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Top Packaging Failures And How To Deal With Them

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Outline

- Top 5 packaging failures
 - Common identifiers
 - Possible causes
 - Case studies
- Finding a solution
 - When to consider a contract lab
 - Internal vs. external capabilities
 - What to look for in a testing lab



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Top 5 Packaging Failures

- Migration/Leaching
- Contamination of Packaging Materials
- Adhesion/Sealing Failures
- Physical/Material Defects
- Labeling Failures



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Migration/Leaching

- Materials from the packaging migrate into the product
- Common Identifiers
 - Off-flavor/odor/color of product
 - Visual indicators (particulates, immiscibles, etc.)
- Possible Causes
 - Poor material selection
 - Incompatible raw materials
 - Improper storage
 - Unforeseen logistics issues

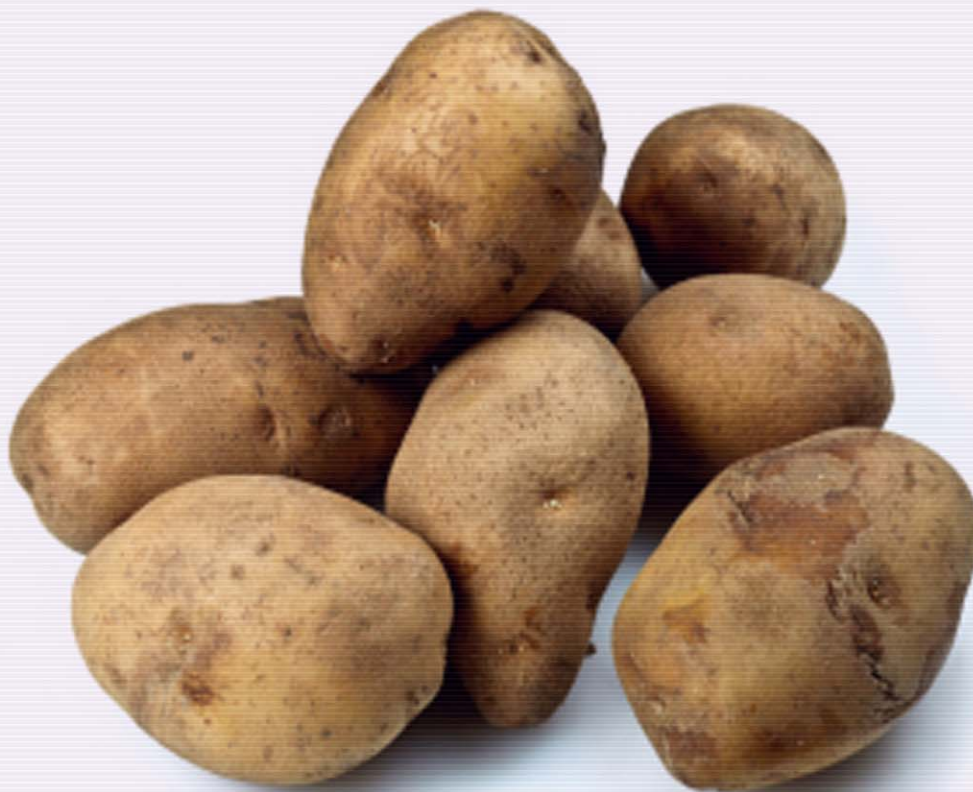
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Migration/Leaching

Case Study: Off-Flavor Food



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Migration/Leaching

Case Study: Off-Flavor Food

- Problem – A client determined their food product had an off-flavor and suspected the secondary packaging material was the contamination source.
- Testing – A comparative analysis of a control batch, the contaminated batch, and the suspected packaging source was performed using SPME/GC/MS.

