Process Control for Fat Content in Butter and Margarine Products

Introduction

Over the last several years consumer perceptions have shifted, leading to significantly greater demand for butter, cream, and other commodities rich in butterfat. Now, more than ever, consumers are willing to pay a premium for products with more butterfat, which are viewed as being high-end. Traditionally, fat testing for butter and margarine products has been performed using gravimetric extraction, which is time consuming, demands skilled technicians, and requires hazardous solvents. Various rapid techniques (TD-NMR, NIR, FT-IR, and FT-NIR) have been introduced, each with their own shortcomings due to the need for extensive calibration development and maintenance.

The ORACLE™ is a rapid time domain NMR (TD-NMR) instrument incorporating proprietary technology that allows for direct determination of fat in any dairy sample. Unlike other rapid techniques, the ORACLE is able to completely isolate the detection of fat in complex matrices, eliminating the need for calibration. To achieve both rapid moisture and fat testing, the ORACLE can be coupled with a SMART 6™ moisture/solids analyzer.

To demonstrate the ability of the SMART 6 and ORACLE to accurately and reliably determine the fat and moisture content in butter and margarine samples, an assortment of 5 samples were obtained and analyzed. The samples were selected to represent a range of both matrix types as well as relative fat concentrations.

Key System Benefits of SMART 6 with ORACLE

- Direct technique, requiring no calibration
- Rapid analysis (less than 5 minutes for moisture and fat)
- Bulk measurement (insensitive to color and texture)
- Better repeatability than reference methods

Experimental

Each sample was pre-dried on the SMART 6 for approximately 3 minutes and then prepared for analysis in the ORACLE. Once inserted into the ORACLE magnet, the samples underwent a 35-second scan for NMR analysis. Altogether, the time required to obtain moisture and fat results was between 4 and 5 minutes. Sample sizes ranged from 2–3 grams. Each sample was analyzed in duplicate for the reference analyses (AOAC approved methods) and in triplicate for the SMART 6 and ORACLE analyses.

Note: High-throughput fat analyses can be enabled through the use of batch automation using an optional robot and high capacity heater blocks (100 positions each).

Results and Discussion

The accuracy of the SMART 6 and ORACLE results is demonstrated in **Table 1**, where the average reference results are compared with the average of the SMART 6 and ORACLE results. The average difference ranged from 0.04–0.14% for moisture, and from 0.00–0.08% for fat. Repeatability is shown in **Table 2**, where the standard deviations ranged from 0.09–0.14% for moisture, and from 0.03 – 0.16% for fat.

Table 1: Accuracy of the SMART 6 and ORACLE for Moisture and Fat in Various Butter and Margarine Samples

	Moisture			Fat		
Sample	**SMART 6**	**Oven**	**Difference**	**ORACLE**	**Reference**	**Difference**
Unsalted Butter	17.81	17.87	0.06	80.9	80.8	-0.1
Salted Butter	16.66	16.52	-0.14	80.32	80.32	0.00
Margarine	15.73	15.69	-0.04	82.21	82.26	0.05
Light Margarine	56.65	56.61	-0.04	37.87	37.95	0.08

Table 2: Repeatability of the SMART 6 and ORACLE for Moisture and Fat in Various Butter and Margarine Samples

		Replicates				
Sample	**Component**	**1**	**2**	**3**	**Average**	**Std. Dev.**
Unsalted Butter	Moisture	17.82	17.71	17.89	17.81	0.09
	Fat	80.87	80.92	80.91	80.90	0.03
Salted Butter	Moisture	16.68	16.76	16.53	16.66	0.12
	Fat	80.34	80.33	80.28	80.32	0.03
Margarine	Moisture	15.64	15.66	15.90	15.73	0.14
	Fat	81.33	81.21	81.10	81.21	0.12
Light Margarine	Moisture	56.66	56.73	56.55	56.65	0.09
	Fat	37.76	37.80	38.06	37.87	0.16

Conclusion

These results demonstrate the ability of the SMART 6 and ORACLE to reliably determine the moisture and fat content in dairy samples with an accuracy closely matching that of the reference methods. In addition, there are inherent repeatability advantages over wet chemistry reference methods, which are error prone due to a strong dependence on a range of experimental factors (e.g. extraction time, solvent composition, temperature, etc.).

United States (Headquarters)
800-726-3331
704-821-7015
Fax: 704-821-7894
info@cem.com

France
33 (01) 69 35 57 80
Fax: 33 (01) 60 19 64 91
info.fr@cem.com

Germany, Austria, Switzerland
(49) 2842-9644-0
Fax: (49) 2842-9644-11
info@cem.de

Ireland
+353 (0) 1 885 1752
Fax: +353 (0) 1 885 1601
info.ireland@cem.com

Italy
(39) 35-896224
Fax: (39) 35-891661
info.srl@cem.com

Japan
+81-3-5793-8542
Fax: +81-3-5793-8543
info@cemjapan.co.jp

United Kingdom
(44) 1280-822873
Fax: (44) 1280-822873
info.uk@cem.com

www.cem.com