

## A survey on the quality of traditional butters produced in West Azerbaijan province, Iran

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### Abstract

Food safety include all health aspects of the food especially adulterations. Butter, particularly traditionally produced butters is one of the highly consumed foods in Iran. The aim of this study was to investigate of the chemical and microbial quality of traditional butters produced in west Azerbaijan province, northwest of Iran. Chemical, microbial quality and fatty acid profile of randomly purchased butter samples from 12 cities (10 sample of each city) of west Azerbaijan province were analyzed according to Iranian national standard protocols. Moisture of all samples, Peroxide value of 58.3%, Acidity and Iodine index of 83.3% and Saponification value of 91.7% of samples were out of range in comparing with Iranian national standard. Coliform, mold and yeast contamination were seen in all samples. *Staphylococcus aureus* and *Escherichia coli* were seen in 8.3% and 50% of samples, respectively. Lowest and highest contents of C18:1 fatty acid was 21.27 and 33.34%, respectively. Minimum and maximum content of Linoleic acid isomers were 1.37 and 6.82%, respectively. C18: 3 isomers were seen in 3.8% of samples. Obtained results of this study showed presence of vegetable oils, high degree of oxidation of fatty acids and presence of microorganisms in animal butter samples that represented poor hygienic status of traditional butters currently marketed in West Azerbaijan

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### Introduction

Carbohydrate, proteins, fat and oils are the main components of the food products. Nowadays plant oils greatly reduce animal fats consumption in the diet, nevertheless benefits of animal fats especially milk fats cannot be denied. Recent studies have proven particular composition of animal fats, presence and usefulness of their necessary unsaturated fatty acids (Willett, 2012). Milk and dairy products are one of the most important groups in the daily food pyramid. Economical, commercial, quality and safety aspects of these products are very important. Butter as the oldest dairy products has a significant role in human nutrition (Tvrzicka *et al.*, 2011).

Butter was made industrially of cream and directly from milk in traditional way. Therefore, its quality will depend largely on the quality of milk. Ability to consumption and storing of butter depends on its chemical and biological characterizations that affect by health condition of producing and maintenance (Tofangसान *et al.*, 2009). At present, in many

areas of Iran, butter is produced and supplied in both manner, industrial and traditionally (Tofangसान *et al.*, 2009). Non-standard production at all stages of processing, packaging and supply cause reducing quality and sometimes economic problems and pathogenesis, therefore, quality of these products is important. Due to the nature of butter making in traditional type, adulteration in its production is easier (Lees, 1999).

Chemical and microbiological characteristics of milk made butters have studied by many researchers (Saremnezhad *et al.*, 2008; Zhao *et al.*, 2000; Berhea *et al.*, 2013; Dervisoglu *et al.* 2013). Even the newer methods such as stable isotope analysis (Stable isotope analysis) and near-infrared spectroscopy (Near Infra- Red Spectroscopy) were applied in determining the quality of butter (Gunstone, 2000; Samet-Bali *et al.*, 2009). Bacterial diversity in butter samples, Lactococci, Lactobacilli, Entrococci, and yeasts such as *Saccharomyces cerevisiae* was shown in many studies (Lees, 1999; Benkerroum and Tamime, 2004; Samet-Bali *et al.*, 2009).

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Adulteration was performed mainly by adding plant oils, non-edible oils, old used oils or industrial cream to both industrial or traditional produced butters, which impacts on their quality and nutritional value. Bad conditions of storage and transportation are other important factors that reduce quality and nutritional value of butter (Koca *et al.*, 2010). Due to high consumption of produced butters and different conditions of storage and supplying, the aim of this study was evaluating chemical and biological characteristics and quality matching of traditional butters with Iranian national standard marketed in West Azerbaijan province, North West of Iran. Regarding the effect of the presence of Trans- fatty acids on human health, in addition to fatty acids profile, trans-fatty acid content was measured and evaluated by gas chromatography (GC).

