

Milk composition and energy standardization of Arabian camel's milk

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Introduction

Milk energy content can be estimated from the caloric values of its components (Perrin, 1958).

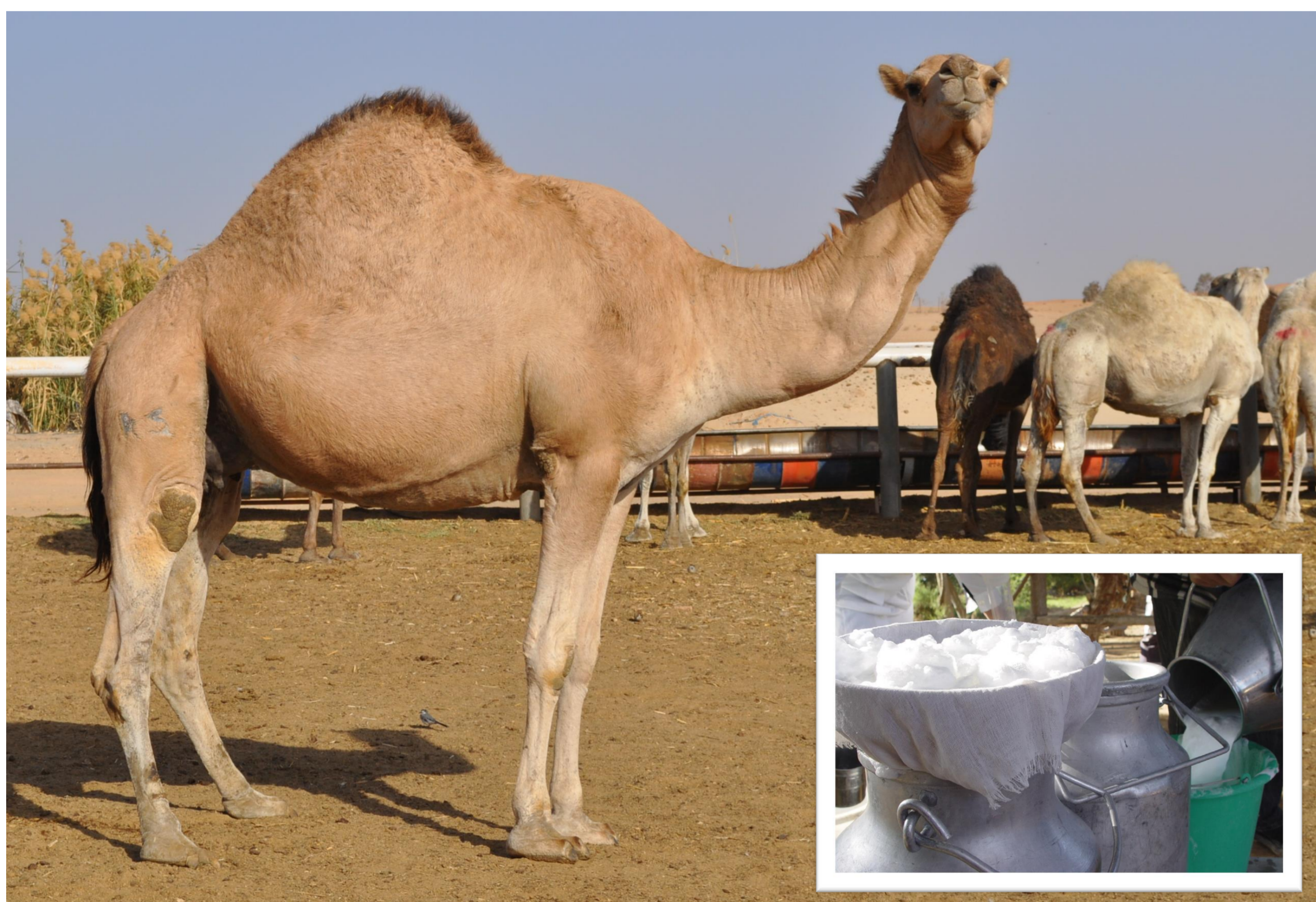
There is not agreement on a standard fat content for camel's milk and the Gaines' standardization equation for cow's milk is used in camels: $FCM_{4\%} = 0.15 \times \text{Fat} (\%) + 0.4$.

