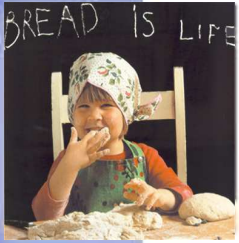


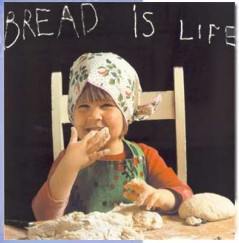
NIR analysis of unground feeds and feed raw materials

Stefan Tordenmalm
Pertten Instruments



Applications of NIR in feed milling

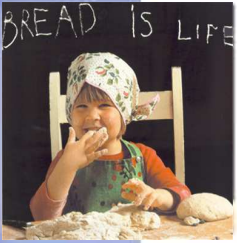
- Raw material analysis
 - For correct least-cost formulation
 - Monitor moisture content
 - Pricing
- Process control
 - Monitor batching of raw materials
 - Optimize additions and drying
- Product verification
 - Ensure correct product is shipped



Feed milling sample types

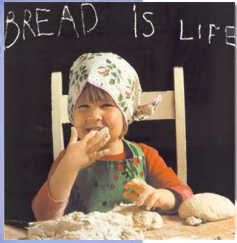
- Grains
- Oilseed meals
- Hay
- Silage
- Pulses, peas
- Feed pellets
- Feed slurries





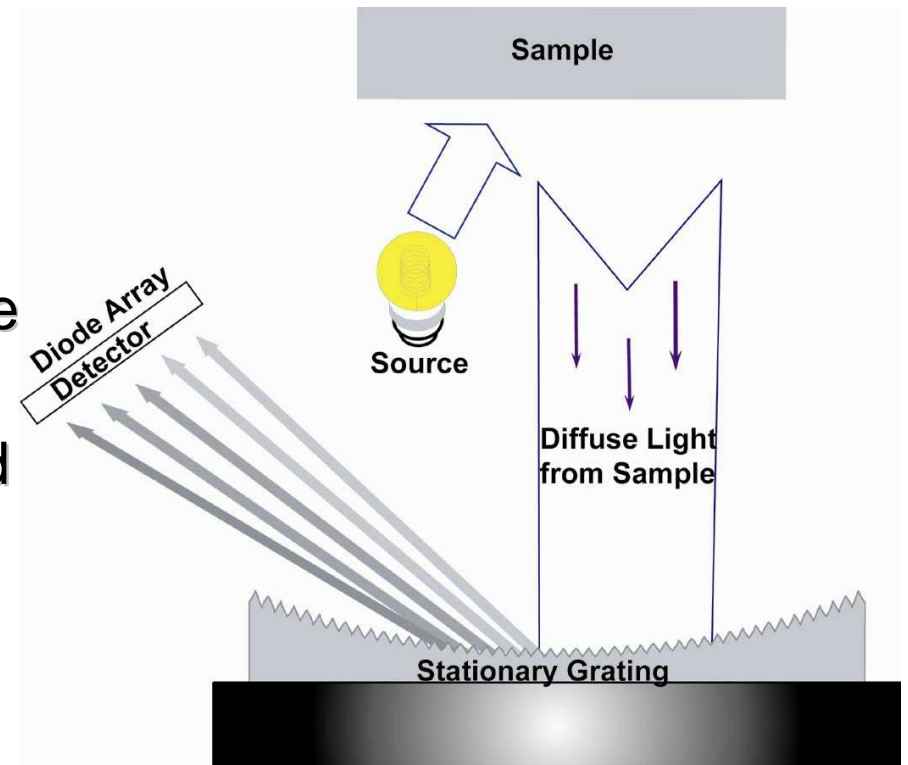
Previous NIR technologies

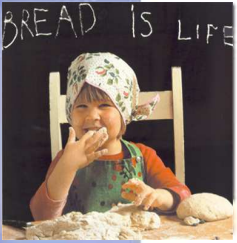
- Filter technology (~1980)
 - Raw materials and finished feeds
 - Requires grinding of sample
 - Analysis time ~30 seconds
- Scanning grating (~1980)
 - Raw materials and finished feeds
 - Requires grinding of sample
 - Analysis time ~30 seconds



Modern NIR technology

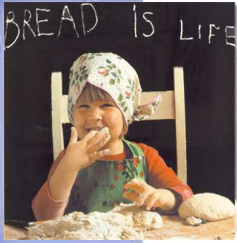
- Diode array system
 - One detector per wavelength
 - All wavelengths measured at the same time
 - 100 scans per second
 - Large sample area is analyzed
 - No need to grind inhomogeneous samples





