Rapid Total Solids & Fat in Cream

Introduction

Cream is important in the global dairy industry as both a finished product and as a raw ingredient for a variety of other consumer dairy products such as butter, ice cream, sour cream, coffee creamer, and many others. Produced most commonly by separating the butterfat from unhomogenized milk, it is categorized (graded) according to its butterfat content, which generally ranges from approximately 18 % for light cream to more than 36 % for heavy cream. As a result of the high value of butterfat, accurate fat analysis is critical for dairy manufacturers processing cream. Solids analysis is also an important quality control metric as it strongly impacts texture, taste, grade, and overall quality.

The SMART 6™ – ORACLE™ is a combination system for rapid solids and fat determination, coupling dual-frequency drying (iPower) in the SMART 6 with advanced NMR technology in the ORACLE. Dual-frequency drying in the SMART 6 allows for rapid and precise solids determination in both powdered and liquid cream samples. The ORACLE is a rapid time-domain NMR (TD-NMR) instrument incorporating breakthrough technology that allows for direct determination of fat in food products. By completely isolating the detection of fat even in complex sample matrices, the ORACLE eliminates the need for method development. Together, the paired system delivers rapid, accurate, and precise total solids and fat in cream.

To demonstrate the ability of the SMART 6 – ORACLE to determine the solids and fat content in cream, an assortment of 11 different cream samples (including two Certified Reference Materials) were obtained and analyzed.

Key System Benefits

- **No Method Development**: every system ships with single pre-installed method

- **Rapid**: less than 5 minute analysis

- **Accurate**: extensively validated with CRMs (certified reference materials) for several dairy matrices, including liquid and powdered cream

- **Precise**: better repeatability than wet chemical extraction techniques

- **Stable**: no recalibration or calibration maintenance

- **AOAC Approved Methodology**: AOAC PVM 1:2004 for coupled SMART solids analysis with TD-NMR fat analysis in dairy products

Samples

Nine different light and heavy cream samples were commercially obtained and outsourced to an accredited laboratory for solids (Oven drying, AOAC 990.20[i]) and fat (Roese-Gottlieb, AOAC 920.111[ii]) reference testing (each in duplicate). In addition, two CRM cream samples (MP-0211 and R-0434) were obtained from Muva Kempten (Kempten, Germany).

Certified Reference Materials (CRMs) are food samples which have undergone extensive component testing (using accredited wet chemistry reference methods) as part of multi-lab collaborative studies. In general, CRM samples are submitted to more than 10 accredited laboratories, which are chosen on the basis of prior results exhibiting their proficiency for testing a given sample matrix. This makes CRM's ideal for assessing the accuracy and precision of methods for component analysis. They are commercially available from several vendors (including Muva Kempten, NIST, Actalia Cecalait, LGC, ERM, and others).

Sample Preparation and Analysis

Liquid cream samples were analyzed after equilibrating to room temperature.[iii] Each cream aliquot was slowly and gently inverted 5 – 10 times (avoid shaking, as this can result in agglomeration of fat) to ensure proper mixing prior to analysis.

Samples were dried in the SMART 6, then prepared and inserted into the ORACLE for fat analysis. Each outsourced cream sample was analyzed in triplicate.

Note: For best results, cream samples (particularly unhomogenized cream) should be obtained and analyzed as closely as possible to the production date. If significant amounts of solids are visible in the sample container, it may be difficult to obtain a representative sample (even after tempering).

Results

The accuracy and precision of the ORACLE for both liquid and powdered cream CRM (certified reference materials) samples is demonstrated in **Table 1**, where the average of 5 ORACLE replicates are compared with certified values. The differences between the ORACLE and the certified values are within the uncertainties (Std. Dev.) of the certified values, indicating the reliability of the ORACLE for determining the fat content in both sample types.

