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RELATIONSHIPS AMONG SOME PROPERTIES OF BUTTER AND DIFFERENT TYPES OF MILK

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ABSTRACT

Fresh whole milk (buffaloe, cow, ewe and goat) were separated to cream. Fresh cream from each milk was divided into two parts. The first part was churned to sweet butter, while the second part was fermented, then, churned to fermented butter. Buffalo and cow sweet cream were mixed (1:1) and divided into two parts. The first part was churned to mixed sweet butter (buffalo and cow), while the second part was fermented using a starter, then churned to mixed fermented butter. The chemical properties of each type of butter (sweet and fermented) were studied. The effect of milk type on chemical properties of its butter indicated that the moisture content, acid No., fat, acidity, peroxide value, iodine value and saponification value of butter (sweet and fermented) gave higher values for goats butter than all types of butter. On the other hand, the melting point, unsaponification value took the opposite trend. Statistical analysis reveled that moisture content, acid No., fat acidity were highly affected by fermentation ($P < 0.01$) and peroxide value was significant ($P < 0.05$), while iodine value, melting point, saponification value and unsaponification values were not significantly affected ($P > 0.05$). On the other hand, effect of milk type on chemical properties of butter (sweet and fermented) showed that the moisture content, melting point, peroxide value and saponification value were highly significant ($P < 0.01$), while iodine value was significant ($P < 0.05$). Acid No., fat, acidity and unsaponification value were not significant ($P > 0.05$).

Key words: butter, goat milk, buffalo milk, cow milk, ewe milk, fermentation, properties of butter.

INTRODUCTION

The various properties of fats, *e.g.*, iodine value and melting point, are known to be a function of their compositional quality. The chemical composition of milk fat is affected by many factors therefore it shows marked variations in its properties during the year. Butter is a water-in-oil type emulsion containing about 80% fat, 16% emulsified water, 2% salt and 2% protein (Shukla and Rizvi, 1996).

Biological and biochemical differences have been reported between non-fermented and fermented milk products. Cream for butter making may be either sweet or fermented (Alm, 1982). Fermentation of cream under controlled conditions to produce fermented cream depends on the character and intensity of the products developed by the starter culture. Several investigations have been done on the chemical constants of butter made from buffaloe and cow milk, while little has been done concerning goat's and ewe's butter.

Therefore, the aim of this paper was to study the effect of fermentation on some chemical properties of butter produced from different types of Egyptian milks, namely buffalo, cow, mixed of buffalo and cow, ewe and goat milk.

MATERIALS AND METHODS

Fresh whole buffalo's and cow's milk were obtained from the Institute of Animal Production, Ministry of Agriculture, Dokki, Giza, Egypt. Ewe's and goat's milk were obtained from a private farm, Mansoura, Dakahlia Governorate, Egypt.

Milk was separated into cream using mechanical separator. Cream from each type of milk was divided into 2 parts. The first part was kept at 5°C for 12 hrs., and then churned to butter (sweet butter).

The second part of cream was pasteurised at 75°C for 5 min., cooled to 30°C. Butter starter composed of (1 : 1, V/V) *Lactococcus lactis* subsp *lactis* and *Lctococcus lactis* subsp *cremoris* (Chr. Hansens, Copenhagen, Denmark), was added to the cream at the rate of 20 ml/1 kg cream, incubated at 30°C for 24 hrs., aged at 5°C overnight in a refrigerator then churned into butter (fermented butter).

The resultant sweet cream from buffalo's and cow's milk were mixed (1:1, w/w) and divided in two parts. The first part was churned into butter (mixed sweet butter), while the second part of mixed sweet cream was fermented, churned to butter (mixed fermented butter). Three replicates from each treatment were carried out.

Analytical methods:

The resultant butter was analysed for their chemical properties and fat constants immediately after manufacture. Pyroxide value, moisture % and melting point (°C) were determined following the methods explained by A.O.A.C. (1990). Acid value, acidity % as oleic acid, iodine value (I.V.), saponification number and unsaponifiable matter content were determined in butter according to B.S.I. (1961) method.

