Study Bacteriological Quality of White Cheese in Benghazi Markets, Libya

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Received: 10/08/2020 Accepted: 14/09/2020

Abstract

In this study, the microbial quality of some white cheese (ricotta, halloumi and homemade samples) sold in Benghazi markets was studied in December 2019. Samples were analyzed for total colony count, total coliforms, *Escherichia coli*, and *Staphylococcus aureus*. The total bacterial count ranged from 5.10 to 7.55 log_{10}CFU/g for all cheese types with a mean of 6.88 ± 0.8024 log_{10}CFU/g. Total bacterial counts for ricotta cheese were 5.10 to 7.46, and were 6.54 to 7.49 log_{10}CFU/g for Halloumi cheese manufactured locally in Benghazi, and 5.61 to 7.55 log_{10}CFU/g homemade white cheese. Total coliform count were 2.48 to 6.70 with a mean of 4.67 ± 1.4673 log_{10}CFU/g. Besides, total *Staphylococcus* count was 1 to 4.82, with a mean of 3.68 ± 1.055 log_{10}CFU/g. All cheese samples were highly contaminated with bacteria, as the microbial load was above the acceptable limits (5.70 to 6.18). The studied species were classified as having poor quality. A high microbial load in cheese samples indicates a risk to the general health of consumers. This proves the need to improve food hygiene standards.

Keywords: White cheese, Ricotta, Microbial quality, Contamination.

Introduction:

Animal food, including milk and its derivatives, is one of the main sources of human nutrition, and it has become an important factor in people's lives and their economic prosperity. Therefore, attention is directed on how to provide it, take care of its resources, and work to develop, diversify, and maintain its production during presentation and marketing (Donnelly, 2004).

Cheese has a long history in nourishing human beings, and over the centuries, the process of making cheese as a means of preserving raw milk has involved the process of concentrating raw milk by acidic deposition of milk (Jonnala *et al.*, 2018) fermentation of milk sugar that causes acidification of milk and turns into coagulation. With the swaying movement, the crud is separated from the liquid (whey); the solid mass is removed, dried, and salt added to it to give it the desired flavor (Walther *et al.*, 2008).

In traditional cheeses where active starter cultures are not used, if numbers of Staphylococcus aureus are sufficiently high, may pose a significant risk by toxin production in cheese (Donnelly, 2004). Milk quality, starter culture, or native lactic acid bacterial growth during cheese making, pH, salt, control of aging conditions, and chemical changes that occur in cheese during aging was the factors that contribute to the safety of cheese for pathogenic bacteria (Choi *et al.*, 2016). Other technologies may provide opportunities to add additional barriers to the growth of bacterial pathogens. Producers of raw milk cheeses need to have a documented and systematic approach to ensure product safety (Donnelly, 2004). The microbial load in cheese is determined by several factors, including the quality of raw milk (Jawad *et al.*, 2008), processing temperature, and transport temperature and storage conditions. In addition to the poor health status of workers in the manufacture of cheese, the presence of insects and flies, which constitute an effective source of pollution (Salem *et al.*, 2016).

As many studies have been documented, pathogens such as Salmonella enterica, Listeria monocytogenes, Staphylococcus aureus, and enteropathogenic E. coli posed the greatest risks to the safety of cheese, (Donnelly, 2004; Leong *et al.*, 2014; Chávez-Martínez *et al.*, 2019). Several epidemiological cases have been reported due to the consumption of cheese (Little *et al.*, 2008).

Either by contamination or by the growth of microbes already present in cheese, the types of microbes in milk and cheese may increase. Methods of production, manufacture, and treatment should be designed to prevent either situation. The production of local cheeses includes manual coagulation treatments during the manufacturing, cutting, and molding processes, all of which must be performed under hygienic conditions (Irkin, 2010).

The contamination of milk and milk products by pathogenic microorganisms may be from an internal source in the udder of the infected animal. or from an external source through direct contact with infected animals or through environmental factors, air, water, and workers, and the lack of attention to clean utensils used in milk collection and the equipment used in the preparation of cheese and a failure to follow sanitary procedures in trading, manufacturing, and unpasteurized milk (Talal and Rasoul, 2012).

