

Rapid Fat, Moisture, and Protein Analysis of Raw Meats and Blends



Summary

The economics of the meat and poultry industry are primarily driven by volume and economies of scale. In the United States alone, companies produce nearly 100 billion pounds of meat and poultry each year, contributing over \$1 trillion to the economy. At such large volumes, even the slightest reductions in cost have a significant impact on overall profitability. Rapid and accurate fat determination in raw meat and poultry products allows manufacturers to control their raw material and blending costs more precisely and minimize the use of more expensive lean meat. Least Cost Formulation (LCF) is often utilized to optimize the use of low-cost materials, while still meeting required ingredient guidelines and constraints for a given product. This can be especially challenging in an industry where raw material costs and availability constantly fluctuate. In order for LCF and other process control practices to be effective, it is essential for manufacturers to have a rapid, accurate means of fat testing.

Introduction

The ProFat™ moisture, fat, and protein meat analyzer is an ideal solution for accurate and precise moisture, fat, and protein determination of raw meats and blends, in a single measurement. The system combines a direct microwave moisture measurement with data modeling for fat and protein analysis of various uncooked meat samples (e.g. beef, pork, chicken, turkey, and fish). This multi-component, rapid analysis can be used for process control to make blend corrections, release materials, and ensure LCF. The ProFat can also be used to verify and maintain performance of in-line NIR (Near Infrared) or X-ray devices. The system's accuracy is comparable to standard fat extraction, oven drying, and protein titration methods, for moisture, fat, and protein respectively, with better repeatability often observed. To demonstrate the ability of the ProFat to accurately and reliably determine moisture, fat, and protein content in raw meats and blends, an assortment of eight samples were obtained and analyzed.

Sample Preparation and Analysis

Various raw meat samples were prepared, following AOAC method 983.18 (Meat and Meat Products, Preparation of Test Sample). Samples were blended with a commercial grade food processor and mixed thoroughly with a spatula prior to analysis. Each sample was analyzed in triplicate on the ProFat, which took approximately 2.5 min per sample. For comparison, AOAC reference methods for fat (960.39 - Fat in Meat), moisture (950.46 - Moisture in Meat) and protein (981.10 - Crude Protein in Meat) were completed in triplicate.

Results

The accuracy and precision of the ProFat for various raw meat samples are demonstrated in **Table 1** and **Table 2**, where the average of three ProFat replicates are compared with fat, moisture, and protein values obtained, following AOAC Official Method of Analysis 960.39 (Fat in Meat), 950.46 (Moisture in Meat), and 981.10 (Crude Protein in Meat).

As shown in **Table 1**, the difference between the ProFat and Soxhlet results ranged from 0.00–0.18% fat, the difference between the ProFat and the oven results ranged from 0.01–0.14% moisture, and the difference between the ProFat and Kjeldahl results ranged from 0.00–0.35% protein.

As shown in **Table 2**, the standard deviations ranged from 0.02–0.36% for fat, 0.02–0.28% for moisture, and 0.00–0.08% for protein on the ProFat. These results indicate the ProFat is able to reliably match existing reference chemistry results for moisture, fat, and protein analysis of various raw meat samples and blends.

Table 1: Accuracy of ProFat for Fat, Moisture, and Protein in Raw Meats and Blends

Sample	% Fat			% Moisture			% Protein		
	ProFat	Soxhlet	Difference	ProFat	Oven	Difference	ProFat	Kjeldahl	Difference
Beef, Fat Ground	29.04	29.22	0.18	55.02	54.93	0.09	14.91	14.91	0.00
Beef, Ground	19.90	20.03	0.13	62.11	62.18	0.07	17.40	17.36	0.04
Beef, Lean Ground	28.42	28.38	0.04	54.04	53.98	0.06	16.34	16.33	0.01
Beef/Pork Blend	21.99	21.81	0.18	60.50	60.53	0.03	16.95	17.25	0.30
MSC, 11% Fat	11.14	11.11	0.03	70.46	70.49	0.03	17.18	17.13	0.05
MSC, 15% Fat	16.84	16.77	0.07	66.96	66.86	0.10	14.70	14.35	0.35
Pork, Ground	26.55	26.55	0.00	57.46	57.47	0.01	15.45	15.50	0.05
Turkey, 18% MDB	18.00	17.97	0.03	67.03	66.89	0.14	13.67	13.89	0.22

Table 2: Precision of ProFat for Fat, Moisture, and Protein in Raw Meats and Blends

Sample	Component	1	2	3	Average	Range	Standard Deviation
Beef, Fat Ground	% Fat	29.23	29.06	28.84	29.04	0.39	0.20
	% Moisture	54.88	55.01	55.18	55.02	0.30	0.15
	% Protein	14.87	14.91	14.96	14.91	0.09	0.05
Beef, Ground	% Fat	19.79	19.94	19.97	19.90	0.18	0.10
	% Moisture	62.20	62.08	62.06	62.11	0.14	0.08
	% Protein	17.42	17.39	17.39	17.40	0.03	0.02
Beef, Lean Ground	% Fat	28.57	28.35	28.33	28.42	0.24	0.13
	% Moisture	53.92	54.09	54.11	54.04	0.19	0.10
	% Protein	16.30	16.35	16.36	16.34	0.06	0.03
Beef/Pork Blend	% Fat	21.74	21.82	22.40	21.99	0.66	0.36
	% Moisture	60.69	60.63	60.17	60.50	0.52	0.28
	% Protein	17.00	16.98	16.86	16.95	0.14	0.08
MSC 11% Fat	% Fat	11.01	11.46	10.95	11.14	0.51	0.28
	% Moisture	70.46	70.54	70.39	70.46	0.15	0.08
	% Protein	17.20	17.13	17.21	17.18	0.08	0.04
MSC, 15% Fat	% Fat	16.99	16.65	16.87	16.84	0.34	0.17
	% Moisture	66.84	67.12	66.96	66.97	0.28	0.14
	% Protein	14.67	14.73	14.69	14.70	0.06	0.03
Pork, Ground	% Fat	26.52	26.45	26.67	26.55	0.22	0.11
	% Moisture	57.48	57.54	57.37	57.46	0.17	0.09
	% Protein	15.46	15.47	15.42	15.45	0.05	0.03
Turkey, 18% MDB	% Fat	18.01	17.98	18.00	18.00	0.03	0.02
	% Moisture	67.02	67.05	67.03	67.03	0.03	0.02
	% Protein	13.67	13.67	13.67	13.67	0.00	0.00

Conclusion

The ProFat provides complete multi-component analysis in minutes, with accuracy and precision comparable to the longer AOAC methods. Using an extensive library of pre-defined methods, users can quickly analyze raw meats as well as meat blends, with little to no time spent on method development. Because results are based on direct analysis of the entire sample, the ProFat is ideal for calibrating on-line X-ray and NIR systems.

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

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