Analysis of Moisture and Fat in Dry Dog Food Using the *FAST* Trac

Introduction

Time Domain NMR (TD-NMR) is a technology ideally suited for the measurement of moisture and fat (oil) in dry pet food. This technology works by exploiting the differences in NMR relaxation rates between solids and bound moisture (rapid relaxation) and oil (slow relaxation). Because moisture is tightly bound in dry pet food, the signal due to moisture can be readily distinguished from the signal due to fat.

Unlike other rapid methods, NMR obtains a signal from the entire sample (not just the surface), which ensures representative sampling and the most accurate results.

Calibration is quick, easy, and highly robust. Calibration is done through simple linear regressions (no multivariate techniques required) and only a handful of samples are needed to create new calibrations. Calibrations are insensitive to additives, and are not affected by sample granularity or color.

FAST Trac

The *FAST* Trac is a newly developed product from CEM that features the ability for rapid testing (less than 2 minutes) in a small footprint and with an easy-to-use touch screen interface. With intuitive software, the instrument is remarkably easy to operate…you don't have to be experienced in chemometrics or spectroscopy to obtain accurate and reliable results.

**Heater block and external balance not shown.

Key Features and Benefits:

- 2-minute analyses using new QuikPrep™ Technology (Patent Pending) for rapid sample conditioning
- IFM™ Technology (Interference-free moisture) for reliable moisture determinations regardless of fat concentration
- More accurate and robust than NIR
- Accuracy comparable to standard methods
- Calibrations are simple to create, and are insensitive to additives, sample color, and granularity
- Intuitive software and easy-to-use touch screen interface

Method Development

To demonstrate the potential of the *FAST* Trac for the analysis of dry dog food, moisture and fat methods were created using the traditional conditioning approach, as well as a newly developed rapid-conditioning approach, known as QuikPrep™. Reference values were obtained using standard methods (acid hydrolysis and oven drying). From a total of 18 samples (three different pet food producers), 6 samples were used as calibration samples (3 samples to span the fat range and 3 samples to span the moisture range). Each sample was prepared and analyzed 5 times to ensure a representative result. The calibration curves are shown in Figures 1 – 4.

To complete each analysis, samples (ground into a powder) were weighed on a glass fiber pad, rolled up in Trac film, and inserted in a Trac tube. Samples were then conditioned using either the rapid approach (QuikPrep™) or the traditional conditioning approach. For dog food samples, QuikPrep™ conditioning is complete within 45 seconds. For the traditional conditioning approach, the samples were placed on a heater block set at 40 °C for 1 hour prior to being placed into the magnet. Once inserted into the magnet, analysis is complete within 1 minute.