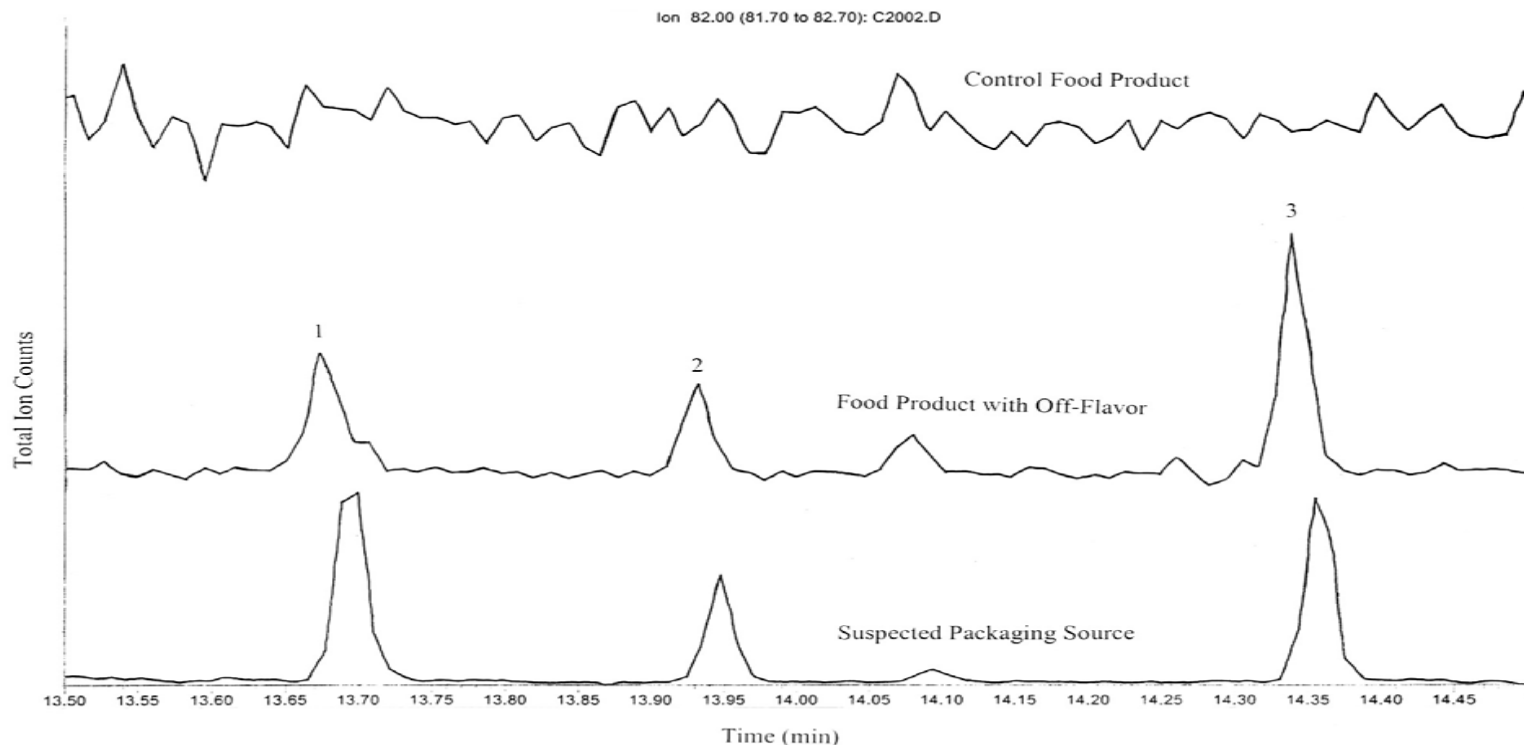
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Migration/Leaching Case Study: Off-Flavor Food

SPME-GC-MS Extracted Ion Chromatograms used in a Contaminant Source Identification



Peak Identities: (1) 2-(1,1-dimethylethyl)-cyclohexanol; (2) 4-*tert*-butylcyclohexyl acetate-*cis*; (3) 4-*tert*-butylcyclohexyl acetate-*trans*

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Migration/Leaching

Case Study: Off-Flavor Food



- Outcome – The results clearly identified the secondary packaging as the source of the offending components.

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Contamination

- Packaging materials are contaminated
- Common Identifiers
 - Off-color/discolored particles
 - Off-odor
- Possible Causes
 - Contaminated raw materials
 - Production line/processing issues



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Contamination

Case Study: Off-Odor Boxes



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Contamination

Case Study: Off-Odor Boxes

- Problem – A food manufacturer found an off-odor in boxes from China.
- Testing – Our scientists performed headspace GC/MS to determine the cause of the odor.

