

Microbiological quality and safety of cooking butter in Beni-Suef governorate-Egypt

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Abstract

Background: Cooking butter is one of the most popular types of fat consumed in Egyptian houses. It is produced in villages by rural women that are usually using their traditional knowledge during manufacturing.

Objective: To study the rate of contamination and hygienic quality of cooking butter

Methods: A total of 60 random samples of cooking butter, were collected from different farmers' houses in different villages, Beni-Suef Governorate, Egypt. Cooking butter samples were examined for psychrotrophic bacteria, total coliforms, faecal coliforms and molds and yeasts counts. Additionally examination for the presence of pathogenic bacteria like *E.coli*, *S.aureus* and *Ps.aeruginosa* were also performed.

Results: The microbiological examination revealed that 100, 100, 36.7, 31.7, 31.7 and 23.3 % of the examined samples were contaminated by psychrotrophic bacteria, molds and yeasts, coliforms, faecal coliforms, *E.coli* and *S.aureus*, respectively. None of the examined cooking butter samples contained *Ps.aeruginosa*. The means values of sodium chloride and titratable acidity were 0.57 ± 0.05 % and 0.20 ± 0.013 %, respectively.

Conclusion: The present study showed that cooking butter is produced under unhygienic condition and without good manufacturing practice. The Public health significance and suggestive control measures are discussed.

Keywords: cooking butter, microbiological quality, Egypt

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Introduction

Cooking butter is one of the most popular types of fat consumed in Egyptian houses. It is produced in villages by rural women that are usually using their traditional knowledge during manufacturing. It is eaten as butter, used as oil for food preparation or for cooking and also used as hairdressing and as a skin cosmetic by both sexes.

Cooking butter is obtained by churning of mechanically separated cream, after storing in skin bag called "Kerba" made from a goat skin in one piece for 2-3 days at room temperature. Excessive amount of sodium chloride is added to external surface of "Kerba" during storage. The churning is achieved after hanging the "Kerba" which is filled with cream and vigorously shaking it back and forth till the coalescence of the fat globules, which indicated by the sound of butter lumps when shaking. After churning, the butter is manually worked and stored

in refrigerators till sold on market-day, which is held once a week in each village.

Although the butter is not a highly perishable food, it does undergo spoilage by bacteria and molds. The main source of microorganisms of butter is cream, whether sweet or sour, raw or pasteurized¹. Yeast and molds are important spoilage microorganisms of butter and can result in surface discoloration and off-flavor. Psychrotrophic Gram negative bacteria may develop and result proteolytic and lipolytic changes².

Microbiological analysis of butter for specific pathogens is not considered justified and testing is restricted to potential spoilage microorganisms; together with *Escherichia coli* and coliform bacteria³.

Likewise, many studies have been carried out in Egypt to evaluate the microbiological quality of cooking butter^{4,5,6,7,8,9,10,11}. However, recent information concerning the microbiological quality of cooking butter in Beni-Suef governorate are sketchy or totally absent. Therefore, in this work cooking butter were examined in terms of microbial counts that allow the quantitative checking of principal hygienic parameters including the psychrotrophic bacteria, total coliforms, faecal

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coliforms and Molds and Yeasts counts. Additionally examination for the presence of pathogenic bacteria like E.coli, S.aureus and Ps.aeruginosa were also performed.

Methods

Collection of samples

A total of 60 random samples of refrigerated cooking butter were aseptically collected from different farmer's houses in different villages, Beni-Suef Governorate, Egypt during winter period (2009). All samples were taken in sterilized bottles and transported under refrigerated condition to the laboratory. Analyses were started without any delay.

Microbiological analyses

Samples preparation and serial dilutions were made according to IDF¹², and then subjected for the following examinations:

- Psychrotrophic colony count was carried out using plate count agar (Difco) after incubation at 7 °C ± 1 ° C for 10 days¹³.
- Total coliforms, faecal coliforms and E.coli were estimated by a three tube most probable number (MPN) technique¹⁴.
- Enumeration and isolation of S.aureus, was carried out by surface plating technique onto Baird Parker agar (Oxoid)¹⁵.
- Enumeration and isolation of Ps.aeruginosa, was carried out on Cetrimide agar (Biolife)¹⁶.
- Molds and yeasts were enumerated on Sabouraud dextrose agar after incubation at 30 ° C for 3 days¹⁷.

Sanitary and chemical analyses

a- The Titratable acidity (TA) (as lactic acid %) was measured as method described by Atherton and Newlander¹⁸.

b- NaCl concentration was determined using the method described by O'Connor¹⁹.

Statistical analysis

SPSS pocket program for windows was used for the statistical analysis. Values of different parameters were expressed as the mean ± standard error (±S.E).

