The Ministry of Planning

The Central organization for Standardization and quality Control

Department of food industries

Microbial laboratory

Evaluating the efficiency of sterilization methods using the autoclave and pasteurization on raw milk samples

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Study framework

The current study was designed to examine raw milk samples which were collected randomly at early morning from different location at a rate of once each month during study period which commenced in February 2023 and ended in June 2023.

Aim of the study

Demonstrating the efficiency of methods for sterilizing raw milk from bacteria through the boiling process (pasteurization) and the use of the autoclave in order to control the sterilization process time.

Summary

Milk is exposed to various physical, chemical and biological pollutants due to producing, transporting and marketing processes such as certain temperature, bacteria and others. This study was designed to examine raw milk bacterial loads and micro-organisms associated with milk handling practices which collected randomly at early morning from different location once monthly during study period which commenced in February 2023 and ended in June 2023. The microorganisms were isolated and identified. Total bacterial counts (TBC) were determined after and before Pasteurization and sterilization.

The results of the study revealed raw milk contaminated by many bacterial strain including Grame negative bacteria (*Salmonella typhi, Escherichia coli, Pseudomonas aeruginosa, K. pneumonia*) and Grame positive (*Bacillus cereus, Enterococci, Clostridium species, Staphylococcal aureus, S. epidermidis, Lactobacillus, and Micrococcus spp*.).

Total bacterial count (TBC) 100.000 cfu/ml considered first grade (acceptable) was found in 40% of samples and TBC 50.000 cfu/ml considered first grade (good) was found in 60% of samples showing the suitable condition of milk production according to Iraqi Standards (IQS) [12].

The current study, it was found that the raw milk (cow and buffalo) samples were contaminated with different types of negative and positive bacteria, and after the sterilization process was carried out by the autoclave and pasteurization, the results showed that it conformed to the microbial limits according to Iraqi standard, and it was found that the sterilization method showed results of less bacterial growth than pasteurization.

In conclusion, Sterilization seeks to eliminate all microorganisms and spores, while in pasteurization, the most resistant forms and some spores remain present.Therefore, sterilized foods are kept at room temperature for longer periods of time, while pasteurized foods, in contrast, require refrigerated preservation to delay the proliferation of possible microorganisms or spores present in the food.

1. Introduction

Milk is a proper and complete healthy nutrient for all organisms. Milk contains all the main nutrients like carbon, calcium, and rich water content which encourage bacterial contamination if hygienic conditions are not properly maintained [22]. Pasteurization is a heating process that destroys harmful pathogenic microorganisms by heating to a specific temperature for a specific period of time. The pasteurized milk is a type of milk that is heated to a high temperature so that any harmful pathogenic microorganisms that may be present in raw milk are killed. The pasteurized milk is then

packed into aseptic containers in aseptic conditions like Tetra bottled milk or bottled milk [17].

French scientist Louis Pasteur pioneered this process during the 19th century. The goal of pyrolysis food is to produce food that is safe for human consumption and to improve its shelf life. Thus, thermally processed/pasteurized foods have a longer shelf life (for example, pasteurized milk can be stored for about 6 months). Pasteurization is a common heat treatment method used to produce long life milk and fruit juice. But pasteurized products must be stored under refrigerated conditions because this heat treatment is not enough to destroy the spores of pathogenic microorganisms. However, heat treatment results in a change in the sensory characteristics (eg: taste and color) and a slight decrease in the nutritional quality of the food [8].

High-temperature short-time (HTST) pasteurization, like that used for milk (71.5 °C (160.7 °F) for 15 seconds) ensures safety of milk and provides a refrigerated shelf life of about two weeks. While, in ultra-high-temperature (UHT) pasteurization, milk is pasteurized at 135 °C (275 °F) for 1–2 seconds, which provides the same level of safety, but along with the packaging, extends shelf life to three months under refrigeration [11].

Sterilization can be defined as any process that removes or destroys all forms of microorganisms and other biological agents (such as germs) present in a defined area, such as a food material, surface, liquid volume, packaging material, pharmaceuticals, tools, or in biological culture media. Sterilization can be achieved using one or a combination of these food technologies such as heat, chemicals, radiation, high pressure, and filtration. Sterilization differs from disinfection, sterilization, and pasteurization in that sterilization

eradicates, inactivates, or removes all forms of life and other biological agents [4].

Bacteria are unicellular organisms that have a simple internal structure compared with the cells of other organisms. The increased number of bacterial population is commonly referred to as bacterial growth by microbiologists. This growth is the result of the division of one bacterial cell into two identical bacterial cells, a process called binary fission. Under optimal growth conditions, a bacterial cell may divide approximately every 20 minutes. Thus, a single cell can produce almost 70 billion cells in 12 hours. The factors that influence the growth of bacteria include nutrient availability, moisture, pH, oxygen levels, and the presence or absence of inhibiting substances (e.g., antibiotics), [16].

This study aimed to demonstrating the efficiency of methods for sterilizing raw milk from bacteria through the boiling process (pasteurization) and the use of the autoclave in order to control the sterilization process time.

1.1 Bacterial Contamination

The major group of bacteria in milk is the group of lactic acid bacteria. These are able to use the lactose in the milk and to convert it into lactic acid.

The most important family in this group is the Streptococcus lactis. They multiply and grow very fast when the milk is kept at ambient temperatures after milking. They produced lactic acid causes the natural souring of milk. The primary source of these bacteria is the environment: air, dust, dirty equipment and operators, etc. How soon the milk turns sour depends on the degree of contamination and on the temperature of the milk [16].