## Materials and Methods

### Sampling

In this study, 120 samples of traditional butter made from cow's milk were purchased randomly in 12 city (Urmia, Mahabad, Salmas, Khoy, Piranshahr, Naghadeh, Miandoab, Maku, Bukan, Sardasht, Oshnaviyeh, Shahindezh) of West Azerbaijan province (10 samples from each city) since May to September 2013. All samples were transferred to laboratory in cold condition. Chemical and biological characteristics of all samples were tested according to standard methods provided by the National Institute of Standards and Industrial Research of Iran and repeated three times. Routine equipment of laboratory was used. All used chemicals and media were manufactured by Merck of Germany. Fatty acids profile of butter samples was analyzed by gas chromatography (Agilent 6890 N, USA) with BPX70 column, N<sub>2</sub> carrier gas, FID detector with 1 microliter volume injection.

### Chemical tests

Chemical quality of butter samples was investigated by measurement of saponification value, Iodine value, peroxide value, moisture, Acidic value, and also determination of fatty acid profiles according to standard protocols provided by the national institute of standards and industrial research of Iran, according to Iranian national standards No.10501, 4888, 4179, 8389-1 and 4178, respectively (ISIRI No. 10501, 2007 ; ISIRI No. 4888, 2000 ; ISIRI No. 4179, 1998 ; ISIRI No. 8389-1, 2007; ISIRI No. 4178, 1996). Determination of fatty acid composition was analyzed in accordance with Iranian national standard No. 8818 (Preparation of fatty acid methyl

esters) and 8819 (measuring of fatty acids) using gas chromatography (ISIRI No. 8818, 2006; ISIRI No. 8819, 2006).

### Microbial tests

Microbial quality of produced traditional butter was investigated according Iranian national standard protocols. Total count of bacteria, coliforms, *Escherichia coli*, *Staphylococcus* and mold was evaluated accordance Iranian national standard No. 2406 (ISIRI No.2406, 2008).

### Statistical analysis

Statistical analysis (Mean±SD) of all samples was performed using SPSS software version 16 software.

## Results

Obtained results of chemical and microbial investigation in 120 samples of traditional butters from 12 city of West Azerbaijan province and analysis of fatty acids profile have been shown in Tables 1-3. The moisture content of all samples was out of national standard range. Average moisture content of samples was 27.33±4.46 % (Table 1). Peroxide value of seven cities was out of standard range. Average peroxide value was 2.44±2.01 mEq/kg (Table 1). Only samples of two cities had Iodine value within standard range. Average Iodine value was 15.74±8.89 (Table 1). Acidic value of ten city samples was incompatible with national standard limits with average 1.56±1.15 (Table 1). Average measured saponification value of butter samples was 250.93±34.10 (Table 1). Samples of a city were in standard range (City No. 3). Fatty acids content of butter samples showed in Table 2. Minimum and maximum content of C18: 1 fatty acid was seen in samples of cities No.7 (21.27%) and No.9 (33.34 %), respectively (Figure 1 and Table 2). Minimum content of linoleic acid belonged to samples of city No.9 (1.37%) and maximum was for samples of city No.1 (6.82%) (Figure 2 and Table 2).

Coliform, mold and yeast contamination was found in all butter samples. *Staphylococcus aureus* has found only in samples of a city (City No. 6 but *Escherichia coli* contamination was found in samples from six understudy cities. Coliform, mold and yeast, *S.aureus*, *E.coli* count of all contaminated samples was over 100 CFU/gr.All analyzed samples had coliform contamination (Table 3).

## Discussion

Evaluating of chemical and biological

Table 1. Mean of moisture, peroxide value, acidity, iodine value, saponification value

Cities code	Moisture (%)	Peroxide value (mEq/kg)	Acidity (%)	Iodine value	Saponification value
1	20.73	0.99	1.67	29.14	250.56
2	26.44	7.33	1.01	9.4	261.02
3	29.46	1.62	0.56	12.84	225.69
4	31.51	4.22	1.39	7.55	274.88
5	35.07	3.21	4.54	9.42	295.86
6	25.65	2.54	1.67	9.95	270.26
7	32.62	2.38	2.74	20.41	284.33
8	30.81	2.59	2.11	16.6	192.11
9	23.56	1.22	0.47	11.02	247.6
10	25.55	3.16	0.78	36.64	287.02
11	23.12	0	1.16	14.7	214.62
12	23.53	0	0.67	11.3	207.55
<b>Mean± SD</b>	<b>27.33±4.46</b>	<b>2.43±2.01</b>	<b>1.56±1.15</b>	<b>15.74±8.89</b>	<b>250.95±34.10</b>
<b>Standard limit</b>	<b>16</b>	<b>1.7</b>	<b>0.3- 0.5</b>	<b>26-40</b>	<b>225-235</b>