The aim of this work was:

to study the relationship between the major milk components and to propose energy- and fat-corrected milk equations for standardizing camel's milk.

Material & Methods

- **Animals:** 180 dairy camels (*Camelus dromedarius* L.) of 4 breeds (Majahim, 58; Maghatir, 49; Shu'l, 39; Sufer, 34) from the **Riyadh region** (Saudi Arabia), milked **twice daily** at different stages of lactation (29 to 372 DIM).
- **Milk samples:** 720 samples collected by hand-milking of each udder quarter at the **a.m. milking**.



Analyses:

- **Major milk components** (fat, protein, lactose and total solids) by **Lacto Star** (Funke-Gerber, Labortechnik, Berlin, Germany).
- **Minerals** analyzed from milk ashes (550°C) by **atomic absorption spectrometry** (Analyst Spectro-photometer 300, Perkin-Elmer, Shelton, CT, USA).
- **Gross energy** from a freeze-dried sample subset (**n = 225**) using an **adiabatic calorimeter** (IKA calorimeter, Janke & Hunkel, Heitersheim, Germany).

Statistical analyses:

Data analyzed for simple and multiple linear regressions by the REG procedure of SAS (SAS version 9.1, SAS Inst. Inc., Cary, NC, USA).

Conclusions

1) Camel milk standardization proposals:

- **Fat corrected milk at 3%** ($FCM_{3\%}$) was recommended as the standard, being: **1 kg $FCM_{3\%}$ = 642 kcal (153 kJ)**
- Standardization equation: **$FCM_{3\%} = 0.2 \times \text{Fat} (\%) + 0.4$**

2) Inverted fat content (fat < protein) was detected in more than 2/3 camel milk samples and a divergence at the intercept (~ 95 kcal = 1% fat) as a consequence of skim milk samples.

Results

Milk composition (**Table 1**) showed **79% inverted fat and protein contents (fat < protein)** which may have been a consequence of incomplete milk letdown during milking (i.e., milk without stimulatory calf suckling).

Table 1. Milk composition of dairy camels in Saudi Arabia

Milk component	Overall (n = 720)		Selected subset (n = 225)	
	Mean ± SE	Range	Mean ± SE	Range
Fat, %	2.94 ± 0.03	1.35 – 5.85	2.88 ± 0.05	1.39 – 5.63
Protein, %	3.45 ± 0.01	2.45 – 4.40	3.44 ± 0.02	2.72 – 4.31
Lactose, %	4.98 ± 0.02	3.56 – 5.99	4.99 ± 0.02	3.93 – 5.97
Total solids, %	12.1 ± 0.1	9.0 – 15.6	12.1 ± 0.1	9.6 – 15.6
Ashes, %	0.74 ± 0.01	0.59 – 0.95	0.74 ± 0.01	0.61 – 0.88
Ca, mg/L	9.03 ± 0.07	5.01 – 13.03	9.25 ± 0.13	5.06 – 13.00
Na, mg/L	3.57 ± 0.04	1.08 – 8.01	3.73 ± 0.09	1.07 – 8.02
K, mg/L	8.72 ± 0.11	3.06 – 19.41	9.55 ± 0.21	3.33 – 19.41
Energy, kcal/kg				
Measured	n/d	n/d	626 ± 6	403 – 890
Estimated ¹	655 ± 3	447 – 928	667 ± 5	458 – 942

¹ Gross Energy (kcal/kg) according to Perrin (1958) = $95 \times \text{Fat} (\%) + 53 \times \text{Protein} (\%) + 40 \times \text{Lactose} (\%)$.

Equations for milk energy obtained from the measured (calorimeter; $r^2 = 0.73$) and estimated (Perrin; $r^2 = 0.89$) data showed divergence at the intercept (**Figure 1**) as a result of the skim milk samples which will need further research.

The proposed fat-corrected milk equation for milk standardization at 3% fat (**1 kg $FCM_{3\%}$ = 642 kcal or 153 kJ**) in dairy camels from our data differed from that of Gaines and was:

$$FCM_{3\%} = 0.197 \times \text{Fat} (\%) + 0.408$$

Figure 1. Energy content of camel's milk (- -○- -, estimated; measured, -●-) according to milk fat.

