Bone Content Analysis for Dry and Wet Pet Food Manufacturers

Abstract

Ash content in pet foods is a critical parameter that must be controlled in order to maintain proper formulation and avoid digestive issues in pets. Ash content correlates closely with bone content which has traditionally been measured using chemical titration, but rapid alternatives such as ash analysis offer comparable results in significantly less time. The Phoenix BLACK™ microwave muffle furnace analyzes ash content in both raw ingredients and finished products in approximately 30 minutes, without the use of chemical reagents.

Introduction

The global pet food market, valued at nearly 100 billion USD, is expected to continue to grow as pet ownership gains in popularity. Increasing consumer awareness regarding natural and organic pet food products has forced pet food manufacturers to shift their focus from synthetic to natural products, which have acted as one of the major forces impacting the global market. Convenience benefits related to dry organic and natural pet food is projected to drive the product demand, though wet foods still comprise a significant size of the market, due to advantages of palatability and certain health benefits, making it easier to digest for pets with health issues.

Nearly all pet foods contain meat as an ingredient. As a result, ash content in pet foods is comprised primarily of bone. One thing all pet food formulations require, whether wet or dry, is the proper amount of ash content. As a general rule of thumb, ash or bone content must be controlled at 2% or less of the final product. If bone content reaches a level greater than 2%, digestion issues can occur. Conversely, bone is a very low cost component, so controlling the manufacturing process to include the proper levels of bone content allows for formulation cost optimization.

The Phoenix BLACK is a rapid ashing system that removes all organic material in a pet food sample, leaving nothing but mineral content (i.e. bone and any added mineral supplements) behind. In this application note, we show the repeatability of ash content measurements via Phoenix BLACK.

Bone Content and Ash Analysis

Bone content can be measured using a fairly wide variety of techniques, but the three most common methods all rely on the fact that bone is almost exclusively comprised of calcium. The first method is chemical titration, which utilizes an indicator dye system, such as napthol blue and EDTA. The titration turns the dissolved sample from light pink to dark blue at the endpoint. To get calcium into solution, the bone-containing sample must be treated by boiling in hydrochloric acid, which poses considerable safety risks. Another method that requires the use of hazardous reagents is the determination of calcium via inductively coupled plasma (ICP) wherein the sample is digested in acid, then analyzed in an ICP instrument. Alternatively, bone content can be measured by ash analysis, wherein a sample is placed in a muffle furnace at a sufficient temperature to burn away all organic matter, leaving behind nothing but the mineral content (i.e. bone) of the sample. Ash analysis is straightforward, but can take eight hours or more to ash a sample in a traditional muffle furnace with ceramic crucibles.

For meat-based ingredients, ash content is equivalent to bone content [1]. For in-process and finished products, ash content is comprised of a combination of bone and mineral-containing additives.

The Phoenix BLACK microwave muffle furnace, when used in combination with quartz-fiber crucibles, optimizes airflow in and around the sample to reduce test time from eight hours to approximately 30 minutes.

Methods and Results

To evaluate the performance of the Phoenix BLACK, a series of finished pet food samples, as well as raw ingredients were gathered and analyzed for ash content. Samples were dry ashed at 550-650 °C for 15-45 minutes, depending on the specific sample type. Quartz-fiber crucibles were used to aid in rapid ash analysis.

Table 1 shows the repeatability of ash analysis for finished wet and dry pet foods, as well as for a dry pet treat. Overall, the dry pet foods showed slightly higher variation, with an average standard deviation of 0.10%, compared to an average standard deviation of 0.02% for dry finished products.

Table 1. Repeatability of the Phoenix BLACK for Ash Analysis of Finished Pet Food Samples

Product	Trial 1	Trial 2	Trial 3	Average	STDEV
Dry Pet Food 1	6.42%	6.28%	6.51%	6.40%	0.11%
Dry Pet Food 2	13.93%	13.72%	13.93%	13.86%	0.12%
Dry Pet Food 3	14.35%	14.33%	14.46%	14.38%	0.07%
Wet Pet Food 1	2.16%	2.17%	2.19%	2.17%	0.02%
Wet Pet Food 2	1.87%	1.83%	1.84%	1.85%	0.02%
Wet Pet Food 3	1.43%	1.47%	1.45%	1.45%	0.02%
Dry Pet Treat	4.50%	4.50%	4.52%	4.51%	0.01%

Table 2 shows the repeatability of bone analysis for pet food ingredients, particularly meats. Raw cod, which was comprised of whole ground fish, showed the highest standard deviation of 0.15%. This high observed variability was due to the non-homogenous nature of the sample, which contained whole scales and other parts that were not easily processed into a uniform sample. Excluding the raw cod sample, the average standard deviation of raw meats was 0.03%. Including the cod sample, the overall repeatability of raw ingredients was 0.06%.

Table 2. Repeatability of the Phoenix BLACK for Bone Analysis of Raw Pet Food Ingredients

Product	Trial 1	Trial 2	Trial 3	Average	STDEV
Raw Cod	3.65%	3.36%	3.54%	3.52%	0.15%
Raw Rabbit	0.93%	1.00%	0.97%	0.97%	0.04%
Raw Pork	3.53%	3.62%	3.48%	3.54%	0.07%
Raw Chicken	4.53%	4.51%	4.50%	4.51%	0.02%
Raw Turkey	1.70%	1.69%	1.72%	1.70%	0.02%

Conclusion

The Phoenix BLACK, when used in conjunction with quartz-fiber crucibles, enables users to reduce the time of bone content analysis from hours down to an average of 30 minutes, while eliminating the need for hazardous reagents. By minimizing test time, users are able to implement true process control within the manufacturing process and optimize pet food formulations in real time.

References

[1] CEM Corporation. A Faster Way to Measure Bone Content, 2020. CEM Corporation Website; Application Notes. https://cem.com/en/a-faster-way-to-measure-bone-content (accessed August 5, 2020).

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

France
33 (01) 69 35 57 80
info.fr@cem.com

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

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

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

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

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

www.cem.com