Diseases transmitted through food and food poisoning are now more common in the world, and both public health problems and microbial contamination of food can be reduced through a good selection of raw materials for manufacturing, and adjustment of manufacturing and storage stages.

Because local white soft cheese is one of the food items consumed in the city of Benghazi, which is marketed in unhealthy ways in stores, this study was conducted. This study aims to explore the microbial content locally produced soft and ricotta white cheeses, which are sold in the markets of Benghazi, Libya. By determining the total number of bacteria, the number of coliforms, and Staphylococcus bacteria, in addition to detecting the presence of Escherichia coli and other pathogenic microbial types that can be transmitted through cheese. Comparing this with the Libyan and European local specifications to determine the quality of the cheese in the market

Material and Methods:

Samples collection:

A total number of 10 cheese samples (ricotta, halloumi, and 3 homemade samples) collected from supermarkets of Benghazi twice in December 2019. Samples purchased from supermarkets packed in a nylon bag have no label, no information about production date, expire date, cow's milk or goats, pasteurized or unpasteurized milk. Homemade samples were produced from raw unpasteurized milk (2

from goat milk and 1 from cow milk from the environs). Collected samples were immediately transported to the microbiology laboratory at the Agriculture Faculty - University of Benghazi where the samples analyzed.

Samples preparation:

Twenty-five grams of cheese was added to 225 g of sterile (0.1%) peptone water in a bottle and were shaken well (3 min) to make a 10^{-1} dilution. Then, serial dilutions of 10^{-2}- 10^{-7} were prepared using 0.1% peptone water (Abdalla and Omer, 2017).

Microbiological testing:

For the quantitative of microorganisms by the pour plate method (Andrews, 1992), 1ml from the ten-fold dilutions was inoculated in duplicate. Mixed with standard plate count agar (PCA) (Oxoid) before solidification. To enumerate total bacterial count (TBC), the dishes were incubated aerobically at 35 ± 1 °C for 48 ± 2 h. Total numbers were enumerated and expressed as CFU/g cheese.

Violet red bile salt agar (VRBA) (Oxoid) was used for total coliform counting (TCC) by the pour plate method. After incubation (24 h.; at 37 ± 1 °C) red violet-colored colonies (2-3 mm in diameter) were evaluated as coliform bacteria (*Enterobacteriaceae*). The presence of E. coli was confirmed by eosin methylene blue (EMB) agar. (Cappuccino and Welsh, 2019)

Mannitol salt agar (MSA) (Oxoid) was used for the detection of Coagulase positive Staphylococcus. Prepared plates were inoculated with 0.1 ml of each dilution by streak plate method Spread inoculum over the surface of the agar plate using a sterile bent glass streaking rod (Food and Drug Administration, 2001). After inoculum absorption by agar, plates were incubated for 48h at 35-37 °C. Plates with 20-200 were selected; yellow colonies with yellow zones were counted as *Staphylococcus aureus*.

Xylose Lysine Deoxycholate (XLD) agar and Salmonella & Shigella agar (SS agar) (Oxoid) for *Salmonella* determination. Samples were prepared using lactose broth or peptone water and incubated for (24 h.; at 35 ± 1 °C) for enrichment, then mixed and streaked on XLD and SS agar. *Salmonella* may produce colonies with large, pink colonies with or without black centers, may appear as almost completely black colonies (PHE, 2019), or Good growth; colorless colonies with black centers on SS agar, but Shigella give a Good growth; colorless colonies without black centers. The media used were in a dehydrated form and prepared according to the manufacturer's instructions.

Plates with 30-300 colonies selected for enumeration of the TBC, TCC. One to six colonies randomly selected from PCA and VRBA based on morphological differences in color, whole colony shape, edge, and elevation, were transferred by streaking on nutrient agar (NA) plates and slants to control their purity (FDA, 2001; Ajazi *et al.*, 2018).

Isolates Identification:

Bacterial isolates were identified using Gram stain, and then diagnostic biochemical tests, including catalase, oxidase, urease, lactose fermentation, and coagulase test for Staphylococcus aureus. Motility test, indole test, and sulfide production (SIM), citrate utilization, MR-VP tests, triple sugar iron (TSI) test, (APHA, 1998; FDA, 2001) Bacteria species were determined according to Bergy's manual of determinative bacteriology 9th edition (Andrews, 1992; Holt *et al.*, 1994;).

