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Chemical and Microbiological Properties of Karinyagi (Butter Stored in Rumen) Consumed in Turkey

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Abstract: In this study, moisture content, peroxide and free fatty acid values and microbial counts of 30 Karinyagi samples taken from different retail markets in Afyonkarahisar province have been investigated. The average moisture content of Karinyagi samples was found to be 17.64%. The average peroxide values of the samples was found 2.33 meq O_2/kg fat. Free fatty acid values of samples ranged at 2.2-5.2 mg NaOH/g fat and the average acidity value was found to be 3.43 mg NaOH/g fat. Total aerobic mesophilic bacteria, yeast/mould, coliform group and *Micrococcus/Staphylococcus* counts of Karinyagi samples were 5.59, 5.54, 2.56, 1.24 log CFU/g fat, respectively.

Key words: Butter, Karinyagi, peroxide value, quality.

1. Introduction

Butter is a dairy product with quite large area of use. In Turkish Food Codex, butter is defined as a product produced from milk and/or milk products, from which almost all of the elements of water and fat-free dry matter portions are removed, with a content of milk fat by minimum 80%, up to 90% by weight, a maximum of 2% non-fat dry milk solids and maximum of 16% water [1]. Butter is rich in terms of aroma such that can not be compared with other fats [2, 3]. Butter is a rich dairy product in terms of minerals, primarily calcium and phosphorus, and it is also a rich source in terms of lecithin and iodine. However, butter consumption has decreased due to its high melting point [4]. It is known that butter has an influence on the cardiovascular disorders and this is referred to the cholesterol content of butter, but there was no solid evidence on this [5].

Karinyagi (butter stored in rumen) is a dairy product obtained especially in Mid-Western Anatolia and Mediterranean region by processing raw milk, cream and yoghurt in different methods, and it is consumed with pleasure by the local people. Sheep or goat rumen is used in production of Karinyagi [6]. In the first stage of Karinyagi production, sheep or goat rumen (karin) should be prepared. For this purpose, firstly sheep or goat rumen is separated from esophagus entrance and omasum exit, and fats and lymph nodules veins are removed [7]. Rumen is well washed with 1% NaOH and rinsed with plenty of water several times. After the completion of washing, rumens are salted and hung to dry approximately in one or two weeks [6, 8]. Before filling with butter, the rumen is dampened with warm water. Filling butter should be done carefully for no airspace in the upper part of rumen.

Karinyagi is generally produced with cow-milk cream by three different methods [8, 9] (Fig. 1). Karinyagi is kept in the stores of the markets after being filled into karin at 6-10 °C for about 15 d [7]. The storage period of Karinyagi should not exceed three months [9]. According to consumer demand, salt (usually 2%) is added to Karinyagi and pressed into rumen. Filling proccess should be made carrefully to prevent contamination with microorganisms and lipid oxidation at this stage [6].

