International Association for Food Protection®

Challenges Identified with Food Fraud Implementation – Part 2 of 5: Risk Mitigation Strategies

Presented By: Amanda Manolis, Jennifer Lott, John Szpylka

Sponsored By: Food Fraud PDG

Organized by: Food Fraud PDG



International Association for Food Protection®

Webinar Housekeeping

- For best viewing of the presentation material, please click on ‘maximize’ in the upper right corner of the ‘Slide’ window, then ‘restore’ to return to normal view.
- Audio is being transmitted over the computer, so please have your speakers ‘on’ and volume turned up in order to hear. A telephone connection is not available.
- Questions should be submitted to the presenters during the presentation via the **Questions section** at the right of the screen.


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Webinar Housekeeping

- It is important to note that all opinions and statements are those of the individual making the presentation and not necessarily the opinion or view of IAFP.

- This webinar is being recorded and will be available for access by IAFP members at www.foodprotection.org within one week.

Food Fraud – Part 2 of 5: Risk Mitigation Strategies

- Part 1: A Strategic Approach to Operationalize Food Fraud Mitigation (held on 2/20/19)
- Part 3: Understanding Types of Risk (Regulatory, Operational, Enterprise)
- Part 4: Emerging Issues: Triggers, Indicators, and Risk Analysis
- Part 5: Ecommerce, Counterfeit, and Labeling

Speakers

John Szpylka, PhD
Scientific Affairs Director, Chemistry N.A. - Mérieux NutriSciences
John manages nutritional analytical method development and is a technical leader for chemistry testing in North America. Prior to joining Mérieux NutriSciences, John was a Principal Scientist with General Mills where he oversaw the development and operation of food analytical methods. He is a Fellow of AOAC International and on the AOAC Board of Directors. He is a past chair of the AOACI Official Methods Board. He currently chairs the Non-Targeted Testing Working Group for the AOACI Food Authenticity Initiative. John received his doctorate in analytical chemistry from the Ohio State University.

Jennifer Lott
Food Safety and Auditing Technical Manager - SGS North America
Jennifer's expertise includes FSSC 22000 Manufacturing and Packaging, BRC GS Consumer Products, BRC GS Storage & Distribution, BRC GS Packaging, BRC GS Agents & Brokers, RSPO, and GMP/HACCP. She is an accredited Lead Auditor and Trainer with over 25 years' experience in quality and safety management system development, consulting, packaging and laboratory management.

Amanda Manolis, MBA
Associate Director, Global Brand Marketing - Thermo Fisher Scientific
Amanda is currently strategic business leader for molecular food protection responsible for strategic development and alliance partnerships. She is charged for driving product/market strategies and development of new tools for answering the question of where to focus for the Microbiology Division on the topics of food safety, authenticity and fraud. Amanda holds an MBA in Global Management from Thunderbird School of Global Management, an Integrated Marketing degree from University of California and a BS degree in Biomedical Science from Texas A&M University.

Moderator and Interim Food Fraud PDG Vice Chair: Karen Everstine, PhD, Senior Manager, Scientific Affairs – Decernis

Food Fraud PDG Chair: Neil Bogart, Food & Beverage - Area Technical Support – Ecolab

Challenges Identified with Food Fraud Implementation - Part 2 of 5: Risk Mitigation Strategies

AOAC INTERNATIONAL
FOOD AUTHENTICITY/FRAUD PROGRAM

JOHN SZPYLKA, Ph.D.

MÉRIEUX NUTRISCIENCES

MERIEUX NutriSciences

Agenda

- Definitions
- AOAC Int'l Response
- Non-Targeted Testing
- Targeted Testing
- Priorities
- Additional Aspects

From Association of Official Agricultural Chemists (1884)

Federal and state departments of agriculture through the USDA Bureau of Chemistry.

✓Initially to standardize methodology used for composition of fertilizers by state laboratories

✓Directed by Harvey Washington Wiley who wrote the 1906 law that began the US Food and Drug Administration (FDA)

Evolution from 1884 - 1980s

AOAC's membership grew to include microbiologist, industry scientists, food science professionals, etc…

Known for the compendium of validated methods - ***Official Methods of Analysis of AOAC INTERNATIONAL***

Formalized demonstration of method reproducibility through Interlaboratory studies

To AOAC INTERNATIONAL

Often referred to as Association of Analytical Communities - to encompass all areas of AOAC's work.

In 1991, Association of Official Agricultural Chemists legally changed its name to **AOAC INTERNATIONAL** and it includes

Voluntary Consensus Standards
Method validation programs
Laboratory Proficiency Testing program
Peer Reviewed Journal & ALACC Guided
Memberships & 17 Global Sections
Conferences, Meetings, Networking
Education/Training, ***and more…..***

AOAC - 1887 Meeting

AOAC 2018 Mid-Year Meeting

§2.19 Methods of analysis.

Where the method of analysis is not prescribed in a regulation, **it is the policy of the Food and Drug Administration in its enforcement programs to utilize the methods of analysis of the AOAC INTERNATIONAL (AOAC) as published in the latest edition** (13th Ed., 1980) **of their publication "Official Methods of Analysis of the Association of Official Analytical Chemists," and the supplements thereto** ("Changes in Methods" as published in the March issues of the "Journal of the Association of Official Analytical Chemists"), which are incorporated by reference, when available and applicable. Copies are available from the AOAC INTERNATIONAL, 481 North Frederick Ave., suite 500, Gaithersburg, MD 20877, or at the National Archives and Records Administration (NARA). For information on the availability of this material at NARA, call 202-741-6030, or go to: *http://www.archives.gov/federal_register/code_of_federal_regulations/ibr_locations.html.*

NOTES:

- [42 FR 15559, Mar. 22, 1977, as amended at 47 FR 946, Jan. 8, 1982; 54 FR 9034, Mar. 3, 1989; 70 FR 40880, July 15, 2005; 70 FR 67651, Nov. 8, 2005]
- **Title 21 → Chapter I → Subchapter A → Part 2 → Subpart A → §2.19**
- Accessed on 3-26-2019 https://www.ecfr.gov/cgi-bin/text-idx?SID=7a20040ac19ed218138aed8bacc33e2f&mc=true&node=se21.1.2_119&rgn=div8

e-CFR data is current as of March 26, 2019

Areas of Focus … Despite the Lack of "Internationally Agreed-upon Definition"

- Food Fraud Incidents :
  - Deliberate act
  - Aims for economic gain in an illicit manner
  - Meant to be hidden / not to be discovered
  - Misrepresents the food product to consumers

- US FDA Working definition of "Economically Motivated Adulteration" (EMA)

The fraudulent, intentional substitution or addition of a substance in a product for the purpose of increasing the apparent value of the product, or reducing the cost of its production, i.e. for economic gain.

Clarifications

- *Food authentication**
  - a process to evaluate that state of being
- *Food fraud**
  - the act that creates the problem;
  - the deliberate and intentional substitution, addition, tampering, or misrepresentation of food, food ingredients, or food packaging; or false or misleading statements made about a product, for economic gain.

*John Spink, *quality Assurance & Food Safety*, 2018

Global Food Safety Initiative (GFSI)

- Food fraud vulnerability assessment
  - The standard shall require that the organization has a documented food fraud vulnerability assessment procedure in place to identify potential vulnerability and prioritise food fraud mitigation measures.
- Food fraud mitigation plan
  - The standard shall require that the organization has a documented plan in place that specifies the measures the organization has implemented to mitigate the public health risks from the identified food fraud vulnerabilities.
- Food fraud mitigation plan (Scope)
  - The standard shall require that the organization's Food fraud mitigation plan shall be supported by the organization’s Food Safety Management System.

AOAC Int'l Initiative

- AOAC INT'L Taskforce on Food Fraud:
  - ✓ Shape AOAC's role and future actions to address the Food Fraud
  - ✓ Leverage AOAC's leadership and stakeholder engagement to support sustained action in addressing analytical requirements for a Food Fraud Prevention
  - ✓ **Framework**
    - **Method Availability**
    - **Method Standardization**

AOAC Int'l Board of Directors' Actions

- Created 2 working groups to achieve its objectives and Food Fraud Initiatives :
  - **TT WG:** Map existing methods, their status, needs for method development and Standardization
    - Chaired by Dr. Joe Boison
  - **NTT WG :** Aims to develop Standards Methods Performance Requirements (SMPRs) for such methods to be used in prevention and early detection of food fraud incidents
    - Chaired by Dr. John Szpylka

Targeted Testing (TT)

- Targeted Testing (TT) requires the **prior identification of adulterants** likely to be present in priority food commodities, subject to EMA and is employed to assure that such adulterants is not threatening the safety and overall integrity of the priority ingredient
- Targeted Testing (TT) protocols/procedures to:
  - Support authenticity assurance
  - Ensure the food supply chain integrity
  - Convey the message to those engaged in those practices that they will be prosecuted.

Targeted Testing Working Group

- Actions:
  - Assessment of gaps of current food fraud test method and develop SMPRs to validate targeted testing methods;
  - Developing standards leading to Codex Type 1 methods;
  - Prioritizing actions of adulterants and commodities of interest

Standard Method Performance Requirements (SMPRs®)

- Appendix F: Guidelines for Standard Method Performance Requirements

- SMPR
  - Define the needs first, then look for methods
  - Voluntary consensus standards developed by stakeholders
  - Prescribe minimum analytical performance requirements for classes of analytical methods.
- Then do a Call for Methods

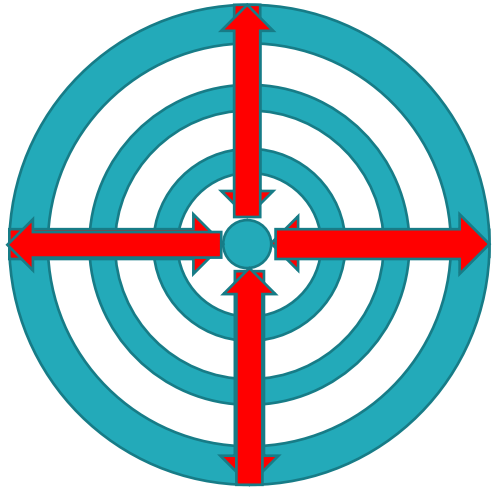
SMPR

Table 1. Analytical range, LOQ, and linearity requirements	
Operating range	0.2–100% (2 to 1000 g/kg) of dry matter
Limit of quantitation (LOQ)[a]	0.2% (2 g/kg) of dry matter
Linearity of standard curve	$r \geq 0.999$, and 95% confidence limit of the *y*-intercept includes zero
[a] Methods that do not achieve the LOQ will still be considered.	