Statistical analysis:

All experimental results are presented as average ± SD. The total number of bacteria was calculated by multiplying the inverse of the dilution factor by the mean number of colonies in the plates (two

replicates per dilution). For statistical analysis, colony-forming units/g (CFU/g) were counted and then converted to Log_{10}CFU/g. The data were analyzed with SPSS software (Statistical Package for Social Science version 23, IBM/SPSS). Descriptive statistics used to data. ANOVA performed. Duncan's test was used as a post hoc test. Mean differences were considered significant at $p \leq 0.05$.

Results:

Milk and cheese highly nutritional food that a good growth medium for a wide range of microorganisms; for this reason, microbiological analyses for assessment of quality and safety are critical.

Table (1) shows the means, standard deviation, median, minimum, and maximum values of the microbiological parameters of white cheese samples (ricotta cheese, halloumi, and traditionally homemade cheese.) that are sold in the Benghazi supermarkets and groceries.

The total bacterial count 5.10 to 7.55 Log_{10}CFU/g for all cheese types, with a mean of 6.88 ± 0.80 Log_{10}CFU/g. Total bacterial counts for ricotta cheese 5.10 – 7.46, 6.54 - 7.49 log_{10}CFU/g for Halloumi cheese, and 5.61 – 7.55 log_{10}CFU/g homemade white cheese. Total coliform count 2.48 to 6.70 with mean 4.67 ± 1.467 log_{10}CFU/g. Also, the total Staphylococcus count was 1 – 4.82; with a mean of 3.675 ± 1.055 log_{10}CFU/g.

Between the three types of cheese; Table (2) we can notice that was no significant difference between the three types of cheese in total bacteria count and the total coliform count. There was a significant difference between the total staphylococcus counts between the three types of cheese at $p \leq 0.05$.

Table 1. Means of the studied parameters

parameter	Minimum - Maximum	Mean ± SD
Total bacteria count	5.10 – 7.55	6.88 ± 0.8024
Total coliform count	2.48 – 6.70	4.67 ± 1.4673
Total staph. count	1 – 4.82	3.68 ± 1.0551

Table 2. Differences between processed cheeses from Benghazi markets

Cheese Kind		Total bacteria count	Total coliform count	Total staph. count
Ricotta	**Mean**	6.8213	4.1027	4.2153 [a]
	Std. Deviation	.8781	1.2625	.3182
	Minimum	5.10	2.48	3.81
	Maximum	7.46	5.56	4.82
Halloumi	**Mean**	6.9917	4.8600	4.2483 [a]
	Std. Deviation	.4584	1.5038	.4334
	Minimum	6.54	3.30	3.83
	Maximum	7.49	6.41	4.67
homemade	**Mean**	6.8989	5.4900	2.3911 [b]
	Std. Deviation	.9151	1.4881	1.0453
	Minimum	5.61	3.48	1.00
	Maximum	7.55	6.70	3.18
P value		0.910	0.071	0.000*

Means in the same column with similar superscripts are not significantly different ($p \leq 0.05$)

To reach these values, three types of cheese isolates were used, purchased from the groceries of Benghazi, in addition to those that were manufactured at home (twice in December 2019). By studying the total number of bacteria and the total coliform count as well as the Staphylococcus count.

Table (3) shows that there is a significant difference between the studied samples, between different marketing sites. Also, between them and homemade samples. Samples H_1 and H_2 were the highest microbial content, and sample H_2 was the highest number of coliform bacteria. Conversely, homemade cheese was the lowest in *Staphylococcus* bacteria.

Table 3. Microbiological count of the cheese samples (mean of two samples for each sector. log_{10}CFU/g)