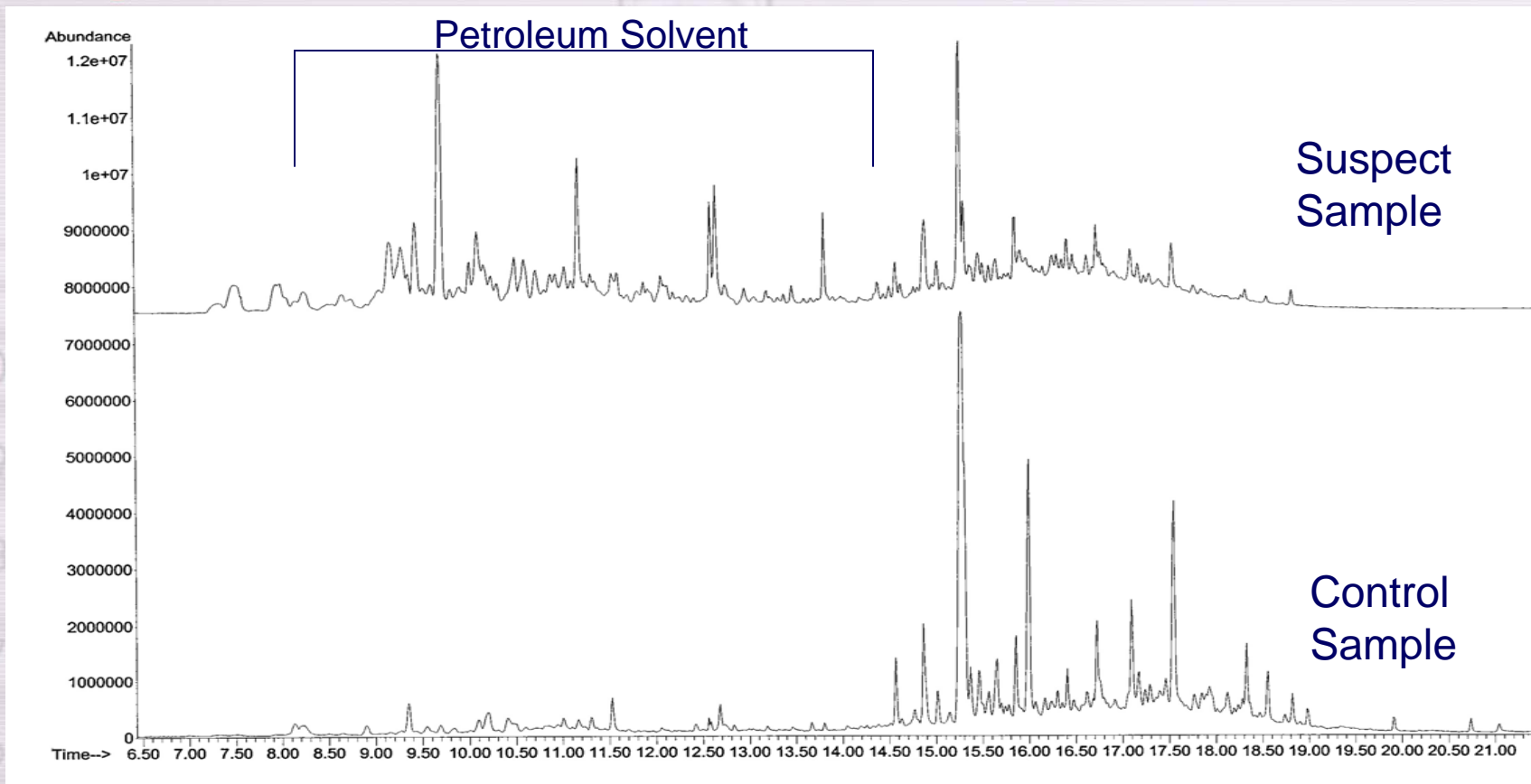
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Contamination

Case Study: Off-Odor Boxes



Qualitative GC/MS Results

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Contamination

Case Study: Off-Odor Boxes



– Outcome

- We found a profile consistent with a low molecular weight hydrocarbon solvent such as mineral spirits or naphtha.
- The client used the data to confront the box manufacturer. The manufacturer confirmed that they had accidentally used naphtha in place of isopropanol to clean the boxes prior to shipping.

