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Quality assessment of white soft cheese retailed in local markets

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ABSTRACT

The presence of various microorganisms in milk and dairy products can lead to potential public health hazards. The aim of this study was to assess the quality of various types of white soft cheeses. A total of 120 samples of soft cheeses were: 60 each of Kareish and Tallaga cheese were randomly collected from local markets. Each sample was divided into three parts and examined. The physical examination showed that the examined samples were normal in flavor, body and texture, appearance and color. Chemically, the mean pH values, NaCl% and Fat/ DM % were 4.48±0.04, 1.35±0.11, 2.50 ± 0.79 and 4.48±0.06, 2.29±0.11, 53.80 ± 1.60 in Kariesh and Tallaga samples, respectively. Microbiological examination included that samples were investigated for *Staphylococcus aureus*, Coliforms, *Escherichia coli*, Salmonella, yeast and mold in addition to serotyping of isolated *Staphylococcus aureus*, *E. coli* and Salmonella. Both Kareish and Tallaga samples were proved to be highly contaminated, exceeding the permissible bacterial load. The mean levels of *Staph. aureus*, Coliforms and yeast and mold were1.00 $\times10^8\pm9.16 \times10^5$, 6.5 $\times10^5\pm7.05 \times10^4$,8.09 $\times10^7\pm7.55 \times10^6$, 5.26 $\times10^7\pm6.34 \times10^6$ for Kariesh samples and 8.58 $\times10^7\pm7.79 \times10^6$, 5.81 $\times10^7\pm4.39 \times10^6$, 3.22 $\times10^7$ ± 3.15 $\times10^6$ for Tallaga samples. While the incidence of *E. coli* and Salmonella was 66.6% and 15% in Kariesh samples and 48.3% and 6.6% in Tallaga samples. The results indicated that unsanitary conditions were present at various stages of production. Consequently, it is highly recommended to implement stringent hygiene and sanitation practices throughout the cheese manufacturing process.

1. INTRODUCTION

Cheese is a broad term for various fermented dairy products, crafted in diverse flavors, textures, and styles worldwide [1]. Nutritionally, cheese provides high levels of protein and fat, while also serving as a valuable source of vitamins and minerals [2]. There is diversity of cheese types such as Kareish, Feta, Domiati and other types [3].Kareish cheese refers to fresh soft unripened cheese obtained after coagulating milk or dairy products that have been pasteurized or treated with any heat treatment equivalent to pasteurization [4]. It is a good source of essential vitamins and minerals [5]. Tallaga cheese is brined ripened soft cheese preserved in brine solution and ripened under refrigeration, obtained after coagulating milk or dairy products that have been pasteurized or treated with any heat treatment equivalent to pasteurization [6]. It is characterized mainly by soft creamy consistency and high moisture content as well as lowered salty taste [7]. Various chemical parameters can influence the quality of white soft cheeses, including pH levels and salt concentrations [8]. Foodborne illnesses represent a major public health concern with substantial economic implications [9].Staphylococcal food poisoning is one of the most commonly occurring foodborne diseases globally. The presence of *S. aureus* in foods

believed to cause staphylococcal poisoning should be interpreted with care [10]. The microbiological quality of dairy products and post heat treatment contamination can be assessed through coliforms counts, with *E. coli* being the most prevalent pathogen associated with outbreaks linked to milk and dairy products [11].Salmonella are the most prevalent pathogenic bacteria affecting humans and animals, leading to Salmonellosis. This illness can arise from various serovars of Salmonella and can range from mild food poisoning to severe enteric fever [12]. Yeasts and molds can alter the biochemical properties, flavor, and appearance of the products, making them less marketable. Additionally, they often lead to a downgrade in the quality assessment of the dairy product [13] [14].Cheese must be free of pathogenic microorganisms, such as *Staph. aureus.* Additionally, they should meet the following microbiological standards: Coliforms must not exceed 10 (CFU/gm), *E. coli* and salmonella must not be present, yeast counts should remain below 400 CFU/gm, while mold counts must not exceed 10 (CFU/gm) [15].

the aim of the study was to estimate the quality of white soft cheese retailed in local markets in Menoufia government, Egypt by evaluating organoleptic, chemical and microbiological characteristics.

2. MATERIALS AND METHODS

1. Collection of samples

A total of 120 random samples (60 Kareish cheese samples and 60 Tallaga cheese samples) were collected from different markets at Menoufia Government, Egypt to be examined for some chemical and microbiological parameters. All samples were collected in their original plastic bags as sold to the public and transported to the Food Hygiene and Control laboratory, Faculty of Veterinary medicine, Menoufia university.