Table 2. Recovery, repeatability, and reproducibility parameters			
Range, %	0.2–1	>1–10	>10–100
Recovery, %	90–110	93–107	95–105
RSD_r, %	≤7	≤5	≤3
RSD_R, %	≤14	≤10	≤6

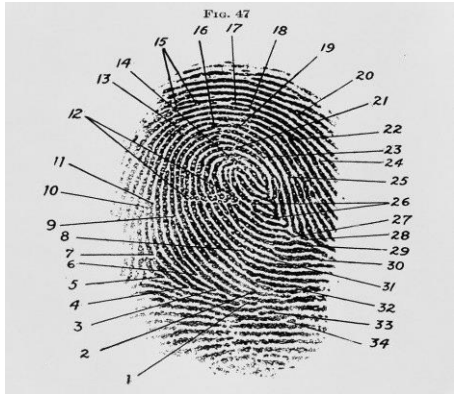
Non-Targeted Testing

- Concept
  - Create a standardized fingerprint for an ingredient.
  - Compare new lots of the ingredient to the fingerprint.
  - Quantify “degree of difference”
    - Small amount of difference is a yellow flag
    - Large difference is a red flag



Non-Targeted Testing (NTT)

- Non-Targeted testing requires the creation of a baseline “fingerprint” to assess degree of difference of a tested lot
- This occurs prior to **identification of adulterants** likely to be present
- This is employed to assess true value of the ingredient/food, and to reduce the risk of a non-safe ingredient or food.



Non-Targeted Technologies

- Variety of methodologies use being used
  - LC-MS/MS
  - GC/MS
  - NMR
  - Spectroscopic
  - XRF and other ones for certain matrices
- Data analysis
  - Chemometrics
  - Principle Component Analysis
  - Customized software
- Requirements don’t exist

NTT Working Group

- Create Standard Method Performance Requirements
  - Demonstration of Non-Targeted Testing method effectiveness
  - Validation/verification guidance
- Apply to NTT tests covering prioritized commodity list

Leverage USP Appendix XVIII

- USP Appendix XVIII, "*Guidance on Developing and Validating Non-Targeted Methods for Adulteration Detection*"
- Applicability Statement
  - Matrix/Purpose/Sensitivity & Sensitivity
  - "Typical Samples"
  - ID adulterants to be used (expected ones)
    - SMPR or Method Developers
  - Validation protocol
    - Levels and Number of Samples

Leverage POI / POD

- AOAC protocols on
  - Probability of Detection (POD)
    - OMA Appendix H
  - Probability of Identification (POI)
    - Applies POD to identifying botanicals

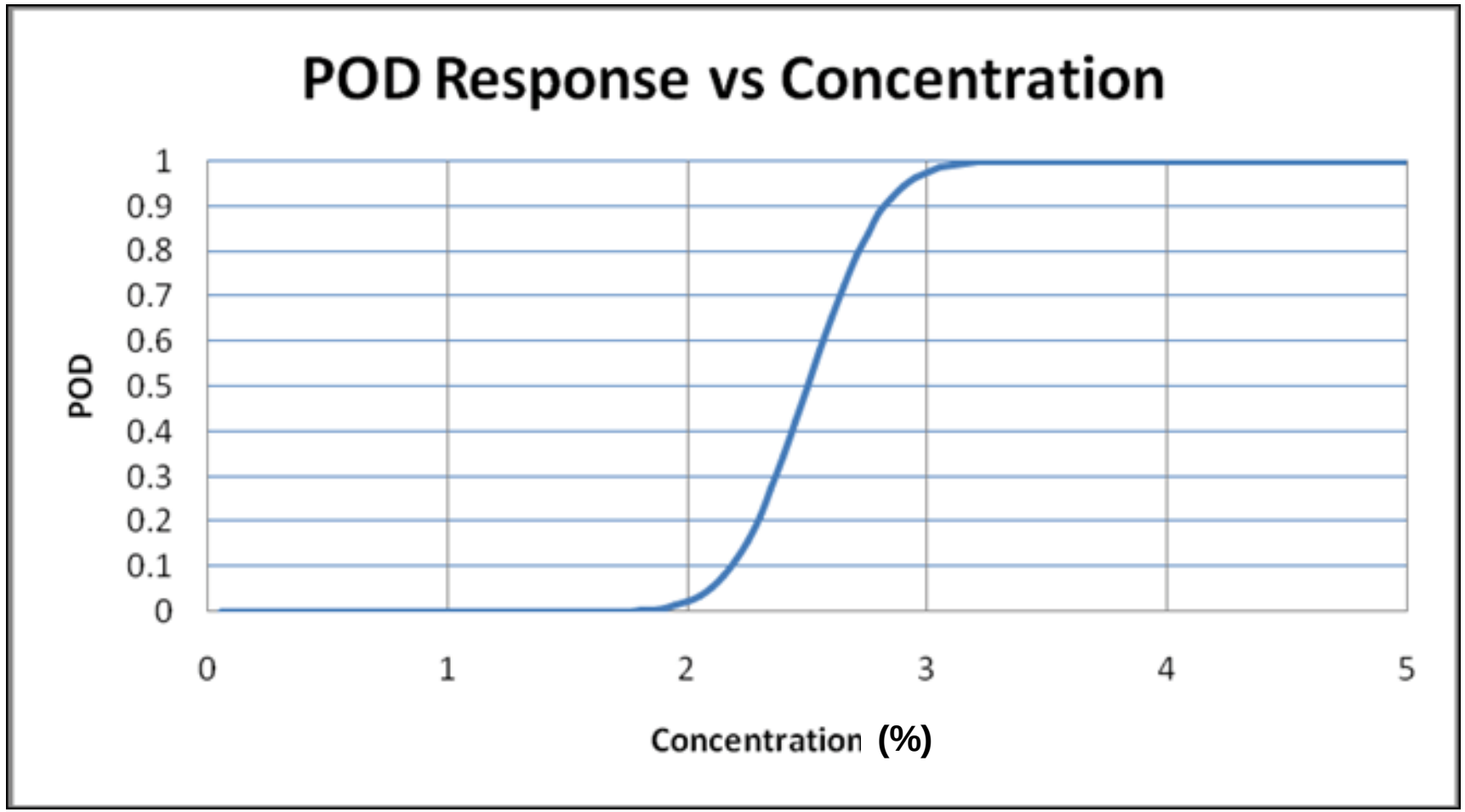
A POI Approach

- Base %EMA.—Estimated adulteration level in an ingredient that results in significant economic gain.
  - NTT methods should take %EMA into account.
- *POI100*.— the lowest concentration of a defined adulteration that can be identified with 100% accuracy.
- *POI50*.— the lowest concentration of a defined adulteration that can be identified with 50% accuracy.

POI Approach

Table 1: Method Performance Requirements					
	Study	Parameter	Parameter requirement	Target Test Conc (%)	Minimum Acceptable Results
Single-Laboratory Validation	Matrix Study	POI below Base %EMA	Minimum 33 replicates representing potential adulterants	TBD by Stakeholder Panel	90% POI (must be decided by task force) of pooled data for all target compounds and matrices
		POI above Base %EMA	Minimum of 5 replicates per ingredient type spiked at Base %EMA	TBD by Stakeholder Panel	100% correct analyses (must be decided by task force)
		False-positive rate	Minimum 5 replicates of each ingredient type know to be non-EMA	TBD by Stakeholder Panel	??
	Selectivity	LPOI	Analyte Specific	Analyte Specific	

Probability of Identification (aka Detection)



Commodity Prioritization Survey

- Commodity Survey Results
  - Olive oil
  - Honey
  - Fish
  - Meat
  - Milk Powder
  - Seafood
  - Grains (rice)
  - Spices

Additional Topics

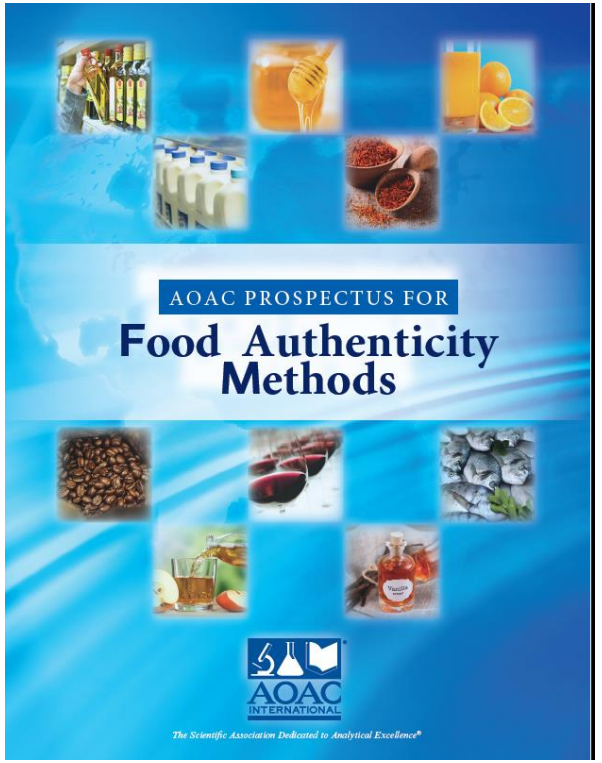
- Consider overlapping technologies for
  - targeted and
  - non-targeted testing procedures
- Recommend AOAC process for standards development and review, in the event of a major international food fraud incident, requiring rapid resource mobilization.
- Figure out how to create and use Reference Materials (and Certified Reference Materials) to assess NTT and TT analytical methods.

