Protein, Fat, and Total Solids Analysis of Cultured Dairy Beverages

Introduction

Cultured dairy products have seen a strong resurgence over the last decade, which started with an increase in popularity of Greek yogurt. Greek yogurt is high in protein and is generally perceived as a very healthy food. As the popularity in cultured dairy products continues to evolve, the demand for Kefir and other dairy-based beverages has grown significantly in the last few years. Kefir is a cultured dairy beverage that is high in protein and is easy to consume on-the-go. High and low fat options are available with fruit flavors being the most popular. Traditionally, fat testing for cultured dairy 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. Protein determination has traditionally been accomplished with Kjeldahl titration, which is similarly time-consuming, requires hazardous chemicals, and is an indirect method that equates total nitrogen with protein levels.

The Sprint™ is a dye-binding technique that measures proteins directly instead of total nitrogen, avoiding error due to the presence of nitrogen in flavorings or additives. 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/solids and fat testing, the ORACLE can be coupled with a SMART 6™ moisture/solids analyzer.

To demonstrate the ability of the Sprint, ORACLE, and SMART 6 to accurately and reliably determine the protein, fat and total solids in cultured dairy samples, an assortment of five samples were obtained and analyzed. The samples were selected to represent a range of protein and fat concentrations.

Experimental

For protein analysis, 1 g of sample was placed in the Sprint inside a sample cup, mixed with dye, and measured for absorbance. For fat and total solids determination, each sample was pre-dried on the SMART 6 for approximately 3 min and then prepared for analysis in the ORACLE. Once inserted into the ORACLE magnet, the samples underwent a 35 s scan for NMR analysis. Altogether, the time required to obtain protein results was four minutes. The time required to obtain moisture and fat results was between four and five minutes. Sample sizes ranged from 2–3 g. Each sample was analyzed in duplicate for the reference analyses (AOAC approved methods) and in triplicate for the Sprint, ORACLE, and SMART 6 and analyses.

Results and Discussion

The accuracy of the Sprint, ORACLE, and SMART 6 results are demonstrated in **Table 1**, where the average reference results are compared with the average rapid results. The average difference ranged from 0.02-0.06% for protein, 0.03-0.13% for fat, and 0.02-0.16% for total solids. Precision of the Sprint, ORACLE and SMART 6 is shown in **Table 2**, where the standard deviations were 0.01 for all protein samples. The standard deviation ranged from 0.01–0.07% for fat, and 0.01–0.11% for total solids.

Table 1: Accuracy of the Sprint for Protein, ORACLE for Fat, and SMART 6 for Solids in Various Kefir Samples

	% Protein			% Fat			% Total Solids		
Sample	**Sprint**	**Kjeldahl**	**Difference**	**ORACLE**	**Mojonnier**	**Difference**	**SMART 6**	**Air Oven**	**Difference**
Lowfat Plain Kefir	3.02	3.06	0.04	1.23	1.26	0.03	9.35	9.33	0.02
Lowfat Strawberry Kefir	2.44	2.46	0.02	1.03	0.93	0.10	14.89	14.73	0.16
Blueberry Kefir	2.92	2.86	0.06	3.65	3.78	0.13	11.67	11.65	0.02
Plain Kefir	2.39	2.40	0.01	2.88	2.99	0.11	16.66	16.69	0.03

Table 2: Precision of the Sprint for Protein, ORACLE for Fat, and SMART 6 for Solids in Various Kefir Samples

Sample	**Component**	**1**	**2**	**3**	**Average**	**Range**	**Standard Deviation**
Lowfat Plain Kefir	Fat	1.17	1.21	1.30	1.23	0.13	0.07
	Total Solids	9.34	9.36	9.34	9.35	0.02	0.01
	Protein	3.01	3.03	3.01	3.02	0.02	0.01
Lowfat Strawberry Kefir	Fat	1.02	1.02	1.04	1.03	0.02	0.01
	Moisture	14.87	14.89	14.92	14.89	0.05	0.03
	Protein	2.43	2.45	2.44	2.44	0.02	0.01
Blueberry Kefir	Fat	3.68	3.62	3.65	3.65	0.06	0.03
	Total Solids	11.55	11.68	11.77	11.67	0.22	0.11
	Protein	2.93	2.91	2.92	2.92	0.02	0.01
Plain Kefir	Fat	2.93	2.85	2.86	2.88	0.08	0.04
	Total Solids	16.67	16.62	16.68	16.66	0.06	0.03
	Protein	2.39	2.41	2.39	2.40	0.02	0.01

Conclusion

These results demonstrate the ability of the Sprint, ORACLE, and SMART 6 to reliably determine the protein, fat and total solids content in cultured 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.).

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