2. Organoleptic examination

Assessment of cheese samples was performed according to standardized sensory evaluation protocols [16] [17] with modifications to a total score of 100 points allocated as follows: 50 points for flavor, 35 for body/texture, 10 for appearance, and 5 for color by a panel test mainly by staff members.

3. Chemical examination

3.1 preparation of samples

Preparation of the samples for the chemical examination was performed according to [18].

3.2 Determination of PH, salt content and fat/dry matter percentage according to [18].

4. Microbiological examination

4.1 Preparation of decimal dilutions:

Ten grams of each prepared cheese sample and 90 mL of sterile distilled water with 2% sodium citrate solution were mixed to make a 1/10 dilution. Next, tenth-fold decimal dilutions were made using 1 mL of the previously prepared homogenate and 9 mL of distilled water [19].

***4.2 Staph. aureus* count:**

Spread 0.1of each formerly prepared serial dilution onto plates of Baird Parker media enriched with egg yolk tellurite emulsion. Next, the plates were then incubated at 37℃ for 48 hours. Suspected colonies were counted, picked up and transmitted to nutrient agar slopes, then incubated at 37 ℃ for 24 h. The purified colonies were submitted for further biochemical and serological examination [19].

4.3 Determination of coliforms count *and isolation* of *E. coli*:

Tubes of MacConkey broth (9 mL) augmented with inverted Durham tubes were inoculated with one milliliter of each formerly prepared serial dilution and incubated at 37 °C for 48 h. Tubes that exhibited acid and gas production were estimated positive for Coliforms and the results were recorded. A loopful from each positive MacConkey broth tube was used for streaking onto Eosin-methylene blue agar (EMB) and incubated at 37 ℃ for 24 h. Suspected colonies were counted, picked up and transmitted to nutrient agar slopes, then incubated at 37 ℃ for 24 h. the purified colonies were submitted for further biochemical and serological examination [20].

4.4 Isolation of Salmonella:

One milliliter of each prepared serial dilution was transmitted to sterile enrichment tubes containing 9 ml selenite-F broth. Then, tubes were incubated for 24 h at 37°C. A loopful from the enriched broth was streaked onto the surface of formerly prepared xylose lysine deoxycholate agar (XLD agar) and Salmonella Shigella agar (S.S agar). Inoculated plates were incubated at 37°C for 24 h. Suspected colonies were picked up and transmitted to nutrient agar slopes, then incubated at 37 ℃ for 24 h. The purified colonies were submitted for further biochemical and serological examinations [21].

4.5 Mold and yeast count:

Inoculate 0.1 ml of each prepared serial dilution onto plates of Sabaroud dextrose agar supplemented with 0.1 g/l chloramphenicol. Inoculated plates were aerobically incubated in an uprightt position at 25 ℃ for 5 days. Mold growth enumerated and recorded as

mold count per gram. Yeast colonies were counted separately and recorded as well [22].

4.6 Biochemical identification: was performed according to [23].

4.7 Serological identification of isolated *S. aureus, E. coli* and Salmonella

4.7.1Detection and typing of enterotoxin of *S. aureus* [24].

4.7.2 Serological identification of *E. coli* [25].

4.7.3. Serological identification of Salmonella according to Kauffman – White scheme [26].

Statistical analysis:

Results were calculated in the form of mean ± and S.E.M. "standard Error of mean" using the program Statistical Package for Social Science (SPSS), version 20.

3. RESULTS

Table (1) Statistical analytical results of the organoleptic examination of the examined white soft cheese samples (n = 60 for each type)

	Cheese type	Min.	Max.	Mean ± S.E.M.
Flavor (50)	Kariesh	30	50	42.40±0.61[b]
	Tallaga	30	49	43.55±0.57[a]
Body and texture (40)	Kariesh	23	36	30.48±0.43[b]
	Tallaga	23	35	30.70±0.37[b]
Appearance (10)	Kariesh	5	9	7.3±0.15[b]
	Tallaga	5	9	7.5±0.16[a]
Color (5)	Kariesh	3	5	4.37±0.09[b]
	Tallaga	3	5	4.47±0.07[a]

Mean values with different superscript letters in the same raw differ significantly (P<0.05).

Table (2) Statistical analytical results of chemical parameters of the examined white soft cheese samples (n = 60 for each type).