Source	Sector	Total Bactria Count	Total Coliform Count	Total Staph. Count
		Mean ± SD	Mean ± SD	Mean ± SD
Ricotta	CHR_1	5.163 ^{g} ± 0.055	2.653 ^{f} ± 0.155	3.877 ^{d} ± 0.061
	CHR_2	7.290 ^{c} ± 0.030	4.267 ^{d} ± 0.061	4.787 ^{a} ± 0.031
	CHR_3	7.293 ^{c} ± 0.035	2.757 ^{f} ± 0.055	4.120 ^{c} ± 0.036
	CHR_4	7.450 ^{ab} ± 0.010	5.493 ^{c} ± 0.065	4.103 ^{c} ± 0.021
	CHR_5	6.910 ^{d} ± 0.020	5.343 ^{c} ± 0.085	4.190 ^{c} ± 0.085
Halloumi	HA_1	7.403 ^{b} ± 0.125	3.497 ^{e} ± 0.186	3.853 ^{d} ± 0.025
	HA_2	6.580 ^{e} ± 0.036	6.223 ^{b} ± 0.207	4.643 ^{b} ± 0.031
homemade	H_1	7.487 ^{ab} ± 0.021	3.513 ^{e} ± 0.031	1.000 ^{f} ± 0.000
	H_2	7.530 ^{a} ± 0.035	6.620 ^{a} ± 0.072	3.087 ^{e} ± 0.090
	H_3	5.680 ^{f} ± 0.061	6.337 ^{b} ± 0.025	3.087 ^{e} ± 0.090
Total		6.879 ± 0.8025	4.670 ± 1.4673	3.675 ± 1.0551
LSD		0.0900	0.1895	0.0956

Means in the same column with similar superscripts are not significantly different ($p \leq 0.05$)

To define the pathogen bacteria present in white cheese, 1-5 isolates were taken from Plate count agar media as well as from the Violet Red Bile Salt agar to determine their types. 47 colonies were isolated and purified according to their morphological shape.

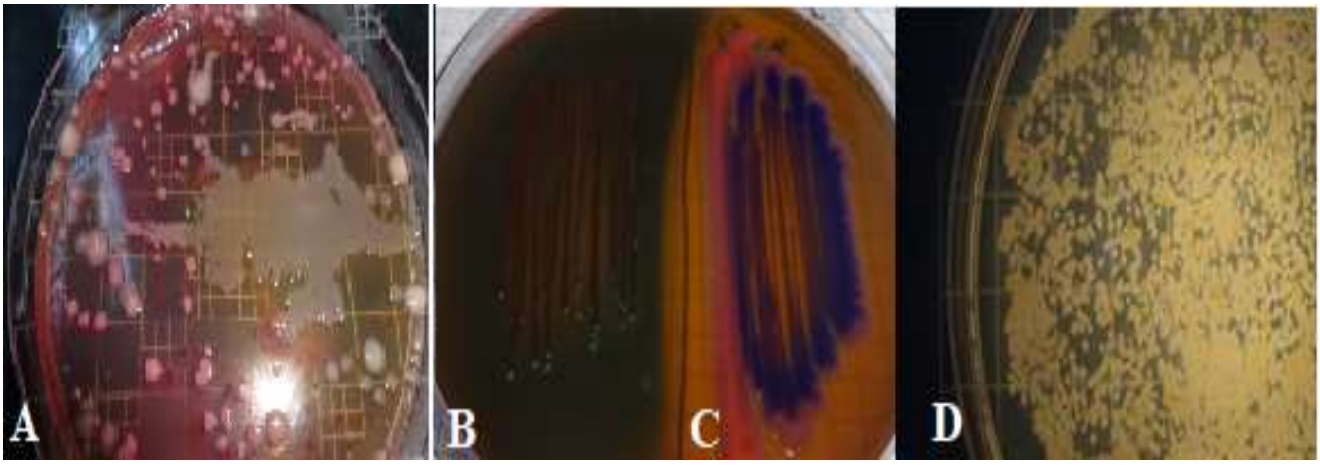

Fig. 1 Isolated *Coliform* (A) *E. coli* (B) *Klebsiella* (C) *Enterobacter* (D)

Table (4) shows the population of the defined microbial and biochemical reactions of these isolates.

Table 4. The type of pathogenic bacteria isolated and identified from white cheese samples from Benghazi city markets.