Grace et al. (2009) reported that bacterial quality declined consistently along the milk pathway and the level of adulteration with water increased. However, at point of consumption, all raw milk had an acceptable total bacteriological plate count according to national standards. In the case of coliform quality, the main risk amplification step (i.e. where quality deteriorated most) was between the last vendor and the consumer.

The presence of Staphylococcus aureus in raw milk generally comes from cows with mastitis, from handlers or from deficient hygiene. When found in milk, high levels of contamination can be reached quickly under favorable conditions. Its presence in foods can be a risk to human health, causing a public health problem, as these bacteria produces toxins that can cause toxic food infections [10]. Various conditions favor the growth of Staphylococcus aureus and the production of enterotoxins such as the temperature, activity of water, concentrations of salts and pH, and even the competitiveness of the micro-flora [13].

E. coli is a most common member of the normal flora, i.e. the natural habitat of it is the intestinal tract of warm-blooded organisms. It is therefore considered an indicator organism for fecal contamination of water and foods. Within a few hours or days after birth E. coli will colonize in the human bowel. E. coli becomes pathogenic only when they reach tissue outside of their normal location [24].

1.2 pasteurisation and sterilization by Autoclaving

The processes of both sterilization and pasteurisation are used to kill and eliminate pathogens or microorganisms such as bacteria, fungi, viruses, etc. Pasteurising is most commonly associated with eliminating harmful microorganisms in some types of food - especially dairy products, wine, and eggs [27].

1.3 Types of Thermal Processing

- Thermization: Heat the milk to between 57°C to 68°C and hold for 15 minutes. Thermization targets pathogenic bacteria while leaving the good bacteria in the product. The low temperatures do not alter the structure and taste of the milk.

- Batch pasteurization: Also known as low-temperature long time (LTLT) pasteurization. Heat the milk to 63°C for 30 minutes. The extended holding time causes the alteration in the milk protein structure and taste.

- Flash pasteurization: Also known as high-temperature short time (HTST) pasteurization. Heat the milk to between 72°C to 74°C for 15 to 20 seconds.

- Ultra-high temperature (UHT) pasteurization: Heat the milk to between 135°C to 140°C for 2 to 4 seconds. The extreme heat targets Coxiella burnetii,

which causes Q-fever. The heat kills all the vegetative forms of bacteria and the milk can survive for 9 months [4].

- Canned sterilization: This is a wet treatment of canned milk products in an autoclave/specialized treatment chamber. Heat to between 115°C to 121°C for 10 to 20 minutes.

An autoclave is a machine that provides a physical method of sterilization by killing bacteria, viruses, and even spores present in the material put inside of the vessel using steam under pressure [28].

Autoclave sterilizes the materials by heating them up to a particular temperature for a specific period of time. The autoclave is also called a steam sterilizer that is commonly used in healthcare facilities and industries for various purposes. The autoclave is considered a more effective method of sterilization as it is based on moist heat sterilization [29].

2. Methods

2. 1. Samples Collection

Raw milk samples were include cow and buffalo milk collected from February/2023 to June/2023 from many cows at different locations of Iraq districts and countryside such as (Abu Ghraib, Fal'loga, Azizia, Madain and Ghazaliya) early morning milking directly into sterile screw cap. Cow and buffalo nipples were also sterilized with cotton diluted with ethanol prior to milking. The samples were then transported to the laboratory immediately in small size ice box in sterile conditions.

2.2. Bacterial isolation and identification

2.2.1. Morphology and Microscopy

All isolates were identified morphologically with colony characteristics and microscopically, the bacteria appeared under oil immersion lens (100x).

2.2.2. Isolation and identification of bacterial contamination

One ml of all milk sample was inoculated into 99 ml of peptone broth and incubated for 24-48 hours at 37°C. Then, about 0.1 ml of inoculated broth were subcultured on Nutrient agar plates, MacConky agar, Eosin methylene blue EMB, Blood agar, Salmonella Shigella Agar SS Agar, sorbitol-MacConky agar with cefixime tellurite and CIN agar. Biochemical is achieved using Epi 20 system [19].

2.2.3. Microbial quantification

The bacterial load estimation per 1 ml of raw milk was done by adding 25 ml of milk samples into 225 ml of sterilized buffered peptone water and were thoroughly shaken to give one-in-ten initial dilution of the milk sample; the stock solution. Ten-folds of serial dilutions were made from the homogenates up to 10^{-6} with three replicates each. Appropriate spread plates were made with 0.1 ml aliquots from all serial dilution tubes and incubated at 37^{o}. Bacterial colonies were counted using colony counter to determine colony forming units (cfu)/ml. Dilutions with the total number of colonies on a plate were used for cfu computation according to the following formula.

Cfu/ml= No. of colony counted on plate/ volume plated (ml) * dilution factor

2.3. Milk pasteurization.

1. The hands and work area was Cleaned and sterilized.

2. The milk was heated to 63°C (150°F) for at least 30 minutes or 72°C (162°F) for at least 15 seconds and the milk kept at the right temperature.

4. The milk was Cooled by Putting the top part of the double boiler in the ice water bath (without getting water into the milk) to cool it fast. To cool faster, the milk was stirred until it reaches 20°C (68°F) or cooler.

