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PJBS

ISSN 1028-8880

Pakistan Journal of Biological Sciences

ANSInet
Asian Network for Scientific Information
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan

Pakistan Journal of Biological Sciences 3 (4): 596-598, 2000

A Study on the Physical and Chemical Properties of Cookery-Type Butter

Şerafettin Çelik, İhsan Bakirci
Department of Food Engineering Agricultural, Faculty of Ataturk University, 25240 Erzurum, Turkey

Abstract: This study was conducted on 33 cookery-type butter samples collected from family plants and small dairies in Erzurum region of Turkey. The average values of samples obtained from family plants and small dairies were as follows: moisture 17.07 ± 0.64 and 19.03 ± 0.91%, salt 0.48 ± 0.12 and 0.33 ± 0.17%, TA (as lactic acid) 0.22 ± 0.01 and 0.33 ± 0.17%, milk fat 79.73 ± 0.62 and 78.46 ± 0.87%, non-fat dry-matter 3.21 ± 0.63 and 2.51 ± 0.90%, melting point 32.61 ± 0.41°C and 32.18 ± 0.58°C, SN 218.91 ± 3.12 and 211.55 ± 4.41 mg KOH/g fat, Reichert-Meissl number 2.86 ± 0.83 and 22.97 ± 1.17, polenske number 2.90 ± 0.23 and 2.27 ± 0.33, acid degree value 7.10 ± 1.21 and 3.14 ± 1.71 mg KOH/g fat and peroxide value 3.10 ± 0.22 and 2.79 ± 0.31 meq O_2/kg fat respectively. These results indicated that the cookery-type butters sold in Erzurum market do not have a standard manufacturing method and their physical and chemical characteristics were not in agreement with the Turkish Food Regulations.

Key words: butter, physical and chemical properties, composition

Introduction

Butter is one of the oldest dairy products known in the world and it has an important role in human nutrition (Metin, 1977). The converting efforts of the milk fat to a more concentrated product dates from many centuries. In the past, the butter had used as an ointment to cure eye and skin diseases in addition to food material (Yoney, 1970; Atamer and Kaptan, 1982; Lane, 1992; Atamer, 1993a).

Butter is essentially the fat of the milk and it is physically made from cream or yoghurt. Therefore, should not contain another fat (Tekinsen *et al*., 1997). It is usually made from sweet cream and is salted. However, it can also be made from acidulated or soured with starter cultures cream. Milk fat contains all of components that constitute the milk dry matter. However, the ratios of these constituents are change significantly different from the milk. For example, during the butter-making process, the fat content of milk increases about 20 times, while the other components of milk decreases significantly (Atamer, 1993a).

Today, the manufacture of butter in Turkey is mainly based upon traditional technologies. The situation causes to the production method, which has not a standardization and quality control in butter production.

Although butter is largely produced in Erzurum region, the number of studies on the physical and chemical properties of butter is limited. Kurdal and Koca (1987) carried out a study on butter and found that moisture content of the samples was between 14.01-22.58%, milk fat 75.50-84.00%, solid non-fat 1.71-4.49%, salt 0.02-1.83%, titratable acidity (as lactic acid) 0.39-0.74%, Reichert-Meissl number 26.58-28.55, polenske number 1.93-2.72 and peroxide value 0.98-1.75 mmol O_2/kg.

A similar study was also conducted by Sengul *et al*. (1998) on butters collected from Trabzon region of Turkey. It was found that the moisture content changed between 7.05-18./03%, milk fat 79.50-87.50%, titratable acidity 0.22-1.47%, salt 0.06-0.29%, melting point 31-35°C, Reichert-Meissl number 9.7-37.8, polenske number 0,.5-2.7, saponification number 124.70-272, and peroxide value 0.20-0.70 meq O_2/kg.

The aim of this study was to determine the physical and chemical properties of cookery type-butter sold in Erzurum market, to compare the results with the Turkish Food Regulations (1989; 1990).

Materials and Methods

In this study, 33 butter samples were randomly taken from Erzurum market, categorised into two groups. The first group included the samples of family plant (n = 22) and the second group involved samples from small dairies (n = 11). The collected samples were immediately transported to the laboratories and kept at 4°C during analysis period.

The contents of moisture, salt and milk fat and titratable acidity (TA) value and melting point of the butter samples were analysed according to the methods given by Kurt *et al*. (1996). Saponification number (SN), Reichert-Meissl (RM) number, Polenske number (PN), acid degree values (ADV), and peroxide value (PV) were determined with the methods given by Atamer (1993b), solid non-fat (SNF) content was established by calculation. In the statistical analysis, comparison of data from family plant and small dairies were carried out according to General Linear Model procedure by using MINITAB packed program.