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Adhesion/Sealing Failures

- Packaging doesn't stay sealed
- Common Identifiers
 - Premature opening
 - Leakage
- Possible Causes
 - Adhesive failure
 - Material failure



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Adhesion/Sealing Failures

Case Study: Heat Seal Failure



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Adhesion/Sealing Failures

Case Study: Heat Seal Failure

- Problem – Our client's new heat seal adhesive was not providing a hermetic seal and released after only a few days. They suspected that the new adhesive's formula, a polyurethane-acrylic hot melt adhesive, was the reason for the failure.
- Testing – Comparative deformation of old and new formulas using a variety of techniques.

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Adhesion/Sealing Failures

Case Study: Heat Seal Failure



– Outcome

- Gel Permeation Chromatographic (GPC) analysis showed significant differences in the molecular weight distribution.
- This implies incomplete polymerization or degradation of the adhesive and thus reduced adhesive performance.
- We recommended a formula adjustment, and our client was able to resume operations.

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Physical/Material Defects

- Faulty materials: packaging physically breaks down
- Common Identifiers
 - Holes
 - Peeling
 - Breaking
 - Off-color/odor
- Possible Causes
 - Raw materials/product contents
 - Processing issues



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Physical/Material Defects

Case Study: Peeling Cans



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Physical/Material Defects

Case Study: Peeling Cans

- Problem – An epoxy liner was delaminating from the inside of a metal can
- Testing – A comparative study between a control and failed sample was performed. We investigated the possibility of the following:
 - Incorrect epoxy application: Cross sectional analysis and microscopy for film thickness
 - Insufficient epoxy curing: Modulated DSC
 - Contamination: Solvent extraction with GC/MS, FT-IR, and surface analysis using EDXA

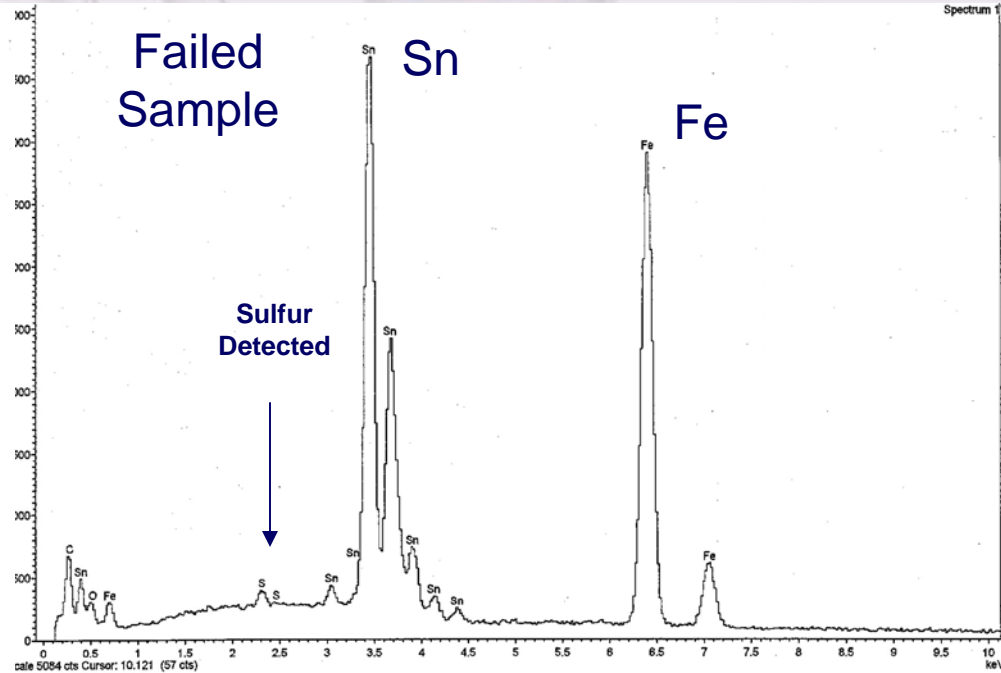
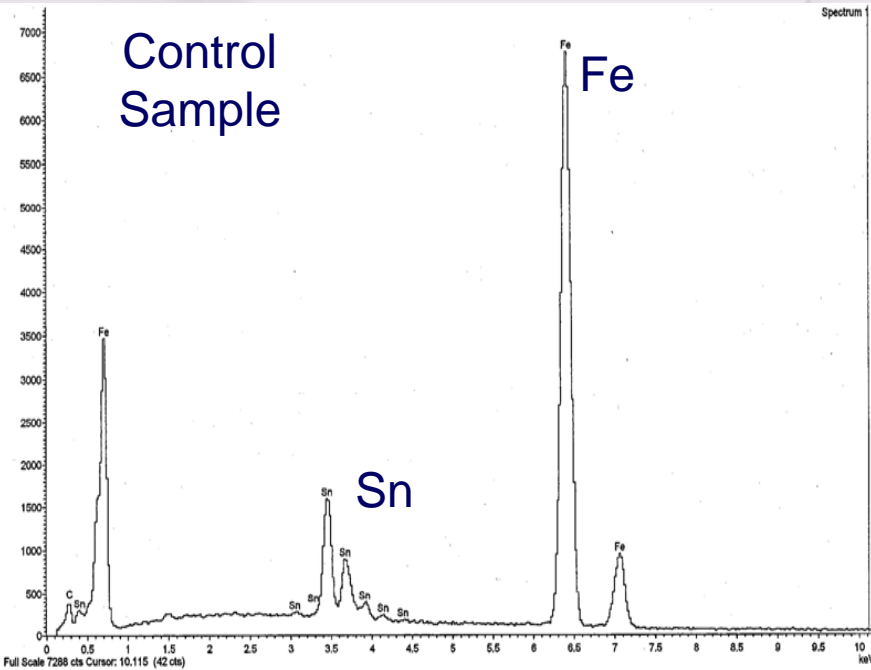
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Physical/Material Defects

