Melting curves of camel milk fat

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1. Introduction

A previous study on camel milk butter showed a difference in churning behaviour between camel and bovine cream (1). Camel cream of varying fat contents (20-30 %) was churned at temperatures between 15 and 36°C. Highest fat yield (80-85 %) in butter from cream with 22.5 % fat content was obtained at a churning temperature of 25°C. This churning temperature was much higher than that commonly used during the manufacture of butter from bovine milk (10-14 °C). The reason for the difference in churnabillty was attributed partly to the higher melting point of camel milk fat (1,2), It was therefore considered useful to study the melting properties of the triglycerides of camel milk in more detail and to compare the results with those obtained for bovine milk fat.

2. Materials and methods

2.1 Butter samples

Camel milk butter was made by a manual churning procedure described previously (1). Four butter samples from different batches of pooled camel *(Camelus dromedanus)* milk were used. All butter samples were obtained at a churning temperature of 25°C from sour cream (S1, S2) and sweet cream (S3, S4) with 22.5 % fat content. Data related to butter from bovine cream (Simmental cows) were collected during a previous study (4).

2.2 Differential scanning calorimetry

Melting thermograms and ratios of solid to liquid in milk fat were determined by differential scanning calorimetry (DSC) as described by RÜEGG *et al* (3). Butterfat was liquefied at 45-50 °C and dehydrated by filtration through a hydrophobic filter. 15 µl of butterfat was then filled and hermetically sealed in aluminium pans and cooled in the calorimeter from 40 to -50°C at a rate of 5 °C/min, The melting thermogram was recorded after 10 min equilibration time at -50°C by heating at a rate of 5 °C/min, The percentage of solid fat was calculated at 10°C Intervals from the area fractions under the melting thermograms. The area fractions were weighted with a factor which is proportional to the heat of fusion of the corresponding butter fat fractions (3), Triplicate measurements were made for each of the 4 butterfat samples. For comparison, both the corrected and the uncorrected percent solid values are reported in Table 1.

Table 1: **Percentages of solid fat as a function of temperature In butterfat prepared from camel milk. Means and standard deviation of 4 samples. Data without standard deviations correspond to predetermined values.**

Temperature (°C)		% Solid fat			
		Uncorrected		Corrected'	
X	S_X	X	S_X	X	S_X
-25.9	2.2	1000	-	1000	-
-20.0	-	99.8	0,1	99.7	0.2
-10.0	-	98.1	0,6	96.8	0.9
0.0	-	94.4	09	91	1.3
10.0	-	87.2	14	81.5	2.6
15.0	-	82.6	16	77.2	1.9
20.0	-	76.8	23	70.7	2.7
30.0	-	49.5	2,1	43.7	2.3
40.0	-	13.0	1,9	11.0	1.7
42.5	1.1	0.0	-	0.0	-

[1] Corrected for the temperature dependence of the heat fusion (3)

3. Results and discussion

Fig. 1 shows typical melting thermograms obtained with dehydrated butter prepared from camel and bovine milk. The thermogram for camel butter differed in shape and did not show the peak around 15°C that is characteristic of the middle melting fraction of triglycerides (5). The different amounts of low, middle and high melting fractions of triglycerides, which are suggested by the shape of the thermograms, are consistent with the differences in the fatty acid

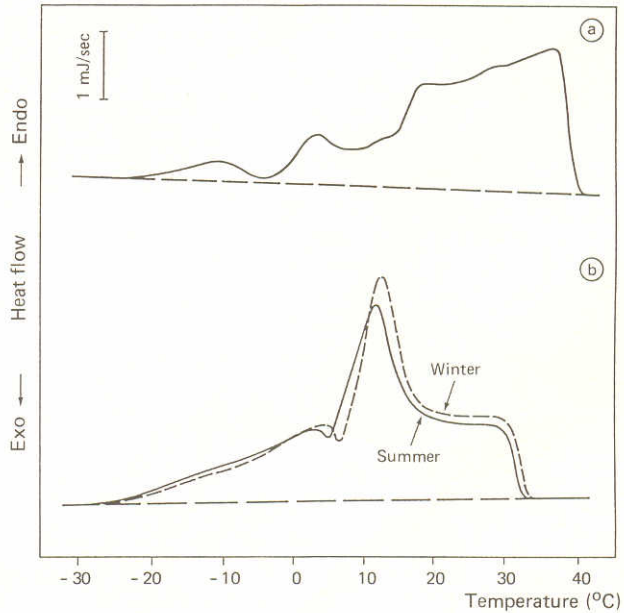

Fig 1 Differential scanning calorimetry thermogram of camel milk tat (a) and bovine milk fat (b)

composition. Camel milk fat contains a lower percentage of short-chain fatty acids (C_4 to C_{12} and a somewhat higher percentage of C_6 acids (1, 2).

