Fatty acids profile by Fourier Transform Infrared Spectroscopy (FTIR) of fat: validation as screening test in dairy herds of Lombardy Region, Italy

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INTRODUCTION

Aim of this work has been to determine the fatty acids profile in the milk of Lombardy Region (41% of the Italian production), using FTIR method, establishing the precision and the accuracy of the method on the bulk tank milk samples analyzed within the payment quality system.
Distribution of fatty acids profiles was outlined from more than 3,000 dairy herds over 36 months (2008-2011).

MATERIAL & METHODS

Equipment

FTIR spectrometry MilkoscanFT6000® (Foss, DK) with management software Foss Integrator®. Calibration curves developed by producer for satured (SAT), unsatured (UNSAT), monounsatured (MONO), polyunsatured (POLY) fatty acids.
Gas chromatography (GC) - HP 6890 GC System (Agilent Technologies Inc.): reference method measurements of milk fatty acid composition.

Samples

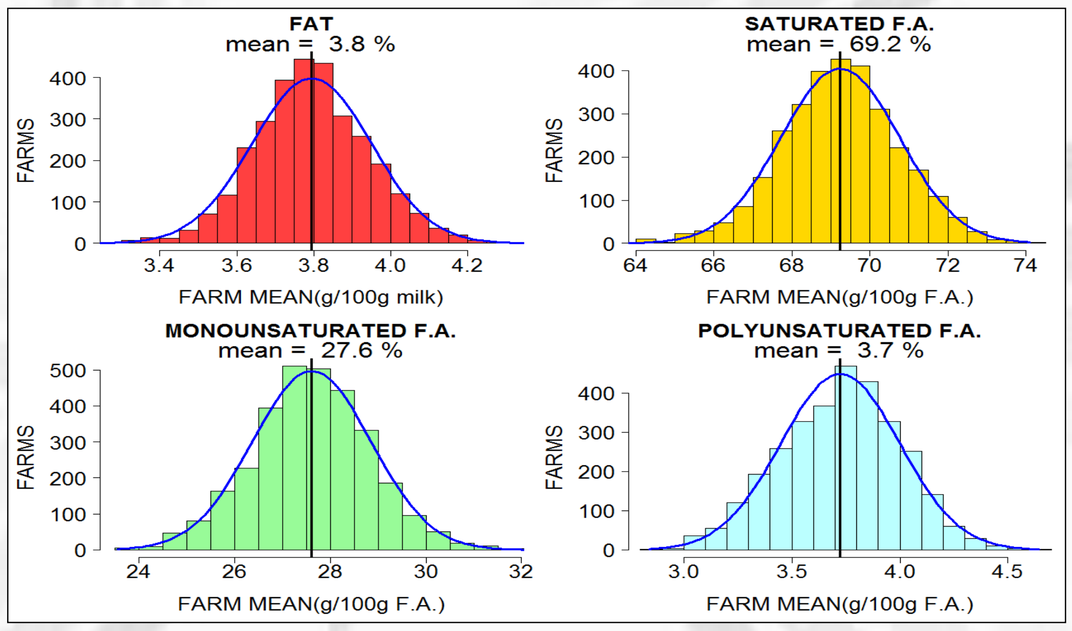
Refrigerated bulk milk samples processed by milk laboratory in Brescia within the payment quality system were selected to carry out the validation.
Bovine milk as internal reference material was used to determine the intra-laboratory repeatability and reproducibility.
Repeated measurements of these reference samples have been gathered over a 30-45 days period.
Accuracy has been estimated on 18 bovine milk samples collected *ad hoc* and analyzed by FTIR spectrometry as raw milk and by Gas Cromatography as frozen milk (table 1, see Root Mean Standard Error of Prediction or RMSEP).

RESULTS

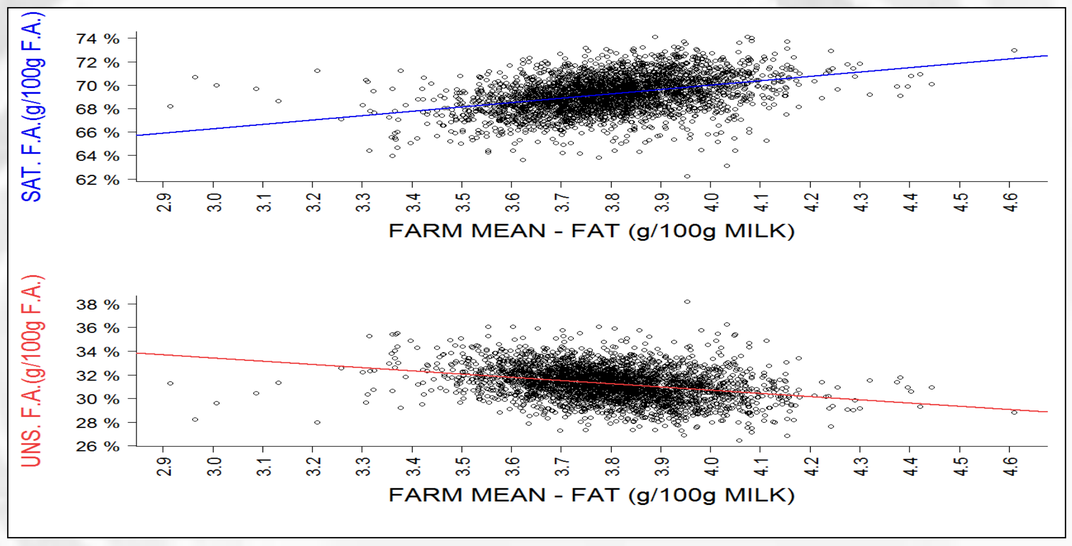
The intra-laboratory values of Repeatability [r], Reproducibility [R] and Standard Error of Prediction with slope and intercept correction [SEPcorr] were estimated on each parameter (table 1) .
Fatty acids profile screening was performed on more than 5,000 dairy herds over a 36 months period analyzing about 320,000 bulk milk samples. Analysis of data was carried out on a sub-population of 3,084 dairy herds, eligible for at least one sampling per month, for a total of 248,244 samples (table 2).

