

Assessment of Chemical and Microbiological Quality of Raw Cow Milk and Some Dairy Products in the Local Market of Aswan Governorate

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Abstract

Food safety concerns in the dairy industry fall into two main categories: microbiological and chemical hazards. The present study was performed to investigate the chemical and microbiological quality of raw cow milk, yoghurt, Kareish cheese, and Domiati cheese purchased from three regions within Aswan Governorate. The obtained results revealed that cow milk exhibited total solids content (11.15 g/100 g) and acidity (0.22% as lactic acid), along with lower fat (2.85 g/100 g) and protein levels (2.90 g/100 g). Additionally, the carbohydrate and ash contents were 4.60 g/100 g and 0.80 g/100 g, respectively, within their standard specifications. The total solids, salt, and acidity levels in Kareish cheese, and Domiati cheese were within the standard limits; however, acidity was notably elevated in most regions. Yoghurt was normal in total solids and lower in fat than legal standards (2.53 g/100 g) in all areas. Furthermore, carbohydrates did not exist in standard specifications of yoghurt, Kareish cheese, and Domiati cheese. The total bacterial counts were recorded as 7.12, 6.09, 4.15, and 3.90 log CFU/g for raw cow milk, yoghurt, Kareish cheese, and Domiati cheese, respectively. All samples contained coliform bacteria, with raw milk displaying the highest count at 4.25 log CFU/g. Mold and yeasts were also presented in all samples, with Kareish cheese exhibiting particularly high levels. Therefore, it was concluded that the microbial quality of raw cow milk and dairy products marketed in the study area was poor, and this suggests the need for improved hygienic practices at all levels of milk processing.

Keywords: Raw milk; Domiati cheese; Kareish cheese; Yoghurt; Local market.

Introduction

Microbiological and chemical hazards are the two primary types of food safety issues in the dairy sector. Foodborne infections are the main source of microbiological hazards. Chemical hazards, like those caused by pesticides and medications, are outside the purview of this subject, and are beyond the scope of this discussion. Milk, though highly nutritious, is an excellent medium for bacterial growth and can pose risks if consumed unpasteurized [1]. Milk is an ideal food, because it contains protein, fat, vitamins, sugar, and minerals. As a result, it is considered an excellent medium for a variety of microorganisms, including coliforms [2]. While milk is sterile at secretion, factors such as animal health, equipment hygiene, and storage conditions influence its microbial load post-milking [3]. Contaminants may also originate from air, soil, and feed [4]. Healthy udders produce milk with minimal bacteria, but environmental contamination can elevate the bacterial counts [5].

The microbiological quality of milk and dairy products depends on initial raw milk flora, processing conditions, and post-heat treatment contamination risks [6]. Yoghurt, Egypt's most consumed fermented milk product, offers health benefits, such as gut bacteria inhibition and improved calcium absorption [7]. Its quality hinges on raw ingredient selection and strict production controls. However, spoilage due to yeast and mold can cause off-flavors and textural defects [8]. Traditional Egyptian dairy products face unique challenges. Kareish cheese, made from raw milk, is prone to pathogen survival and mold growth during storage, compromising its quality [9-10]. Domiati cheese, another popular Egyptian soft cheese, also raises concerns about microbial safety during its fresh and pickled stages.

So, the objective of this research was to assess the chemical and microbiological quality of raw cow milk, yoghurt, Kareish cheese, and Domiati cheese collected from various regions within Aswan Governorate.

Material and methods

Materials

In the current research, 21 samples of raw cow milk and 18 samples of each of yoghurt, Kareish cheese, and Domiati cheese were randomly selected from retail markets and small dairy shops in three different regions of the Aswan Governorate: Aswan city (A), Kom-Ombo (K), and Edfu (E). The samples were transported to the laboratory in a cool, isolated icebox as soon as possible. They were analyzed chemically for moisture, fat, protein, lactose, salt, acidity, and pH, and microbiologically for total bacterial count, coliform bacteria, mold & yeasts.