The objective of this study was to determine some

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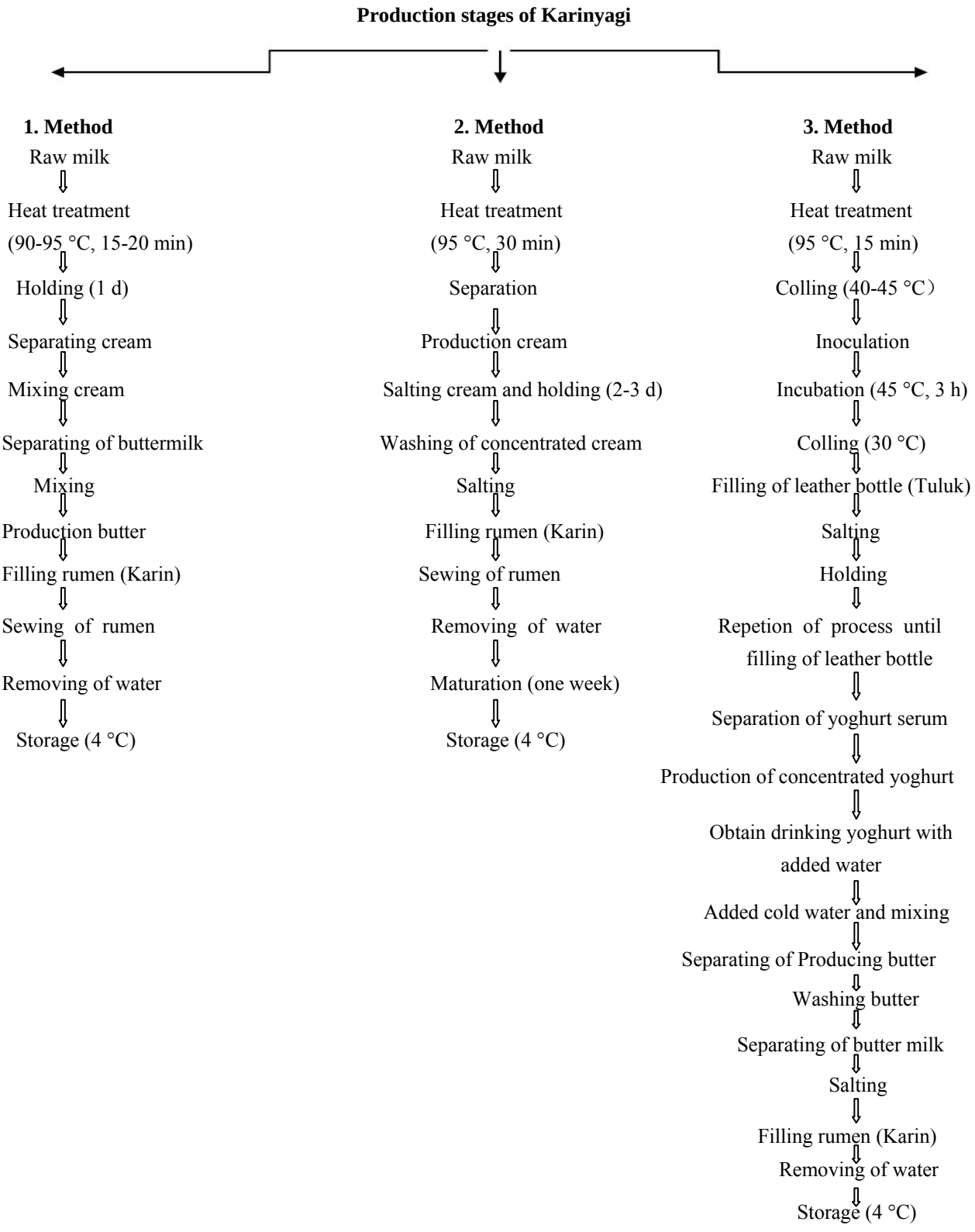

Fig. 1 Production Methods of Karinyagi [8].

chemical and microbiological properties of Karinyagi consumed in Afyonkarahisar province.

2. Materials and Methods

The samples used in the research were obtained from 30 different local markets within two months period (Afyonkarahisar province, Mid-Western Anatolia, Turkey). Karinyagi samples were stored in the market at 10 ± 2 °C. All the samples were immediately brought to laboratory under cold conditions until microbiological and chemical examination. The microbiological evaluation of the samples was performed within the day of sampling. Then, they were held at -20 °C until further chemical analyses.

2.1 Chemical Analysis

Free fatty acid values and peroxide values of the Karinyagi samples were determined according to Association of Official Analytical Chemists (AOAC, 1985) method. According to the method, samples used for the determination of moisture (%) were stored at -20 °C [10].

2.2 Microbiological Methods

10 g of each sample was aseptically taken and homogenized for 3 min with sterilized Ringer solution (Merck) at 1:9 (w/v) dilution in a stomacher Lab-Blender 400 (London, UK). Serial decimal dilutions were prepared with sterilized Ringer solution and then plated in duplicate for bacterial counts [11-13]. Each dilution prepared from samples was inoculated in agar using the spreading plate method for total aerobic mesophilic bacteria (TAMB), yeast/mould, coliforms and *Micrococcus/Staphylococcus* count (Table 1) [14-17].