Statistical analysis:

The obtained data were analysed statistically according to Snedecor and Cochran (1982).

RESULTS AND DISCUSSION

1- Chemical composition of butter from different types of milk:

The effect of starter ripening on the keeping quality parameters of butter is shown in Tables (1 & 2). The results revealed that fermented butter had a higher acid No. and acidity % as oleic acid compared with sweet butter for all types of butter. This may be due to the hydrolysis of the mono and diglycerides present in the fat. These results are in accordance with those reported by Stadhouders and Veringa (1973) who found that butter produced from sweet cream had lower fat acidity than butter produced from fermented cream. The effect of starter ripening (fermentation process) on peroxide values (P.V.) development is presented in Tables (1 & 2). It could be noticed that the peroxide value in fermented butter were higher than that in sweet butter. The results are in agreement with those reported by Tanimura *et al.*

(1982), that peroxide values in fermented butter samples stored at 5°C increased rapidly than in sweet butter under the same condition. The moisture content in goat sweet butter was higher than all types of butter while buffalo sweet butter had the lowest moisture content. On the other hand, the moisture content of fermented butter was higher than that in sweet butter with the same trend. The Iodine values revealed higher values for goat butter (sweet and fermented) than that in all types of butter, this may be due to the differences in unsaturation of fat while the melting point (°C) for (sweet and fermented) butter took the opposite trend. The saponification values of sweet butter showed that goat butter had the highest value while buffalo sweet butter had the lowest values. On the other hand, differences in saponification values of fermented butters took the same trend but with higher values. This may be due to the hydrolysis of glycerides of butter during fermentation process. The unsaponification matter content was higher in sweet than fermented butters. Buffaloe butter (sweet and fermented) gave higher unsaponifiable matter content than that of goats (sweet and fermented) butter. Results of buffalo and cow butter (sweet and fermented) for melting point, peroxide value, iodine value (I.V.), saponification and unsaponifiable matter content are in agreement with that reported by El-Sayed (1989). Also, the results for I.V. and moisture content of buffaloe and cow butter (sweet and fermented) took the same trend as those reported with Hofi *et al.* (1982). On the other hand, The results of goat's butter concerning saponification values (Tables 1 & 2) were in accordance with that reported by Sumit and Rai (1998a). The low melting point and higher (I.V.) observed in goats butter (sweet and fermented) may be due to the high short chain and unsaturated fatty acids of goat's milk fat (Sumit and Rai, 1998b). The iodine values (I.V.) and saponification values for cow's and ewe's butter (sweet and fermented) are in accordance with that found by Al-Khalifah and Al-Kahtani (1993). Abou-Dawood *et al.* (1980) found that the melting point (°C) of goats fat was lower and its iodine value (I.V.) was higher, while ewe's fat showed an opposite trend, which may be explained on the basis that ewe's fat contains low short chain fatty acids content while goats fat contains more short chain fatty acids. Ewe's fat was also higher in saturated long chain fatty acids (palmitic and stearic) while goats fat was higher in the unsaturated long chain fatty acids (oleic, linoleic, and arachidonic). This explain that the I.V. was higher in goats butter and lower in ewe's butter while the melting point took the opposite trend.

Statistical analysis:

A) Effect of milk types on chemical composition of its butter (sweet and fermented):

Table (3) illustrates that the differences in moisture content for all types of butter were highly significant ($P < 0.01$). Butter from goat's milk had the highest moisture content while buffaloe butter had the lowest. Differences in the acid no., acidity % as oleic acid and unsaponification value were not significant. On the other hand, the iodine value (I.V.) of butter from different milks were significant ($P < 0.05$). Goats butter had higher I.V. than

Table (1): Composition of sweet butter from different types of milk.