Identified bacteria	gram stain	TSI				Indole	Motility	citrate	Urease	VP	MR	Catalase	Oxidase
		Slant	But.	H_2S	Gas								
Bacillus cereus	Pos.	R	Y	-	-	-	+	+	-	+	-	+	-
Citrobacter spp.	Neg.	Y	Y	+	+	-	+	+	±	-	+	+	-
E. coli	Neg.	Y	Y	-	+	+	+	-	-	-	+	+	-
Enterobacter aerogenes	Pos.	Y	Y	-	+	-	+	+	-	+	-	+	-
Klebsiella spp.	Neg.	Y	Y	-	+	-	-	+	+	+	-	+	-
Lactobacillus spp.	Pos.	Y	Y	-	-	-	-	-	-	-	-	-	-
Proteus spp.	Neg.	R	Y	+	+	+	+	+	+	-	+	+	-
Pseudomonas spp.	Neg.	R	Y	-	-	-	+	+	-	-	-	+	+
Salmonella spp.	Neg.	R	Y	+	+	-	+	-	-	-	+	+	-
Shigella spp.	Neg.	R	Y	-	-	-	-	-	-	-	+	-	-
Staphylococcus spp.	Pos.	Y	Y	-	-	-	-	+	+	+	+	+	-

R (Alk): alkaline reaction, Y (A): acid reaction, but. : at the bottom, MR: Methyl Red, VP: Vogas Proskauer, (+): positive result, (-): Negative result, (±): Variable

Discussion:

This study evaluated three types of cheese sold in Benghazi markets, ricotta, halloumi cheese manufactured in Benghazi, and homemade white cheese. All types were traditionally manufactured, packed in a nylon bag with no label, no information about production date, and expiry date. The International Organization for Microbiological Specifications of Food has classified cheese as a high-risk food, contributing to several disease outbreaks.

The use of the plate count method is an indication of the level of microorganisms in the product, and the increase in the number of bacteria in milk and their derivatives is evidence of poor product and storage. Cheese naturally contains large numbers of starter bacteria.

The results showed that a total number of bacteria in cheese samples was (6.88 ± 0.8024 $\log_{10}$CFU/g), this result was less than results obtained by (Talal and Rasoul, 2012) 3.9×10^8 CFU/g (8.59 $\log_{10}$CFU/g) ; (Salem *et al.*, 2016) 2.14×10^8 CFU/g (8.33 $\log_{10}$CFU/g), and the result of (Haddad, Yamani, and Abu-Alruz, 2015; Uymaz and Sanlibaba, 2018), 3.63×10^8, 2.19×10^8, and 1.55×10^8 CFU/g (8.56, 8.34 &8.19 $\log_{10}$CFU/g), and (Senbetu, 2014) 8.3×10^7 CFU/g (7.92 $\log_{10}$CFU/g).

However, it is higher than the value specified in the international microbiological standards for dairy products (Fox and Hackney, 2003) directive 92/46/EEC, which set the total bacterial value of 5×10^5 – 1.5×10^6 (5.70 – 6.18 $\log_{10}$CFU/g) in the raw milk used in industrial processes. The Libyan standards 366/1997 did not record any specific acceptable value for the total number of microbes in white cheese as well as the Egyptian standards 1008/2000.

The primitive method of making cheese and the unhealthy conditions under which it is manufactured. Raw milk is not subjected to heat treatment or pasteurization, which leads to the non-killing of bacteria found mainly in the milk, thus increasing their numbers in cheese products. Pink to pinkish-red colonies with bile precipitate Escherichia coli, Identified as Gram (-) (bacilli under the microscope),

urease (-), catalase (+), and oxidase (-). Using the Eosin methylene blue agar test, E. coli appeared Blue-black with a green metallic sheen (fig.1).

The study showed that the average total number of coliform bacteria in local cheese samples was 4.67 ± 1.4673 $\log_{10}$CFU/g (4.86 in halloumi samples, 5.49 in homemade cheese, and the lowest value was 4.10 in ricotta cheese). The high level of contamination with coliform bacteria was unacceptable because it exceeded the limit allowed in the Libyan specification 366/1997. This result remains lower than that recorded (Ghada *et al.*, 2004), as the home-made kareish cheese contained $1.5 \times 10^7 – 7 \times 10^7$ (7.18 – 7.85), (Kursun *et al.*, 2011) found $4.60 \times 10^6 – 1 \times 10^9$ CFU/g (6.66 – 9 $\log_{10}$CFU/g) this value was much higher than that specified by the Egyptian specifications as well as European codecs. This was similar to the results of (Haddad and Yamani, 2017) 5.5 $\log_{10}$CFU/g, and the results of (Ibrahim, *et al.*, 2015) 5.8 $\log_{10}$CFU/g. While (Pešić-Mikulec & Jovanović, 2006) found Enterobacteriaceae bacteria at a level of 4.20±1.93 $\log_{10}$CFU/g.