The cooled milk was poured into sterilized containers right away. The containers was Put in the fridge to cool the milk to 4°C (40°F) or colder [23].

2.4. Sterilization by autoclave

The milk was put in containers and heated to temperature between 115°C to 121°C for 10 to 20 minutes.

3. Results

٣.1. Identification of bacteria microscopically

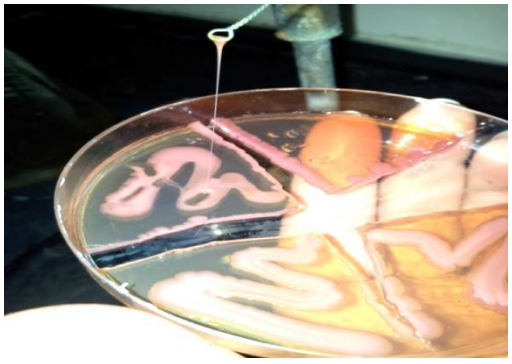


Fig.1:K.pneumonia colonies grown (Mucoid colony) on MacConkey agar incubated at 37ºC for 24hr in raw milk (String test).

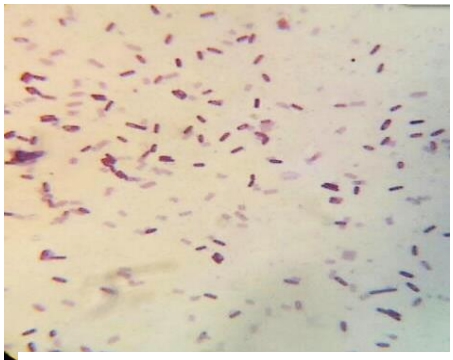


Fig. 2: Bacillus cereus (spore forming) received normal saline. The raw milk sample stained by Gram stain (100x)

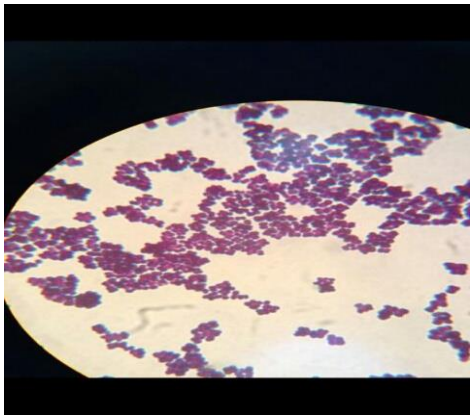


Fig. 3: *Staphylococcus* received normal saline. The raw milk sample stained by Gram stain (100x).

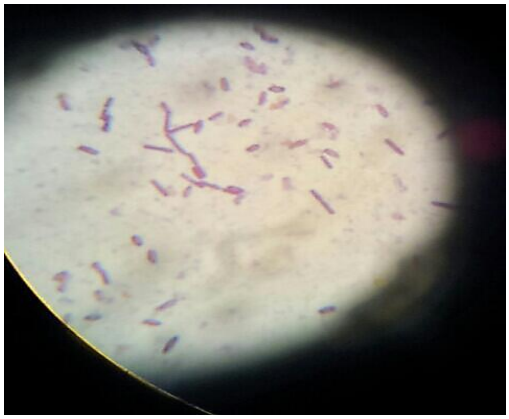


Fig. 4: *Lactobacillus* received normal saline. The raw milk sample stained by Gram stain (100x).

Fig. 6: *Escherichia coli* colonies grown on EMB agar (Green metallic sheen) incubated at 37ºC for 24hrin raw milk.

Fig. 7: *Escherichia coli* (Green metallic sheen) and *K. pneumonia* (pink colony) colonies grown on EMB agar incubated at 37ºC for 24hr in raw milk.

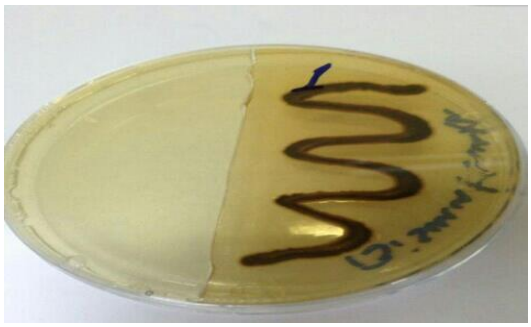


Fig. 8*: S. typhi* colonies grown (dark colony) on Bismuth agar incubated at 37ºC for 24hr in raw milk.

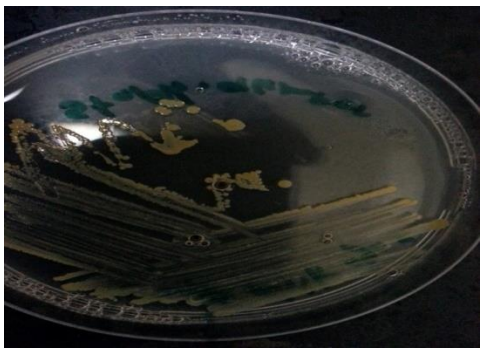


Fig. 9*: Staphylococcus aureus* colonies (golden) grown on Milk agar incubated at 37ºC for 24hr in raw milk.

Fig. 10: Compaire between *S.aureus* β-hemolysis and *S. epidermidis* Non-hemolysis growth on blood agar incubated at 37ºC for 24hr in raw milk.

Fig. 11: *S. epidermidis Non*-hemolysis growth on blood agar incubated at 37ºC for 24hr in raw milk.