Table 1. Certified Reference Materials (CRMs) on ORACLE

Sample	Certified Value (%)		ORACLE (%)		
	Average	StDev	Average	StDev	Difference
Cream Powder (Muva MP-0211)	42.18	0.34	42.31	0.03	0.13
Cream (Muva R-0434)	37.79	0.11	37.68	0.03	0.11

The accuracy and precision of the SMART 6 – ORACLE for the outsourced cream samples are shown in Tables 2 and 3. As shown in **Table 2**, the difference between the SMART 6 and the Oven results ranged from 0 – 0.12 % solids, while the difference between the ORACLE and the Roese-Gottlieb results ranged from 0 – 0.10 % fat. As shown in **Table 3**, the standard deviations ranged from 0.01 – 0.15 % solids for the SMART 6 and from 0.01 – 0.08 % fat for the ORACLE. These results indicate the SMART 6 – ORACLE is able to reliably match existing reference chemistry results for a wide range (ca. 9 – 44 % fat) of liquid cream samples.

Image 1. SMART 6 – ORACLE moisture/solids and fat system

Table 2. Accuracy of SMART 6 – ORACLE

Sample	% Solids			% Fat		
	SMART 6	Oven	Difference	ORACLE	Roese-Gottlieb	Difference
Light Cream 1	17.75	17.79	0.04	9.35	9.39	0.04
Light Cream 2	18.56	18.60	0.04	10.45	10.46	0.01
Light Cream 3	21.54	21.49	0.05	13.43	13.49	0.06
Light Cream 4	25.39	25.34	0.05	17.97	17.92	0.05
Light Cream 5	26.69	26.57	0.12	19.02	19.02	0.00
Heavy Cream 1	37.17	37.12	0.05	30.66	30.73	0.07
Heavy Cream 2	43.20	43.13	0.07	37.31	37.32	0.01
Heavy Cream 3	47.89	47.89	0.00	42.48	42.53	0.05
Heavy Cream 4	49.22	49.21	0.01	44.09	43.99	0.10
		Average	0.05		Average	0.04

Table 3. Precision of SMART 6 – ORACLE

Sample	Component	Replicates (%)			Average	Range	StDev
		1	2	3			
Light Cream 1	Solids	17.74	17.76	17.74	17.75	0.02	0.01
	Fat	9.35	9.36	9.35	9.35	0.01	0.01
Light Cream 2	Solids	18.56	18.58	18.54	18.56	0.04	0.02
	Fat	10.45	10.46	10.45	10.45	0.01	0.01
Light Cream 3	Solids	21.52	21.52	21.57	21.54	0.05	0.03
	Fat	13.43	13.44	13.42	13.43	0.02	0.01
Light Cream 4	Solids	25.34	25.39	25.43	25.39	0.09	0.05
	Fat	18.02	17.98	17.91	17.97	0.11	0.06
Light Cream 5	Solids	26.58	26.74	26.75	26.69	0.17	0.10
	Fat	19.01	19.00	19.05	19.02	0.05	0.03
Heavy Cream 1	Solids	37.14	37.19	37.19	37.17	0.05	0.03
	Fat	30.75	30.60	30.64	30.66	0.15	0.08
Heavy Cream 2	Solids	43.10	43.20	43.30	43.20	0.20	0.10
	Fat	37.23	37.33	37.37	37.31	0.14	0.07
Heavy Cream 3	Solids	47.87	47.87	47.93	47.89	0.06	0.03
	Fat	42.41	42.56	42.48	42.48	0.15	0.08
Heavy Cream 4	Solids	49.38	49.10	49.17	49.22	0.28	0.15
	Fat	44.13	44.02	44.12	44.09	0.11	0.06

i.   AOAC Official Methods of Analysis, 990.20.
ii. AOAC Official Methods of Analysis, 920.111.
iii. If deemed necessary (e.g. solids observed), cream should be tempered in a water bath at 38 ± 1°C according to AOAC Official Method of Analysis 995.19 ("Fat in Cream").