

Summary of Rapid Methods Breakout A

DAY One June 17, 2009



Objectives to Keep In Mind

- Define the Challenges and Opportunities
- Identify analytical techniques to address the challenges
- How to develop and use reference materials?
- Path forward and collaborations



Bob's Ideal Adulteration Detection Method

- Rapid (seconds)
- Available at point of material receipt
- Simple to use
- Able to detect any adulterant
- Inexpensive (capital and reagents)
- No “chemicals” or glass
- No (or infrequent) calibration



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Peter Griffiths: Theory, Instrumentation and Sampling Techniques for Vibrational Spectroscopy

- Overview of Mid-IR, NIR, Raman Spectroscopy
- IR and Raman are complimentary techniques because they “see” different types of bonds
- Questions around the effect of colored samples (black is very bad, absorbing red color is bad, absorbing blue color is usually OK), SERS – can it be used with handheld instruments (yes!), and the effect of sampling on results (large!).
- Handheld instruments: fast, easy to use, ruggedly built



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Karl Norris: NIR Technology to Help Food Technology

- Chemometrics owes more to NIR than NIR owes to chemometrics.
- Sources of error include sampling, sample stability, sample packing, temperature, humidity, others.
- Proposed “derivative-ratio regression” as a method for detecting protein adulteration. Approximate detection limit of 1%.



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David Funk: Intuitive” Chemometrics for Protein Determination and Measurement

- Chemometrics review
- Mahalanobis distance may be used to distinguish atypical samples from typical samples.
- Spectral residuals may also be used for this purpose
- There are many mathematical methods that can be applied to NIR data
- Multiple calibrations must be created to look for atypical samples



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Juan Romero: A Dairy Perspective on the Use and Applications... Challenges Ahead

- Discussed Dairy perspective on adulteration issue.
- FTIR may be used for milk screening – 3 major manufacturers offer suitable units.
- LOD found to be 75-100ppm for melamine by FTIR when it is known to be the adulterant.
- LOD found to be 250-500ppm when the ID of the adulterant is unknown.
- Strategies: Method for melamine/cyanuric acid (short term); provide effective and recognized approaches to counteract adulteration (long term)



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Panel Discussion

Question #1: How do we draw the line between normal variability and adulteration/contamination?

- Classic statistics question of type 1 vs type 2 errors
- Use multiple tests to help ensure correct decision
- What is the adulteration? Knowledge of this will help to make the decision.
- Requirement to bin raw materials so that substitute lot can be used while suspect lot is being re-tested/rejected.
- Use two instruments with orthogonal responses
 - Good example: NIR and Raman
 - Poor example: NIR and FTIR
- Use Mahalanobis distance to ID contamination/adulteration



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Panel Discussion

Question #2: Where can we get true reference materials?

- USP has reference materials, and is willing to develop additional materials as needed by industry
- NIST
- AOCS
- Other organizations
- Make your own



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Panel Discussion

Question #3: How do we measure the degree of success of a qualitative method?

- Ability to pick out contaminated spikes
- What is an acceptable number? Companies will have to set this carefully...a political decision in some cases.



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Moving Forward...

- Multiple methods or a multi-tier approach to testing may be a way forward
- Inability to absolutely predict what adulterants may be present is a major obstacle
- Data, Data, Data. To create a proper calibration, we need to gather a lot of spectral data of “typical” samples.
- Reference materials are needed for raw, “whole” products and for signature components



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Quality Standards for Medicines, Supplements, and Food Ingredients throughout the World

Summary of Rapid Methods Breakout A

DAY Two: June 17, 2009



U.S. PHARMACOPEIA
The Standard of Quality™

Jürgen Möller: Possibilities of FTIR and NIR to Detect Adulteration in Food and Feed

- FTIR and NIR are optimized for measuring quality parameters in protein.
- These methods are fast, cost-effective, and widely used in dairy and food processing industries.
- Specific calibrations may be developed and used for known adulterants.
- Analysis of spectral integrity can detect higher levels of a broad range of unknown adulterants.
- Spectra and reference data of unadulterated samples must be available.
- FTIR and NIR should be used for screening at the raw material source or intake and should be complemented with other methods for final confirmation.



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Peter Griffiths: “Advanced” Vibrational Spectroscopic Techniques for the Investigation of Adulterants

- Reviewed Mid-, Near- and Raman-Spectroscopic Techniques including
 - NIR Diffuse Reflection—a good technique for rapid detection; higher resolution desirable (2-6 nm)
 - Raman Spectroscopy—has a lot of potential, although there are still developments to be made for portable instrumentation. Long-wavelength is key to reduce fluorescence.
 - Surface Enhanced Raman Scattering (SERS)—Extremely effective but limited by expensive substrates (Klarite). Also can reach relatively low LODs.
- Reviewed Hyperspectral Imaging versions of the above
 - More expensive
 - Chemometrics are critical
 - Fusing NIR/Raman data in HI delivers more information



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David Honigs: Classification Technology: Changing From Diagnosing Calibrations to Diagnosing Products

- Two types of Classification: Similarity and Difference
 - Similarity is measured by correlation
 - Difference is measured by subtraction (remainder)
- Both similarity and difference techniques are useful, and may be combined
- Changing the standard practice response to an incorrect M Distance on existing equipment would do a lot
- Qualify before Quantify using SIMCA Analysis or M Distance
- Classification testing can be added for modest cost and effort to current testing.
- These Classification techniques are applicable to NIR, FTIR, or other spectral signatures of the products.



“You get what you inspect”
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Panel Discussion

- The instruments are available and can detect down typically to 1-2% for unknown adulterants and 0.1% for known adulterants
- Need to clarify decision criteria and chemometric approaches need further development to “red light” / “green light” level. Setting a standard via USP or other organization may be desirable to give commonality to decision criteria
- Develop a spectral library for each ingredient, locally or globally, and manufacturers need to work together to make it happen. USP could help to foster cooperation through FCC. Multiple locations/instruments for scanning? Single location/instrument? Hybrid of the two? How to manage updating libraries?
- Need a second level of testing beyond spectroscopic methods for questionable samples.



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