Contamination of cheese with coliform indicates poor health conditions during production, circulation, distribution, and the possible presence of intestinal pathogens (Ghada *et al.*, 2004). E. coli does not exceed 10 cells/gram. It is worth noting that the presence of Escherichia coli in milk and dairy products is an indication of the presence of direct or indirect fecal contamination. Contamination may be through the hands and milk in which living organisms can live well in improperly heated milk. European Commission overview of microbiological criteria for dairy products identified the count of *E. coli* in cheeses made from raw milk between $10^4 – 10^5$ CFU/g (4 – 5 $\log_{10}$CFU/g) the acceptance limits. (directive 92/46/EEC); (Fox and Hackney, 2003).

Through the results of the study, the total rate of staphylococcus bacteria in cheese samples was (3.68 ± 1.055) $\log_{10}$CFU/g, 2.391 $\log_{10}$CFU/g in homemade cheese, 4.248 $\log_{10}$CFU/g in halloumi cheese, and 4.215 $\log_{10}$CFU/g in ricotta cheese. This result is higher than (Talal and Rasoul, 2012) 7.1×10^3 (3.85 $\log_{10}$CFU/g), and similar to (Coveney *et al.*, 1994) how observed $0.47 \times 10^4 – 81 \times 10^4$ CFU/g (3.67 – 5.91). (Kursun *et al.*, 2011) found streptococcus and staphylococcus ranging between 10^3 -10^6 CFU/g. It is less than the results of (Ibrahim *et al.*, 2015) it was 5.3 $\log_{10}$CFU/g (Uymaz and Sanlibaba, 2018) was 1.77×10^6 CFU/g (6.25 $\log_{10}$CFU/g) (Margolles *et al.*, 1996) that it was 1.3×10^7 CFU/g (7.11 $\log_{10}$CFU/g). Circular and oval yellow colonies with yellow zones (fig. 1). Colorless or red colonies with red zones together on mannitol salt agar were given as *Staphylococcus* spp. Identified as Gram (+) (grape-like clusters under microscope), urease (+), catalase (+), oxidase (-). According to the coagulase test, Staphylococcus aureus (coagulase-positive) were detected. The presence of *Staphylococcus aureus* in cheese indicates milk contamination from a diseased animal, uncleaned udder, contaminated unclean hands workers or farmers, sneezing, and coughing.

All samples studied included *Staphylococcus* bacteria in varying numbers (Table 1) (1 - 4.82 $\log_{10}$CFU/g) 50% of samples were within the limits of the analytical value that distinguishes good quality from marginally acceptable quality according to international microbiological criteria for dairy products ($10^3 – 10^4$) (Fox and Hackney, 2003) 50% exceeds the marginal limits of 10^4. Here, it is useful to emphasize that *Staphylococcus aureus* can produce toxins and cause food poisoning. The presence of 0.1 -1 million cells per gram is sufficient to cause food poisoning (ICMSF, 2005) because our samples were contaminated at the time of the examination, but within the limits that do not allow food poisoning to occur.

To define the pathogen bacteria present in white cheese samples, 47 colonies were isolated and purified according to their morphological shape. Table (4) shows the microbial species that were identified after their isolation from the studied cheese samples. By morphological and biochemical identification, we found ***Bacillus cereus***, which was characterized by Gram (+), single rod-shaped, or appears in short chains, urease (-), catalase (+), oxidase (-), indol (-). ***Enterobacter aerogenes***, which is characterized by pink to red colonies, may have a slight precipitate around colonies. Gram (+), urease (-), catalase (+), oxidase (-), indol (-), and its reaction on TSI test. *Citrobacter spp*. Colonies on nutrient agar are smooth, low convex, moist, and entire edge. Gram (-), straight rods, occurring singly, catalase (+), oxidase (-), indol (-), VP (-), and MR (+). *Lactobacillus spp*. Gram (+), urease (-), catalase (-), oxidase (-), indol (-), MR, VP, and citrate utilization tests all isolates were also found negative, thereby these confirming that the isolates were *Lactobacillus* spp (Dhanasekaran *et al.*, 2010). *Salmonella* and *Shigella* were detected in one sample. *Proteus* and *Klebsiella spp.* were found in one sample of ricotta and a sample of halloumi cheese. *Proteus* colonies were characterized by large circular, gray, and smooth colonies. Rod-shaped Gram (-), and positive for all biochemical tests except oxidase and VP. While *Klebsiella spp*. Colonies appear grayish-white, pink to purple without green metallic sheen on EMB, circular colonies, mucoid and gram (-) rod shape (coccobacilli) single or in pairs, catalase, oxidase, urease tests all positive. (fig.1).