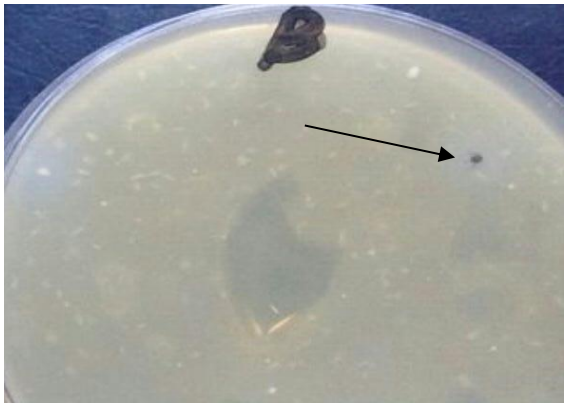


Fig. 12: *Clostiridia sp.* colonies (dark colony) grown on iron sulfat agar incubated at 37ºC for 72hr in raw milk.

3.2. Bacterial Biochemical Identification

The 36 samples of raw milk from different sites during study period were cultured using different biochemical tests and the bacteria identified morphologically with colony characteristics. The result of bacteria genera and species isolated from raw milk revealed the gram negative isolates including species *Salmonella typhi*, *E. coli*, *K. pneumonia*, and *Pseudomonas aeruginosa*, as well as gram positive bacteria including *Bacillus cereus, Enterococci, Clostridium species, Staphylococcal aureus, Staphylococcal epidermidis*, *Lactobacillus and Micrococcus spp*. Table **(**3-1**).**

Table (3-1) Bacterial Identification Morphologically and Microscopically.

Bacterial species	Identified Morphologically and Microscopically
Salmonella typhi	motile, non-sporeforming, Gram-negative, rod-shaped bacterium in the family Enterobacteriaceae.
Escherichia coli	Highly motile, Gram-negative, rod-shaped bacteria.
Pseudomonas aeruginosa	Gram-negative, motile, aerobic rods.
K. pneumonia	Gram-negative, nonmotile, aerobic, mucoid large colony explained in (string test) (Fig.1).
Bacillus cereus	Gram-positive, facultative anaerobic, endospore forming, large rod, *B. cereus* strains are motile (Fig. 2).
Enterococci	Gram-positive, facultative anaerobes that normally are spherical and ovoid, are less than 2 μm in diameter, and occur in chains or pairs or singly.
***Clostridium* species**	An anaerobic, Gram-positive, spore-forming rod.
Staphylococcal aureus* and *S. epidermidis	Gram-positive, nonmotile, catalase-positive, small, spherical bacteria (cocci), which, on microscopic examination, appear in pairs, short chains, or bunched in grape-like clusters.The genus *Streptococcus* is comprised of Gram-positive, microaerophilic cocci that are nonmotile and occur in chains or pairs, and in long chains in broth culture. Cells are normally spherical, ovoid, and less than 2 μm in diameter (Fig. 10).
Lactobacillus	Gram-positive, non-spore-forming, motile rod or coccobacilli, catalase- negative (Fig. 4).
Micrococcus spp.	Gram-positive and catalase-positive, motile cocci appeared diplococcic or trad (Fig. 5).

Current results agree with Rudha [1] who found E. coli, Enterobacter Spp, Pseudomonas Spp, Klebsiella Spp, Staphylococcus aureus , Staph. epidermidis, Proteus spp, Yersinia enterocolitica and Salmonella in both cow and buffalo.

The major group of bacteria in milk is the group of lactic acid bacteria. These are able to use the lactose in the milk and to convert it into lactic acid. The most important family in this group is the *Streptococcus lactis*. They multiply and grow very fast when the milk is kept at ambient temperatures after milking. They produced lactic acid causes the natural souring of milk. The primary source of these bacteria is the environment: air, dust, dirty equipment and operators, etc. How soon the milk turns sour depends on the degree of contamination and on the temperature of the milk [16].

Grace [9] reported that bacterial quality declined consistently along the milk pathway and the level of adulteration with water increased. However, at point of consumption, all raw milk had an acceptable total bacteriological plate count according to national standards. In the case of coliform quality, the main risk amplification step was between the last vendor and the consumer.

The presence of *Staphylococcus aureus* in raw milk generally comes from cows with mastitis, from handlers or from deficient hygiene. When found in milk, high levels of contamination can be reached quickly under favorable conditions. Its presence in foods can be a risk to human health, causing a public health problem, as these bacteria produces toxins that can cause toxic food infections [10]. Various conditions favor the growth of *Staphylococcus aureus* and the production of enterotoxins such as the temperature, activity of water, concentrations of salts and pH, and even the competitiveness of the micro-flora [13].

*E. co*li is a most common member of the normal flora, i.e. the natural habitat of it is the intestinal tract of warm-blooded organisms. It is therefore considered an indicator organism for fecal contamination of water and foods. Within a few hours or days after birth *E. coli* will colonize in the human bowel. *E. coli* becomes pathogenic only when they reach tissue outside of their normal location [24].

Salmonella also are a leading cause of foodborne disease in humans, and consumption of both meat and milk has been implicated in salmonellosis outbreaks in people. In addition, strains of *Salmonella* resistant to multiple antibiotics have been isolated from dairy cows during salmonellosis outbreaks on dairy operations. These same strains have been isolated from ill people [25].