2.3 Statistical Analysis

The results of the chemical and microbiological analyses carried out on Karinyagi samples were compared with TS 1331 butter standard [18] and Turkish Food Codex Communiqué on microbiological criteria butter data [19] for conformability. Statistical package for the social sciences (SPSS, Version 13.0) windows program was used for the statistical analysis [20]. Values of different parameters were expressed as the mean ± standard error (± SE).

3. Results and Discussion

3.1 Free Fatty Acid Values

The free fatty acid content in milk products indicated hydrolytic deterioration (ranciding) of the triacylglycerols, and this alteration mostly occurs under unsuitable conditions of milk samples. Fats with high water content, like butters, are more susceptible to hydrolysis, and they have a unpleasant odour and taste when they become rancid [21]. On contrary, there is no sginificant ($P > 0.05$) correlation between free fatty acid values and moisture content ($r = 0.22$; data not shown). Fatty acid values of Karinyagi samples offered for sale in Afyonkarahisar province were found to be 5.2 (maximum), 2.2 (minimum) and 3.43 mg NaOH/g fat (average) (Table 2). Similarly, Tuğcu [22] in his study reported that these values were between 3.11 mg NaOH/g fat and 3.17 mg NaOH/g fat; Sağdıç et al. [23] reported between 0.66 mg NaOH/g fat and 0.68 mg NaOH/g fat; Şenel [24] reported between 0.8 mg NaOH/g fat and 2.19 mg NaOH/g fat; Gün [8] in his study on some quality characteristics of Karinyagi samples produced in Burdur, reported that the fatty acid values ranged in 0.10-0.34

Table 1 Analysis performed for microorganism groups and incubation conditions.

Microorganism	Media	Incubation conditions	Method
TAMB	Plate count agar	30 °C, 48-72 h-aerobic	ISO 4833 [14]
Yeast/mould	Potato dextose agar	22 °C, 4-5 d-aerobic	Pinchardt [15]
Coliform	Violet red bile agar	30 °C, 24-48 h-aerobic	ISO 4832 [16]
Micrococcus/Staphylococcus	Baird parker agar	37 °C, 24-48 h-aerobic	ISO 6888-1 [17]

mg NaOH/g fat. Differences in values between the samples are thought to arise from cream used in the production and different post-production conditions of storage and sale and seasonal changes.

3.2 Peroxide Values of Karinyagi Samples

Peroxide values in Karinyagi samples were determined as 3.8 (maximum), 0.8 (minimum) and 2.33 meq O_2/kg fat (average) ($P > 0.05$) (Table 2). Kesler [25] similarly reported that the peroxide values of butter samples ranged in 0.8-2.67 meq O_2/kg fat; Urkun and Oysun [26] in their study reported that the peroxide values of butter samples were 0-9.17 meq O_2/kg fat; Efe [27] in their study on butter offered for sale in Ankara market, found that the peroxide values changed between 0.78 meq O_2/kg fat and 2.45 meq O_2/kg fat; Şenel [24] reported that the peroxide values varied in 0.22-0.46 meq O_2/kg fat.

In butter samples stored under normal conditions, peroxide values should be in 0.1-1.0 meq O_2/kg fat

Table 2 Micriobioligical and chemical contents of Karinyagi samples.