Chemical analysis

The chemical composition of all samples (moisture, protein, fat, and ash) contents was determined according to the methods described by [11]. Titratable acidity was measured as lactic acid (%) [11], and pH values were measured using a pH meter (Jenway, 3505, Jenway Ltd., Felsted, Dunmow, Essex, UK).

Total carbohydrate content

A known weight (0.2-0.5g) of the ground sample was placed in a test tube, then sulfuric acid (10 ml 1 N) was added. The tube was sealed, and overnight placed in an oven at 100 °C. The solution was then filtered into measuring flask (100 ml) and completed to the mark with distilled water. The total hydrolysable carbohydrate was determined with the phenol-sulphuric acid according to the method of Dubois et al. [12].

Microbiological analysis

Total bacterial count (TBC), coliform bacteria, and mold & yeasts were determined according to the methods described by [13]. Tryptone glucose extract agar medium was used for the enumeration of TBC after incubation at 37ºC for 2 days under aerobic conditions. Coliform bacteria were enumerated on Violet Red Bile Agar (Oxoid) after incubation at 37 ºC for 24 h. Antibiotic standard plate count agar medium was used for the enumeration of mold & yeasts after incubation at 25 °C for 5 days under aerobic conditions.

Statistical analysis

Tests and analyses including each sample and each test parameter mentioned above were conducted in triplicate. The collected data were statistically analyzed using the general linear model in IBM SPSS Statistics 25 software, and the Duncan's multiple range test was applied to determine significance at a p-value of ≤ 0.05 .

Results and discussion

Physiochemical properties of raw cow milk samples

The data presented in Table 1 reflects the average chemical composition of cow milk collected from three distinct areas within the Aswan Governorate. The findings indicate that the cow milk samples are likely adulterated with water, as evidenced by their low total solids content (11.15 g/100 g) and low-fat levels (2.85 g/100 g), which fall below the Egyptian Standard (ES) [14] for raw cow milk. The observed ranges for total solids, protein, fat, carbohydrate, ash, acidity, and pH were 10.83–11.47 g/100g, 2.75–3.10 g/100g, 2.80–2.90 g/100g, 4.50–4.65 g/100g, 0.78–0.82 g/100g, 0.22–0.23 %, and 6.50–6.53, respectively. Similarly, Hamad and Baiomy [15] analyzed cow milk in the Qena Governorate, reporting fat, total solids, protein, lactose, ash, and pH values of 4.28 g/100g, 12.60 g/100 g, 3.37 g/100g, 4.47 g/100g, 0.69 g/100g, and 6.65, respectively. Furthermore, Ismail et al. [16] assessed raw cow milk from four different regions in the New Valley Governorate, revealing high moisture content (88.69%) and acidity (0.23%) alongside low-fat content (2.41%), with other components deemed within normal ranges.

Property	Different regions					
	Α	К	Е	Mean [*]		
Total solids (g/100g)	11.15 ^b	11.47ª	10.83 ^c	11.15 ^b		
Protein (g/100g)	2.85 ^b	3.10 ^a	2.75°	2.90		
Fat (g/100 g)	2.85 ^b	2.90 ^a	2.80 ^b	2.85		
Carbohydrates (g/100 g)	4.65 ^a	4.65 ^a	4.50 ^b	4.60		
Ash (g/100g)	0.80 ^a	0.82ª	0.78 ^a	0.80		
рН	6.60 ^a	6.50 ^b	6.50 ^b	6.53		
Acidity (%)	0.22ª	0.23ª	0.22ª	0.22		

Table 1: Chemical properties, pH, and acidity (%) of cow milk samples collected from different areasof Aswan Governorate.

* a, b & c....: means with the same letter among treatments are significantly different ($p \le 0.05$).

**A: Aswan city region; K: Kom-Ombo region; E: Edfu region.

The elevated acidity levels in the milk pose challenges for heating and pasteurization processes, which can be attributed to the high climatic temperatures in these areas, inadequate cooling systems, or poor sanitation and hygiene practices during milking and handling. The carbohydrate and ash content in cow milk across all regions appeared normal. However, the overall chemical quality of cow milk in all regions of the Aswan Governorate is unsatisfactory, necessitating stricter quality control measures.