Main Points

- AOAC Int'l focusing on defining how to evaluate the reliability analytical methods used to identify food fraud events
- Targeted Test Methods
  - Identify and/or measure known adulterations
- Non-Targeted Test methods
  - Screening tools to evaluate degrees of difference of a food to a baseline material
- Now defining how the methods must perform to meet the industry needs

AOAC Food Authenticity Working Group

- For information on how to join any of the AOAC Food Authenticity Working Groups below, please contact Delia Boyd, Sr. Manager at dboyd@aoac.org.
  - Non-Targeted Testing Working Group
  - Targeted Tested Working Group



Thank you

FOOD SECTOR

MAKING THE DIFFERENCE

INNOVATIVE SAFETY, QUALITY AND SUSTAINABILITY SOLUTIONS FOR YOUR SUPPLY CHAIN

Food Fraud Risk Assessments
Supplier Selection and Accountability

WHEN YOU NEED TO BE SURE

SGS

SUPPLIER SOURCING: FUNDAMENTALS

- In 1995, industry simplified supplier sourcing into 10C's *(Ray Carter, Purchasing and Supply Management)*

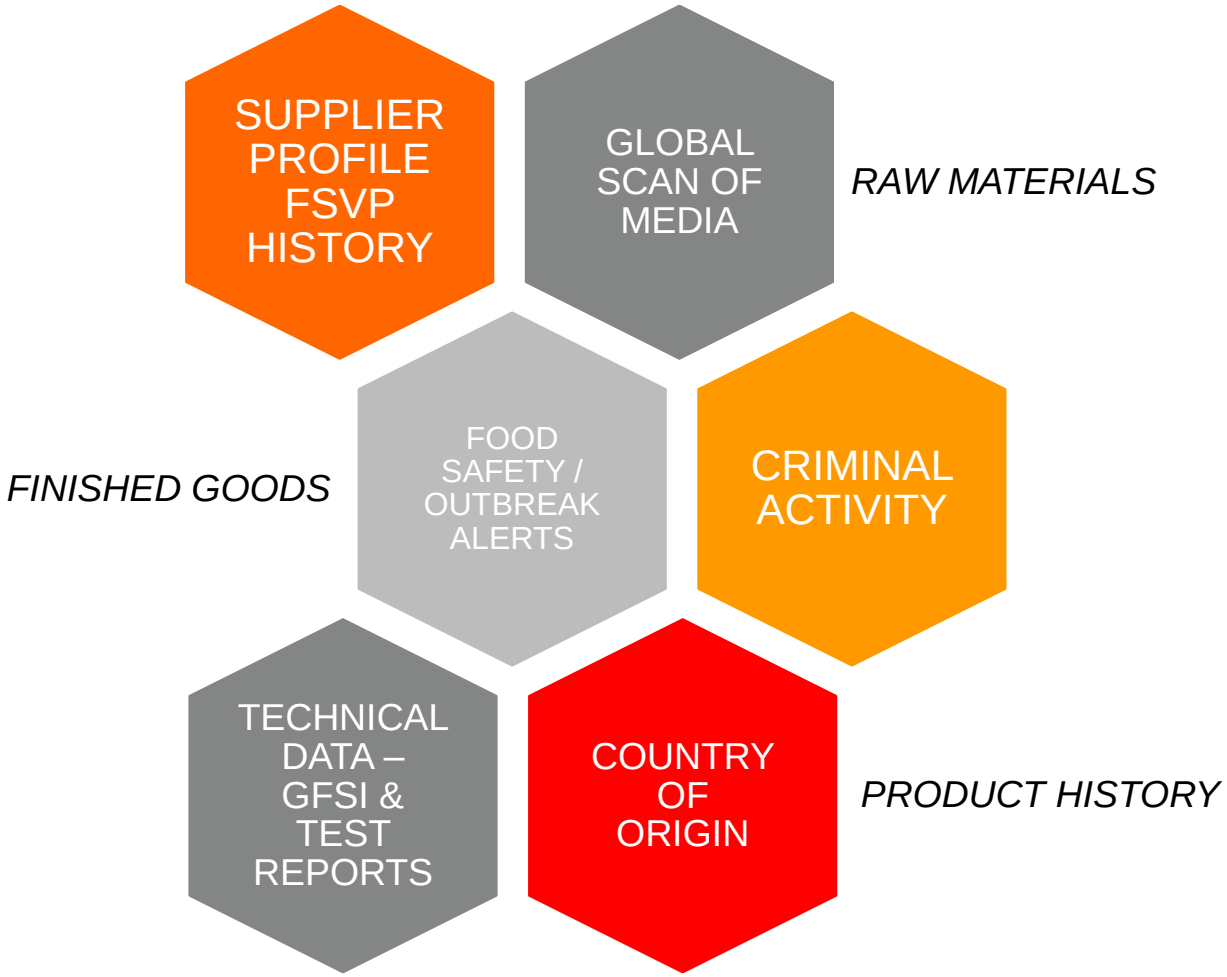
Competency Capacity Commitment Control Cash

Cost Consistency **Culture** Clean Communication

- Today, we spend a lot of time on Culture *(it "eats strategy for lunch")*, and determining how to quantify that.