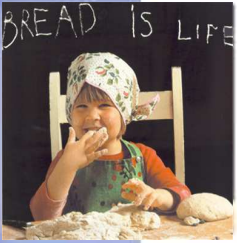
Scope of study

- Three products that typically requires sample preparation
 - Soymeal (grinding)
 - Hay (drying + grinding)
 - Poultry feed (grinding)
- Parameters that are often analyzed in these products



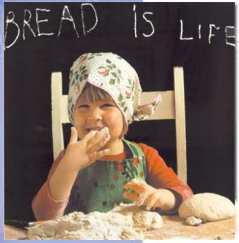
Experimental - NIR system DA 7200

- Supplied by Perten Instruments, Sweden
- Diode array based system
- 900-1700 nm
- 3-second analysis
- Open sample dish analysis
- No drying or grinding required
- Stand-alone unit (Windows XP computer)



Experimental - analysis procedure

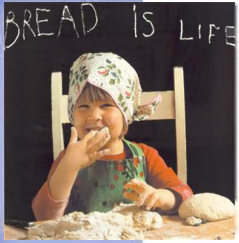
- Sample poured into dish
- Excess sample struck off by object similar to a ruler
- Spectral data collected 2 times on the same surface (repeats)
- New portion of the same sample analyzed (repacks)
- Average of these spectra was used



Soymeal study

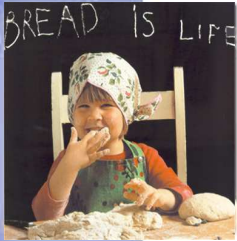
- 150 samples acquired from sources in Germany and USA
- Chemical analyses by AnalyCen, Sweden
- NIR spectra collected on 3 DA 7200 units, on unground samples. 2 repeats and 2 repacks per sample
- PLS calibrations with pretreatments (MSC, 1st and 2nd derivatives)