TABLE 1	r	R	RMSEP
	g/100 g milk		
Saturated F.A.	0.054	0.076	0.040
Unsaturated F.A.	0.048	0.065	0.021
Monounsaturated F.A.	0.042	0.065	0.029
Polyunsaturated F.A.	0.014	0.014	0.023

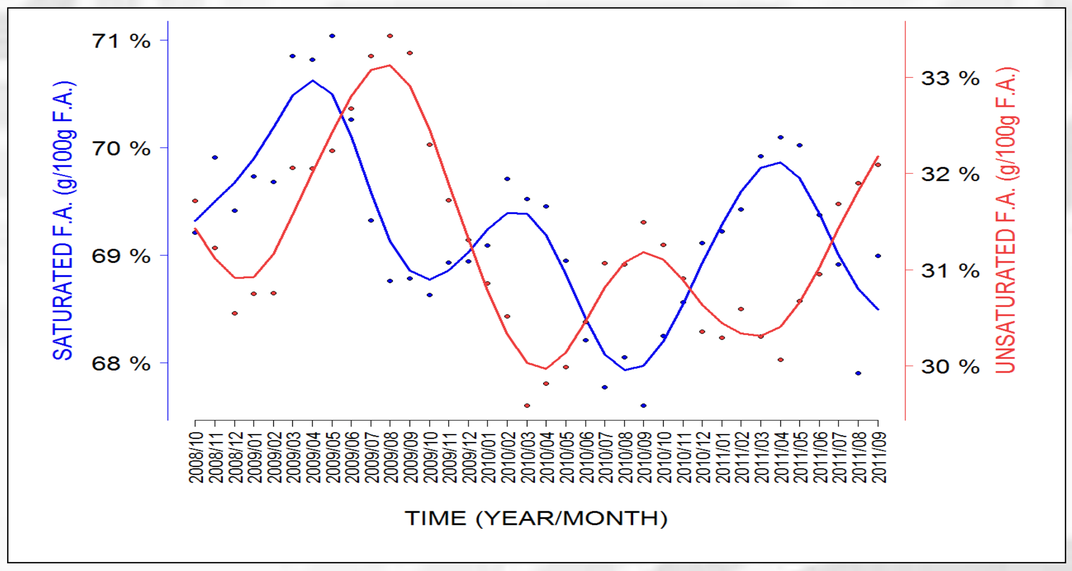
TABLE 2	Fat	Saturated F.A.	Unsaturated F.A.		
			total	MonUns.	PolyUns.
units	g/100g milk	g/100g F.A.	g/100g F.A.	g/100g F.A.	g/100g F.A.
median	3.7864	0.6928	0.3117	0.2758	0.0373
mean	3.7930	0.6922	0.3127	0.2762	0.0373
S.D.	0.2682	0.0240	0.0232	0.0207	0.0039
C.V.	7.1%	3.5%	7.4%	7.5%	10.5%



Graphic 1. Total Fat and Fatty Acids distribution (herd mean value).



Graphic 2. Relationship between Saturated-Usaturated F.A. and Total Fat level (herd mean value).



Graphic 3.Trend of monthly means of Saturated and Unsaturated F.A. over 3 years (2008-2011)

CONCLUSIONS

The estimated precision and accuracy of fatty acids profile by Fourier Transform Infrared Spectroscopy (FTIR) of fat agree with previous studies and instrumental performances specification.
Both Fat and Fatty Acids show a normal distribution, calculated as herd mean value (graphic 1).
An increasing of Saturated F.A. and a decreasing of Unsaturated F.A. were observed moving towards high values of total Fat, calculated as herd mean value over 36 months (graphic 2).
The highest level of Unsaturated F.A. and the lowest values of Saturated F.A. were detected in summer time, showing a seasonal opposite trend along the year (graphic 3) .
In the next future it will be of interest to evaluate the relationship between the cattle feeding and the fatty acids composition in the milk and dairy products. FTIR spectrometry is a useful screening tool to determine the fatty acids mean in bulk tank milk.