Cheese type	pH			Salt%			Fat/ DM%		
	Min.	Max.	Mean ± S.E.M.	Min.	Max.	Mean ± S.E.M.	Min.	Max.	Mean ± S.E.M.
Kariesh cheese	3.99	5.21	4.48 ± 0.04[a]	0.33	3.34	1.35 ± 0.11[b]	1.20	14.21	2.50 ± 0.79[b]
Tallaga cheese	3.94	6.54	4.48 ± 0.06[a]	0.83	4.51	2.29 ± 0.11[a]	25.17	76.35	53.80 ± 1.60[a]

Mean values with different superscript letters in the same column differ significantly (P<0.05).

Table (3) Statistical analytical results of *Staphylococcus aureus* count (CFU/ml) of the examined white soft cheese samples (n= 60 for each type)

	Positive samples		Min.	Max.	Mean ± S.E.M.
	No.	%			
Kariesh cheese	42	70	1.10×10^{7}	3.23×10^{8}	$1.00 \times 10^{8} \pm 9.16 \times 10^{5b}$
Tallaga cheese	36	60	5.9×10^{5}	2.8×10^{8}	$8.58 \times 10^{7} \pm 7.79 \times 10^{6a}$
Mean values with different superscript letters in the same column differ significantly (P<0.05).					

Table (4) Enterotoxins of *Staphylococcus aureus* isolated from the examined white soft cheese samples (no. of isolates = 26)

***Staph. aureus* Enterotoxins**	**Number of isolates**	**Percentage %**
A+C	3	11.53
B	2	7.69
A	1	3.84
Non enterotoxigenic strains	20	76.92
total	26	100

Table (5) Statistical analytical results of Coliforms (MPN/g) of the examined white soft cheese samples (n= 60 for each type).

Cheese type	Positive samples		Min.	Max.	Mean ± S E.M.
	No.	%			
Kariesh cheese	51	85	7.4×10^{3}	1.4×10^{6}	$6.5 \times 10^{5} \pm 7.05 \times 10^{4a}$
Tallaga cheese	50	83.3	1.1×10^{4}	3.0×10^{6}	$1.25 \times 10^{6} \pm 1.41 \times 10^{5b}$

Mean values with different superscript letters in the same column differ significantly (P<0.05).

Table (6) Incidence of *Echerichia coli* in examined cheese samples of the examined white soft cheese samples (n= 60 for each type).

Cheese type	Total number of samples	Positive samples	percentage
Kariesh cheese	60	40	66.6
Tallaga cheese	60	29	48.3

Table (7) Serovars of *Echerichia coli* isolated from the examined white soft cheese samples (no. of isolates = 9).

Identified serovars	Number of isolates	Percentage in isolates	Strain characterization
O114: H4	3	33.3	EPEC
O121: H7	2	22.2	EHEC
O127: H6	1	11.1	ETEC
O159	1	11.1	EIEC
O26: H11	1	11.1	EHEC
O15: H2	1	11.1	ETEC
Total	9	100	

Enterotoxigenic (ETEC), Enteropathogenic (EPEC), Enteroinvasive (EIEC), Enterohemorrhagic (EHEC)

Table (8) Incidence of Salmonella in examined cheese samples.

Cheese type	Total number of samples	Positive samples	percentage
Kariesh cheese	60	9	15
Tallaga cheese	60	4	6.6

Table (9) Serovars of isolated Salmonella from the examined white soft cheese samples (no. of isolates = 12).

Identified serovars	Number	Percentage	Group	Antigenic structure	
				O	H
Salmonella Typhimurium	4	33.3	B	3,10	d: 1,5
Salmonella ParatyphiA	3	25	A	1,2,12	i : 1,5
Salmonella Enteritidis	2	16.6	D1	1,9,12	g,m : -
Salmonella Virchow	2	16.6	C1	6,7,14	r: 1,2
Salmonella Chester	1	8.3	B	1,4,5,12	e,h : e,n,x
Total	12	100			

Table (10) Statistical analytical results of Yeasts and Molds count (CFU/ml) of the examined white soft cheese samples.

	Mold count					Yeast count				
Cheese sample	**Positive samples**		**Min.**	**Max.**	**Mean ± S.E.M.**	**Positive samples**		**Min.**	**Max.**	**Mean ± S.E.M.**
	No.	**%**				**No.**	**%**			
Karieshcheese	56	93.3	1.80×10^5	2.67×10^8	$5.26 \times 10^7 \pm 6.34 \times 10^6$	51	85	3.00×10^6	3.13×10^8	$8.09 \times 10^7 \pm 7.55 \times 10^{6b}$
Tallagacheese	50	83.3	2.7×10^5	9.20×10^7	$3.22 \times 10^7 \pm 3.15 \times 10^6$	53	88.3	2.4×10^5	1.35×10^8	$5.81 \times 10^7 \pm 4.39 \times 10^6$a

Fig. 1. Staphylococcus aureus colonies on Baird Parker agar medium.