Results

Sixty random samples of refrigerated cooking butter were examined. Results given in Tables 1&2 show that the psychrotrophic bacteria could be detected in 100 % of the examined butter samples with a mean count of $3.5 \times 10^4 \pm 1.3 \times 10^4$ cfu /g. Total coliforms and faecal coliforms were detected in 36.7and 31.7 % of the examined butter samples with a mean value of $8.9 \times 10^2 \pm 4.05 \times 10^2$ and $6.33 \times 10^2 \pm 3.28 \times 10^2$ MPN/g respectively. E.coli was found in 19 (31.7%) out of 60 examined butter samples. Moreover, the mean count of E.coli was $3.16 \times 10^2 \pm 2.52 \times 10^2$ organisms/g (MPN).

Fourteen (23.3%) butter samples yielded S.aureus ranging from 10^2 to 3×10^3 cfu/g. None of the examined butter samples contained Ps.aeruginosa. All of the examined butter samples contained Molds and Yeasts with a mean count of $6.3 \times 10^3 \pm 1.07 \times 10^3$ cfu/g. Table 3 showed that the mean values of Titratable acidity and NaCl % were 0.20 ± 0.013 and 0.57 ± 0.05 respectively.

Table 1: Statistical analytical results of different microbial groups/g of examined cooking butter samples

Organisms	Min.	Max.	Mean	± S.E.
Psychrotrophic count	1×10^1	6×10^5	3.5×10^4	1.3×10^4
Total coliforms	<3	1.5×10^4	8.9×10^2	4.05×10^2
Faecal coliforms	<3	1.5×10^4	6.33×10^2	3.28×10^2
E.coli	<3	1.5×10^4	3.16×10^2	2.52×10^2
S.aureus	<100*	3×10^3	1.55×10^2	6.6×10^1
Ps.aeruginosa	<100*	<100*	0	0
Molds & Yeasts	4×10^1	3×10^4	6.3×10^3	1.07×10^3

* Not detectable colonies on the plates

Table 2: Frequency distribution of different microbial groups/g of examined cooking butter samples

Intervals	Psychrotrophic		Total coliforms		Faecal coliforms		E.coli		S.aureus		Molds &Yeasts	
	No	%	No	%	No	%	No	%	No	%	No	%
<3	-	-	38	63.33	41	68.3	41	68.3	-	-	-	-
3- <10 ¹	-	-	5	8.33	6	10	7	11.6	-	-	-	-
10 ¹ - <10 ²	6	10	7	11.67	4	6.7	6	10	46	76.7	2	3.3
10 ² - <10 ³	18	30	5	8.33	5	8.3	4	6.7	11	18.3	12	20
10 ³ - <10 ⁴	16	26.7	3	5	3	5	1	1.7	3	5	34	56.7
10 ⁴ - <10 ⁵	13	21.7	2	3.33	1	1.7	1	1.7	-	-	12	20
10 ⁵ - <10 ⁶	7	11.6	-	-	-	-	-	-	-	-	-	-
Total	60	100	60	100	60	100	60	100	60	100	60	100

Table 3: Statistical analytical results of Titratable acidity and NaCl% of examined cooking butter samples

Test	Min.	Max.	Mean	± S.E.
Acidity %	0.04	0.55	0.20	0.013
NaCl %	0.10	1.8	0.57	0.05

Discussion

The microflora of butter reflects the quality of cream, the sanitary conditions of equipment used to manufacture the butter and the environmental and sanitary conditions during packaging and handling of such product ²⁰.

In this study, all of the samples were contaminated by psychrotrophic bacteria. In previous studies, nearly similar level of psychrotrophic counts were recorded by Ahmed et al. ⁸ and Henin and Kaldes ⁹ with mean values of 3.06×10^4 and 3.01×10^4 cfu/g, respectively. On the contrary, none of the examined cooking butter samples contained detectable level of psychrotrophic bacteria (<10/g) was reported by El-Sherief ²¹.

Psychrotrophic Gram negative bacteria such as *Pseudomonas* spp. and *Flavobacterium* spp. may develop and cause off-odour formation and rancidity. Growth of *Alteromonas putrefaciens* or *Flavobacterium malodoris* may lead to surface taints very quickly affecting the mass of the product and accompanied by development of a putrid, decomposed or cheesy flavour that render the product unmarketable, leading to economic losses ².

Spoilage of butter may result from the presence of heat resistant proteases and lipases produced by psychrotrophic bacteria during storage of raw milk or cream even after death of spoilage organisms ²².

Total and faecal coliforms counts (MPN technique) were carried out for faecal pollution analysis. In this study, Total coliforms and faecal coliforms were detected in 36.7 and 31.7 % of the examined butter samples respectively. Many reports dealing with occurrence of coliforms in butter have been accumulated. In those studies, various rates of coliforms were reported as 35, 67, 82, 77.5, 72, 100, 96.67 and 66.7 % of examined cooking butter samples by Ghoneim ⁴; Bakheet ⁶; El-Essawy ⁷; Ahmed et al. ⁸; Henin and Kaldes ⁹; El-Kholy ¹⁰; El-Kosi ¹¹ and Karagozlu and Ergonul ²³ respectively. According to Egyptian standards ²⁴, total coliforms and faecal coliforms counts of butter should not exceed the limit 10/g and standards suggested by Robinson ²⁵ should be < 10 /g, 17 (28.3%) out of 60 samples were found to be highly contaminated with coliforms, whereas 13 (21.7%) out of 60 samples were found to be highly contaminated with faecal coliforms over this limit. The presence of coliforms in butter is an indicative of poor hygiene and potential risk of food poisoning ²⁶.