Case Study: Peeling Cans



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Physical/Material Defects

Case Study: Peeling Cans



- Outcome – The only detectable difference between the samples was the presence of sulfur on the metal surface of the failed sample. Our client was able to bring the data to the can manufacturer so they could fix the problem.

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Labeling Failures

- Label discoloration or peeling
- Common Identifiers
 - Off-color labels
 - Peeling labels
 - Ink migration from labeling
- Possible Causes
 - Contamination
 - Adhesive failure



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Labeling Failures

Case Study: Ink Migration



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Labeling Failures

Case Study: Ink Migration

- Problem – A client observed an off-flavor and color in a pre-packaged alcohol-based food product.
- Testing – Comparative analysis was performed on suspect and control samples of the lids by GC/MS to look for potential contaminants or impurities contributing to the off-flavor.

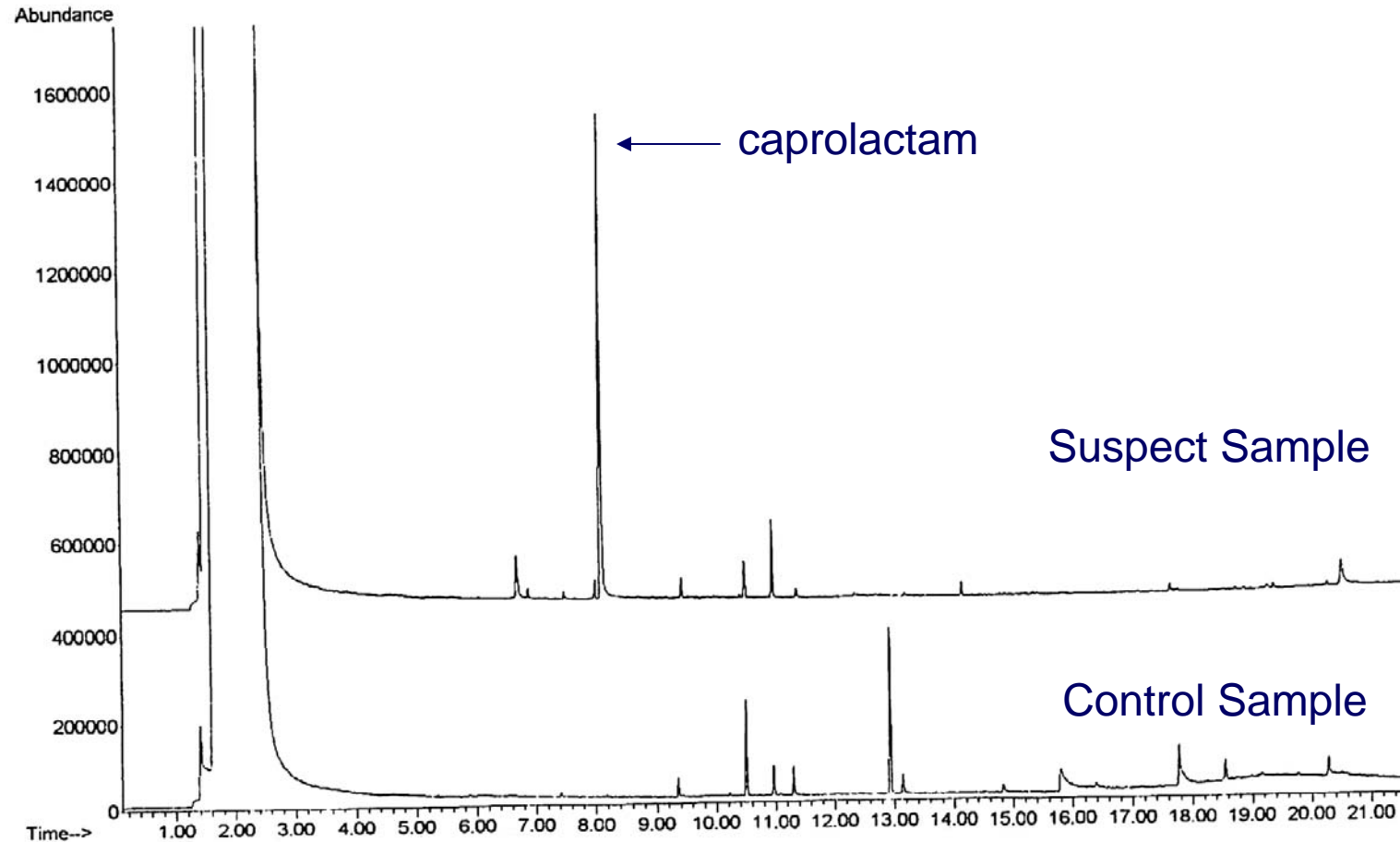
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Labeling Failures

Case Study: Ink Migration



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Labeling Failures

Case Study: Ink Migration



- Outcome – Significant levels of caprolactam were found in the suspect sample, but not in the control.
 - Caprolactam is an alcohol-soluble component of the ink used on the outside surface of the lids.
 - Lids were “stacked” during manufacturing allowing for transfer of ink components into the food-contact side of the lids and eventual migration into the alcohol-based food.

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Finding a Solution

- When to consider a contract lab
- What to look for in a contract lab



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When to Use a Contract Lab

- We don't have the internal capabilities
 - Contract labs often specialize in certain areas and are therefore more experienced and cost effective with the testing you need
- We don't have the instrumentation
 - It is often cheaper to use an outside lab than to buy needed equipment