Sample number	TAMB	Yeast and mold (log CFU/g)	Total coliform (log CFU/g)	*S. aureus* (log CFU/g)	FFA values (mg NaOH/g fat)	Peroxide value (meq O_2/kg fat)	Moisture value (%)
1	4.80	3.38	2.49	1.23	4.6	3.0	19.27
2	4.54	3.97	< 1	-	3.6	2.0	18.67
3	4.41	4.96	2.00	-	3.0	3.2	18.99
4	3.90	4.86	1.83	< 1	3.4	1.0	18.87
5	4.23	3.28	< 1	-	3.2	1.4	19.09
6	5.17	4.54	2.60	-	3.2	2.2	18.73
7	4.95	5.25	2.84	-	4.4	2.8	19.54
8	4.89	5.14	2.61	-	2.8	2.0	15.64
9	4.84	4.98	< 1	-	3.6	2.2	19.04
10	5.54	4.79	3.23	1.83	2.2	3.0	17.87
11	4.52	4.49	2.67	-	3.4	3.4	17.83
12	5.69	5.44	< 1	1.07	3.2	2.8	15.83
13	5.64	5.43	2.61	1.97	2.8	3.4	18.89
14	6.30	6.30	3.07	-	4.4	3.0	14.87
15	5.41	5.25	< 1	-	3.2	1.2	18.77
16	4.20	4.90	2.55	-	3.0	2.2	15.87
17	6.32	6.30	2.74	2.38	4.4	2.2	16.93
18	5.20	5.14	< 1	1.64	3.2	1.6	14.33
19	4.68	4.91	2.57	-	4.0	2.6	18.74
20	4.65	4.65	< 1	-	3.0	2.2	17.13
21	4.57	4.58	< 1	-	4.6	0.8	16.18
22	3.20	3.20	2.50	1.20	2.8	2.0	14.94
23	6.30	6.30	2.67	-	3.6	2.8	18.09
24	3.89	3.89	-	-	3.2	3.8	15.52
25	6.32	6.32	3.23	-	2.6	2.2	16.60
26	3.63	3.63	-	-	5.2	1.6	20.64
27	5.40	5.39	2.72	1.28	3.6	2.0	16.84
28	5.25	5.07	2.86	-	3,2	1,0	17.86
29	4.00	4.00	< 1	-	2.8	2.8	19.84
30	5.54	5.54	2.43	< 1	2.6	3.4	17.73
Mean	4.93 ± 0.83	4.86 ± 0.87	2.39 ± 0.35	1.58 ± 0.46	3.43 ± 0.71	2.33 ± 0.79	17.64 ± 1.65

TAMB: total aerobic mesophilic bacteria; FFA: free faty acids.

and should not exceed 0.2 meq O_2/kg fat in fresh butter samples [28-30]. In TS 1331 butter standard [18], it was notified that the maximum peroxide value should be 5 meq O_2/kg fat. Accordingly, the peroxide values of Karinyagi samples used in the research were within the specified limits.

3.3 Moisture (%) Contents of Karinyagi Samples

Moisture (%) contens of Karinyagi samples offered for sale in Afyonkarahisar province were found to be 20.64% (maximum), 14.33% (minimum) and 17.64% (average) (Table 2). As a result of the similar studies, Urkun and Oysun [26] reported that moisture values of their samples ranged between 12.32% and 15.32%; Efe [27] in his study in Ankara reported that the moisture values of samples ranged between 10.94% and 17.89%; Sağdıç et al. [31] reported that the moisture values of their samples ranged between 15.72% and 15.49%; Tuğcu [22] in her study on the effect of using different cultures on the butter quality, reported the moisture values ranged between 9.52% and 10.74%; Gün [8] reported that the moisture of Karinyagi samples ranged between 12.0% and 17.44%.

When the autors' results are compared with similar results, it was found that the moisture (%) values of samples are higher than all the samples from similar studies. This is considered to be due to the production conditions of the butter and inadequate post-production quality control analyses.

3.4 Microbiological Analysis

3.4.1 Total Aerobic Mesophilic Bacteria Counts

TAMB counts in Karinyagi samples were found 6.32 (maximum), 3.20 (minimum) and 5.59 log CFU/g (average) ($P < 0.05$) (Table 2). Similar to the study, Patır et al. [32] in their study on determination of quality of breakfast butters offered to consumption in Elazığ province, found the total microorganism count as 6.95 log CFU/g. Gün [8] in his study on some quality characteristics of Karinyagi products produced in Burdur, found the total bacteria count of samples between 2.14 log CFU/g and 7.00 log CFU/g. The differences of bacteria counts between samples were due to poor hygiene and sanitation practices in production, and storage and sales conditions of Karinyagi products.