Conclusion:

Soft cheeses are a risk to human health and can be considered a potential carrier of infection or pathogenic microbes. Dairy animals should be examined, especially the udder, and sick animals should be isolated. This study recommended the necessity to follow healthy methods during milking, the treatment and processing of cheese, storage (packing and preserving), and marketing.

In summary, measures should be taken to improve health conditions while collecting raw milk and in sterilization and pasteurization of the saline solution used after collecting cheese. Using high-quality raw materials and new technologies Training individuals dealing with cheese processing, continuous cleaning, and sterilizing the hands of workers, tools, surfaces, treatment devices, and filtration systems for the air of the preparation rooms will help in removing pollution and pollutants from the manufacturing process and preserve the product.

HACCP application should be introduced in the cheese industry to improve the quality of these products manufactured in Libya.

Carrying out periodic and permanent health control of cheese products to produce cheese that meets the specifications, which need to be reviewed and redeveloped in line with the development taking place at the world level. Good quality processed cheese can be produced when milk is pasteurized before processing to eliminate the original microflora.

The constant affirmation that the milk included in the manufacture of cheese must be of first-class and of high quality to ensure high-quality products. Carrying out permanent health control over workers in the field of processing cheese, transporting, selling, and storing cheese.

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دراسة النوعية البكتريولوجية للاجبان البيضاء في اسواق بنغازي، ليبيا

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تاريخ الاستلام: 2020/08/10 تاريخ القبول: 2020/09/14

الملخص

تم دراسة النوعية الميكروبية لبعض أنواع الجبن الأبيض (ريكوتان والحلوم والجبنة البيضاء المصنعة منزلياً) من أسواق مدينة بنغازي، ليبيا في ديسمبر 2019، حيث درس العدد الكلي للميكروبات، وعدد بكتيريا الكوليفورم *Coliform* و *E. coli* وكذلك المكورات العنقودية الذهبية *Staphylococcus aureus*. كان العدد الكلي للبكتيريا 5.10 – 7.55 لو$_{10}$ وحدة منتجة للمستعمرة/غ (لو$_{10}$ و.م.م./غ) لكل أنواع الجبنة، بمتوسط 6.88 ± 0.8024 لو$_{10}$ و.م.م./غ. العدد الكلي للبكتيريا في جبنة الريكوتا 5.10 – 7.46 لو$_{10}$ و.م.م./غ، و 6.54 – 7.49 لو$_{10}$ و.م.م./غ لجبنة الحلوم. أما الجبنة البيضاء المصنعة منزلياً فكان العدد الكلي للبكتيريا 5.61 – 7.55 لو$_{10}$ و.م.م./غ. العدد الكلي لبكتيريا الكوليفورم *Coliform* 2.48 – 6.70 لو$_{10}$ و.م.م./غ بمتوسط 4.67 ± 1.4673 لو$_{10}$ و.م.م./غ. أما عدد المكورات العنقودية الذهبية *Staphylococcus aureus* فكان 1 – 4.82 بمتوسط 3.68 ± 1.055 لو$_{10}$ و.م.م./غ. كل عينات الجبنة المدروسة كانت عالية التلوث بالبكتيريا، حيث كانت الحمولة الميكروبية أعلى من حدود القبول (5.70 إلى 6.18)، لذلك صنّفت الأنواع المدروسة بأنها من الأنواع الضعيفة، كما تشير الحمولة الميكروبية إلى الخطورة على صحة المستهلك، وهذا يؤكد ضرورة تحسين المعايير الصحية للغذاء.

الكلمات المفتاحية: الجبنة البيضاء، الريكوتا، النوعية الميكروبية، التلوث.