Chemical Properties	Type of butter				
	Buffalo	Cow	Mixed (buffalo + cow)	Ewe	Goat
Moisture %	16.32	19.37	16.49	18.34	20.65
Acid number	0.727	1.640	0.680	0.475	1.410
Fat acidity	0.365	0.820	0.340	0.240	1.710
Iodine value	30.72	33.00	32.00	31.80	34.90
Melting point	37.0	32.00	32.50	36.50	30.00
Peroxide value	0.2	1.84	1.20	0.80	2.00
Saponification value	234.5	240.20	233.20	235.50	242.70
Unsaponifiable matter	400	390	394	395	350

Iodine value = number of iodine which was observed by 100 g fat.
Melting point = °C
Peroxide value = m/eq/kg fat.
Saponification value = mg/100 g fat.
Unsaponifiable matter = mg/100 g fat.

Table (2): Composition of fermented butter from different types of milk.

Chemical Properties	Type of butter				
	Buffalo	Cow	Mixed (buffalo + cow)	Ewe	Goat
Moisture %	17.80	21.00	20.00	20.33	22.01
Acid number	2.360	1.820	2.940	5.500	2.680
Fat acidity	1.180	0.910	1.470	2.750	1.850
Iodine value	31.50	34.00	33.00	32.30	36.65
Melting point	36.00	31.00	31.50	35.50	29.50
Peroxide value	0.46	1.90	1.67	0.84	2.34
Saponification value	235.70	241.30	234.50	236.20	243.20
Unsaponifiable matter	394	370	392	387	335

Iodine value = number of iodine which was observed by 100 g fat.
Melting point = °C
Peroxide value = m/eq/kg fat.
Saponifiable matter = mg/100 g fat.
Unsaponification value = mg/100 g fat.

Table (3): Effect of milk type on chemical properties of its butter (sweet and fermented.

Chemical Properties	Type of butter					Signi f- ican
	Buffaloe	Cow	Mixed (buffaloe + cow)	Ewe	Goat	
Moisture %	17.06	20.19	18.25	19.34	21.33	**
Acid number	1.54	1.73	1.81	2.99	2.05	n.s.
Fat acidity	0.77	0.87	0.91	1.50	1.01	n.s.
Iodine value	31.00	32.25	32.15	32.00	32.90	*
Melting point	36.50	31.50	32.50	32.75	30.50	**
Peroxide value	0.33	1.37	0.94	0.82	2.17	**
Saponification value	234.95	240.85	235.00	235.50	242.65	**
Unsaponifiable matter	400	380	395	390	370	n.s.

Iodine value = number of iodine which was observed by 100 g fat.
Melting point = °C
Peroxide value = m/eq/kg fat.
Saponification value = mg/100 g fat.
Unsaponification value = mg/100 g fat.
Sig. = significance.
n.s. = not significant
*** = significant at (0.05).**
**** = high significant at (0.01).**

the other types of butter while buffalo butter had lower I.V. The differences in the melting point and saponification value were highly significant ($P < 0.01$). Buffalo butter had the highest melting point and goats butter showed the lowest, while saponification value took the opposite trend. The differences in the peroxide value of butter from different milks were highly significant ($P < 0.01$).

B) Effect of fermentation on the chemical properties of butter from different types of milk:

The effect of fermentation on the chemical properties of butter from different types of milk was presented in Table (4). The iodine value, melting point, saponification and unsaponification values were not significant. On the other hand, the acid No. and acidity percent were highly significant ($P < 0.01$), this may be due to that fermentation process increased acidity of butter for all types of milk. Also the moisture content was highly significant ($P < 0.01$) because of fermentation. The peroxide value of all types of butter was significant ($P < 0.05$) which may be due to fermentation process increase the unsaturation and increased peroxide value (oxidation process).

C) Interrelationship between the chemical properties of butter from different types of milk:

Table (4): Effect of fermentation process on chemical properties of butter from different types of milk.