Figure 1. Average content of C18:1 in butter samples of 12 city of west Azerbaijan province, Iran



Figure 2. Average content of C18:2 in butter samples of 12 city of west Azerbaijan province, Iran

characteristics and quality matching of traditional butters with Iranian national standard marketed in West Azerbaijan province was the aim of this study. Chemical parameters such as moisture, peroxide value, Iodine value, acidity, saponification value and fatty acids profile and microbial quality of traditional butter samples was determined in this study. According to obtained results, maximum standard limit for moisture in butter is 16% (ISIRI No. 8818, 2006; ISIRI No. 8819, 2006). High moisture content in traditional butters is justified because of the traditional butters preparation method. Since unlike industrial preparation protocol, milk's fat not removes completely and water substitute as a fat replacer in butter formulation (Saremnezhad *et al.*, 2008; Idoui *et al.*, 2013). High moisture predispose lipase activity, stimulates the growth of microorganisms and hydrolysis of the triglycerides (Idoui *et al.*, 2013).

Three cities samples peroxide value were in range of national standard and of two cities was zero. Standard limit for peroxide value is 1.7 mEq/kg. This value is measured as an indicator of fat oxidation. Oxygen, metal ions and light as oxidant factors can affect on this value (ISIRI No. 4179, 1998). According to Iranian national standard, Iodine value for butter samples is 26-40. This value shows unsaturated fatty acids content and their resistance to oxidation which confirmed by showed results in table 2 (ISIRI No.4888, 2000). Maximum limit of acidity in Iranian national standard is 0.3 % and 0.5% for imported and internal produced butters, respectively. Butters high acidity represents the presence of high levels of free fatty acids according to oleic acid (ISIRI No.4178, 1996).

According to Iranian national standard, saponification value of butter sample should be in the range 225-235 (Table No. 1) (ISIRI No. 10501,

Table 2. Mean content of Fatty acids in Butter samples of 12 cities in West Azerbaijan province, Iran (Mean  $\pm$  Sd)