Results and Discussion

The results obtained from the study are shown in Table 1. In cookery type-butter samples analysed, moisture contents of samples collected from the family plants and small dairies were found as 11.07-23.25 and 16.67-23.40% and the mean values were 17.7 ± 0.91 and 19.03 ± 0.91% respectively. These results were higher than that obtained by Sengul *et al*. (1998) from Trabzon butters. TS 331 specified the maximum moisture content in the cookery type-butters as 16% (1989). According to this 16 of 22 samples obtained from family plants and all of samples obtained from small dairies exhibited higher moisture content than that proposed value by TS 1313. Statistical analysis indicated that moisture level of the samples analysed was negatively correlated with acid degree value, PV and SN.

The lowest and highest salt contents of butter samples from family plants and small dairies were 0.10-3.10 and 0.10-0.30% and the average values were found as 0.48 ± 0.12 and 0.33 ± 0.17% respectively (Table 1). Sengul *et al*. (1998) reported that the ssalt contents of Trabzon butters were 0.02-1.83%, which were lower than out results. TS 1331 proposed the maximum salt content in cookery type-butters as 2%. In this case, the mean values of both groups were in agreement with TS 1331.

Acidity value, as lactic acid, of butter samples of family plants and small dairies were changed between 0.14-0.28 and 0.11-0.32%, and mean values were 0.22 ± 0.01 and 0.33 ± 0.17% respectively. Acidity value is usually accepted as an index for the product quality. In the Turkish Food Regulations, therefore, butter is mainly classified into three types on the basis of the maximum TA, i.e., first-class, second-class and third-class. In the first-class

Table 1: Physical and chemical properties of cookery type butter sold in Erzurum

	Family Plant (n = 22)			Small Dairies (n = 11)		
	Min.	Max.	Mean	Min.	Max.	Mean
Moisture (%)	11.07	23.25	17.07 ± 0.91	16.67	23.40	19.03 ± 0.91
Salt (%)	0.10	3.10	0.48 ± 0.12	0.10	0.30	0.33 ± 0.17
TA (%)	0.14	0.28	0.22 ± 0.01	0.11	0.32	0.33 ± 0.17
Fat (%)	75.00	86.00	79.73 ± 0.62	74.00	82.00	78.46 ± 0.87
SNF (%)	0.35	13.85	3.21 ± 0.63	0.91	5.30	2.51 ± 0.90
Melting Point (°C)	29.50	38.00	32.61 ± 0.41	30.00	37.00	32.18 ± 0.58
SN	191.00	244.00	218.91 ± 3.12	186.00	237.00	211.55 ± 4.41
RM Number	22.70	29.75	26.86 ± 0.83	11.62	28.51	22.97 ± 1.17
PN	1.44	5.86	2.90 ± 0.23	1.06	3.84	2.27 ± 0.33
ADV (mg KOH/g fat)	1.05	25.05	7.10 ± 1.21	1.39	6.91	3.14 ± 1.71
PV (meq O_2/kg fat)	1.35	5.86	3.10 ± 0.22	1.99	4.23	2.79 ± 0.31

the maximum TA is 0.27%, in the second and third-classes are 0.56 and 0.63% respectively (Anonymous, 1989, 1990). As a result, the samples analysed of both plants were included in the first-class in terms of TA values.

Butter is mainly composed of milk fat. Therefore, fat analysis is important to evaluate the compositional properties of butter. The fat contents of the samples from family plants and small dairies were found between 75-86 and 74-82% and average milk fat contents were 79.72 ± 0.62 and 78.46 ± 0.87% respectively (Table 1). TS 1331 specified that the lowest milk fat of cookery-type butter must be 82%. The results showed that the values of 8 samples obtained from family plants and only one sample from small dairies in agreement with the TS 1331 and the Turkish Food Act in terms of milk fat contents.

Solid non-fat content: SNF contents of butter samples analysed, which collected from family plants and small dairies were between 0.35-13.85% and 0.91-5.30% and the average values were 3.21 ± 0.63 and 2.51 ± 0.91% respectively (Table 1). According to TS 1331, SNF in the cookery-type butters must be 2% as maximum. In this case, SNF contents of 9 samples from family plants and 6 samples from small dairies were higher than that in related regulations. These values obtained from samples showed that the butter manufacture was in poor conditions and the employment of personnel was not sufficiently qualified. Also, the small dairies were deprived of modern technology and suitable equipment.

Melting Point: There is not a specification about the melting point established for butter in TS 1331 and the Turkish Food Act. However, in some dairy technology textbooks the melting point of milk is given between 28°C and 39°C and also the average melting point is 35-36°C. This constant is one of very important criteria for discrimination of milk fat from vegetable and animals fats (Yoney, 1970; Kurt *et al*., 1996; Metin, 1996). As can be seen from Table 1; the melting point values in butter samples from family plants and small dairies were 29.5-38.0 and 30.0-37.0°C, the average values were 32.61-0.41 and 32.18 ± 0.58°C respectively (Table 1). These values were close to the figures given by the indicated sources above.