In the dairy food industry, the psychotropic *Pseudomonas* are the most frequently bacteria associated with deterioration of raw milk stored at refrigerated temperature; *P. fluorescens* is especially being important as a biofilm-forming bacterium capable of contaminating milk previously processed [14]. Although not very common among the *pseudomones* isolated from raw milk, *P. aeruginosa* was isolated by [7] from milk of cows suspected of being infected with mastitis.

Pandey and Voskuil, [16] revealed the physical and chemical changes occurring after milking either due to microbial reactions or environmental factors, mitigation action to prevent further milk quality spoilage has to be observed. The raw milk is one of the most suitable media for the growth of a wide variety of bacteria. Especially immediately after milking when it is almost at body temperature. However, milk contains a natural inhibitory system which prevents a significant rise in the bacterial count during the first 2-3 hours. If milk is cooled within this period to 4ºC, it maintains nearly its original quality. Timely cooling ensures that the quality of the milk remains good for processing and consumption. Ayub [3] mentioned that the bacterial load in fresh raw milk should be less than

50,000 per ml when it reaches the collection point or processing plant. To prevent a too high multiplication of bacteria, the milk has to be produced and should be cooled or heated at the earliest.

3.3 Total Bacterial Count (T.B.C) Test

The results of this test including 10^{-2}, 10^{-3} and 10^{-4} are given in table (3-2) for cow and table (3-3) for buffalo. In general highest value was for10^{-2}, 10^{-3} and 10^{-4} and cow milk sample had the highest contamination whilst buffalo sample had the lowest contamination.

Table (3-2) raw milk samples of different sites during study period

Cow Milk from different area	**Raw milk cfu/ml**	**Pasteurization cfu/ml**	**after week of pasteurization cfu/ml**	**Sterilization cfu/ml**	**After 2 months of Sterilization cfu/ml**
Cow milk 1	$7.5*10^2$	$2*10^1$	$2.1*10^1$	6	6
Cow milk 2	$4.5*10^4$	$2*10^1$	$2*10^1$	7	7
Cow milk 3	$6.5*10^4$	$2.9*10^1$	$2.9*10^1$	8	9
Cow milk 4	$8*10^4$	$2.1*10^1$	$2.5*10^1$	9	8
Cow milk 5	$7.5*10^4$	$2.5*10^1$	$2.5*10^1$	10	9
Microbial range	$5*10^4$- $1*10^5$	$1*10^4$- $5*10^4$	$1*10^4$- $5*10^4$	Zero-$1*10^1$	Zero-$1*10^1$

Table (3-3) raw milk samples of different sites during study period

Buffalo Milk from different area	Raw milk cfu/ml	Pasteurization cfu/ml	after week of pasteurization cfu/ml	Sterilization cfu/ml	After 2 months of Sterilization cfu/ml
Buffalo milk 1	$3*10^3$	$1.1*10^1$	$1.3*10^1$	2	2
Buffalo milk 2	$1.5*10^3$	$2.1*10^1$	$2.1*10^1$	2	3
Buffalo milk 3	$1.7*10^3$	$1*10^1$	$1.1*10^1$	2	2
Buffalo milk 4	$1.2*10^3$	$2.2*10^1$	$2.3*10^1$	1	1
Buffalo milk 5	$1.5*10^3$	$1.5*10^1$	$1.7*10^1$	1	1
Microbial range	$5*10^4$-$1*10^5$	$1*10^4$-$5*10^4$	$1*10^4$-$5*10^4$	Zero-$1*10^1$	Zero-$1*10^1$

This study was carried out to evaluate the quality of raw milk measured by Total Bacterial Count (TBC). Results showed a wide variation of TBC during study period. TBC 100.000 cfu/ml considered first grade (acceptable) was found in samples (40%) and TBC 50.000 cfu/ml considered first grade (good) was found in samples (60%) area showing the suitable condition of milk production according to Iraqi Standards (IQS) [12].Similar observation, the high variability of TBC was found in the present study was supported by the finding [21, 6].

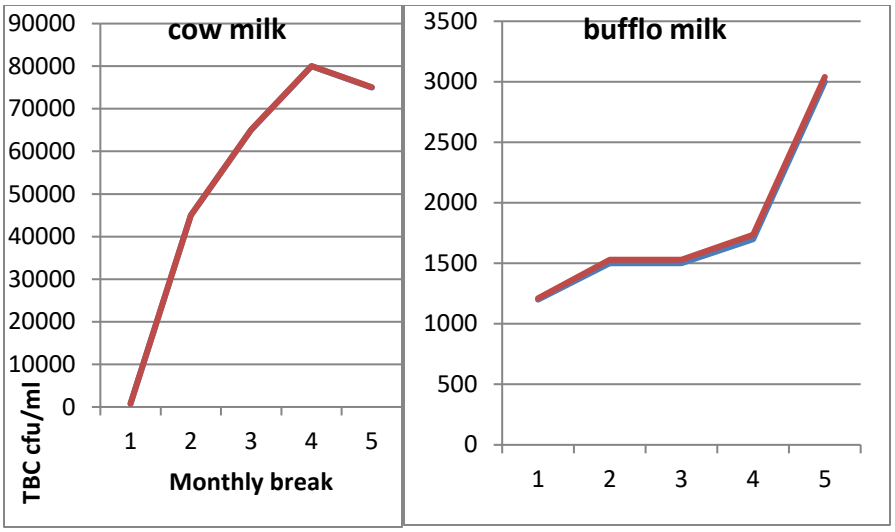
However, the growth of bacteria accompanied by lacking of cooling environment through long distance of milk transportation. Srairi [21] also reported similar problems concerning hygienic quality of raw milk received in Morocco. Similarly, Aumaitre [2] observed similar results due to lapses in milk sanitation. [15, 18] documented difficulties to obtain high quality milk during summer season. They reported that the increase in air temperatures favor the increase of bacterial growth, especially on the surfaces of not well cleaned milking equipment which were the potential source of infection.