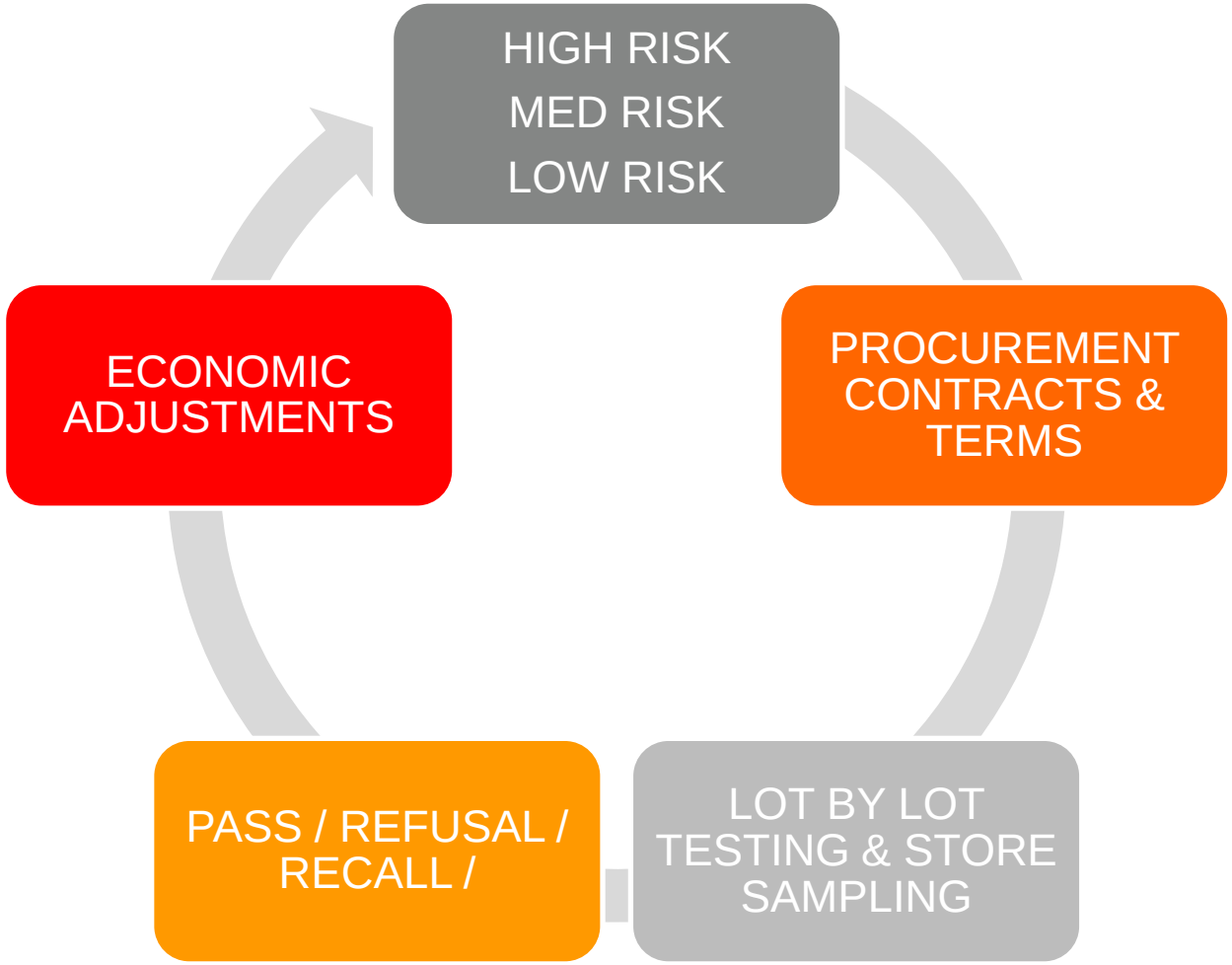
SOURCING SUPPLIERS & CONSTANT VIGILANCE

Private Label Retail

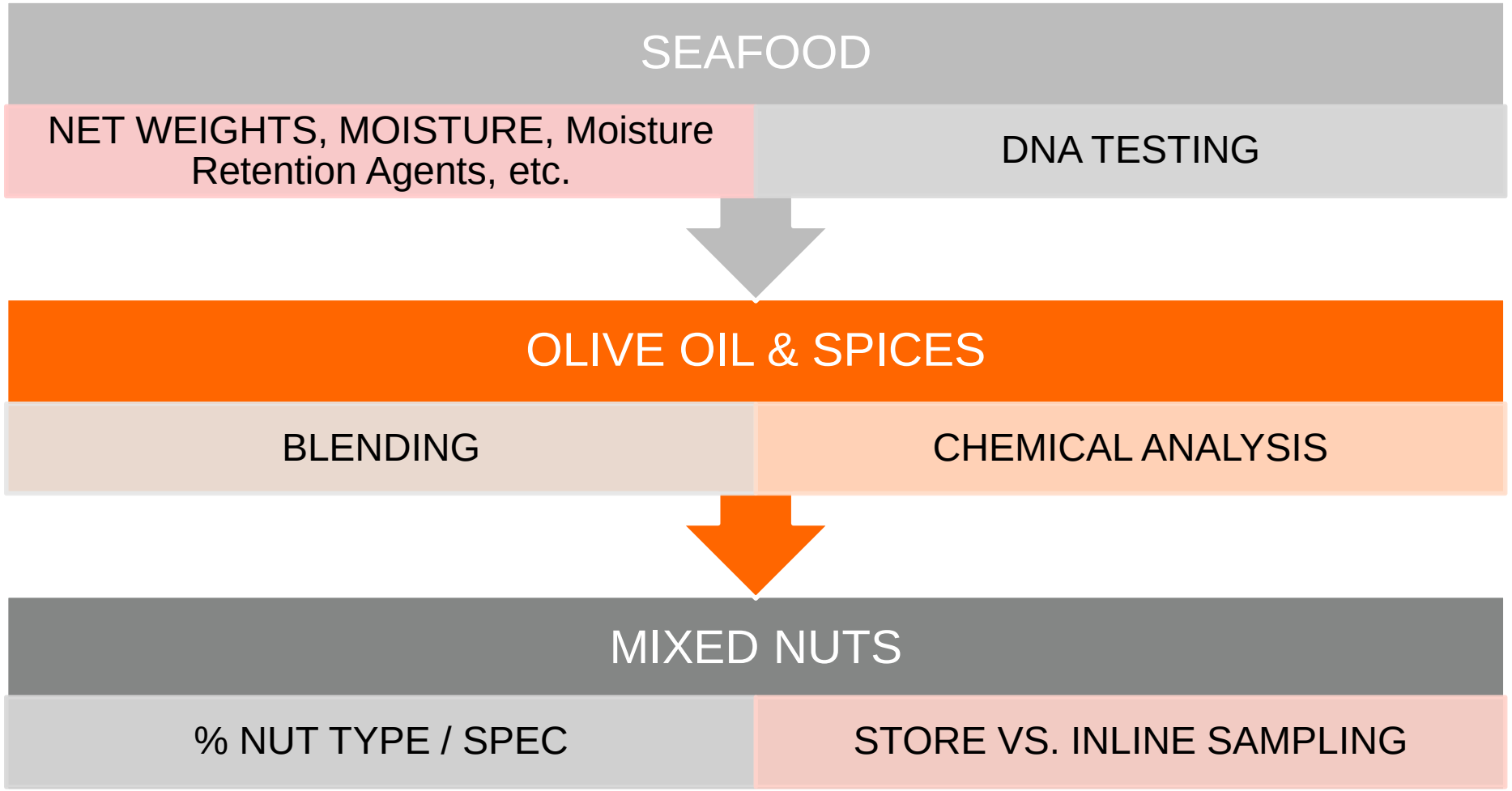


SUPPLIER ACCOUNTABILITY

Private Label Retail



MONITORING SUPPLIER ACCOUNTABILITY



RETAILER TO SUPPLIER / ACCOUNTABILITY

- Supplier Policies & Guidelines Manual
  - Compliance aligns the organization
  - Non-compliance jeopardizes the business relationship
- Examples:
  - **Animal Welfare**: Products must obtain annual third party audits to verify proper animal handling and must present the results of such audits…annually.
  - **Fruit & vegetable** - Farm Food Safety Management Systems audited by an approved independent third-party food safety auditor and/or certification provider. Access to perform an assessment of working conditions on the farms of any Supplier of fresh fruits or vegetables. Full details upon request.
- Frozen food: evidence of temperature abuse? "Retailer" may reject the entire load.

RETAILER ACCOUNTABILITY REQUIREMENTS

- “Retailer” shall have the absolute right in its sole discretion to terminate any part or all of its relationship with Supplier at any time for any reason.
- Retailer’s suppliers must maintain documented procedures for food safety training of all personnel who manufacture, process, pack, or hold food.
- Retailer requires that all Suppliers of Products that are finished food, ingredients and food packaging material achieve and maintain certification audits from one of the Global Food Safety Initiative (GFSI) benchmarked audit standards.

PRIVATE LABEL IMPORTER

- We vett our vendors through a combination of:
  - Auditing (for example, BRC as a worldwide standard)
  - third party testing.
    - The testing is designed to detect food fraud in high risk categories (i.e. DNA testing of fish).
  - Site visits - areas (i.e. Parma Italy) where we need to review items that typically have food fraud issues:
    - (i.e. ham, vinegar, honey, spices, olive oil).

SPEAKER CONTACTS

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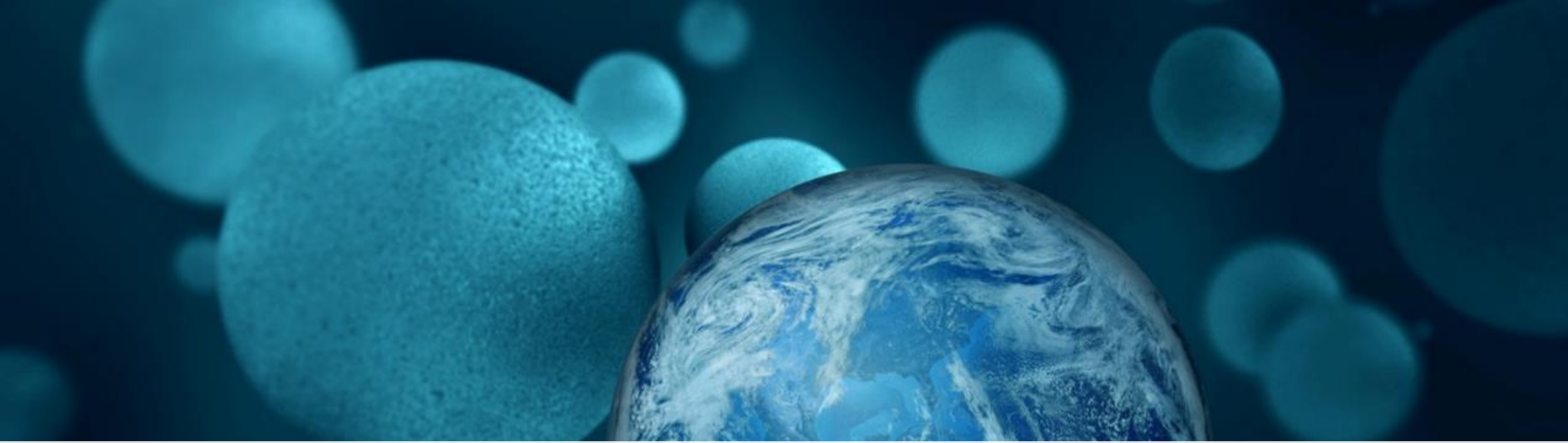
Email: jennifer.lott@sgs.com



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Food Integrity with New Analytical Technologies: Unlocking the Truth

Amanda Manolis BS, MBA
April 2, 2019

We take pride in our Mission

We enable our customers to make the world healthier, cleaner and safer

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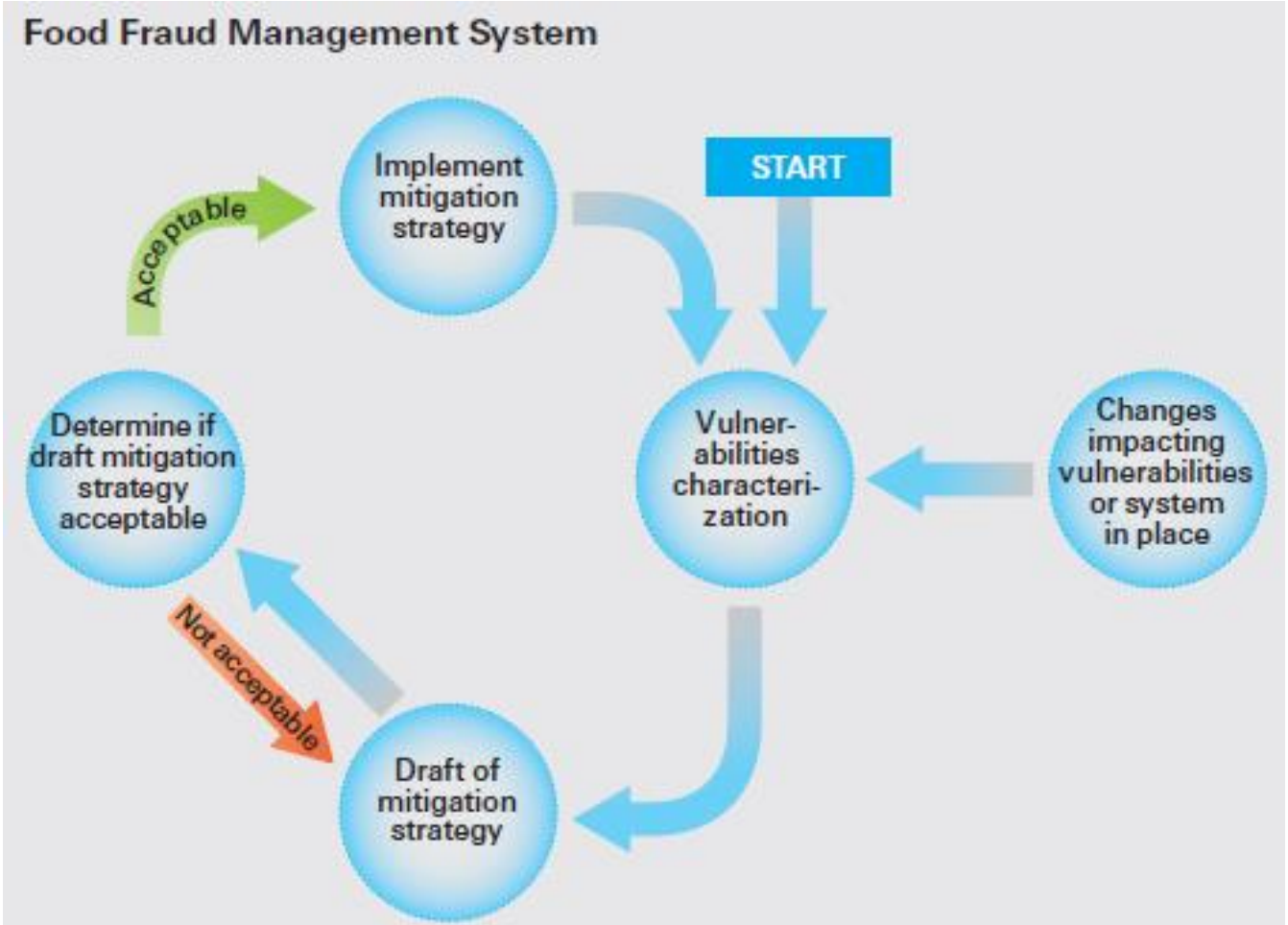
How can a business protect itself against food fraud?