Fatty acid	Cities												
	C6	C8	C10	C12	C14	C14:1	C16	C16:1	C18:0	C18:1	C18:2	C18:3	C20
1	0.84 $\pm$ 0.16	0.66 $\pm$ 0.07	1.84 $\pm$ 0.16	0.66 $\pm$ 0.21	10.8 $\pm$ 0.49	1.44 $\pm$ 0.14	35.5 $\pm$ 0.82	1.85 $\pm$ 0.17	9.4 $\pm$ 1.22	22 $\pm$ 1.14	6.82 $\pm$ 0.07	0.42 $\pm$ 0.15	0.77 $\pm$ 0.21
2	0.92 $\pm$ 0.44	0.28 $\pm$ 0.28	1.69 $\pm$ 0.61	2.45 $\pm$ 0.9	10.5 $\pm$ 3.32	1.44 $\pm$ 0.53	38.04 $\pm$ 6.4	1.78 $\pm$ 0.64	8.0 $\pm$ 1.68	23.7 $\pm$ 6.5	3.84 $\pm$ 7.11	0	0.64 $\pm$ 0.24
3	0.32 $\pm$ 0.4	0.23 $\pm$ 0.3	0.84 $\pm$ 0.7	1.39 $\pm$ 0.79	6.82 $\pm$ 3.66	0.84 $\pm$ 0.55	35.37 $\pm$ 6.3	0.57 $\pm$ 0.27	9.2 $\pm$ 1.48	31.4 $\pm$ 6.6	4.82 $\pm$ 3.43	0	0.52 $\pm$ 0.18
4	0.34 $\pm$ 0.74	0.57 $\pm$ 0.26	1.56 $\pm$ 0.73	2.24 $\pm$ 0.96	9.13 $\pm$ 3.64	1.26 $\pm$ 0.66	37.68 $\pm$ 4.9	0.42 $\pm$ 0.19	8.8 $\pm$ 3.17	26.2 $\pm$ 6.7	3.23 $\pm$ 3.14	0	0.5 $\pm$ 0.16
5	0.79 $\pm$ 0.04	0.6 $\pm$ 0.01	1.67 $\pm$ 0.1	2.33 $\pm$ 0.21	10.12 $\pm$ 0.9	1.23 $\pm$ 0.26	33.85 $\pm$ 2.8	0.48 $\pm$ 0.02	11.8 $\pm$ 1.6	26.6 $\pm$ 2.8	1.92 $\pm$ 0.36	0	0.49 $\pm$ 0.09
6	0.83 $\pm$ 0.42	0.62 $\pm$ 0.31	1.68 $\pm$ 0.85	2.35 $\pm$ 1.21	10.23 $\pm$ 4.5	1.35 $\pm$ 0.77	39.92 $\pm$ 4	0.41 $\pm$ 0.23	7.3 $\pm$ 1.38	23.5 $\pm$ 7.7	4.37 $\pm$ 3.29	0	0.5 $\pm$ 0.06
7	0.73 $\pm$ 0.13	0.66 $\pm$ 0.12	1.98 $\pm$ 0.26	1.35 $\pm$ 1.22	8.23 $\pm$ 4.4	1.55 $\pm$ 0.78	36.92 $\pm$ 3.1	1.41 $\pm$ 0.34	8.3 $\pm$ 1.29	33.3 $\pm$ 7.4	3.47 $\pm$ 2.34	0	0.54 $\pm$ 0.17
8	0.78 $\pm$ 0.24	1.2 $\pm$ 0.23	1.58 $\pm$ 0.44	2.25 $\pm$ 0.23	11.23 $\pm$ 4.3	1.15 $\pm$ 0.59	36.92 $\pm$ 2.1	2.41 $\pm$ 0.35	9.85 $\pm$ 1.4	27.6 $\pm$ 8.7	3.31 $\pm$ 1.36	0	0.49 $\pm$ 0.18
9	0.88 $\pm$ 0.35	0.82 $\pm$ 0.34	0.98 $\pm$ 0.58	2.05 $\pm$ 1.24	10.23 $\pm$ 4.6	1.45 $\pm$ 0.80	35.92 $\pm$ 3.2	0.6 $\pm$ 0.26	9.2 $\pm$ 1.11	21.3 $\pm$ 2.6	1.37 $\pm$ 0.32	0	0.6 $\pm$ 0.26
10	0.81 $\pm$ 0.26	0.42 $\pm$ 0.15	1.78 $\pm$ 0.69	1.35 $\pm$ 1.35	6.23 $\pm$ 4.13	1.55 $\pm$ 0.61	37.92 $\pm$ 3.1	0.91 $\pm$ 0.37	7.45 $\pm$ 1.89	25.5 $\pm$ 1.8	2.37 $\pm$ 0.83	0	0.55 $\pm$ 0.41
11	2.5 $\pm$ 0.47	0.52 $\pm$ 0.33	1.58 $\pm$ 0.9	2.45 $\pm$ 28	11.23 $\pm$ 4.6	1.25 $\pm$ 0.82	39.42 $\pm$ 3.4	1.21 $\pm$ 0.28	9.33 $\pm$ 1.73	21.3 $\pm$ 3.51	3.37 $\pm$ 0.9	0	0.65 $\pm$ 0.12
12	1.3 $\pm$ 0.48	0.32 $\pm$ 0.37	1.65 $\pm$ 0.91	2.15 $\pm$ 1.17	10.23 $\pm$ 3.6	0.95 $\pm$ 0.93	37.52 $\pm$ 3.1	1.21 $\pm$ 0.19	8.14 $\pm$ 1.9	29.5 $\pm$ 4.8	5.37 $\pm$ 2.35	0	0.51 $\pm$ 0.52
Control	0.8 - 3.6	0.5 - 1.8	1.7 - 3.9	2.2 - 4.5	5.4 - 14.6	0.5 - 1.85	22 - 41	0.7 - 6	6 - 15	18.26 - 38.2	0.68 - 5.5	0	0.05 - 1