Coorevits [5] reported that the bacterial contamination of raw milk can originate from different sources: air, milking equipment, feed, soil, feces and grass. The number and types of micro-organisms in milk immediately after milking are affected by factors like season, food and animal health [20].

In this study, the TBC in milk varied from one region to another and varied among seasons, duo to environnemental pollution and poor cleaning of the milking system. Milk can contain bacteria, either from the cow or buffalo (if it is ill) or from the handling of the milk before it is packaged and delivered to the store in region with highest TBC, while region with lowest TBC was showing healthy environment suitable for cattle breeding and the better condition of milk production and sample collected milk from clean, healthy cows or buffalo.

3.4 Trend of Monthly Recordings of T.B.C

Trend of monthly recordings of overall mean T.B.C (cfu /ml) milk have been depicted in (Fig. 14) Overall mean TBC were considerably higher during April, May and June at high mean ambient temperature recorded 31, 35, 40°C respectively, than the rest of months. Lower microclimatic temperature during winter was recorded 11, 29°C in February and March respectively, also reduced bacterial count.



(Fig. 14): High positive correlation between Temp. rise and growth rate of bacteria.

The present observation of reduced number of TBC, as winter advanced, was in agreement with earlier finding of [21]who also observed the highest TBC of raw milk during the hottest months of April followed by May and June and the lowest TBC during the coolest or driest month of February and March. A similar observation was recorded by [26] in different agro-climatic region in buffalo milk.

Comparing the pasteurization and sterilization methods before and after storing.

In case of CFU $X10^{-1}$ Test, the highest growth value (29/ml) was recorded in pasteurized cow milk samples cow milk samples and the lowest value (20 /ml) while for sterilized cow milk samples the highest value (8 /ml) and the lowest value (5 /ml) (Fig. 15).

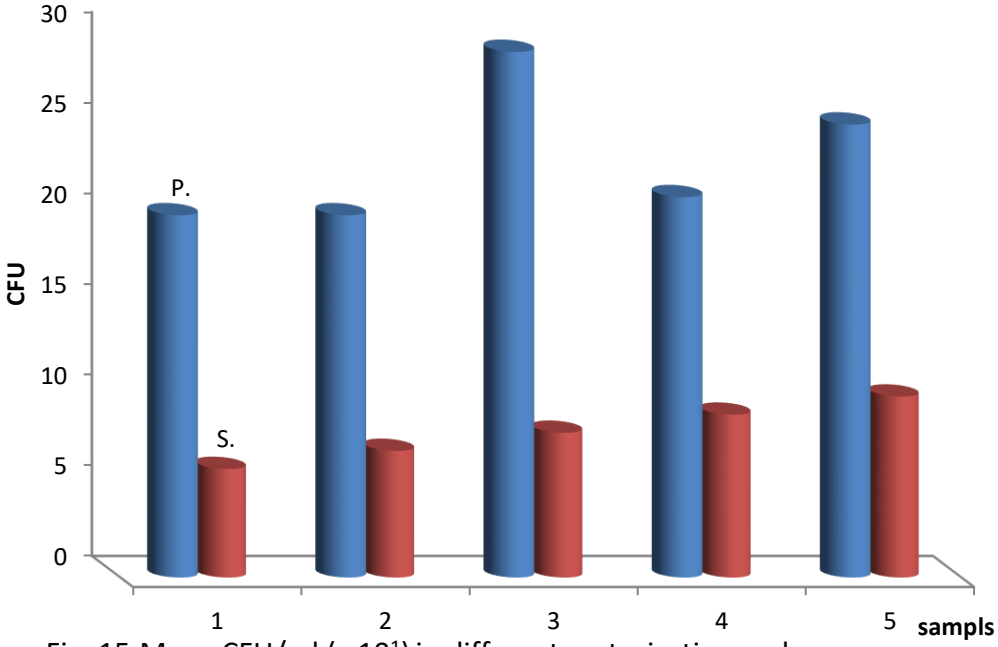


Fig. 15:Mean CFU/ml (x 10^{1}) in different pasturization and sterilization cow milk sampls

In case of CFU $X10^{-1}$ Test, the highest growth value (29/ml) and the lowest value (20 /ml) was recorded in pasteurized cow milk samples compared with the pasteurized cow milk samples after storage for a week, the highest value (29 /ml) and the lowest value (20 /ml) (Fig. 16).

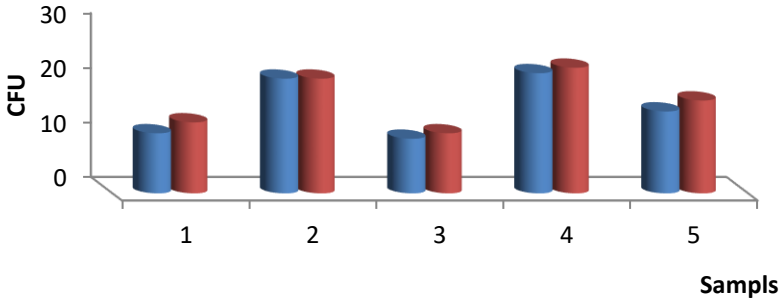


Fig 16: Mean CFU/ml (x10^{1}) in different pasturization and after stored for a week of pasturization of cow milk sampls

In case of CFU X10^{-1} Test, the highest growth value (8/ml) and the lowest value (5 /ml) was recorded in sterilized cow milk samples compared with the value of sterilized cow milk samples after storage for a week the highest value (9 /ml) and the lowest value (6 /ml) (Fig. 17).