Continuous process:

- Evaluation to characterize food fraud vulnerabilities
- Design & review of a mitigation strategy
- Implementation & testing
- Regular review & update, particularly as changes are introduced, e.g. new supplier

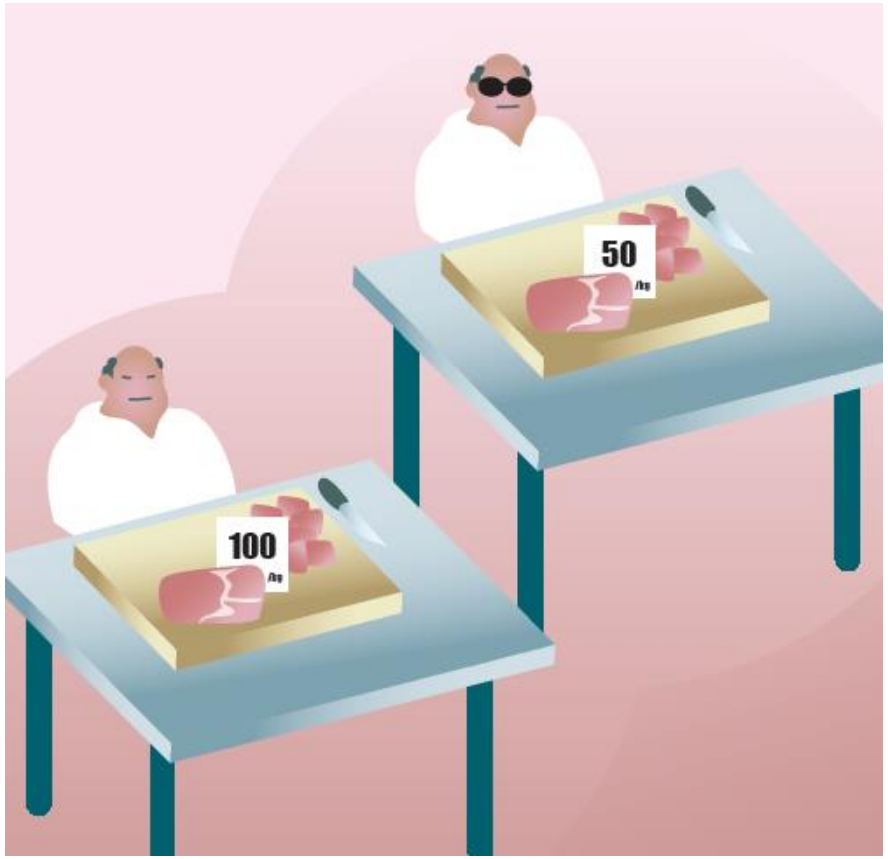


from U.S. Pharmacopeia Appendix XVII: Food Fraud Mitigation Guidance

Excerpt from: https://www.nestle.com/asset-library/documents/library/documents/suppliers/food-fraud-prevention.pdf

Vulnerability assessment

- Know your materials & risks
- Know your suppliers
- Know your supply chain
- Know your existing control measures

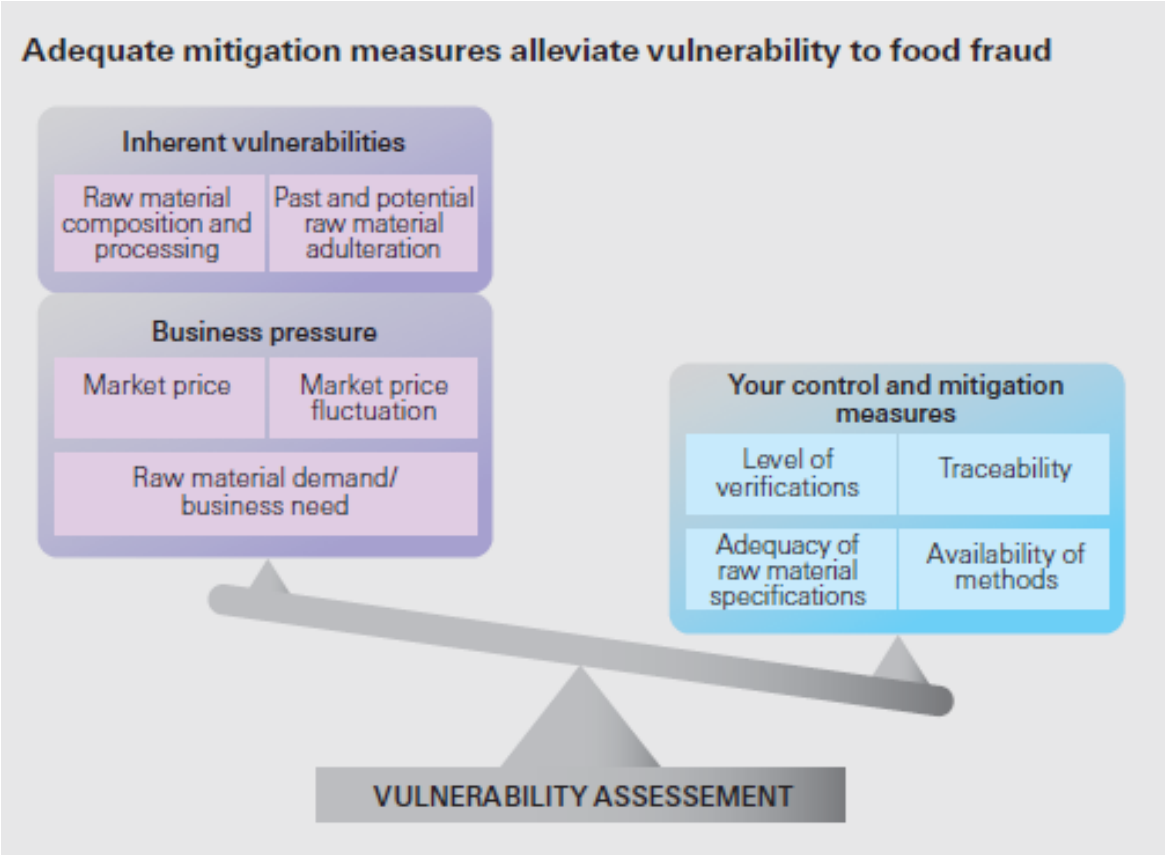


If the price of a valuable food seems too good to be true it probably is!

Excerpt from: https://www.nestle.com/asset-library/documents/library/documents/suppliers/food-fraud-prevention.pdf

Mitigation against food fraud

- Raw material specifications
- Supplier relationship
- Supplier audit
- Supply chain transparency and simplification
- Alert system
- Analytical surveillance



Excerpt from: https://www.nestle.com/asset-library/documents/library/documents/suppliers/food-fraud-prevention.pdf

Choosing the right analytical strategy to reduce the food fraud risk

Analytical Strategy for Food Integrity

Blatantly counterfeit product ⇨ Visual and/or organoleptic verification of labels, container, content

Adulteration
Enhancement
Dilution
Substitution ⇨ Chemical or biomolecular composition: chromatography, spectroscopy, DNA profile