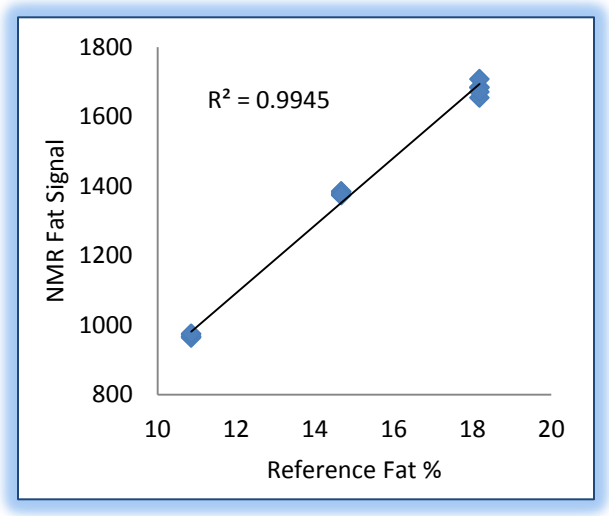

Figure 1: Fat calibration curve using QuikPrep™ Technology

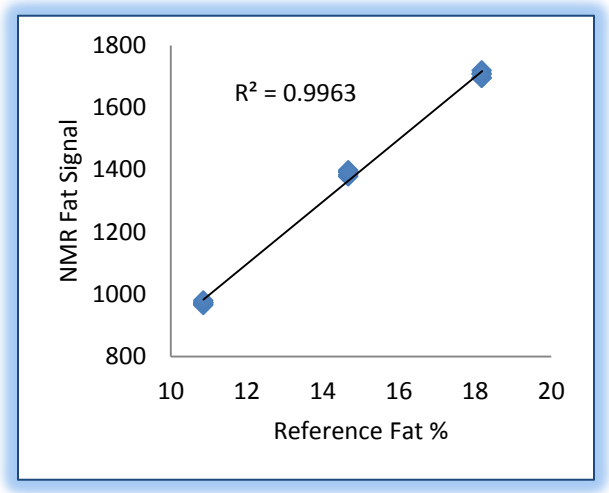

Figure 2: Fat calibration curve using traditional conditioning

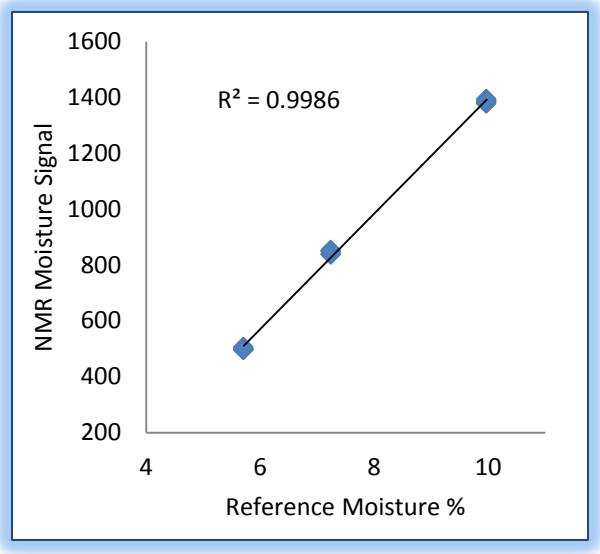

Figure 3: Moisture calibration curve using QuikPrep™ and IFM™ Technology

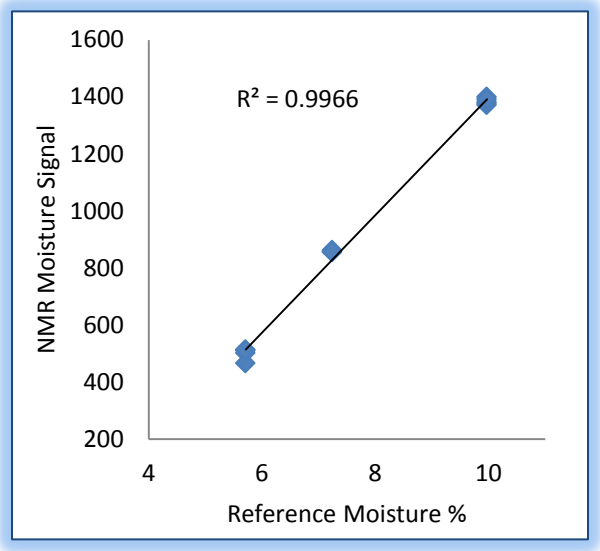

Figure 4: Moisture calibration curve using traditional conditioning approach.

Results

To illustrate the accuracy obtainable using a method created with only 3 reference points, the remaining 15 samples were run on each of the methods. The overall accuracies for 15 samples (5 replicates each) are shown in Table 1, below. While the overall fat error is slightly improved using traditional conditioning, the overall moisture error is nearly identical for both conditioning approaches. The accuracy and repeatability for each sample are shown in Tables 2 – 5.

Table 1: Accuracy Comparison

Method	Avg. Moisture Error (%)	Avg. Fat Error (%)
QuikPrep™	0.19	0.46
Traditional Conditioning	0.22	0.37

These results show that the *FAST* Trac is able to analyze dry dog food samples with high accuracy and precision using methods created with only three reference points. In addition, these results suggest that QuikPrep™ methods would be expected to produce accuracies and repeatabilities very similar to methods created using traditional conditioning.