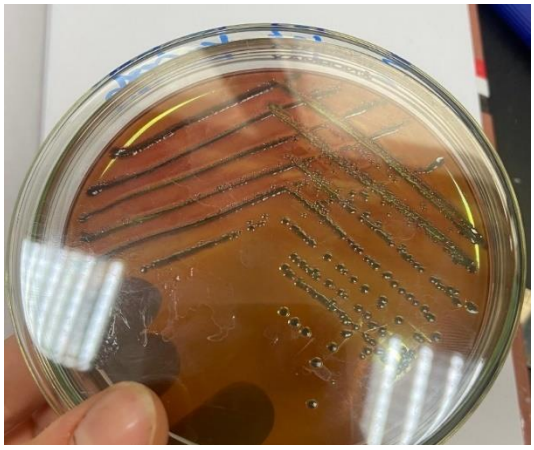

Fig .2 *Echerichia coli* colonies on Eosin Methylene Blue agar medium.

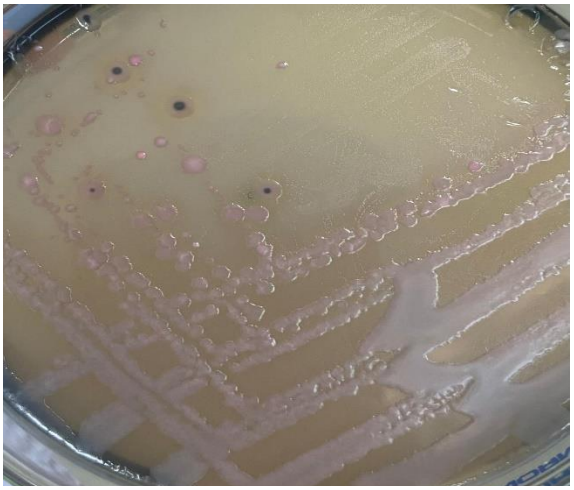

Fig .3 Salmonella colonies on Salmonella Shigella agar medium

Fig .4 Salmonella colonies on Xylose Lysine agar medium

Fig .5 Yeasts and Molds colonies on Sabouraud Dextrose agar medium.

4. DISCUSSION

Data in Table (1) illustrates the Statistical analytical results of the organoleptic examination of the examined white soft cheese samples. The analysis indicated that the samples examined exhibited normal flavor, body and texture, appearance, and color. [27] recorded that the flavor of Kareish cheese samples from the Pareis area was unsatisfactory, while samples from other areas were acceptable. The taste was generally liked across all regions, with a salty flavor and an average taste rating of 2.83 for Kareish cheese. The texture was well-received in most Kareish cheese samples, except for those from the Elfarafra area.

Data presented in Table (2) showed that the maximum and minimum values of pH. These results were similar to those obtained by [28] who recorded the maximum and minimum values of pH of 4.65, 4.21 in the examined Kariesh cheese samples. [29] illustrated higher mean values of pH of the examined low salt soft cheese samples of 5.83±0.52 in Alexandria and 5.40±0.70 in El-Behera samples.

Results presented in Table (2) showed that the mean values of salt%. Similar results were recorded by [30] who stated that the mean of salt% in the examined Kariesh and Tallaga cheese samples was 1.03 ± 0.05 and 2.5 ± 0.27, respectively. Higher results were obtained by [31] who reported that salt% ranged from 1.5% to 4.0% with a mean value of 2.75% in the examined Kariesh cheese samples. [15] stated that table salt% in white soft cheese must not be more than 6% which is in compliance with our results.

Table (2) shows the mean values of Fat/DM%. [32] stated higher results in Tallaga cheese samples with a mean value of 69.24±1.54. [30] reported higher mean results of Fat/DM% in Kareish cheese samples of 47.8 ±1.44 and nearly similar results in Tallaga cheese samples of 44.9 ±1.44. According to [4][6], examined Kariesh and Tallaga cheese samples were within the permissible limit. The high moisture content (low TS) in Kareish cheese could be primarily attributed to the acid coagulation method used in its production [33].

