

Rapid Compositional Analysis for Better Process Control in Egg Processing Plants



Summary

CEM equipment has been trusted for over 40 years as a source of dependable process control. The ORACLE™, SMART 6™, Phoenix BLACK™ and Sprint® instruments all provide rapid and direct analysis for egg processing.

To demonstrate the ability of the ORACLE, SMART 6, Phoenix BLACK and Sprint to accurately and reliably determine the fat, moisture, ash and protein content throughout the various egg processing steps, an assortment of in-process and finished product samples were obtained and analyzed.

Introduction

Egg Processors are faced with a demand for an increasingly large variety of final products and customer requirements. Egg products must be created in liquid or powder form, egg yolks or egg whites, sugared or frozen, all to support a mix of both retail and wholesale customers. In order to remain competitive, costs must be kept low, with many egg breakers looking to improve process and quality control as a way to increase yield and profit. Critical testing points, such as fat and solids content, are used to ensure product quality. These test results can be used to make adjustments to in-process goods, reducing additional steps, such as fat reblending, which result in significant savings over time.

CEM's rapid process control analyzers have proven to not only reduce test time, but to do so while maintaining the accuracy and precision typically found with traditional industry standard methods. This combination allows most users of the SMART 6, ORACLE, Sprint, and Phoenix BLACK technologies to see ROI's of less than one year. The SMART 6 provides solids results on any egg product, liquid or powder, in just 2-3 minutes. The ORACLE universal fat analyzer is the first rapid fat analysis system that detects phospholipids and triglycerides, in as little as 90 seconds, to give a complete and accurate total fat analysis without the need for calibration.

Procedure

Moisture/Solids Analysis with the SMART 6

The SMART 6 Moisture/Solids Analyzer uses a proprietary combination of microwave and infrared energy to rapidly analyze any product, regardless of whether it is liquid or powder, sugared or salted, frozen or raw. Most analyses are complete in less than 3 minutes. Results are comparable to the precision previously only obtainable by ASTM oven methods, which can take hours to perform. With a touchscreen interface, built-in training videos, and full LIMS integration potential, the SMART 6 is the most advanced moisture/solids analyzer on the market.

For moisture/solids analysis, a 2 g sample was dried in the SMART 6 until a constant weight was achieved, taking approximately 3 minutes. Reference testing was performed in an air-oven for comparison. **Table 1** highlights the high degree of precision and accuracy of the SMART 6, which closely matched the air-oven method.

Table 1: Accuracy of SMART 6 for Moisture and Solids in Egg Samples

Sample	Dried Whole Egg (% Moisture)	Dried Egg Yolk (% Moisture)	Egg White (% Solids)	Sugar Yolk (% Solids)	Salted Yolk (% Solids)	Whole Egg (% Solids)
1	3.78	3.99	5.85	47.82	49.47	23.74
2	3.78	3.99	5.87	47.98	49.48	23.77
3	3.79	3.99	5.90	47.74	49.56	23.81
4	3.79	3.99	5.96	47.93	49.56	23.85
Average	3.79	3.99	5.90	47.87	49.52	23.79
Reference	3.79	3.99	5.91	47.87	49.57	23.81

Total Fat Analysis with the ORACLE

The ORACLE Fat Analyzer is the first system that can accurately test fat content with no method development, calibration, or sample validation. The ORACLE can achieve accuracy equal to standard extraction methods with no solvents. This means results that are equal to reference extraction techniques, with better consistency and repeatability than NIR technologies. Without calibration maintenance or frequent validation necessary, the ORACLE system can help save thousands of dollars a year in calibration costs, regardless of sample type.

For total fat analysis, a 2 g sample was dried, and then inserted into the ORACLE. Total scan time was 90 seconds. Reference testing was performed by solvent extraction for comparison. The average difference between the ORACLE and reference chemistry was less than 0.08%, as shown in **Table 2**.

Table 2: Accuracy of ORACLE for Fat in Egg Samples

Sample	Chicken Egg Yolk (% Fat)	Duck Egg Yolk (% Fat)	Quail Whole Egg (% Fat)	Cage-Free Whole Egg (% Fat)
1	30.38	28.68	12.62	8.89
2	30.29	28.78	12.72	8.71
3	30.28	28.88	12.64	8.80
4	30.24	28.82	12.80	8.71
Average	30.30	28.83	12.72	8.78
Reference	30.30	28.92	12.60	8.88

Protein Analysis with the Sprint

The Sprint Rapid Protein Analyzer is a breakthrough technology that fully automates an AOAC approved dye-binding technique, proven effective for food samples since the 1970s. 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 non-protein nitrogen (NPN) molecules. The hazardous chemicals and complicated gas lines and tubes used with these other methods have been replaced by CEM's patented iTag® solution. Upon introduction, the Sprint won the 2009 Presidential Green Chemistry Challenge Award, presented by the EPA due to the lessened environmental impact. Analysis is simple enough for first day technicians to use, and results are immediately recorded and stored for future reference.

Protein content was determined by placing a 2 g sample in a Sprint sample cup, which is automatically reacted with iTag solution. The mixture is homogenized, then filtered and the filtrate is analyzed for absorption, which correlates with protein concentration, at 480 nm. **Table 3** highlights the accuracy of Sprint protein results compared to reference chemistry. The average difference between Sprint and Kjeldahl values was approximately 0.11%.

Table 3: Accuracy of Sprint Compared to Reference Chemistry for Protein in Egg Samples

Sample	Cooked Egg (% Protein)	Egg Whites (% Protein)	Dried Whole Egg (% Protein)	Dried Egg White (% Protein)
1	10.38	82.64	48.78	81.86
2	10.44	82.64	48.72	81.81
3	10.37	82.41	47.97	81.94
4	10.40	82.31	48.76	81.76
Average	10.40	82.50	48.56	81.84
Reference	10.40	82.58	49.21	81.82

Table 4: Repeatability of the Phoenix BLACK for Ash in Egg Samples

Sample	Egg Whites (% Ash)	Whole Eggs (% Ash)
1	0.26	0.93
2	0.25	0.92
3	0.24	0.95
4	0.26	0.91
Average	0.25	0.93

Ash Analysis with the Phoenix BLACK

The Phoenix BLACK is the fastest microwave muffle furnace on the market for determining ash, or total mineral content, for egg 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 due to the combination of microwave energy, used for rapidly heating the furnace, and quartz fiber crucibles which promote the circulation of air throughout the entire sample. To highlight the speed of the Phoenix BLACK, egg samples were placed in a quartz fiber crucible and ashed to a constant weight, which was accomplished in only 20 minutes. Traditional muffle furnace methods require 48 hours to obtain comparable results. **Table 4** shows the repeatability of ash analysis in the Phoenix BLACK.

Conclusion

The SMART 6, ORACLE, Sprint, and Phoenix BLACK systems provide accurate alternatives to traditional methodologies while saving time in the production environment. All of the information gained during analysis can be used to quickly and accurately make adjustments, which directly translate to bottom line savings for egg breakers.

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