Chemical Properties	Type of butter		Significance
	Sweet butter	Fermented butter	
Moisture %	18.23	20.33	**
Acid number	0.99	3.06	**
Fat acidity	0.50	1.52	**
Iodine value	32.79	32.98	n.s.
Melting point	33.30	33.10	n.s.
Peroxide value	0.99	1.26	*
Saponification value	237.42	237.50	n.s.
Unsaponifiable matter	390	385	n.s.

Iodine value = number of iodine which was observed by 100 g fat.
Melting point = °C
Peroxide value = m/eq/kg fat.
Saponification value = mg/100 g fat.
Unsaponifiable matter = mg/100 g fat.
Sig. = significance. n.s. = not significant
*** = significant at (0.05) . ** = high significant at (0.01).**

The relationship between the chemical properties of butter from different types of milk (Table 5), (sweet butter), indicated that, the unsaponifiable matter content was correlated positively with the melting point ($P < 0.01$) while ti was correlated negatively with both iodine value ($P < 0.05$), and the acid No., acidity and saponification value ($P < 0.05$) of butter. On the other hand, it was non significantly correlated with the moisture content. Saponification value was correlated positively with moisture %, and iodine value ($P < 0.01$) and it was non significantly correlated with the acid No., fat, acidity, melting point and peroxide value ($P > 0.05$). The peroxide value was

correlated positively with the moisture content, acid No. and acidity ($P < 0.01$) while it was non significantly correlated with the iodine value and the melting point ($P > 0.05$). The melting point was correlated negatively with moisture content, acid No. and fat acidity ($P > 0.05$) while it was non significantly correlated with iodine value ($P > 0.05$). The iodine value was non-significantly correlated with the moisture content, acid No. and acidity ($P > 0.05$). The fat acidity was correlated positively with moisture content and acid No. ($P < 0.01$). Finally, the acid No. was correlated positively with moisture content ($P < 0.01$).

Table (5): Interrelationship between chemical properties of sweet butter from different types of milk.

Chemical Properties	Unsaponifiable	Saponification value	Peroxide value	Melting point	Iodine value	Acidity fat	Acid No.	Moisture %
Moisture %	- 0.38	+0.62[1]	+0.67[1]	- 0.84[1]	+ 0.29	+0.81[1]	+0.80[1]	____
Acid number	- 0.48[2]	+ 0.22	+0.94[1]	- 0.60[1]	+ 0.02	+0.96[1]	____	
Fat acidity	- 0.49[2]	+ 0.27	+0.94[1]	- 0.60[1]	+ 0.02	____		
Iodine value	- 0.74[1]	+0.91[1]	+ 0.07	- 0.09	____			
Melting point	+0.73[1]	- 0.22	- 0.38	____				
Peroxide value	- 0.36	+ 0.22	____					
Saponification value	- 0.48[2]	____						
Unsaponifiable mattert	____							

1 = high significant (P < 0.01) correlation (r).
2 = Significant (P < 0.05) correlation (r).
n = 15 samples. Every type of butter was carried out in three replicates.
R (5%) = 0.482. r(1%) = 0.606.

D) Interrelationship between chemical properties of fermented butter from different types of milk:

Table (6) presents the unsaponification value of fermented butter was correlated positively with melting point ($P < 0.01$); and correlated negatively with the iodine value, saponification value and moisture content ($P < 0.05$). On the other hand, it was non significantly correlated with acid No., fat acidity and the peroxide value ($P > 0.01$). The saponification value was correlated positively with moisture content and the iodine value ($P < 0.01$) while it was non significantly correlated with acid No.; acidity; melting point and peroxide value ($P > 0.05$). The peroxide value was correlated positively with acid No., fat acidity and the iodine value ($P < 0.05$) and it was non significantly correlated with moisture content and the melting point ($P > 0.05$). The melting point was correlated negatively with the moisture content ($P < 0.01$) and the iodine value ($P < 0.05$). However, the melting point was non significantly correlated with acid No. and fat acidity ($P > 0.05$). Iodine value was correlated positively with the moisture content ($P < 0.01$) and with acid No. and fat acidity ($P < 0.05$). The fat acidity was correlated positively with acid No. ($P < 0.01$) but it was non significantly correlated with the moisture content ($P > 0.05$). Finally, acid No. was non significantly correlated with moisture % ($P > 0.05$).