Results in Table (3) and fig. (1) indicated that S*taph. aureus* was present in 70 % and 60% of the analyzed Kariesh and Tallaga cheese samples, respectively. Lower values were detected by [34] who detected average values of Kareish and Tallaga cheese samples of $1.7x10^3$ and $8.7x10^2$ CFU/gm, respectively. Nearly similar results were recorded by [32] who declared that 42 (84%) of the samples were positive for *Staphylococci* with mean value of $60\times10^6\pm20\times10^6$ CFU/gm. According to [4] and [6] which stated that Kariesh and Tallaga cheese must be free from *Staph. aureus*, 70% of Kariesh and 60% of Tallaga cheese samples were incompatible with this limit. The presence of *Staph. aureus* in cheese suggests direct contamination from workers' hands, particularly if they have abrasions or wounds, or from inadequately cleaned equipment, leading to *Staph. aureus* intoxication [35].

Table (4) illustrates results of total Coliforms count. Lower results were indicated by [36] who detected total Coliforms mean values of $5.3x\ 10^3 \pm 3.03x\ 10^3$ MPN/gm in Tallaga cheese samples and higher mean values of total Coliforms of $7.7\ x\ 10^6 \pm 3.7x\ 10^6$ MPN/gm in Kareish cheese samples. Nearly similar results were recorded by [32] who declared that the mean count of Coliforms (MPN/gm) in Tallaga cheese samples was $10^5\pm3.8\times10^4$. According to [4] and [6] which stated that Coliforms count must not exceed 10 CFU/gm 85% of Kariesh and 83.3% of Tallaga cheese samples examined disagreed with the permissible limit. Coliforms serve as indicators of fecal contamination, and a high Coliform count significantly affects product safety and quality, as they can cause holes that make the final product unsuitable for consumers [37].

The results obtained in Table (6) and fig. (2) reveal the incidence of *E. coli.*, [38] detected lower E. coli incidence of 40% and 24% in the examined Kareish and Tallaga cheeses samples. Nearly similar results were estimated by [34] who found that 50 and 42% of the examined Kariesh and Tallaga cheese samples were positive for *E. coli.* According to [4] and [6] which stated that Kariesh and Tallaga cheese must be free from E. coli, 66.6% of Kariesh and 48.3% of Tallaga cheese samples were incompatible with this limit. The higher incidence of *E. coli* in cheese samples indicates lack of proper sanitation during production, handling and distribution [39].

The results obtained in Table (8) and fig. (3,4) reveal the incidence of salmonella. Nearly similar results were recorded by [40] who showed that Salmonella was isolated from 10 Kariesh samples, with a percentage of 20%. Additionally, [41] reported the incidence of Salmonella of 0% and 2.8% in the examined Kariesh and Tallaga cheese samples, respectively. According to [4] and [6]

which stated that Kariesh and Tallaga cheese must be free from Salmonella, 15% of Kariesh and 6.6% of Tallaga cheese samples were incompatible with this limit. The varying occurrence of Salmonella may be attributed to factors such as farm management practices, sampling methods, sample origins, microbiological techniques for pathogen detection, and manufacturing processes [42].

Table (10) and fig. (5) revealed Yeast and mold counts. Nearly similar results of total Yeasts and Molds count in Kariesh cheese samples of $2.4x10^7$ CFU/gm were reported by [43]. Lower counts of total Yeasts and Molds in Kariesh cheese samples were detected by [31] with a mean value of $42x10^2$ CFU/gm. According to [4] and [6] which stated that Yeast count which must not exceed 400 CFU/gm in Kariesh and Tallaga cheese, 85% of Kariesh and 88.3% of Tallaga cheese samples examined were incompatible with this limit. While 93.3% of Kariesh and 83.3% of Tallaga cheese samples examined were incompatible with the limit for Mold count that must not exceed 10 CFU/gm. presence in dairy products may result from inadequate hygiene during processing, packaging, or distribution, as well as the use of low-quality raw materials [44].

5. CONCLUSIONS

Cheese, especially unpackaged types like Kariesh, is prone to bacterial contamination (e.g., *Staph. aureus, E. coli*, *Salmonella*), posing health risks due to poor production hygiene. Thus, this emphasizes the need for certain essential recommendations to be applied including:

Farm & Milk: Test animals, ensure clean milking, and refrigerate milk.

1. **Production:** Pasteurize milk, use antimicrobials (like CS-NPs), and enforce strict hygiene (HACCP/GMP).
2. **Packaging:** Use sealed containers to prevent contamination.
3. **Consumers:** Buy only pasteurized, well-packaged cheese from trusted sources.

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