

Moisture, Fat, and Protein Analysis for Non-dairy Products



Summary

CEM has been a pioneer in moisture analysis for over 40 years, working with companies large and small to develop better processes for improved product quality. In this application note, we show the benefits of accurate moisture, fat, and protein analysis of dairy alternatives, which do not always conform to traditional test methods. Having the right moisture, fat, and protein levels means translates into high-quality products that are safe, flavorful, and long-lasting.

Introduction

The demand for vegan, vegetarian, and clean label foods has undergone unprecedented growth in recent years. With ever-increasing focus on sustainability and health, the dairy alternative market in particular is expected to continue to grow for years to come. With new ingredients being regularly introduced, traditional dairy tests are not always the best option for accuracy, particularly for fat and protein, which are typically unique to the food source. One test that effects all food products is moisture. If moisture levels are too high in ingredients or final products, the shelf life will be significantly diminished. Careful control of moisture, fat, and protein levels in dairy alternatives ensures least-cost formulation that maintains high-quality and good consistency.

The SMART 6™ with ORACLE™ is a combination system for rapid moisture and fat determination, with results in less than five minutes. The SMART 6 moisture and solids analyzer utilizes dual-frequency energy to rapidly analyze any product, wet or dry, in three minutes or less. ORACLE eliminates the need for method development by completely isolating the signal from fat molecules, even in complex sample matrices. Sprint® is a direct protein measurement system, which utilizes dye-binding technology to

ensure only true protein is detected, not total nitrogen, which can result in erroneous measurements when non-protein nitrogen is present. Sprint does not require regular calibrations, and methods are easy for any lab user to create. Competitive, rapid technologies (NIR, FT-IR, TD-NMR) require ongoing, expensive calibrations and method development for each unique sample due to variations in color, texture, and consistency.

This study demonstrates that CEM's innovative technology can rapidly analyze a wide range of dairy alternatives for moisture, fat, and protein with accuracy and precision that matches reference methods.

Experimental

To evaluate the performance of the SMART 6, ORACLE and Sprint, more than 30 dairy alternative products were obtained. For moisture determination, a 2 gram sample of each product was analyzed in the SMART 6. Reference testing was performed in an air oven in triplicate to establish a basis of comparison. The air-oven method was set for eight hours at 100 °C, followed by a cooling period under desiccation to ensure complete drying. For fat analysis, the dried samples were removed from the SMART 6, placed in the ORACLE and scanned for 30 seconds, with no need for calibration or method development. Fat reference testing was performed using the Mojonnier method. For protein analysis, 1 gram samples were weighed into a Sprint sample cup and placed into the Sprint unit. The dye-binding reaction is completely automated and takes approximately four minutes to complete. Protein results were compared to Kjeldahl digestion.

Results

The average results for moisture, fat, and protein using CEM's rapid technology compared closely to reference results, as illustrated in **Table 1**, **Table 2**, and **Table 3**. Standard deviations for moisture, fat, and protein were all lower for CEM technology compared to reference chemistry. For fat, the average difference between Mojonnier and ORACLE was 0.01%. For moisture, the average difference between SMART 6 and the air oven was 0.02%. For protein, the average difference between Sprint and Kjeldahl was 0.02%.

Table 1. Comparison of Fat Content Between ORACLE and Reference Chemistry for Non-Dairy Products

Sample ID	Mojonnier	ORACLE	Difference	%RSD
Nectar	1.85	1.94	0.09	4.86%
Crème Anglaise	3.49	3.30	-0.19	-5.44%
Milked Cashews	3.33	3.33	0.00	0.00%
Milked Walnuts	4.55	4.39	-0.16	-3.52%
Milked Almonds	3.90	3.92	0.02	0.51%
Soy Vanilla	1.68	1.64	-0.04	-2.38%
Soy Original	1.61	1.62	0.01	0.62%
Soy Chocolate	2.32	2.33	0.01	0.43%
DHA Choc	1.03	1.13	0.10	9.71%
Peanut Crème	29.51	29.53	0.02	0.07%
Chickpea Powder	20.58	20.41	-0.17	-0.83%
Rice Powder	3.63	3.81	0.18	4.96%
Whole Grain Powder	7.62	7.56	-0.06	-0.79%
Almond Greek Yogurt	6.00	5.96	-0.04	-0.67%
Almond Van Gr Yogurt	6.24	6.34	0.10	1.60%
Almond Coconut Gr Yog	6.22	6.40	0.18	2.89%
Almond Berry Gr Yog	6.52	6.44	-0.08	-1.23%
Soy Oil Sour Cream	16.97	16.98	0.01	0.06%
Soy/Palm Sour Cream	17.33	17.30	-0.03	-0.17%
Palm Oil Sour Cream	16.79	16.90	0.11	0.66%
Plant Based Creamer A	8.38	8.21	-0.17	-2.03%
Plant Based Creamer B	7.25	7.14	-0.11	-1.52%
Plant Based Creamer C	6.53	6.39	-0.14	-2.14%
Plant Based Creamer D	5.36	5.37	0.01	0.19%
Plant Based Creamer E	4.98	4.90	-0.08	-1.61%
Vegan Cream Cheese 1	24.85	24.90	0.05	0.20%
Vegan Cream Cheese 2	25.12	25.14	0.02	0.08%
Vegan Cream Cheese 3	25.11	25.13	0.02	0.08%
Non-Dairy Cheese Slices	23.31	23.22	-0.09	-0.39%
Non-Dairy Cheese Slices	22.66	22.57	-0.09	-0.40%
Coconut Ice Cream	16.72	16.69	-0.03	-0.18%
Soybean Lecithin	91.68	91.81	0.13	0.14%
		Average	-0.01	0.12%

