



ORACLE

Fat Analyzer

The first ever rapid fat analyzer with no method development.

Introduction

Fat and moisture testing for foodstuff samples has traditionally been done by wet chemistry techniques, which are laborious and time consuming and often involve skilled technicians and hazardous solvents. Various rapid techniques (TD-NMR, NIR, FT-IR, and FT-NIR) have been introduced, but none have been universally accepted due to the need for often extensive calibration development and maintenance.

The ORACLE is a rapid time-domain NMR (TD-NMR) instrument incorporating breakthrough technology that allows for direct determination of fat/oil in foodstuffs. Unlike other rapid techniques, the ORACLE is able to completely isolate the detection of fat in complex matrices which eliminates the need for calibration development. To allow for rapid moisture/solids as well as fat testing, the ORACLE can be coupled with a SMART 6 moisture/solids analyzer.

To demonstrate the ability of the ORACLE and SMART 6 to accurately and reliably determine the fat and moisture content in meats, an assortment of 13 samples were obtained and analyzed. The samples were selected to represent a range of both matrix types as well as relative component concentrations.

Key Benefits of ORACLE

- Direct technique, requiring no calibration
- Rapid (less than 5 minutes for moisture and fat)
- Bulk measurement (insensitive to color and granularity)
- Better repeatability than reference methods



*Robot and high capacity heater blocks (100 positions)
with ORACLE*

Experimental

To complete each analysis, the samples were pre-dried on the SMART 6 (ca. 3 – 4 minutes) and then prepared for analysis in the ORACLE. Once inserted into the ORACLE magnet, the samples are rapidly conditioned (30 s) using the QuikPrep™ prior to NMR analysis (35 s). The samples size was 2 grams. Each sample was analyzed at least in duplicate for the reference analyses (AOAC approved methods), and at least 3 times for the SMART 6 – ORACLE analyses.

Note: High-throughput analyses can be enabled through the use of batch automation using an optional robot and high capacity heater blocks (100 positions).

Results and Discussion

The accuracy of the SMART 6 and ORACLE results is summarized in Table 1, where the average reference results are compared with the SMART 6 and ORACLE results. The average difference ranged from 0.02 - 0.65 % for moisture/solids, and from 0.02 – 0.56 % for fat. Repeatability is summarized in Table 2, where the standard deviations ranged from 0.04 – 0.64 % for moisture/solids, and from 0.03 – 0.84 % for fat.

These results suggest the ability of the SMART 6 – ORACLE to reliably determine the moisture/solids and fat content in meat samples with an accuracy closely matching that of the reference methods. In addition, there are inherent repeatability advantages over the reference methods, which are error prone due to a strong dependence on a range of experimental factors (e.g. extraction time, solvent composition, temperature, etc.).

Table 1: Accuracy

Sample	Moisture/Solids			Fat		
	SMART 6	Oven	Difference	ORACLE	Solvent Extraction	Difference
Hot Dog	52.97	53.66	0.60	30.25	30.09	0.15
Beef	67.57	67.82	0.34	12.08	11.94	0.14
Beef (deboned)	67.01	66.86	0.15	15.95	15.68	0.27
Chicken (low fat)	72.65	73.05	0.53	7.95	7.84	0.11
Chicken (high fat)	66.43	66.69	0.02	18.33	17.95	0.38
Chicken (MSC)	70.10	70.43	0.12	13.87	13.78	0.09
Turkey	68.27	68.15	0.53	13.64	13.37	0.27
Pork	70.23	70.08	0.26	10.26	10.14	0.12
Fish (Salmon)	74.45	74.63	0.33	4.08	4.00	0.08
Fish (Catfish)	66.56	67.09	0.08	15.60	15.57	0.03
Potted Meat	69.99	70.00	0.19	12.87	13.04	0.17
Bacon	34.20	33.96	0.16	54.58	54.60	0.02
Viscera	68.05	68.70	0.65	16.05	15.49	0.56
		Average	0.30		Average	0.18

Table 2: Repeatability

Sample	Component	Replicates			Average	Range	Std. Dev.
		1	2	3			
Hot Dog	Moisture/Solids	53.06	52.96	52.90	52.97	0.16	0.08
	Fat	30.13	30.34	30.27	30.25	0.21	0.11
Beef	Moisture/Solids	67.65	67.47	67.60	67.57	0.18	0.09
	Fat	12.06	12.00	12.18	12.08	0.18	0.09
Beef (deboned)	Moisture/Solids	66.66	67.49	66.87	67.01	0.83	0.43
	Fat	16.00	15.88	15.98	15.95	0.12	0.06
Chicken (low fat)	Moisture/Solids	72.87	72.35	72.74	72.65	0.52	0.27
	Fat	7.97	8.05	7.83	7.95	0.22	0.11
Chicken (high fat)	Moisture/Solids	65.81	66.53	66.94	66.43	1.13	0.57
	Fat	18.04	18.74	18.22	18.33	0.70	0.36
Chicken (MSC)	Moisture/Solids	70.13	70.18	69.98	70.10	0.20	0.10
	Fat	13.85	13.61	14.15	13.87	0.54	0.27
Turkey	Moisture/Solids	68.06	68.23	68.53	68.27	0.47	0.24
	Fat	13.61	13.53	13.79	13.64	0.26	0.13
Pork	Moisture/Solids	70.38	70.06	70.25	70.23	0.32	0.16
	Fat	10.30	10.24	10.24	10.26	0.06	0.03
Fish (Salmon)	Moisture/Solids	74.51	74.22	74.61	74.45	0.39	0.20
	Fat	4.03	4.10	4.10	4.08	0.07	0.04
Fish (Catfish)	Moisture/Solids	67.29	66.33	66.07	66.56	1.22	0.64
	Fat	15.22	15.44	16.15	15.60	0.93	0.49
Potted meat	Moisture/Solids	69.98	70.03	69.96	69.99	0.07	0.04
	Fat	12.99	12.76	12.85	12.87	0.23	0.12
Bacon	Moisture/Solids	34.15	34.71	33.74	34.20	0.97	0.49
	Fat	54.51	53.77	55.45	54.58	1.68	0.84
Viscera	Moisture/Solids	67.58	68.25	68.32	68.05	0.74	0.41
	Fat	16.12	15.76	16.28	16.05	0.52	0.27