Physiochemical properties of yoghurt, Kareish cheese, and Domiati cheese samples

As shown in Table 2, the average TS (g/100g) of yoghurt, Kareish cheese, and Domiati cheese samples collected from three regions in Aswan Governorate fell within the normal range for these

types of products and conformed to Egyptian Standards (ES) [17]. In Kareish cheese, no significant differences were observed between the different regions. In Domiati cheese, the lowest total solids (TS) was recorded in the Edfu region (E) (42.15 g/100g), while the highest TS was recorded in the Aswan city region (A) (45.25 g/100g). Several authors have studied the composition of Domiati cheese samples, including Salem [18], who analyzed samples collected from the Alexandria region and reported moisture, salt, and ash contents of 57.03 g/100 g, 5.24 g/100 g, and 4.58 g/100g, respectively. Also, Ismail [16] found moisture and salt were 42.51 g/100 g and 5.11 g/100 g for samples collected from the New Valley, Governorate. As seen in Table 2, no significant differences were observed in fat or protein contents between the different regions for yoghurt, Kareish cheese, and Domiati cheese samples collected from different regions in Aswan Governorate complied with Egyptian Standards (ES). Similarly, no significant differences were observed in the ash content of yoghurt, kareish cheese, or Domiati cheese, or Domiati cheese. A consistent trend was also noted for pH values. The total carbohydrate content in yoghurt, Kareish cheese, and Domiati cheese samples collected from the seven the cheese, and Domiati cheese samples collected from the seven the differences were observed in the ash content of yoghurt, kareish cheese, or Domiati cheese. A consistent trend was also noted for pH values. The total carbohydrate content in yoghurt, Kareish cheese, and Domiati cheese samples collected from the seven the seven the ash content of the three regions in Aswan Governorate is also presented in Table 2.

Property	Sample		Regions		Means [*]
		Α	К	E	
Total solids (TS) (g/100g)	Yoghurt	13.60 ^b	14.08ª	13.22 ^c	13.63
	Kareish cheese	25.32ª	25.80 ^a	25.62ª	25.58
	Domiati cheese	45.25ª	43.35 ^b	42.15 ^c	43.58
Fat (g/100g)	Yoghurt	2.60 ^a	2.50 ^a	2.50ª	2.53
	Kareish cheese	3.90 ^b	4.10 ^a	4.23ª	4.08
	Domiati cheese	22.67ª	23.25ª	21.80ª	22.57
Protein (g/100g)	Yoghurt	3.20 ^a	3.10 ^a	2.95ª	3.08
	Kareish cheese	6.90ª	7.35ª	6.80ª	7.02
	Domiati cheese	10.09ª	9.21ª	10.13ª	9.81
Fat/Dry matter (%)	Yoghurt	19.11 ^ª	17.76 ^c	18.91 ^b	18.59
(F/DM)	Kareish cheese	15.40 ^c	15.89 ^b	16.51ª	15.93
	Domiati cheese	50.10 ^c	53.63ª	51.72 ^b	51.82
Ash (g/100g)	Yoghurt	0.95ª	0.90 ^a	0.92ª	0.92
	Kareish cheese	1.15 ^b	1.46ª	1.44ª	1.35
	Domiati cheese	2.13ª	2.10 ^a	1.92ª	2.05
Salt (NaCl) (%)	Kareish cheese	1.87 ^b	2.13ª	2.09ª	2.03
	Domiati cheese	6.25ª	5.90 ^b	6.30ª	6.15
Total carbohydrates (g/100g)	Yoghurt	6.85 ^b	7.58ª	6.85 ^b	7.09
	Kareish cheese	13.37ª	12.89 ^a	13.15ª	13.14
	Domiati cheese	10.36ª	8.79 ^b	8.30 ^b	9.15
Acidity (%)	Yoghurt	0.96 ^b	1.05ª	0.94 ^b	0.98
	Kareish cheese	1.45ª	1.50ª	1.48ª	1.48
	Domiati cheese	1.25ª	1.16 ^b	1.30ª	1.24
рН	Yoghurt	4.68 ^a	4.60 ^a	4.70 ^a	4.66
	Kareish cheese	4.36 ^a	4.34 ^a	4.40 ^a	4.37
	Domiati cheese	4.60 ^a	4.66ª	4.50 ^a	4.59

