Process Control for Pet Food Production

Introduction

The Pet Food industry is being subjected to increased regulation every year and is becoming one of the most competitive markets in the food industry. Every manufacturer needs to ensure the product they make is not only up to the expectation of the consumers, but economically viable so the product can be offered at a competitive price. Moisture, fat, and protein are three of the most important, and expensive, components of both wet and dry products. Whether testing protein of incoming meats, fat content in finished kibble, or water concentration of the flour additives, not having an accurate analysis of these ingredients will lower yields and cause a loss in revenue. The SMART 6™ and ORACLE™ are able to analyze both incoming raw meats and finished dry products for moisture/solids as well as fat, the Phoenix™ can analyze any sample for ash content, and the Sprint® Protein Analyzer can analyze any food product for true protein.

Key Benefits

- Approved AOAC Official Methodology
  - 2008.06
  - 2011.04
- Better repeatability than reference methods
- Direct techniques, requiring no calibration maintenance
- Not sensitive to color, texture, or consistency changes
- Easy and intuitive user interfaces to simplify analysis
- Data storage for quick reference and export

SMART 6 and ORACLE

With CEM's SMART 6 and ORACLE, moisture and fat are tested using NMR coupled with iPower® drying and iDri™ technology, which has been proven to be the most accurate rapid method available. By analyzing the entire sample on a molecular level, not just the surface, precise, real time results are ensured. Additionally, NMR never requires calibration, which not only removes the possibility of results that may drift, but saves time and money throughout the life of the instrument over typical NIR systems.

The ORACLE Universal Fat Analyzer in the first system that can accurately test fat content of any food product in 30 seconds with no method development, calibration, or sample validation. The ORACLE can achieve accuracy equal to standard extraction methods for any food product with no solvents. This mean results that are equal to reference extraction techniques, with better consistency and repeatability than NIR technologies can obtain. The ORACLE can test both liquid and powder products, and with no calibration maintenance or frequent validation necessary, the system can help save thousands of dollars a year in calibration costs.

The ORACLE is a major breakthrough in NMR technology developed by CEM that requires no method development. As accurate as reference techniques, the ORACLE completely isolates the detection of the proton signal in fat molecules from all other compositional proton sources (protein, carbohydrates, ash) for a complete determination of the fat content throughout each sample. It can determine the fat content of any dried sample, either oven dried or dried using the SMART 6. In as little as 60 seconds, the SMART 6 system can dry any sample and determine the moisture content. Both systems utilize AOAC approved methods for meat products, and have proven to be more accurate than FTIR, NIR, and FTNIR systems. While its accuracy is in line with most reference methods, the easy-to-use interface produces full results in 3- 5 minutes. It eliminates the need for hazardous solvents and/or glassware that traditional wet techniques require. Finally, any changes to color, granularity, texture, or additives have no effect on results, removing the need for costly recalibrations.

Phoenix

The Phoenix Microwave Muffle Furnace is an innovative heating technique for rapidly determining ash, or total mineral content, for pet food samples. What previously took hours, can now be accomplished in minutes with this 1200°C ASTM conforming muffle furnace. The Phoenix performs many high temperature applications, up to 10 times faster than traditional methods. Most pet food analyses can be performed in 10-15 minutes, versus hours using standard methods. Having test results within minutes transforms the exercise from mundane record keeping to active process control.

Sprint

Protein is also directly tested using the Sprint Rapid Protein Analyzer, eliminating calibrations and drifting results, using dye-binding technology. CEM's proprietary iTag Solution binds directly to protein molecules at 4 distinct locations, ensuring only true protein is read. Other technologies use nitrogen analysis, which can produce inaccurate data as a result of adulterants or miscalculations.

The Sprint protein analyzer uses an AOAC Approved technology that automates and advances dye-binding techniques that have proven effective since 1970. Because it directly measures protein, there is no need for the calculation or calibration that is seen with Kjeldahl and combustion, and it is not swayed by the presence of adulterants or other NPN molecules. The hazardous chemicals along with complicated gas lines and tubes used with these other methods were replaced with CEM's patented iTag solution, winner of the 2009 Presidential Green Chemistry Challenge Award, presented by the EPA. Analysis is simple enough for first day technicians to use, and results are immediately recorded after a rapid 3 minute test and stored for future reference.

Conclusion

The SMART 6, ORACLE, Phoenix, and Sprint systems were able to accurately and quickly determine the amount of moisture, fat, and protein for each sample - wet and dry. All results were within an acceptable amount of error.

Pet Food Moisture, Fat, Protein, and Ash Data

Raw Chicken and Beef Blend

Sample Number	Moisture			Fat			Protein		
	Reference	Results	Error	Reference	Results	Error	Reference	Results	Error
1	63.22	62.99	0.23	17.54	17.54	0.00	13.38	13.32	0.06
2		62.92	0.30		17.57	0.03		13.65	0.27
3		63.07	0.15		17.33	0.21		13.47	0.09
4		63.11	0.11		17.43	0.11		13.88	0.50
5		62.90	0.32		17.52	0.02		N/A	N/A
Average		**62.99**	**0.23**		**17.48**	**0.06**		**13.58**	**0.2**

Raw Meat Slurry

Sample Number	Moisture			Fat			Protein		
	Reference	Results	Error	Reference	Results	Error	Reference	Results	Error
1	56.53	56.23	0.30	26.52	26.69	0.14	8.42	8.46	0.04
2		56.44	0.09		26.24	0.28		8.35	0.07
3		56.36	0.17		26.63	0.11		8.42	0.00
4		56.73	0.20		26.68	0.16		8.44	0.02
5		56.65	0.12		26.39	0.13		8.50	0.08
Average		**56.48**	**0.05**		**26.53**	**0.01**		**8.44**	**0.02**

Finished Kibble

Sample Number	Moisture			Fat			Protein		
	Reference	Results	Error	Reference	Results	Error	Reference	Results	Error
1	6.42	6.51	0.09	15.27	15.32	0.05	21.29	21.35	0.06
2		6.61	0.19		15.17	0.10		21.38	0.09
3		6.19	0.23		15.23	0.04		21.14	0.15
4		6.37	0.05		15.09	0.18		21.33	0.04
5		6.46	0.04		15.15	0.12		21.30	0.01
Average		**6.43**	**0.01**		**15.19**	**0.08**		**21.30**	**0.01**

Finished Canned Pet Food

Sample Number	Moisture			Fat			Protein		
	Reference	Results	Error	Reference	Results	Error	Reference	Results	Error
1	75.26	75.43	0.17	5.62	5.60	0.02	10.29	10.34	0.05
2		75.20	0.06		5.59	0.03		10.40	0.11
3		75.29	0.03		5.64	0.02		10.33	0.04
4		75.37	0.11		5.58	0.04		10.31	0.02
5		75.27	0.01		5.59	0.03		10.33	0.04
Average		75.31	0.05		5.60	0.02		10.34	0.05

Ashing Various Pet Food Samples

Sample Name	Specification	Sample 1	Sample 2	Sample 3	Average	Standard Deviation
Pet Food	15%-22%	19.71	19.48	19.81	19.67	0.17
Chicken Meal	<12%	11.91	12.02	12.07	12	0.08
Turkey Meal	<18%	15.66	15.12	15.29	15.36	0.27
BSA	<1.94%	1.81	1.80	1.60	1.74	0.12
Supplement	N/A	1.70	1.70	1.75	1.72	0.03

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