Table 2. Comparison of Moisture Content Between SMART 6 and Air Oven

Sample ID	Air Oven	SMART 6	Difference	%RSD
Nectar	13.50	13.49	-0.01	-0.07%
Crème Anglaise	18.03	18.20	0.17	0.94%
Milked Cashews	8.70	8.71	0.01	0.11%
Milked Walnuts	7.90	7.68	-0.22	-2.78%
Milked Almonds	9.52	9.38	-0.14	-1.47%
Soy Vanilla	11.01	10.93	-0.08	-0.73%
Soy Original	7.34	7.23	-0.11	-1.50%
Soy Chocolate	15.44	15.42	-0.02	-0.13%
DHA Chocolate	13.93	13.89	-0.04	-0.29%
Peanut Crème	32.97	32.77	-0.20	-0.61%
Chickpea Powder	4.41	4.66	0.25	5.67%
Rice Powder	3.70	3.97	0.27	7.30%
Whole Grain Powder	4.45	4.78	0.33	7.42%
Almond Greek Yogurt	24.39	24.29	-0.10	-0.41%
Almond Van Gr Yogurt	26.29	26.49	0.20	0.76%
Almond Coconut Gr Yog	26.10	25.92	-0.18	-0.69%
Almond Berry Gr Yog	25.99	26.08	0.09	0.35%
Soy Oil Sour Cream	29.31	29.32	0.01	0.03%
Soy/Palm Sour Cream	28.46	28.48	0.02	0.07%
Palm Oil Sour Cream	30.06	29.99	-0.07	-0.23%
Plant Based Creamer A	41.85	41.84	-0.01	-0.02%
Plant Based Creamer B	39.87	40.01	0.14	0.35%
Plant Based Creamer C	39.05	39.30	0.25	0.64%
Plant Based Creamer D	38.04	38.05	0.01	0.03%
Plant Based Creamer E	37.43	37.58	0.15	0.40%
Vegan Cream Cheese 1	65.39	65.73	0.34	0.52%
Vegan Cream Cheese 2	65.42	65.60	0.18	0.28%
Vegan Cream Cheese 3	65.81	65.43	-0.38	-0.58%
Non-Dairy Cheese Slices	52.31	52.18	-0.13	-0.25%
Non-Dairy Cheese Slices	50.69	50.60	-0.09	-0.18%
Coconut Ice Cream	32.97	32.99	0.02	0.06%
Soybean Lecithin	0.07	0.06	-0.01	-14.29%
		Average	0.02	0.02%

Table 3. Comparison of Protein Content Between Sprint and Kjeldahl

Sample ID	Kjeldahl	Sprint	Difference	%RSD
Oat Syrup	1.62	1.61	-0.01	-0.62%
Oat Syrup	7.00	6.97	-0.03	-0.43%
Chickpea Flour	21.70	21.54	-0.16	-0.74%
Chickpea Flour	40.40	40.19	-0.21	-0.52%
Oat Flour	12.00	12.22	0.22	1.83%
Oat Flour	15.60	15.77	0.17	1.09%
Oatmeal Slurry	0.65	0.67	0.02	3.08%
Oatmeal Slurry	3.21	3.20	-0.01	-0.31%
Almond Milk	5.15	5.17	0.02	0.39%
Almond Milk	3.82	3.83	0.01	0.26%
Almond Ricotta	7.78	7.90	0.12	1.54%
Almond Meal	34.15	34.17	0.02	0.06%
Choc Soy Milk	5.64	5.70	0.06	1.06%
Choc Soy Milk	3.68	3.65	-0.03	-0.82%
Vanilla Soy Milk	6.23	6.24	0.01	0.16%
Soy Milk Conc	6.45	6.43	-0.02	-0.31%
Mango Soy Milk	1.64	1.63	-0.01	-0.61%
Raw Cashew	17.19	17.21	0.02	0.12%
Raw Soybean	31.51	31.61	0.10	0.32%
Soy Isolates	85.46	85.49	0.03	0.04%
Firm Tofu	7.54	7.60	0.06	0.80%
Chick Peas	11.11	11.16	0.05	0.45%
Oat Drink	0.17	0.18	0.01	5.88%
Oat Base	2.74	2.78	0.04	1.46%
Oat Yogurt	9.95	9.93	-0.02	-0.20%
Oat Yogurt	4.90	4.94	0.04	0.82%
Oat Grains	14.59	14.64	0.05	0.34%
Grain Waste	4.08	4.09	0.01	0.25%
Peach Grain Yog	1.68	1.68	0.00	0.00%
Grain Van Drink	0.63	0.65	0.02	3.17%
Grain Choc Drink	0.82	0.80	-0.02	-2.44%
	Average		0.02	0.52%

Conclusion

For dairy alternatives where moisture, protein, and fat levels are formulated to match flavor and texture profiles of traditional dairy products, CEM offers rapid testing options with results that match reference methods. CEM's combination of proprietary and patented technology translates into some of the fastest and most accurate food composition tests on the market. With short test times and accurate results, the SMART 6, ORACLE, and Sprint analyzers save time, improve least-cost formulation, and ultimately save money.

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