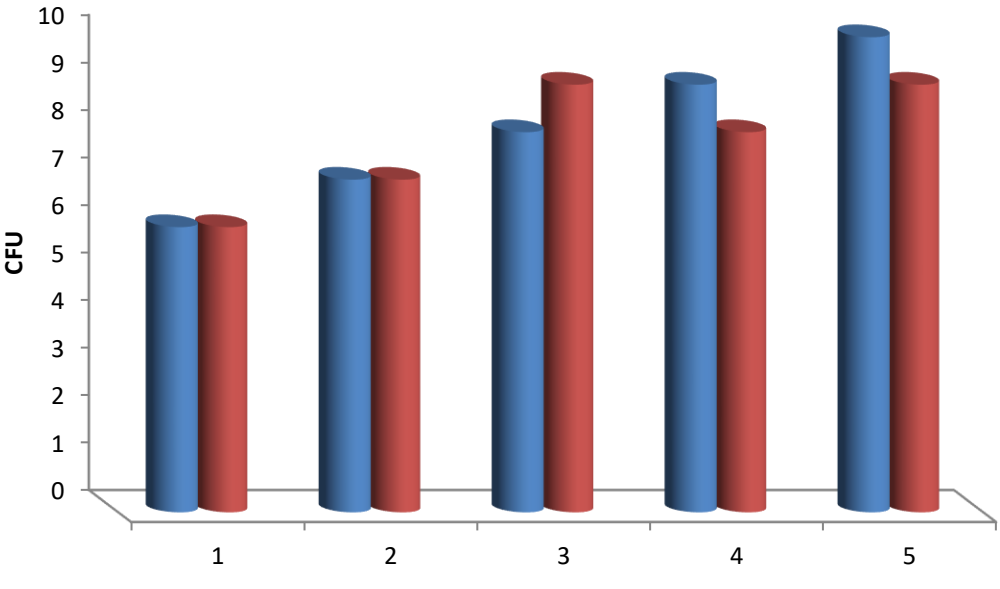


Fig. 17: Mean CFU/ml (x10^{1}) in different sterilization and after stored for aweek in room tempretuer cow milk sampls

In case of CFU $X10^{-1}$ Test, the highest growth value (22/ml) and the lowest value (10 /ml) was recorded in pasteurized buffalo milk samples, while for sterilized buffalo milk samples, the highest value (2 /ml) and the lowest value (1 /ml) (Fig. 18).

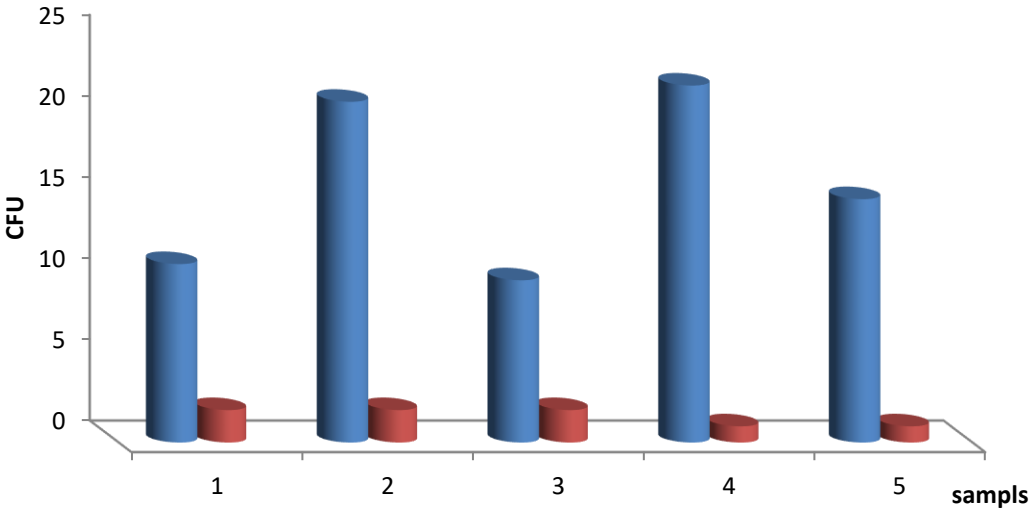


Fig. 18: Mean CFU/ml ($x10^1$) in different pasturization and sterilization of buffalo milk sampls

In case of CFU $X10^{-1}$ Test, the highest growth value (22/ml) and the lowest value (10 /ml) was recorded in pasteurized buffalo milk samples compared with the value of pasteurized buffalo milk samples after storage for a week, the highest value was (23 /ml) and the lowest value was (11 /ml) (Fig. 19).

