added to each of the three tubes containing 10 ml of MacConkey broth culture medium with a Durham's tube.
- Put All tubes and control tube in incubator at \(37^\circ C\) for 24 - 48 h.
- Positive tubes was registered after 48 h.
- Presumptive positive results (acid and gas produced) were confirmed by streaking across MacConkey’s agar plates.

Numbers of bacteria was looked out from statistically calculated, MPN prepared table used for Most Probable Number (10).

**Ethical consideration (clearance):**

Ethical permission for the study was obtained prior to the beginning of the study, by contacting the environmental health manager of the locality of shekan, in El Obied City. As well as from milk handlers.

**The results:**

Only 22.62% of milk handlers were trained about hygienic handling of milk and 77.38% of milk handlers were not received the training as shown in Fig. (1).
Fig. (1): Training of milk handlers about hygienic handling of milk in Elobeid markets – 2015 (N=84)

As shown in this fig. (2) the existence of coliforms bacteria in boiled milk was found in 77.38% of milk samples.

Fig. (2): The existence of coliforms bacteria in boiled milk vended in Elobeid markets – 2015 (N=84)
Table (1): The relation between training of milk handlers about hygienic handling and the presence of coliforms bacteria in the samples of boiled milk vended in Elobeid markets – 2015

<table>
<thead>
<tr>
<th>Presence of coliforms</th>
<th>Present (%)</th>
<th>Absent (%)</th>
<th>Total (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Training of milk handlers</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trained handlers (%)</td>
<td>17.86</td>
<td>4.76</td>
<td>22.62</td>
</tr>
<tr>
<td>Untrained handlers (%)</td>
<td>59.52</td>
<td>17.86</td>
<td>77.38</td>
</tr>
<tr>
<td>Total</td>
<td>77.38</td>
<td>22.62</td>
<td>100%</td>
</tr>
</tbody>
</table>

N= 84, $X^2$: calculated = 46.65 and tabulated = 3.84, Significant level = 0.05

As shown in above table (1) the presence of coliforms bacteria in milk in the case of the presence of trained handlers was 17.86%. And the presence of coliforms bacteria in milk in the case of the presence of untrained handlers was 59.52%.

As presented in Fig. (3), the Knowledge of milk handlers about the diseases transmitted by contaminated was only 28.57%.

Fig. (3): Knowledge of milk handlers about the diseases transmitted by contaminated milk in Elobeid markets – 2015
Table (2): The relation between knowledge of milk handlers about the diseases that are transmitted by contaminated milk and the presence of coliforms bacteria in the milk - Elobeid – 2015

<table>
<thead>
<tr>
<th>Presence of coliforms</th>
<th>Knowledge of milk handlers for the diseases (%)</th>
<th>Present (%)</th>
<th>Absent (%)</th>
<th>Total (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Handlers with knowledge of the diseases</td>
<td>23.81</td>
<td>4.76</td>
<td>28.57</td>
<td></td>
</tr>
<tr>
<td>Handlers without knowledge of the diseases</td>
<td>53.57</td>
<td>17.86</td>
<td>71.43</td>
<td></td>
</tr>
<tr>
<td>Total (%)</td>
<td>77.38</td>
<td>22.62</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>

N= 84 , $X^2$ : calculated = 40.84 and tabulated = 3.84 , Significant level = 0.05.

As shown in the above table (2) the presence of coliforms bacteria in milk in the case of the presence of handlers with knowledge of the diseases was 23.81%. And the presence of coliforms bacteria in milk in the case of the presence of handlers without knowledge of the diseases was 53.57%.

Table ( 3): The knowledge of milk handlers for the complete maturity of milk in Elobeid markets – 2015

<table>
<thead>
<tr>
<th>Knowledge of milk handlers for the complete maturity for milk</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>By bubbling</td>
<td>61</td>
<td>70%</td>
</tr>
<tr>
<td>By boiling</td>
<td>26</td>
<td>30%</td>
</tr>
<tr>
<td>Total</td>
<td>87</td>
<td>100%</td>
</tr>
</tbody>
</table>
As shown in above table (3) there was 70% of milk handlers were known the complete maturity of milk by bubbling and 30% of them were known the complete maturity of milk by boiling.

Discussion:

The lack of training for milk handlers about milk hygiene and safety was 77.4% as in Fig.(1). This consider a disagreement for what mentioned by WHO (2): "Food handlers should therefore receive suitable training in the basic principles of food safety". Also the lack of training for milk handler does not agree what mentioned by Springer (4): "Staff must be trained and supervised to ensure the continuous implementation of good hygiene practices". The low educational level of milk handlers (29% of them were illiterate), as in table (3) was one of the factors that contributed to lack of training. This according to World Health Organization (3): "The low level of education of most vendors makes training difficult". The violations in the hygienic handling of milk were referred to the lack of training, and this agree what mentioned by Adams, and Motarjemi (5): "If people are not familiar with what good practices are, they are likely to make more than just one error". Therefore the milk in the markets of Elobeid City was handled under unsanitary conditions because the low level of education and lack of training for milk handler. The training helps the milk handlers to reduce the contamination by coliforms. The results of table (1) indicate that the high percentage (59.52%) for the presence of coliforms bacteria belongs to untrained handlers, and the minimum percentage (17.86%) for the presence of coliforms bacteria belongs to trained handlers. Those results confirm that the training of milk handlers about hygienic handling reduces the existence of coliforms on milk and the lack of training contributes the increasing of coliform to 59.52%. This results were have statistical significance, because the calculated value of $X^2$ was larger than the tabulated value (46.65 > 3.84) under the significance level 0.05.

Lack of knowledge of milk handlers for the complete maturity of milk is also consider one of the factors that contribute to the existence of coliforms bacteria in boiled milk, where it found that (70%) of them known the complete maturity of milk by bubbling (table 3), which not considered enough for heating all parts of milk as mentioned by El-kholy (13). And this method for maturity consider
inadequate heat treatment of milk. This conforms with Health Protection Agency (8): "the presence of indicator bacteria in ready-to-eat food [like the milk], can be indicative of poor practice that may be one or more of the following: Undercooking; poor temperature and time control".

Fig. (3) showed the knowledge of milk handlers about the diseases that are transmitted by contaminated milk. Twenty four (28.57%) of them said that they know those diseases, and 60 (71.43%) of them said that they do not know those diseases. It was understood from this results that the knowledge of milk handlers for those diseases made them to avoid causes of milk contamination, so reduction of the presence of coliforms on milk. The results of table (2) indicate that the high percentage (53.57%) for the presence of coliforms bacteria in milk samples belongs to milk handlers without knowledge about the diseases that are transmitted by contaminated milk, and the minimum percentage (23.81%) for the presence of coliforms bacteria belongs to the milk handlers with knowledge about the diseases that are transmitted by contaminated milk. Those results confirm that the knowledge of milk handlers about the diseases reduces the presence of coliforms on milk to 23.81%, and the lack of knowledge contributes the contamination by coliforms on milk in 53.57%. This results were have statistical significance, because the calculated value of $X^2$ was larger than the tabulated value ($40.84 > 3.84$) under the significance level 0.05.

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