3.4.2 Coliform Group Bacteria Counts

In the study, the total coliform group bacteria count of the samples was found 2.56 log CFU/g on average ($P < 0.05$) (Table 2). In similar studies, Esis [33] reported that the coliform group bacteria counts varied in 0-5.09 log CFU/g. Gün [8] found the coliform group bacteria counts in Karinyagi samples produced in Burdur between 0 log CFU/g and 2.82 Log CFU/g. In another study, Doğan et al. [34] found that coliform group bacteria counts in butter samples ranged in 0-3 log CFU/g and 57.5% these bacteria of the samples have proliferated. In Ref. [8], 53.8% total coliform bacteria counts of 91 butter samples were found higher than the levels notified in the microbiological criteria of Turkish Codex [1]. The differences between the samples are considered to result from the microbiological quality of the cream, cleaning and storage conditions of the leather bottle in which the butter is placed and the inadequate hygiene and sanitation practices during production, storage and sale.

3.4.3 Yeast and Mould Counts

In Karinyagi samples, yeast and mould counts were 6.0 (maximum), 3.28 (minimum) and 5.54 log CFU/g (average) ($P < 0.05$) (Table 2). Similar to the results, Hayaloğlu and Konar [35] in their study on microbiological characteristics of 25 butter samples produced from yoghurt and cream in Malatya region, reported the yeast and mould count 6.69 log CFU/g and Gün [8] reported that the yeast and mould count of Karinyagi samples produced in Burdur varied in 0-3.94 log CFU/g. The differences between results are thought to result especially from the inadequate importance given to hygiene and sanitation guidelines in post-production.

3.4.4 *Micrococcus*/*Staphylococcus* (Coagulase Positive *Staphylococci*) Counts

Micrococcus/Staphylococcus (coagulase positive *Staphylococci*) counts of Karinyagi samples were found 1.24 log CFU/g on average ($P > 0.05$) (Table 2). In 20 samples used in the study, no *Micrococcus/Staphylococcus* (coagulase positive *Staphylococci*) proliferations were observed. This primarily indicates that the hygiene and sanitation guidelines were adequately followed in production and post-production phases and especially there were no human originated contaminations. Related to the samples in which the *Micrococcus/Staphylococcus* activity was detected, it is concluded that the personnel hygiene guidelines were not followed, primarily in production and storage stages.

4. Conclusions

In this study, some chemical and microbiological properties of 30 Karinyagi samples offered to sale in different regions of Afyonkarahisar province were determined. It was found that 68.5% of these samples in terms of chemical characteristics and 90% of these samples in terms of microbiological characteristics were not in accordance with the limit values specified in TS 1331 butter standard and Turkish Food Codex Communiqué of microbiological criteria in the butter section. High water rates in samples, especially in those collected from retail markets, show clearly that the samples sold in these places are not adequately controlled and this is an abuse of the manufacturer.

It is significantly observed that the higher counts of coliform bacteria and yeast and mould found in Karinyagi samples are due to sales of these products unpackaged and without paying attention to the guidelines of hygiene and sanitation; this constitutes a risk to public health. The authors obviously emphasize the necessity of increasing the controls in order to improve the conditions regarding production and sales of Karinyagi, which is consumed with pleasure by local people. It is essential to utilize more technology in Karinyagi production to follow the hygiene and sanitation guidelines, to intensify the controls in production and sales places by relevant agencies and organizations and to speed up work on the dissemination for this subject throughout the country.

As a result, with the increasing quality of Karinyagi, which is a local product identified with a unique taste and aroma, the narrowed consumption of this product in a certain area will be spreaded throughout the country and the production will be standardized.

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