Table 2: Chemical properties, pH, and acidity (%) of yoghurt, kareish cheese, and Domiati cheese samples collected from different areas of Aswan Governorate.

* a, b & c...: means with the same letter among treatments are significantly different ($p \le 0.05$).

**A: Aswan city region; B: Kom-Ombo region; C: Edfu region.

The carbohydrate contents were 7.09, 13.14, and 9.15 (g/100g) for yoghurt, Kareish cheese, and Domiati cheese, respectively. These values did not conform to Egyptian Standards (4.5 g/100 g). The higher carbohydrate content in these samples suggests that manufacturers might have added non-dairy ingredients or whey powder to increase the total solids and improve the cheese's quality. These results highlight the extent to which the market suffers from the absence of regulatory oversight and enforcement by relevant authorities.

Microbiological assessment of raw cow milk, yoghurt, Kareish cheese, and Domiati cheese samples

The average total bacterial count (TBC) of raw cow milk, yoghurt, Kareish cheese, and Domiati cheese samples collected from various regions within Aswan Governorate is summarized in Table 3. The TBC values for areas A, K, and E were closely comparable, with no significant differences (p<0.05) observed among the raw cow milk samples. The lowest TBC was recorded in area A (6.90) log CFU/g), while the highest was observed in area C (7.25 log CFU/g). Notably, all cow milk samples had TBC levels above one million CFU/g, exceeding the Egyptian Standard's limitations, surpassing the limits specified by the Egyptian Standard [14]. The TBC serves as an indicator of sanitation and hygiene during the milking process and subsequent handling until the milk reaches the consumer. Meshref [19] reported a standard plate count for raw cow milk of 7.56 log CFU/g, while El-Leboudy [20] documented a mean TBC of 4.51 log CFU/g in Alexandria. Furthermore, Meshref et al. [21] recorded a TBC of 7.18 log CFU/g in raw cow milk from Beni-Suef Governorate. In the same Table, the TBC in both kareish and Domiati cheese were not significantly different (p < 0.05) in all regions. Overall, the total bacterial count (TBC) of yoghurt across the three regions in Aswan Governorate was relatively consistent, with no significant differences (p < 0.05). The average TBC for yoghurt in these regions was 6.40 log CFU/g. El-Ansary [22] previously reported that yoghurt sold in El-Behera Governorate exhibited poor microbiological quality.

Property	Sample	Regions			Means [*]
		Α	К	E	
Total bacterial count	Raw cow milk	6.90 ^b	7.15ª	7.25ª	7.10
(log CFU/g)	Yoghurt	6.30ª	6.34ª	6.56ª	6.40
	Kareish cheese	5.56ª	4.90 ^a	5.15ª	5.20
	Domiati cheese	4.35 ^a	4.68 ^a	4.40 ^a	4.48
Coliform count (log	Raw cow milk	3.76 ^c	4.25 ^b	4.60ª	4.20
CFU/g)	Yoghurt	2.59 ^b	3.09 ^a	2.70 ^b	2.79
	Kareish cheese	3.30 ^c	4.15ª	3.69 ^b	3.71
	Domiati cheese	2.10 ^a	1.70 ^b	1.50 ^c	1.77
Mold & yeasts count	Raw cow milk	4.40 ^a	2.89 ^c	3.80 ^b	3.70
(log CFU/g)	Yoghurt	3.90ª	3.80 ^a	3.70 ^a	3.80
	Kareish cheese	3.65ª	2.90 ^b	2.40 ^c	2.98
	Domiati cheese	2.06ª	1.16 ^c	1.54 ^b	1.59

Table 2: Total bacterial, coliform, and mold & yeasts count (log CFU/g) of raw cow milk, yoghurt, kareish, and Domiati cheese samples collected from different areas of Aswan Governorate.