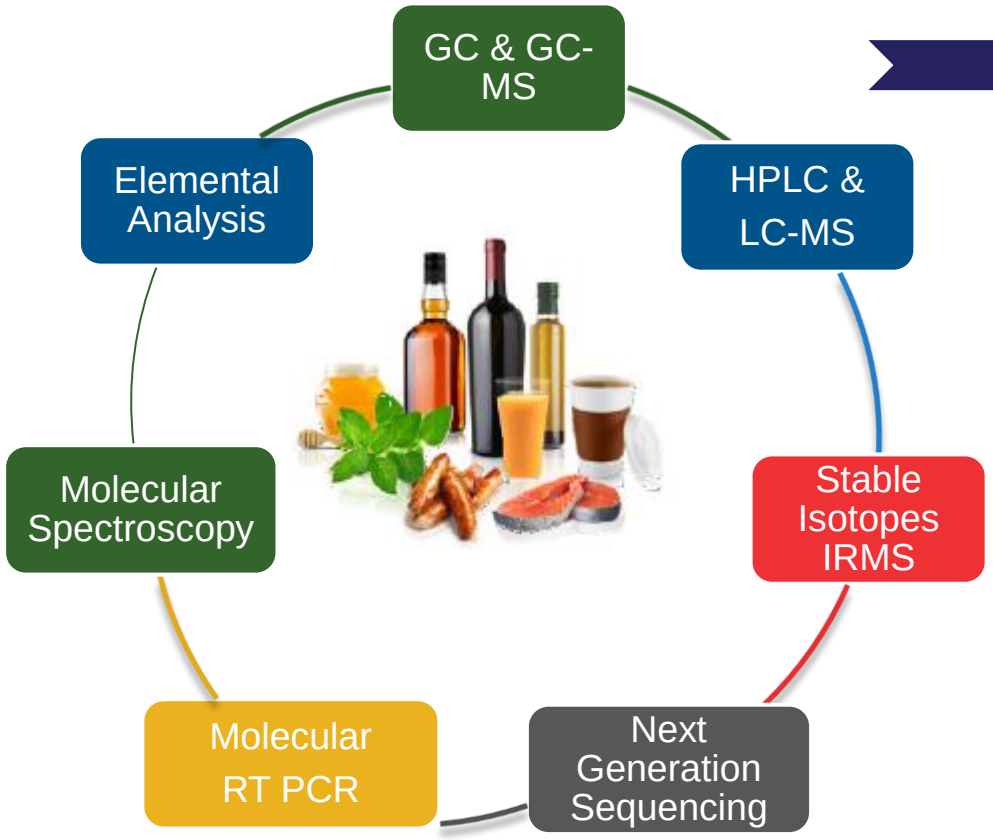
Geographical origin
Production method ⇨ Stable isotope analysis, trace element profile

All or some of the above! ⇨ Untargeted or targeted approach

Analysis – Targeted and untargeted methods

- Adulteration
  - Targeted methods are used to detect and quantify a known substance used for adulteration
  - Untargeted methods can be used initially to screen for possible adulteration, leading to identification of the substance responsible and then subsequent target analysis often follows.
- Authenticity
  - For authenticity untargeted methods are used to ‘fingerprint’ foods, by measuring a number of different variables and looking for characteristic patterns employing statistical techniques (chemometrics) or genetic markers (DNA profiling)
  - Databases are critical for establishing ‘fingerprints’ of genuine food & beverages

Targeted and untargeted methods to test for authenticity

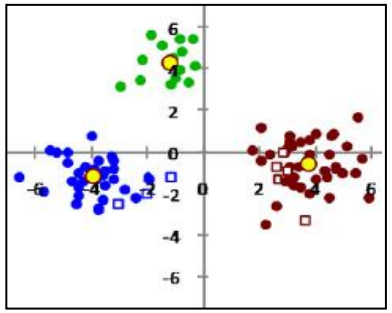


Different statistical tools are used to establish which parameters show maximum discrimination

Database of Authentic Foods

DNA Analysis and Results

Selection of Appropriate Chemometrics



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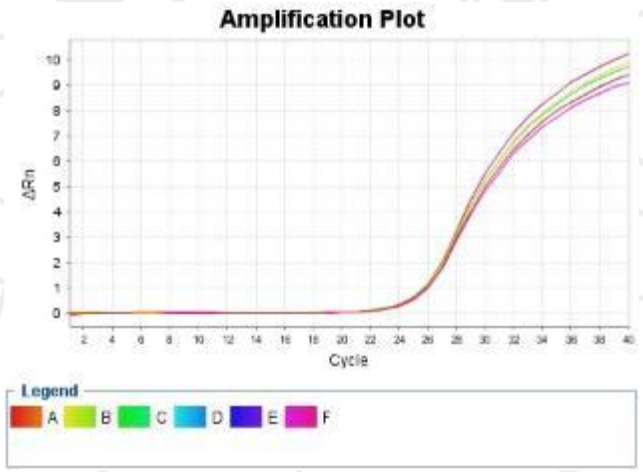
DNA fingerprints

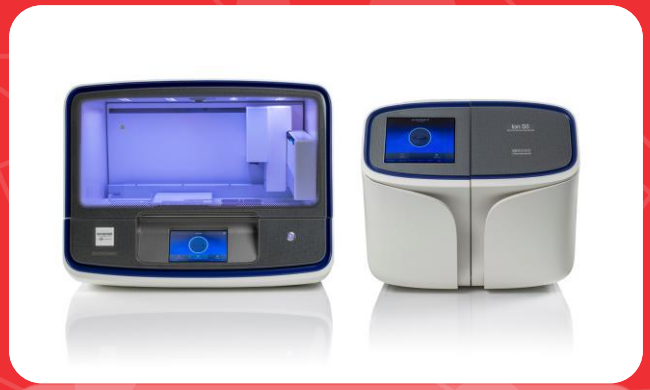
- To visualize DNA fingerprints, molecular detection can be used, e.g. real-time PCR (qPCR) and Next Generation Sequencing (NGS)
- DNA fingerprints can provide a unique insight into food integrity investigations around applications of authenticity, adulteration and mislabeling for brand and consumer protection
- The most common method to verify species substitution and animal species identification and quantitation is real-time PCR
- NGS is a high-throughput methodology that enables rapid sequencing of the base pairs in DNA samples. Supporting a broad range of applications, including microbial profiling, food authenticity and traceability, detection of epigenetic changes, and molecular analysis.

Multi-species identification using DNA fingerprints

Real time PCR



Next Generation Sequencing



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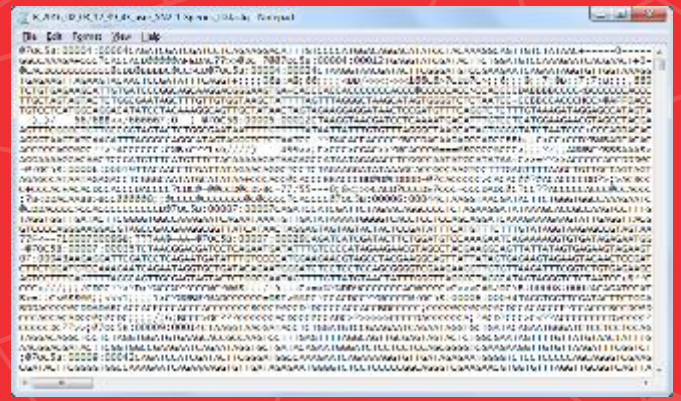

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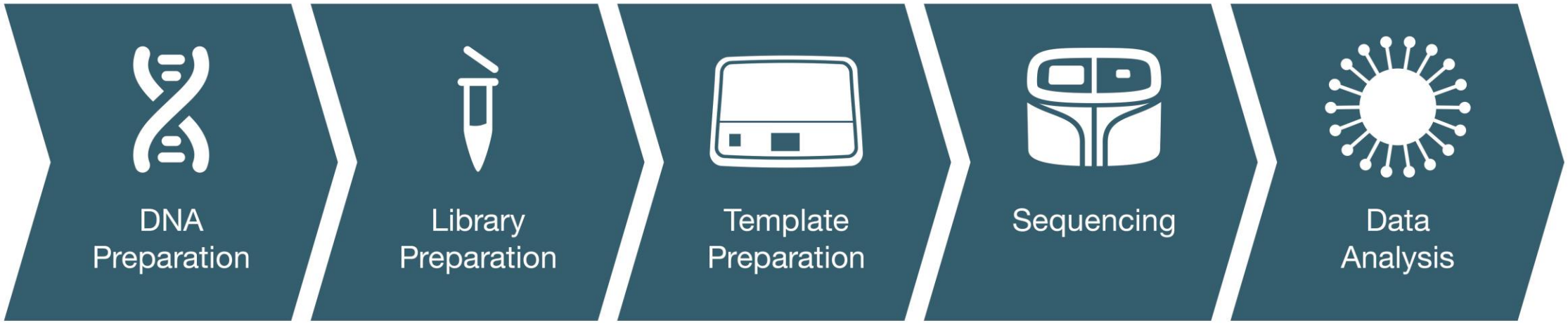
Multi-species screening and identification

The new **Thermo Scientific™ NGS Food Authenticity Workflow** is a complete, automated, next generation sequencing workflow and software database for multi-species ID screening



* DNA preparation time range includes overnight incubation for select few sample types

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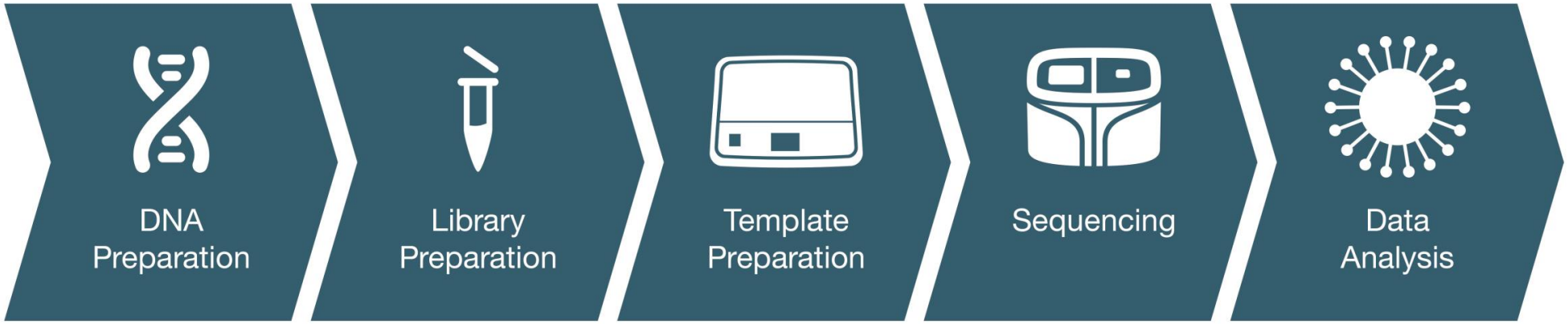
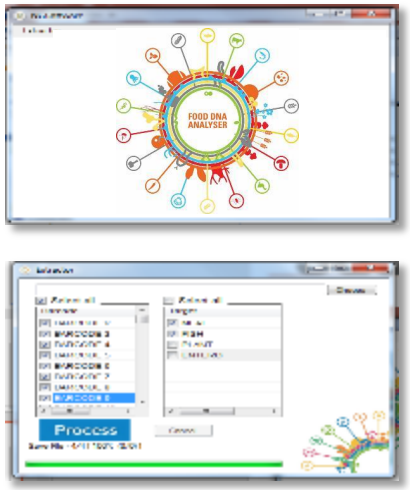
Data analysis made simple with SGS All Species ID Software