Fusion of the camel milk fat started around -26 'C and was complete at about 43 °C (Table 1). Mean values and standard deviations of these temperatures are given in Table 1. Corresponding values for bovine milk were -25 and 37 °C, respectively, with a standard deviation of 2 'C

The average heat of fusion, calculated from the area under the thermograms, was 79.2 J/g, with a standard deviation of 35 J/g, Using the same method, butterfat samples from bovine milk gave values in the range of 70-80 J/g.

The percentages of solid fat in the 4 samples of camel milk fat were determined from the melting thermograms and plotted as a function of temperature in Fig. 2. For comparison, a typical curve for butterfat from bovine milk is included. The mean percentages of solid fat and their standard deviations are summarized in table 1.

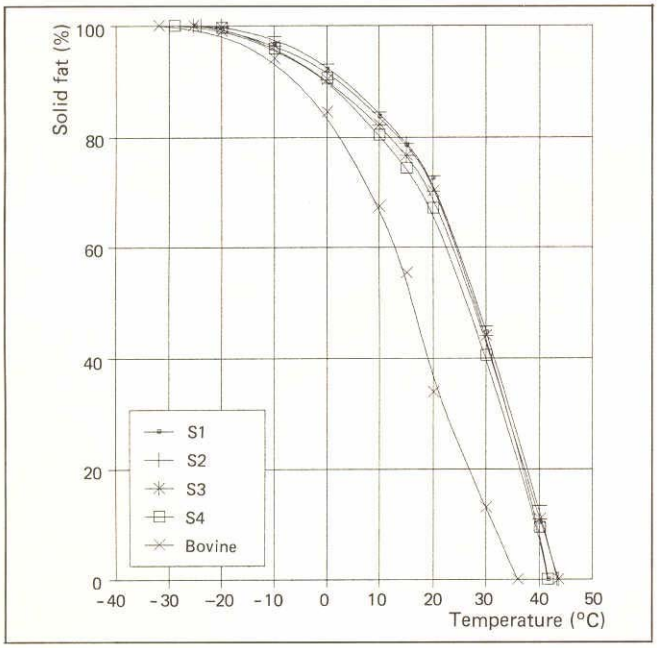

Fig 2 Melting curves of camel milk fat compared with typical curve for bovine milk fat Percentage of fat being solid as a function of temperature

It is evident from these data that butter from camel milk contains significantly higher percentages of solid fat over the entire melting range relative to butter from bovine milk (Fig. 2). At around 25 °C, *i.e.,* the temperature which gave the best churning results, about 55 % of camel milk fat was in crystalline form. Temperatures commonly used in similar procedures for cream from bovine milk are in the range of 10 to 14 °C. It is interesting to note that similar percentages of solid fat are found at these temperatures.

Acknowledgement

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4. References

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5. Summary

RÜEGG, M.W., FARAH, Z.: Melting curves of camel milk fat Milchwissenschaft 46 (6) 361-362 (1991)

44 Milk fat (camel milk)

Melting behaviour of camel milk fat was studied by differential scanning calorimetry. Melting thermograms were measured in the temperature range of -50 to +50 °C. Melting started around -26 °C and was complete below 43 °C. The average heat of fusion was 79.2 J/g. Compared to bovine milk fat, camel milk fat contains a higher amount of high melting triglycerides and a lower percentage of triglycerides that melt in the medium range around 15 °C. Melting curves derived from thermograms explain some of the difficulties encountered when converting camel milk into butter and should allow optimization of the temperature profile used during butter manufacture.

RÜEGG, M.W., FARAH, Z.: Schmelzverhalten von Kamelmilchfett Milchwissenschaft 46 (6) 361-362 (1991)
44 Milchfett (Kamelmilch)

Das Schmelzverhalten von Kamelmilchfett wurde mit Hilfe der Differential-Scanning-Kalorimetrie im Temperaturbereich von -50 bis +50 °C gemessen. Das Kamelmilchfett begann bei -26 °C zu schmelzen und war bei 43 °C vollständig verflüssigt. Die mittlere Schmelzwärme betrug 79.2 J/g. Im Vergleich zu Kuhmilch enthält Kamelmilch grössere Anteile an hochschmelzenden Triglyceriden und geringere Anteile an Triglyceriden, die im mittleren Temperaturbereich um 15 °C schmelzen. Die Schmelzkurven erklären einige Schwierigkeiten bei der Verbutterung von Rahm aus Kamelmilch und können zur Optimierung des Verbutterungsprozesses dienen.

RÜEGG, M.W., FARAH, Z. Comportement de fonte de matiere grasse laitiere de chamelle. Milchwissenschaft 46 (6) 361-362 (1991).
44 Matiere grasse laitiere (lalt de chamelle)

RÜEGG, M.W., FARAH, Z.: Caracteristicas de fusion de materia grasa láctea de camella. Mllchwissenschaft 46 (6) 361-362 (19911.
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