- We don't have the capacity
 - Contract labs can help when overflow or emergency testing needs to be performed
- Potential for Legal Claims
 - Legal issues often require an independent testing lab
 - Patent infringement, product failure, product recall, etc.

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What to Look for in a Contract Lab

- Routine vs. Non-Routine
- Quality & Communication
- Final Deliverable
- Turnaround Time & Cost



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Routine vs. Non-Routine

- Routine Labs
 - Often specialize in a particular method or matrix/sample type
 - Higher level of experience and throughput in those areas
- Non-Routine Labs
 - Specialize in solving obscure and complex problems that often require unique and inventive approaches
 - Use a variety of investigative analytical techniques
 - Diverse experience base regarding problems and how to solve them

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Quality & Communication

- Quality
 - Accreditation
 - Company quality policies
- Communication
 - Does the project designer ask the right questions before beginning?
 - Who will be my contact?
 - Will they be available to answer my questions?
 - Are they qualified to answer my questions?
 - How will results be communicated and when?
 - Regular updates



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Final Deliverable

- Results are best presented in a comprehensive report
 - Conclusions
 - Methods and observations
- Original data should be included, along with scientific interpretations



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Turnaround Time & Cost

- Be prepared for increased costs for expedited services
 - Rush costs may be balanced against manufacturing down time or potential legal challenges
- When comparing contract laboratory fees, make sure you are looking at similar investigative analyses
 - A customized laboratory will cost more than a routine lab
 - Take care to make “apples to apples” comparisons when evaluating costs or comparing proposals from different labs

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Questions?

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