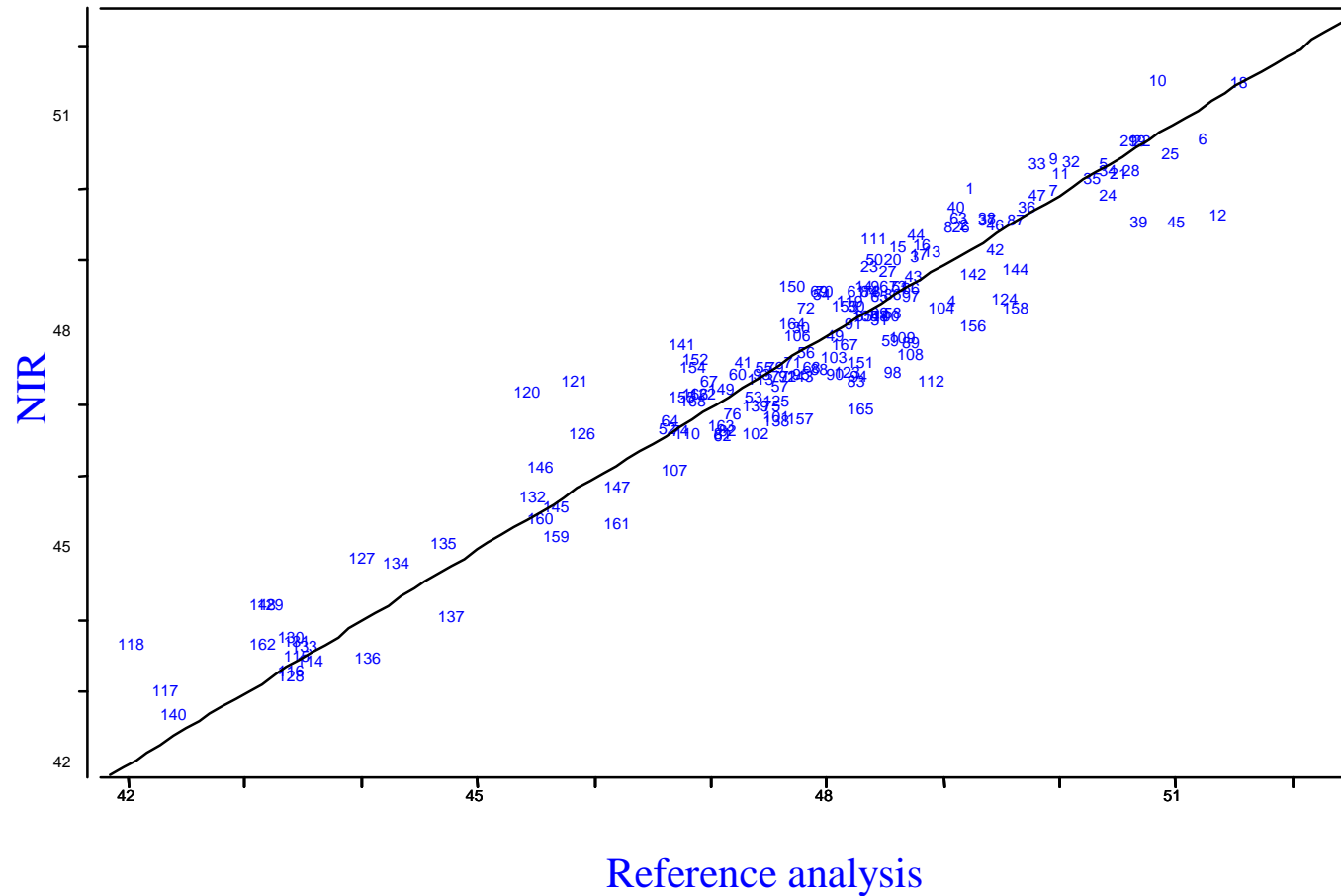


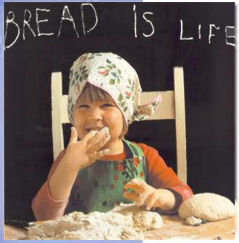
Soymeal results

Parameter	Range	Samples	R2	<u>SECV*</u>
Moisture	9.0 - 14.3	154	0.933	0.28
Protein	42.1 - 51.6	154	0.921	0.55
Fat	0.1 - 2.2	154	0.949	0.21
Ash	5.4 - 6.9	154	0.654	0.19
Fiber	2.7 - 9.3	154	0.945	0.41



Soymeal protein graph

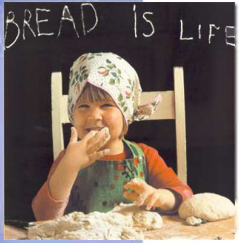




Poultry feed

- 300 samples acquired from Swedish feed producer Svenska Foder. Samples collected over three years.
- Chemical analyses performed by AnalyCen, Sweden.
- Spectra collected on 1 DA 7200. 2 repeats and 2 repacks per sample.
- PLS calibrations with pretreatments (MSC, 1st and 2nd derivative)