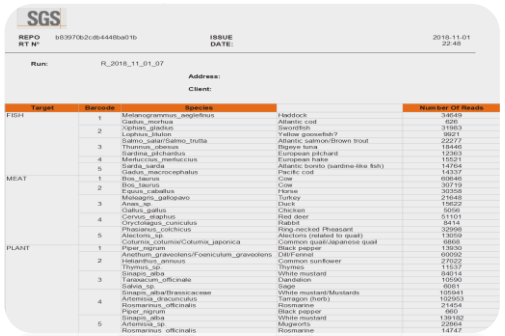


Fastq file

All Species ID Software



User-friendly output



Data analysis and results

- Validated database
- All targets detected

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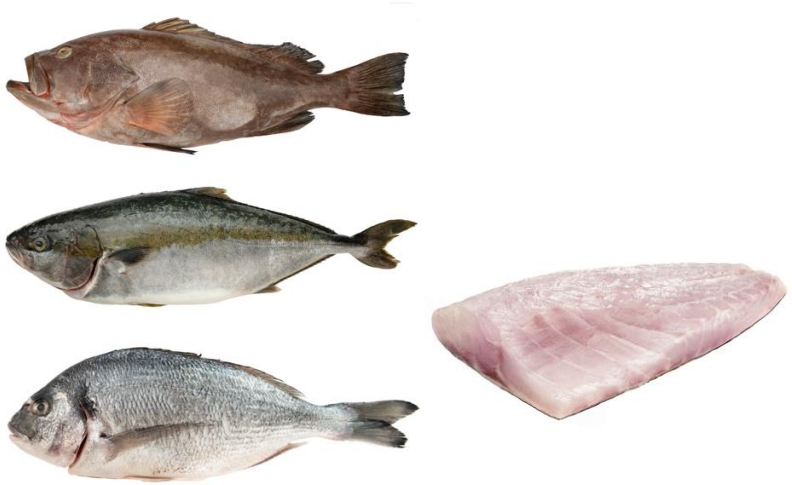
Informative and reliable results

- All targets are detected in a single run (meat, fish & plant)
  - Regularly up-dated database currently containing over 17,000 species
- Optimized sampling and sample preparation
- Reliable results in complex (multi-ingredient) and processed samples
  - DNA sequencing – most reliable method for species confirmation
  - DNA can be highly fragmented as the regions targeted are very short, e.g. 100 nucleotides
- NGS is on its way to for international standardization:
  - NWIP (new work item proposal) ISO project: ISO TC 34/SC 16 ISO 22949-1
  - Molecular biomarker analysis – Detection and identification of animal species by DNA sequencing methods (Including NGS)
- Fast, easy to use, precise and cost effective
- Bringing next generation sequencing to routine testing

Case study: Grouper fillet

SITUATION

- Retailer requested species ID for seafood. Confirm grouper species authentication
- Sanger sequencing ID that is appropriate for single species products originated a mixture of DNA sequences and no identification results



RESPONSE

- NGS Mutli-Species ID was performed, revealed 4 different fish species
- Few species identified where not commercially authorized fish species – one of the species toxic
- Supplier after knowing the NGS results confirmed that in spite of the fillet format of the product it was not a true fillet but processed fish sample with a fillet format

VALUE DELIVERED

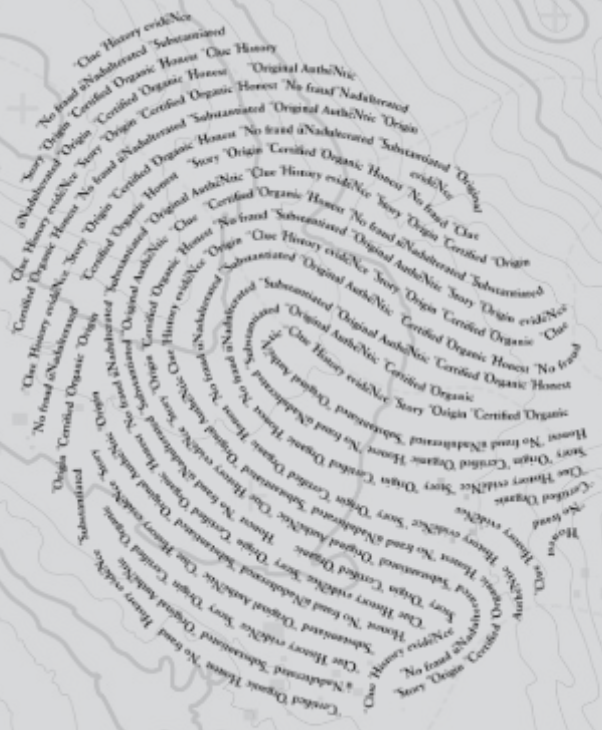
Rapid Response
Hours to days to sequence sample, and provide accurate analysis back

Customer Solution
Specific for fish species ID testing in food

Scientific Expertise
Highly skilled and supportive scientists dedicated to food safety and integrity

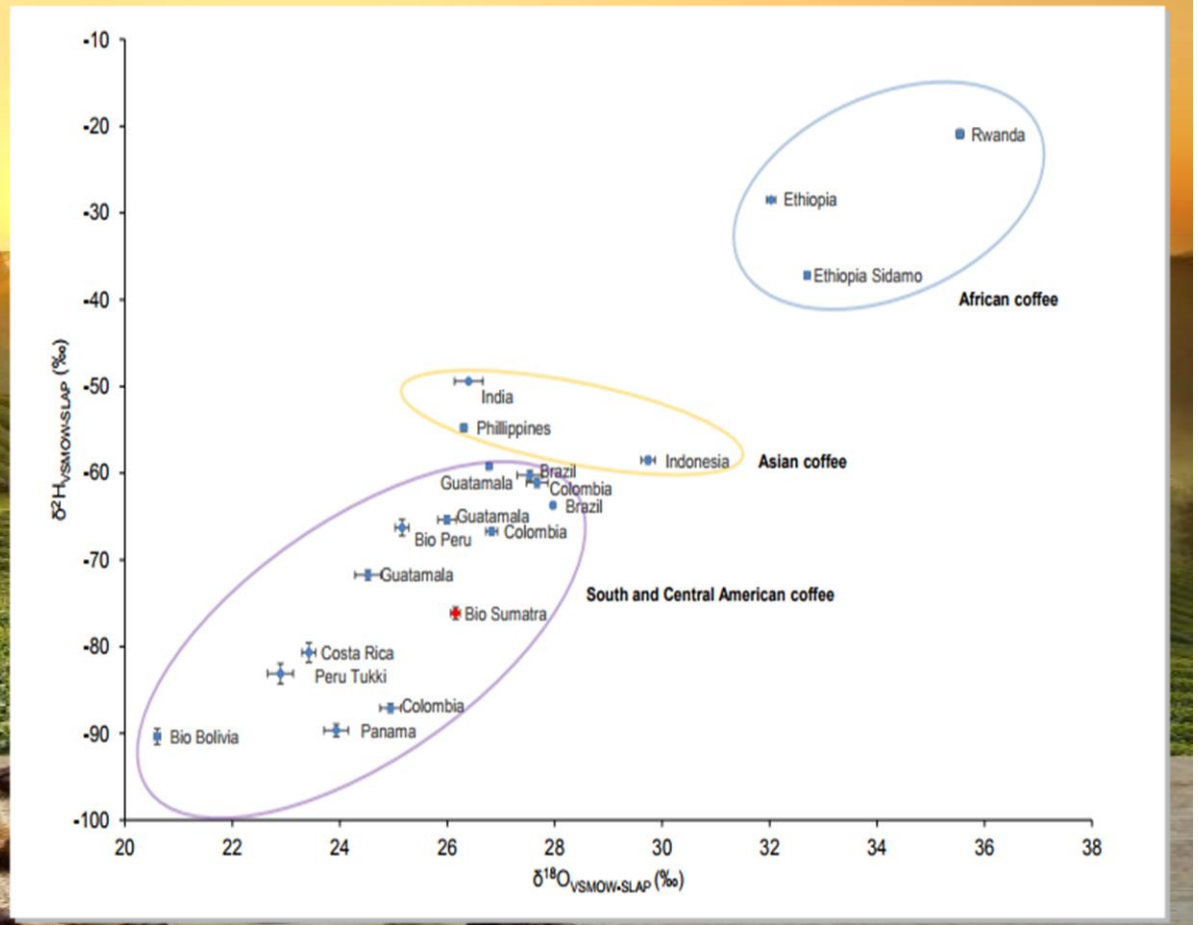
Chemical fingerprints: Chemically similar but physically different

- **Materials have a fingerprint, a unique chemical signature that allows the sample to be identified**
- **To visualize this fingerprint, Isotope Ratio Mass Spectrometry (IRMS) is used to measure stable isotopes and identify the isotope fingerprint of a material or product**
- **IRMS traces carbon, nitrogen, sulfur, oxygen, and hydrogen isotopes by detecting their natural variations, which can reveal the origin and history of samples.**



Tracing the geographical origin of coffee

- Hydrogen and oxygen isotope fingerprints
- The *Coffea* species plants, cultivated as the source of the coffee beans, carry an isotopic fingerprint associated with local-regional rainfall
- Differentiation of American, Asian and African coffee beans (green and roasted)
- Identification of mislabeled coffee