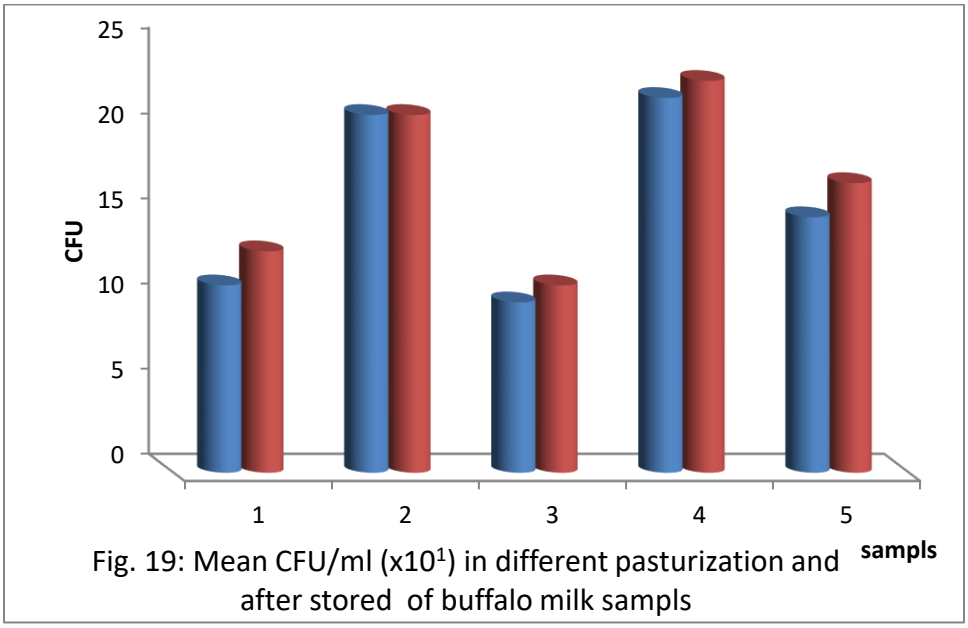


Fig. 19: Mean CFU/ml (x10^{1}) in different pasturization and after stored of buffalo milk sampls

In case of CFU $X10^{-1}$ Test, the highest growth value (2/ml) and the lowest value (1 /ml) was recorded in sterilized buffalo milk samples compared with the value of sterilized buffalo milk samples after storage for a week, the highest value (3 /ml) and the lowest value (1 /ml) (Fig. 20).

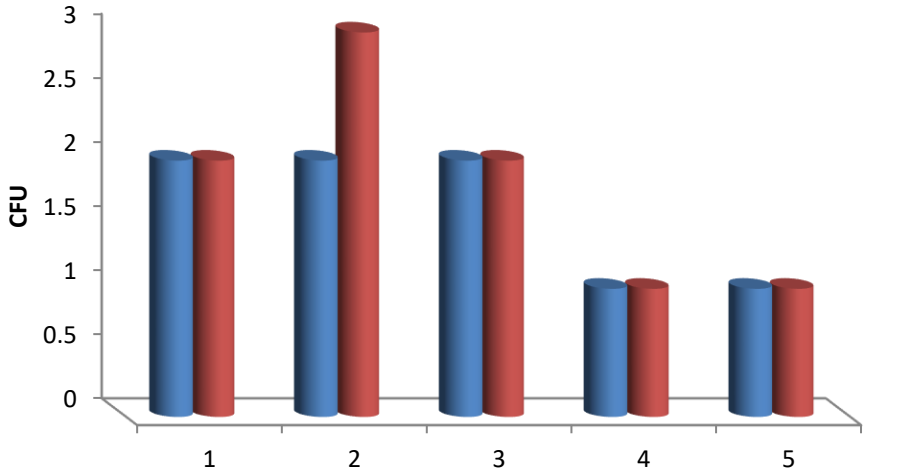


Fig. 20: Mean CFU/ml (x 10^1) in different sterilization and after stored in room temprutuer sampls

The current study, it was found that the raw milk (cow and buffalo) samples were contaminated with different types of negative and positive bacteria, and after the sterilization process was carried out by the autoclave and pasteurization, the results showed that it conformed to the microbial limits according to Iraqi standard, it was found that the sterilization method gave results of less bacterial growth than pasteurization.

Its main difference lies in the fact that sterilization seeks to eliminate all microorganisms and spores, while in pasteurization, the most resistant forms and some spores remain present.

Therefore, sterilized foods are kept at room temperature for long periods of time, while pasteurized foods, in contrast, require refrigerated preservation to delay the proliferation of possible microorganisms or spores present in the food.

Conclusions

1. Bacterial contamination was found in raw milk samples which were collected from different location of Iraq. Microbial counts as quality indicator of raw milk and the possible impact of specific influence factors are of central importance, and such specific influencing factors are therefore of great concern in hygienic milk production.
2. Pasteurizing is most commonly associated with eliminating harmful microorganisms in some types of food but sterilization more effective at eliminating bacteria and other microorganisms.
3. The autoclave is considered a more effective method of sterilization as it is based on moist heat sterilization than pasteurization

Recommendation

1- Evaluate other biological content such as virus and other dangerous bacterial strains, again in raw milk in Iraq.

2- The assessment of other environmental variables of breeding and manufactured dairy products.

3- Find alternative sterilization methods to control sterilization time.

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وزارة التخطيط

الجهاز المركزي للتقييس والسيطرة النوعية

قسم الصناعات الغذائية

المختبر المايكروبي

تقييم كفاءة طرق التعقيم باستخدام جهاز الاوتوكليف والبسترة على عينات الحليب الخام

د. مروة صباح طالب

معاون رئيس بايولوجيين

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