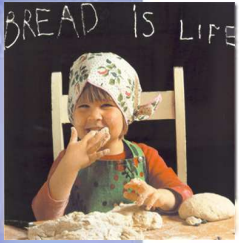


Poultry feed results

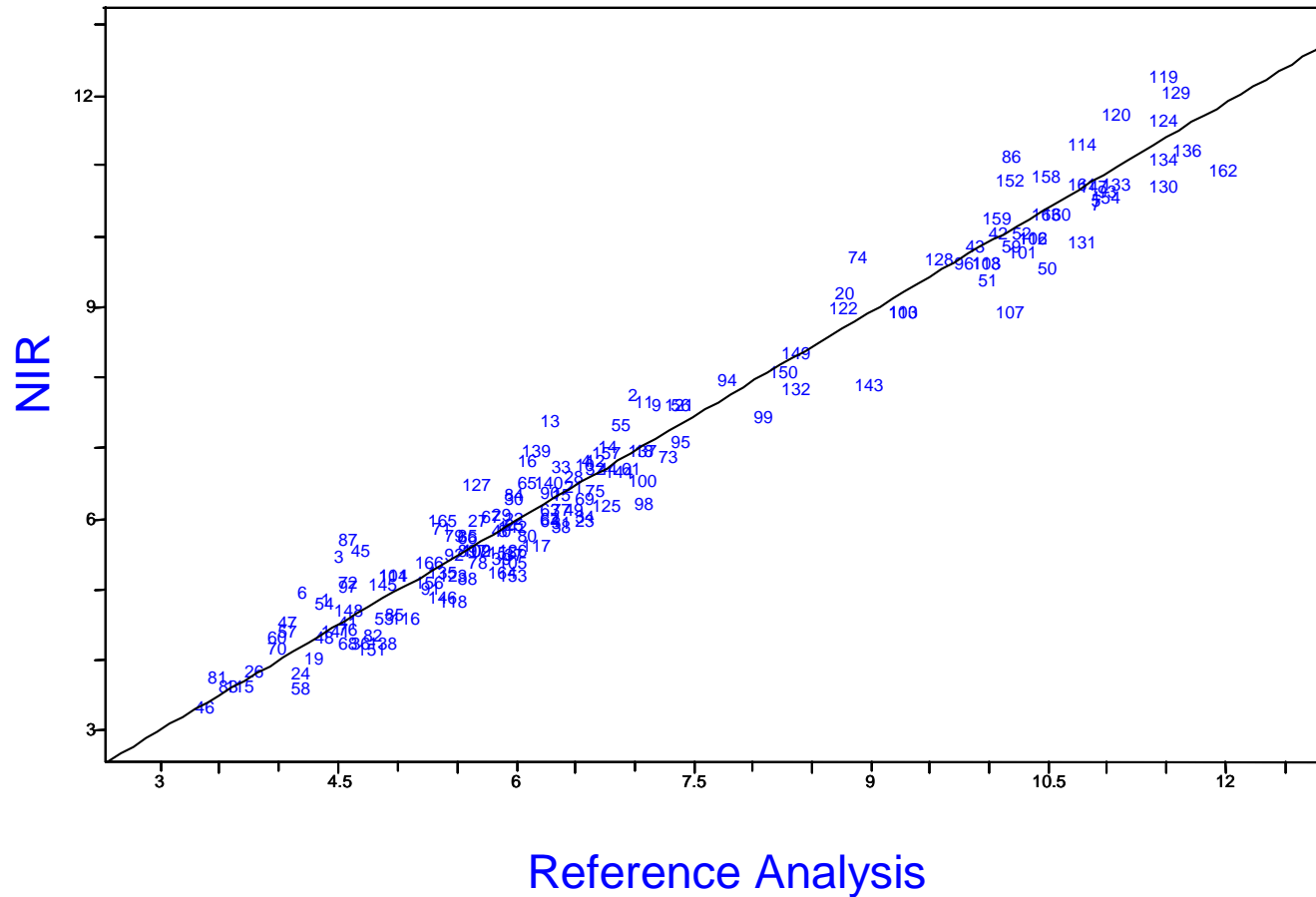
Parameter	Range	Samples	R2	<u>SECv*</u>
Moisture	9-15.7	273	0.8	0.45
Protein	13.1-36.8	294	0.92	0.91
Fat	3.4-12	166	0.96	0.45

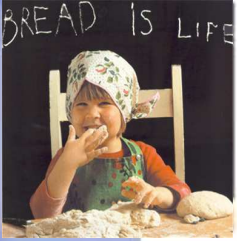
NIR analysis of unground feeds and feed raw materials

SPECIALISTS IN QUALITY CONTROL OF GRAIN, FLOUR, FOOD AND FEED



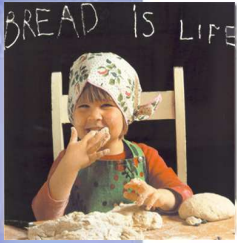
Poultry feed fat graph





Hay study

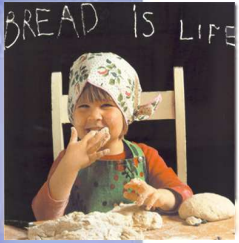
- About 70 samples of hay (cut into 4 cm pieces) were acquired through a North American commercial lab.
- Chemical analyses were performed by the same lab
- Spectral data was collected on one DA 7200. 4 repeats and 4 repacks per sample.
- PLS calibrations with pretreatments (MSC, 1st and 2nd derivatives)



Hay results

Parameter	Range	Samples	R2	SECV
Protein	7.6-16.5	69	0.68	1.15
ADF	29.4-39.2	69	0.49	1.58
NDF	39-62	69	0.75	2.7

Note: The variability within the samples was very high. As the subsample analyzed by DA 7200 was not exactly the same as the subsample analyzed by reference method, the sampling error is a major contributor to the total error.



Conclusions

- It is possible to analyze unground feeds and feed raw materials in the DA 7200 with high accuracy, in only 3 seconds.
- Parameters such as moisture, protein, oil, fiber and others show a very high correlation to the respective wet chemical method.