2007). This index shows presence of long-chain fatty acids which confirmed by showed results in Table 2. Presence of unsaturated fatty acids accelerates butter spoilage if hygienic conditions of production, maintenance and supply were incorrect (Saremnezhad, 2008; Samet-Bali, 2009). Isomers of C18:3 were found only in samples of one city (City No. 1) that represented using vegetable oils in formulation of butter (Table 2). Permissible amount of fatty acids in butter samples showed in Table 2 (ISIRI No.8818, 2006; ISIRI No.8819, 2006). High price, presence of triglycerides and specific fatty acids differentiated animal butter of plant oils. Edible oils and fats are different from point of view carbon chain length of fatty acids, degree of saturation (number of double bonds in the carbon chain), location and geometric condition of bands (cis or Trans isomers) (Idoui *et al.*, 2013). Any changing of unsaturated fatty acids content in butter samples influenced on Iodine, peroxide and saponification values as indicators for presence of them.

Maximum permissible content of coliforms in Iranian national standard for imported butters and internal produced butters is zero and 20 CFU/gr, respectively (Table 3) (ISIRI No. 2406, 2008). Packaging equipment and personnel contamination are the main causes of coliforms presence in butter samples (Tofangsazan *et al.*, 2009). According to national standard of Iran, *S. aureus* should not be

Table 3. Microbial contamination of butter samples

Microbe	Results	Standard limit (CFU/gr)
Coliforms	Contamination was found in all cities samples (50-100 cfu/gr in all samples)	$\leq$ 20
<i>E. coli</i>	Contamination was found in samples of 6 city (cities No: 3,4,5,6,7,10) (50-60 cfu/gr)	Negative
<i>S. aureus</i>	Contamination was found in samples of a city (city No: 6) (50 cfu/gr)	Negative
Mold and Yeast	Contamination was found in all cities samples 150-200 cfu/gr	$\leq$ 100

observed in butter (Table 3) (ISIRI No. 2406, 2008). Contamination with *S. aureus* may be due to the manipulation and transferring agents during butter packaging.

Maximum permissible level of molds in standard is 100 CFU/gr (Table 3) (ISIRI No. 2406, 2008). Since the main source for entrance of molds and yeasts to butter samples is environment of making site, therefore presence of this type of microbes is justified particularly in traditionally produced butters. According to national standard permissible level for presence of *E.coli* is zero (Table 3) (ISIRI No. 2406, 2008). *E.coli* is an indicator of fecal contamination in foods. Therefore, presence of *E.coli* in butter was due to non-compliance with hygienic

conditions in all steps of production, maintenance and supplying. Other researchers have studied chemical and biological quality of different types of butter. Obtained results of this study corresponded with the results of other researchers in Iran and other parts of the world (Rady and Badr, 2003; Idoui and Karam, 2008; Saremnezhad *et al.* 2008; Tofangsazan *et al.*, 2009; Honfo *et al.*, 2011).

## Conclusion

Obtained results of this study showed presence of vegetable oils, high degree of oxidation of fatty acids and presence of microorganisms in animal butter samples that represented poor hygienic status of traditional butters currently marketed in West Azerbaijan province of Iran. Avoiding to mixing vegetable oils with animal butters, personal hygiene, environment, equipment and tools sanitizing, preventing microbial contamination of samples during production, transportation, storage and distribution, control of hygienic conditions and storage temperature at retails, keeping the cold chain until the consumption are the best suggestions to producing high quality butters.