Spanoification Number: Although the SN is one of the considerable constants to distinguish the milk fat from other fats (Atamer, 1993b; Kurt *et al*., 1996). The Turkish Food Regulations proposed any acceptable limit for this subject. In the sources related to dairy technology, it was presented different information about this subject. For example, in some sources (Yoney, 1970; Kurt *et al*., 1996), the SN of milk fat is given between 209 and 238, whereas Atamer (1993b) reported that this number is changed from 210 to 235. In the samples obtained from family plants and small dairies, the lowest numbers were 191 and 186, the highest numbers were 244 and 234 and also mean values were found as 218.91 ± 3.12 and 211.55 ± 4.44 respectively (Table 1). The values obtained from this study exhibit a great variation than that expressed in the literatures. This variation probably arises from different manufacturing methods.

Reichert-meissl number: RM number, indicating the amount of short chain free fatty acids, is a characteristic for milk fat. At the same time, this number explains the amount of fatty acids evaporating with water vapour and in water-soluble in 5 g milk fat. It is suggested that this number may be between 23-33 in the butter (Kurt *et al.,* 1996). The Turkish Food Regulations proposed that this number must be 24 as minimum in butter. In this study, RM numbers of samples obtained from family plants and small dairies changed between 22.70-29.75 and 11.62-28.51 and average values were 26.86 ± 0.86 and 22.97 ± 0.17 respectively (Table 1). In this case, the mean value of RM of samples from family plants was in agreement with related regulations. In contrast to , mean value of samples from small dairies was lower. The results obtained by Kurdal and Koca (1987) were parallel to our results. RM numbers of five samples examined were lower than that value proposed by TS 1331 and the Turkish Food Act. This was probably originated from high moisture and SNF contents of butter samples. Also, differences between mean values of samples family plants and small dairies were significant ($p < 0.05$) statistically. In addition, the RM number was positively correlated with SN.

Polenkse number: PN is a constant, which express the amount of free fatty acids evaporating with water vapour and alcohol-soluble in 5-g of butter and varies between 1.0-3.5 in cow's milk (Kurt *et al*., 1996). There is not a limitation in Turkish Food Regulations. In this study, polenske numbers were found between 1.44-5.86 for family plants and 1.06-3.84 for small dairies. Also, mean values were 2.90 ± 0.23 and 2.27 ± 0.33 respectively (Table 1). The average values were higher than that value reported by Kurdal and Koca (1987) and Sengul *et al*. (1998). It was found that PN was positively correlated with RM number.

Acid degree value: ADV is accepted as an important index for lipolysis in milk fat. It was assumed that this value is an indicator for rancidity level arising from breakdown of free fatty acids (Allen, 1994). The Turkish Food Regulations has not stipulated any specification about this value. Atamer (1993b) reported that off-flavour of butter was felt when ADV reached at 1.8 mg KOH/g fat. The ADV of samples from family plants and small dairies changed between 1.05-25.05 and 1.39-6.91 mg KOH/g fat and mean values were found as 7.10 ± 1.21 and 3.14 ± 1.17 mg KOH/g fat respectively (Table 1). It was observed

that ADV showed a positive correlation with peroxide value.

Peroxide value: Peroxide value, one of the tests to determine the oxidation level in butterfat, is used to obtain the amount of the first product of hydroperoxides. The main principle of all the PV methods is based on the detection of active O_2 amount (Atamer, 1993b). In the samples of family plants and small dairies, peroxide values changed between 1.35-5.86 and 1.99-4.23 meq O_2/kg fat, mean values were 3.10 ± 0.22 and 2.79 ± 0.31 meq O_2/kg fat respectively (Table 1). The Turkish Food Regulations specified the PV as 10-meq O_2/kg fat as maximum. Al of samples analysed were in agreement with he related regulations in terms of peroxide value.

Results of this study indicated that the butters made in family plants and small dairies have not a standard production method and modern technology. According to the results of variance analyses, the butters made in family plants and small dairies have not any significant differences with regard to investigated properties except RM number. That the mean RM numbers of samples of small dairies were being lower than the expected values, it was presumably originated from relatively higher moisture and SNF contents. The mean values of moisture, milk fat, SNF contents in both groups and RM value of samples obtained from small dairies were not in agreement with the Turkish Food Regulations. Thus, the production method of cookery-type butters should firstly be improved using modern equipment and technology and the qualified personnel should be employed in these plants.

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