E.coli is an indicator of faecal contamination and the possibility of the presence of enteric pathogens. 31.7% of the samples contained *E.coli*. In previous studies, higher incidence rates were reported by Ahmed et al. ⁸; Henin and Kaldes ⁹ and Karagozlu and Ergonul ²³ as they found 55, 56 and 64.4 % of the samples were contaminated with *E.coli*, respectively. All positive samples do not comply with both Egyptian standards ²⁴ and standards suggested by Robinson ²⁵, since both recommended the freedom of 1g of butter from *E.coli*.

In the present study, 23.3 % of the butter samples do not comply with the Egyptian standards ²⁴ and standard suggested by Robinson, ²⁵

of freedom of 1 g of butter from *S.aureus*. The detection rate of *S.aureus* was not in agreement with the result of Karagozlu and Ergonul²³ who reported no *S.aureus* in their butter samples. The presence of *S.aureus* in cooking butter may be from an endogenous source, i.e. using raw cream for manufacture of butter or from an exogenous source, i.e. a result of handling and inadequate personnel hygiene of farmer's wife.

Neither the absence of *S.aureus* nor the presence of small numbers of organism can provide complete assurance that the butter is safe, since conditions inimical to the survival of *S.aureus* may result in a diminished population or death of viable microbial cells, while sufficient toxins remains to elicit symptoms of staphylococcal food poisoning²⁷.

Ps.aeruginosa was not detected in any butter samples. This finding is completely in agreement with those of Nasr et al.²⁸, who stated that this may be due to the effect of high acidity and salt content.

The examined butter is considered having unacceptable hygienic quality, since all of the samples contained molds and yeasts counts above the limit of < 10 cfu/g. suggested by Robinson²⁵.

Many reports are dealing with the occurrence of molds and yeasts in butter. In those studies, various rates of molds and yeasts were reported as 9.4, 50 and 92.7 % of the examined butter samples by Hankin and Hanna²⁹; Paula et al.³⁰ and Con³¹ respectively. Recent studies found that 56 & 84 %³² and 75 & 85 %³³ of examined cooking butter samples were contaminated with molds and yeasts respectively. Several previous studies recorded higher levels of molds and yeasts contamination in butter as 5.3×10^4 , 2.7×10^4 , 7.11×10^4 and 6.99×10^4 by Ozalp et al.,³⁴ Ozdemir,³⁵ Ahmed et al.⁸ and Henin and Kaldes⁹ respectively.

The presence of molds and yeasts in butter are objectionable as they grow at a wide range of temperature and pH values resulting surface discoloration and off-flavour². However, of even more serious concern is that some molds are capable of producing toxic metabolites known as mycotoxins. Some of these toxins, such as aflatoxins, are known carcinogens³⁶.

Generally, the microbial contamination of butter could be attributed to the fact that it is usually made from raw cream, in addition to the primitive way of processing, handling, storage and marketing. Similar TA was reported in earlier study on cooking butter by El-Kholy¹⁰. On the contrary, higher mean

values of TA were reported by Sagdic et al.³⁷ and Mourad and Nour-Eddine³⁸.

The mean NaCl% in the present study was nearly similar to those reported by Sagdic et al.³⁷ and lower than those recorded by El -Sadek et al.³⁹; Hayaloglu⁴⁰ and Mourad and Nour-Eddine³⁸. While El-Kholy¹⁰ and Samet-Bali et al.⁴¹ noted lower mean values than in this study.

According to the Egyptian Standards, all of the samples were in comply with the limit not exceed 2 % salt. Butter usually contains 1.5-2% NaCl will contain 9- 12.5 % in the aqueous phase, a concentration strongly inhibitory to most microorganisms. On the other hand, lactic acid level produced as a result of natural souring during storage of cream in Kerba may be sufficiently high to exert an inhibitory effect^{3,22}. Likewise, Minor and Marth⁴² reported that *S.aureus* was able to grow in butter with 0- 1% salt. Therefore a combination of poor hygiene, low salt concentration (or inadequate salt dispersal) and temperature abuse could allow growth of *S.aureus* in stored butter⁴². This can conclude that the role of NaCl% (0.57%) in this study on controlling the microbial growth in cooking butter may be questionable and the probability of growth of pathogenic microorganisms like *S.aureus* is high.

Conclusion

The results suggest that cooking butter is produced under unhygienic condition at Beni-Suef governorate. The counts of microorganisms above the recommended criteria and the presence of pathogenic bacteria may pose a risk for public health. Therefore, there is a necessity for developing the hygienic status of locally produced butter through provision of information to rural women on good process hygiene and to consumers on how to handle their foods including correct storage to protect them from infection and to save a lot of products from being deteriorated. Also, butter should not be manufactured from raw cream or, if it is, it should be used only for cooking where it will receive adequate heat treatment.

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