* a, b & c...: means with the same letter among treatments are significantly different ($p \le 0.05$).

****A**: Aswan city region; **K**: Kom-Ombo region; **E**: Edfu region.

The presence of coliform count in milk or other dairy products gave an indication of the bad quality of these products with a fecal contamination, which may cause diseases [23]. It should not be presented in these dairy products. The coliform count of raw cow milk, yoghurt, Kareish cheese and Domiati cheese is presented in Table 3. In the three Aswan Governorate zones, the average coliform count in raw cow milk is 4.20 log CFU/g. There is a significant difference (p<0.05) between the coliform count in the (A and K) area and other areas. The highest coliform count was recorded in area E (4.60 log CFU/g) and the lowest was in area A (3.76 log CFU/g).

The Aswan Governorate's average coliform count in yoghurt was 2.79 log CFU/g. region K had the highest coliform count (3.09 log CFU/g), while region A had the lowest (2.59 log CFU/g). The presence of coliform count means inadequate heating of the milk or post-contamination, as yoghurt milk should be heated to around 85-90 °C for 10 minutes in yoghurt processing. In Kareish cheese, the average coliform count in Aswan Governorate was recorded 3.71 log CFU/g. The highest coliform count was recorded in area E (3.69 log CFU/g) and the lowest was in area A (3.30 log CFU/g). The sanitation of kareish cheese making in Aswan governorate regions is not adequate.

In Domiati cheese, there is a significant difference (p<0.05) between coliform count in the all areas. The average coliform count in Domiati cheese was 1.77 log CFU/g. The low coliform count in Domiati cheese as compared to other products could be explained by the effect of high salt content (> 6%), which affect the growth of most of the coliform count. The microbiological quality of white soft cheese in various Egyptian types is influenced by factors such as salt concentration and acidity levels. Kareish cheese is acid-coagulated, while Domiati cheese is enzyme-coagulated, ripened in brine solutions, and stored under specific temperature conditions [24].

The presence of molds and yeasts in milk or dairy products, even at low counts, is undesirable as it adversely affects product quality [25]. Since most molds and yeasts are destroyed during heat treatments, their presence typically indicates post-heat treatment contamination. The mold and yeast count for raw cow milk, yoghurt, Kareish cheese, and Domiati cheese are shown in Table 3. Raw cow milk across the three regions of Aswan (A) is highly contaminated with molds and yeasts. The lowest count was observed in region K (2.89 log CFU/g), although there were no significant differences (p<0.05) among the regions. In yoghurt, yeast contamination negatively affects taste, potentially leading to alcoholic fermentation and undesirable flavors. The mold and yeasts count in yoghurt showed no significant differences among the regions, with an average count of 3.80 log CFU/g. For Kareish and Domiati cheeses, mold and yeast counts were notably high in all three regions, with average counts of 2.98 and 1.59 log CFU/g, respectively. This may be indicated to poor hygiene practices during cheese production. Previous studies by Hassan and Gomaa [26] reported higher average mold and yeast counts for Kareish and Domiati cheeses, at 5.49 and 5.23 log CFU/g, respectively.

Conclusion

Raw cow milk and several dairy products that were gathered from three different locations in the Aswan Governorate had chemical compositions that were within normal limits. However, the fat content in raw milk and yoghurt was below the legal standards. Microbiological analysis indicated the presence of coliform bacteria in raw milk and some dairy product samples, accompanied by total bacterial, mold, and yeast counts exceeding the recommendations of the Egyptian Standard (ES). To

enhance the safety of raw milk and other dairy products, it is imperative to improve hygiene practices, enhance raw milk quality, and ensure proper decontamination of processing equipment.

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