Table 2: QuikPrep™ Moisture Method Results

Sample	Ref. Moist. %	Repeats 1	2	3	4	5	Average NMR Moist. %	Std. Dev.	Error %
Producer 1									
Duck 1	7.24	---------- Calibration Sample ----------							
Duck 2	6.82	7.20	7.22	7.17	7.26	7.19	7.21	0.03	0.39
Duck 3	7.09	7.23	7.25	7.24	7.23	7.19	7.23	0.02	0.14
Adult 1	6.75	6.82	6.83	6.86	6.83	6.85	6.84	0.02	0.09
Adult 2	6.15	6.44	6.46	6.45	6.47	6.48	6.46	0.02	0.31
Adult 3	6.90	6.65	6.80	6.86	6.82	6.83	6.79	0.08	0.11
Senior 1	6.59	6.88	6.93	6.91	6.88	6.90	6.90	0.02	0.31
Senior 2	6.42	6.77	6.84	6.55	6.67	6.74	6.71	0.11	0.29
Chicken 1	6.97	7.18	7.22	7.16	7.17	--	7.18	0.03	0.21
Chicken 2	7.09	7.20	7.19	7.14	7.18	7.18	7.18	0.02	0.09
Chicken 3	6.33	6.56	6.65	6.70	6.72	6.70	6.67	0.06	0.34
Producer 2									
Puppy	5.71	---------- Calibration Sample ----------							
Natural 1	6.37	6.57	6.57	6.55	6.55	6.53	6.55	0.01	0.18
Natural 2	6.99	7.01	6.99	7.00	7.05	6.99	7.01	0.02	0.02
Lamb	6.63	6.54	6.55	6.56	6.51	6.52	6.54	0.02	0.09
Adult	6.90	6.90	6.88	6.89	6.87	6.89	6.89	0.01	0.01
Producer 3									
Adult	9.97	---------- Calibration Sample ----------							
Puppy	8.53	8.66	8.80	8.70	8.68	8.90	8.75	0.10	0.22
								Average =	**0.19**

Table 3: Moisture Method Results Using Traditional Conditioning

Sample	Ref. Moist. %	Repeats 1	2	3	4	5	Average NMR Moist. %	Std. Dev.	Error %
Producer 1									
Duck 1	7.24	---------- Calibration Sample ----------							
Duck 2	6.82	7.28	7.29	7.27	7.28	7.29	7.28	0.01	0.46
Duck 3	7.09	7.27	7.29	7.27	7.28	7.31	7.28	0.02	0.19
Adult 1	6.75	6.80	6.91	6.85	6.86	6.83	6.85	0.04	0.10
Adult 2	6.15	6.53	6.56	6.35	6.52	6.48	6.49	0.08	0.34
Adult 3	6.90	6.88	6.84	6.84	6.84	6.90	6.86	0.03	0.04
Senior 1	6.59	6.92	6.91	6.94	6.92	6.93	6.92	0.01	0.33
Senior 2	6.42	6.89	6.89	6.88	6.85	6.84	6.87	0.03	0.45
Chicken 1	6.97	7.23	7.18	7.21	7.23	7.21	7.21	0.02	0.24
Chicken 2	7.09	7.22	7.20	7.20	7.23	7.20	7.21	0.02	0.12
Chicken 3	6.33	6.81	6.78	6.70	6.69	6.72	6.74	0.05	0.41
Producer 2									
Puppy	5.71	---------- Calibration Sample ----------							
Natural 1	6.37	6.59	6.55	6.55	6.52	6.55	6.55	0.02	0.18
Natural 2	6.99	7.03	7.01	7.02	7.07	6.99	7.02	0.03	0.03
Lamb	6.63	6.49	6.63	6.55	6.54	6.53	6.55	0.05	0.08
Adult	6.90	6.92	6.96	6.93	6.93	6.93	6.93	0.02	0.03
Producer 3									
Adult	9.97	---------- Calibration Sample ----------							
Puppy	8.53	8.69	8.77	8.88	8.74	8.73	8.76	0.07	0.23
							Average =		**0.22**