Table (6): Interrelationship between chemical properties of different types of butter as affected by fermentation process.

Chemical Properties	Unsaponifiable	Saponification value	Peroxide	Melting point	Iodine value	Fat acidity	Acid No.	Moisture %
Moisture %	- 0.85[1]	+0.62[1]	+0.12[1]	- 0.87[1]	+0.62[1]	+0.07	+0.06	_____
Acid number	- 0.32	+ 0.15	+0.96[1]	- 0.06	+0.59[2]	+0.92[1]	____	
Fat acidity	- 0.33	+ 0.17	+0.94[1]	- 0.07	+0.49[2]	_____		
Iodine value	- 0.74[1]	+0.75[1]	+0.56[2]	- 0.57[2]	_____			
Melting point	+0.94[1]	- 0.45	- 0.09	_____				
Peroxide value	- 0.35	+ 0.08	_____					
Saponifiable matter	- 0.48[2]	_____						
Unsaponification matters	_____							

1 = high significant (P < 0.01) correlation (r).
2 = Significant (P < 0.05) correlation (r).
n = 15 samples. Every type of butter was carried out in three replicates.
R (5%) = 0.482. r(1%) = 0.606.

CONCLUSION

The strong correlations mentioned above indicate some trends and relationship between fermentation process and chemical properties of butter such as the moisture content, acid No., fat acidity, melting point, iodine value and saponification value while in sweet butter strong correlations were observed between moisture content, acid No., fat acidity, iodine value, melting point and saponification value, respectively.

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العلاقة بين بعض خصائص الزبد ونوع اللبن المصنعة منه

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تم فرز اللبن الكامل الطازج من كل من اللبن الجاموسى – اللبن البقرى – لبن الغنم ولبن الماعز إلى قشدة ، وبعد ذلك تم تقسيم كل نوع من أنواع القشدة إلى قسمين . القسم الأول تم خضه مباشرة إلى زبدة (غير متخمرة) بينما القسم الثانى تم تخميره وبعد ذلك تم خضه إلى زبدة (زبدة متخمرة) . درست الخواص الكيماوية لكل نوع من أنواع الزبد سواء كان متخمر أو غير متخمر .

وقد إتضح أن محتوى الرطوبة ورقم الحموضة وحموضة الدهن ورقم البيروكسيد والرقم اليودى ورقم التصبن للزبد المتخمر والغير متخمر أعطى قيمة عالية فى زبد الماعز مقارنة ببقية أنواع الزبد الأخرى .

وعلى الجانب الآخر أخذت درجة الإنصهار والمواد غير المتصبنة الإتجاه العكسى .

ومن التحليل الإحصائى للنتائج إتضح أن محتوى الزبد المتخمر من الرطوبة ورقم الحموضة وحموضة الدهن كانت معنوية جداً ، وقد كان رقم البيروكسيد معنوى (0.05%) بينما كان الرقم اليودى ودرجة الإنصهار ورقم التصبن والمواد الغير متصبنة غير معنوى (0.05) .

وعلى الجانب الآخر كان تأثير نوع اللبن على الخواص الكيماوية للزبد الناتج سواء كان متخمر أو غير متخمر أن محتواها من الرطوبة ونقطة الإنصهار ورقم البيروكسيد ورقم التصبن معنوى جداً على مستوى (0.01%) بينما كان الرقم اليودى معنوى على مستوى (0.05%) وأخيراً كان كل من رقم الحموضة وحموضة الدهن والمواد الغير متصبنة غير معنوية .