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## References

- Benkerroum, N. and Tamime, A.Y. 2004. Technology transfer of some Moroccan traditional dairy products (Iben, jben and smen) to small industrial scale. *Food Microbiology* 65: 1-15.
- Berhea, T., Seifua, E. and Kurtua, M.Y. 2013. Physicochemical properties of butter made from camel milk. *International Dairy Journal* 31(2): 51–54.
- Dervisoglu, M., Gul, O., Guvenc, D., Yazici, F., Atmaca, E. and Aksoy, A. 2013. Evaluation of Chemical and Microbiological Characteristics and Fatty Acid Profiles of Butter Samples Collected from the Black Sea Region of Turkey. *Asian Journal of Chemistry* 25(18): 10185-10190.
- Gunstone, F.D. 2000. Composition and properties of edible oils. *Edible oil processing*. In W.Hamm and R. J. Hamilton (Eds.). England: Sheffield Academic Press: 3-5.
- Honfo, F., Hell, K., Akissoé, N., Coulibaly, O., Fandohan, P. and Hounhouigan, J. 2011. Effect of storage conditions on microbiological and physicochemical quality of shea butter. *Journal of Food Science and Technology* 48(3): 274-279.
- Idoui, T. and Karam, N.E. 2008. Lactic acid bacteria from Jijel's traditional butter: Isolation, identification and major technological traits. *Grasas y Aceites* 59: 361-367.
- Idoui, T., Rechak, H. and Zabayou, N. 2013. Microbial quality, physicochemical characteristics and fatty acid composition of a traditional butter made from goat milk, *Annals Food Science and Technology* 14(1): 108-114.
- Iran National Standard. 2007. Animal and vegetable fats and oils- Determination of saponification value, ISIRI No. 10501: 1-13.
- Iran National Standard. 2000. Animal and vegetable fats and oils - Determination of iodine value, ISIRI No. 4888: 1-14.
- Iran National Standard. 1996. Animal and vegetable fats and oils- Determination of acid value and acidity, ISIRI No. 4178: 1-16.
- Iran National Standard. 2007. Butter - Determination of moisture, non-fat solids and fat contents Part 1: Determination of moisture content, ISIRI No. 8389-1: 1-12.
- Iran National Standard. 2008. Microbiology of milk and milk products, ISIRI No. 2406: 1-14.
- Iran National Standard. 2006. Milk fat - Preparation of fatty acid methyl esters, ISIRI No. 8818: 1-16.
- Iran National Standard. 2006. Milk fat – Determination of the fatty acid composition by gas-liquid chromatography, ISIRI No. 8819: 1-23.
- Iran National Standard. 1998. Peroxide value determination of edible fats and oils, ISIRI No. 4179: 1-7.
- Koca, N., Kocaoglu-Vurma, N.A., Harper, W.J. and Rodriguez-Saona, L.E. 2010. Application of temperature-controlled attenuated total reflectance-mid-infrared (ATR-MIR) spectroscopy for rapid estimation of butter adulteration. *Food Chemistry* 121(3): 778-782.
- Lees, M. 1999. WHO Food Authenticity. Eurofins Scientific, Nantes, (Issues and Methodologie).
- Rady, A.H. and Badr, H.M. 2003. Keeping the quality of cows' butter by  $\gamma$ -irradiation. *Grasas y Aceites* 54: 410-418.
- Samet-Bali, O., Ayadi, M.A. and Attia, H. 2009. Traditional Tunisian butter: Physicochemical and microbial characteristics and storage stability of the oil fraction. *LWT - Food Science and Technology* 42(4): 899–905.
- Saremnezhad, S., Azizi, M.H. and Hoseini, S.K. 2008. Evaluation of chemical and microbial characteristics of butter packaged by dairy industries. *Journal of Food Science and Technology* 5(4): 37-46.
- Tofangsazan, F., Khamiri, M., Karim, G., Hassani, S. and Seifhashemi, S. 2009. Evaluation of microbial quality of marketed butters in Tehran at 2007, *Iranian Journal of Medical Microbiology* 3(1): 36-42.
- Tvrzicka, E., Kremmyda, L.S., Stankova, B. and Zak, A. 2011. Fatty acids as biocompounds: their role in human metabolism, health and disease—a review. Part 1: classification, dietary sources and biological functions. *Biomedical papers* 155(2): 117-130.

- Willett, W.C. 2012. Dietary fats and coronary heart disease. *Journal of International Medicine* 272(1): 13–24.
- Zhao, T., Doyle, M.P. and Berg, D.E. 2000. Fate of *Campylobacter jejuni* in butter. *Journal of Food Protection* 63(1466): 120-122.