Table 4: QuikPrep™ Fat Method Results

Sample	Ref. Fat %	Repeats 1	2	3	4	5	Average NMR Fat %	Std. Dev.	Error %
Producer 1									
Duck 1	15.23	16.08	16.06	15.89	16.01	15.91	15.99	0.09	0.76
Duck 2	15.73	15.96	15.94	15.99	16.06	16.00	15.99	0.05	0.26
Duck 3	15.84	16.33	16.36	16.24	16.34	16.35	16.32	0.05	0.48
Adult 1	14.67	---------- Calibration Sample ----------							
Adult 2	15.27	15.80	15.66	15.72	15.58	15.64	15.68	0.08	0.41
Adult 3	14.89	15.17	15.32	15.19	15.10	15.24	15.20	0.08	0.31
Senior 1	11.97	12.50	12.39	12.44	12.51	12.56	12.48	0.06	0.51
Senior 2	12.23	12.69	12.62	12.58	12.70	12.69	12.66	0.05	0.43
Chicken 1	16.07	16.69	16.46	16.72	16.86	--	16.68	0.17	0.61
Chicken 2	15.84	16.26	16.43	16.21	16.29	16.33	16.30	0.08	0.46
Chicken 3	15.91	16.64	16.60	16.61	16.58	16.56	16.60	0.03	0.69
Producer 2									
Puppy	16.83	17.14	17.20	17.11	17.03	17.19	17.14	0.07	0.30
Natural 1	15.47	16.11	16.07	16.14	16.12	16.60	16.21	0.22	0.74
Natural 2	15.83	15.52	15.65	15.82	15.70	15.66	15.67	0.11	0.16
Lamb	11.50	11.97	12.07	11.89	12.42	11.91	12.05	0.21	0.55
Adult	10.86	---------- Calibration Sample ----------							
Producer 3									
Adult	12.80	12.64	12.53	12.42	12.66	12.65	12.58	0.10	0.22
Puppy	18.18	---------- Calibration Sample ----------							
							Average =		**0.46**

Table 5: Fat Method Results Using Traditional Conditioning

Sample	Ref. Fat %	Repeats 1	2	3	4	5	Average NMR Fat %	Std. Dev.	Error %
Producer 1									
Duck 1	15.23	15.67	15.77	15.79	15.84	--	15.77	0.07	0.54
Duck 2	15.73	15.73	15.86	15.80	15.90	15.86	15.83	0.07	0.10
Duck 3	15.84	16.19	16.17	16.31	16.22	16.19	16.22	0.06	0.38
Adult 1	14.67	---------- Calibration Sample ----------							
Adult 2	15.27	15.42	15.52	15.41	15.37	15.56	15.46	0.08	0.19
Adult 3	14.89	15.07	15.20	15.08	15.09	15.21	15.13	0.07	0.24
Senior 1	11.97	12.39	12.40	12.35	12.41	12.42	12.39	0.03	0.42
Senior 2	12.23	12.59	12.58	12.65	12.62	12.71	12.63	0.05	0.40
Chicken 1	16.07	16.48	16.61	16.68	16.73	16.62	16.62	0.09	0.55
Chicken 2	15.84	16.18	16.11	16.18	16.18	16.24	16.18	0.05	0.34
Chicken 3	15.91	16.37	16.45	16.50	16.60	16.62	16.51	0.10	0.60
Producer 2									
Puppy	16.83	16.89	16.91	16.91	16.91	16.91	16.91	0.01	0.08
Natural 1	15.47	15.97	16.11	16.09	16.20	16.22	16.12	0.10	0.65
Natural 2	15.83	15.91	15.60	15.74	15.72	16.12	15.82	0.20	0.16
Lamb	11.50	12.09	12.32	12.03	11.91	12.05	12.08	0.15	0.58
Adult	10.86	---------- Calibration Sample ----------							
Producer 3									
Adult	12.80	12.54	12.38	12.50	12.50	12.57	12.50	0.07	0.30
Puppy	18.18	---------- Calibration Sample ----------							
							Average =		**0.37**