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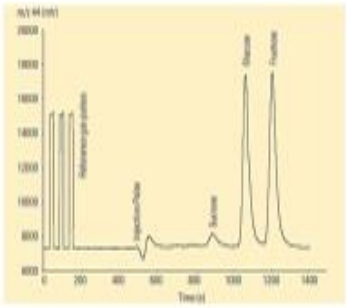
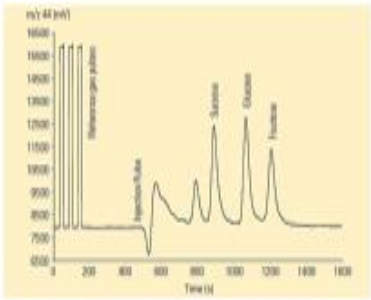
Extending the application of EA-IRMS: Honey adulteration

- EA-IRMS to assess $\delta^{13}C$ value of honey and its protein fraction (limit of detection ~ 7% of C4 sugar addition)
- Solution: irm-LC/MS using the LC IsoLink™ interface allows:
  - Comparison of $\delta^{13}C$ value of different sugars
  - Determination of the sugar pattern
  - Higher sensitivity - 100x more sensitive than direct EA-IRMS
- See our application note AN30024 - Testing honey adulteration by $\delta^{13}C$-EA/LC-IRMS for full details

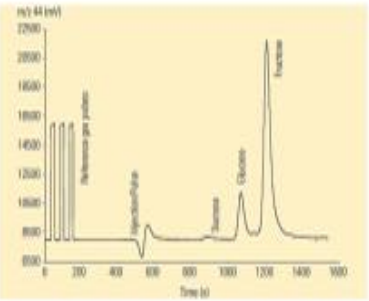
HONEY	SUCROSE ‰	GLUCOSE ‰	FRUCTOSE ‰	FRU/GLU RATIO OF AREAS	EA HONEY(4) ‰	EA PROT.(4) ‰	ADULT.(4) %	
1	-23.3	**-23.2**	**-22.9**	1.07	**-21.8**	-24.2	**16.7**	**adulterated**
2	-11.3	**-11.2**	**-13.9**	**0.65**	**-11.9**	n.a.	n.a.	**adulterated**
3	-25.3	-24.9	-24.9	1.42	-24.8	-24.8	0.0	
4	-26.4	-26.5	-26.4	0.97	-25.4	-21.6	0.0	
5	n.d.	-26.1	-26.0	**4.53**	-25.8	-26.1	1.9	**adulterated**
6	-26.1	-25.0	-25.3	1.62	-24.3	-24.3	0.0	
7	-25.0	-25.2	-25.1	1.16	-24.2	-24.7	3.4	
8	n.d.	**-25.1**	**-26.4**	2.17	-24.8	-25.1	1.5	**adulterated**



Honey 1



Honey 2



Honey 5

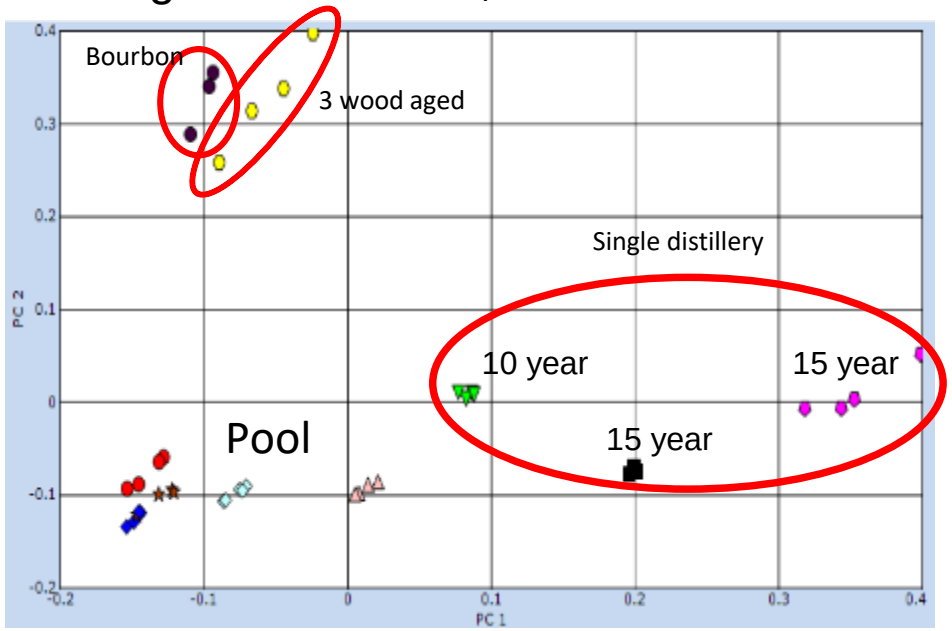
Chemical profiling: Chemically different but physically similar

- **Chromatography and High Resolution Mass Spectrometry**

Whisky authenticity by GC-HRAM

- Study to determine the chemical differences between whisky samples?
  - Type of Whisky: Bourbon or Scotch Whisky
  - Geographical Origin: USA or Scotland, Highland or Lowland
  - Age of Whisky: 10 or 15 year aging

- Approach: A non-targeted (screening) analysis and statistical software tools
  (including NIST libraries, deconvolution software, elemental composition and fragment matching software)



- Bourbon and 3 wood aged clearly different from other whiskies
- Single distillery whiskies also show clear differences

Food solutions: Comprehensive solutions to protect our food supply

Gas Chromatography

Ion Chromatography

Liquid Chromatography

Molecular Spectroscopy

Isotopic and Elemental Analysis

Next Generation Sequencing and RTPCR Molecular Analysis

Maintain Safety Standards

Detect Contamination

Confirm Authenticity

Determine Purity

Ensure Quality

Helping our customers to deliver healthier and safer food products

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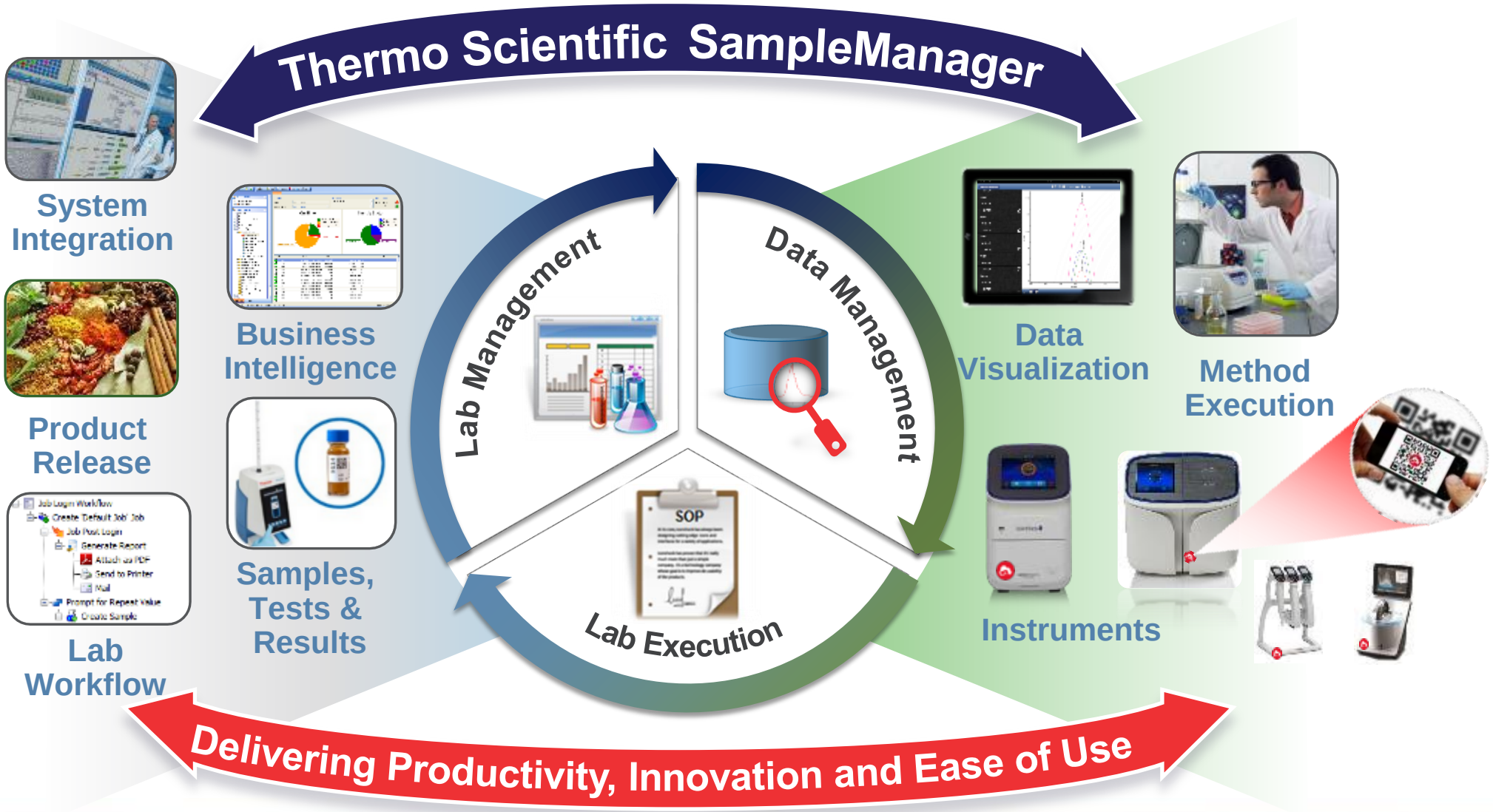

Thermo Scientific SampleManager
System Integration
Business Intelligence
Product Release
Samples, Tests & Results
Lab Workflow
Lab Management
Data Management
Lab Execution
SOP
Data Visualization
Method Execution
Instruments
Delivering Productivity, Innovation and Ease of Use

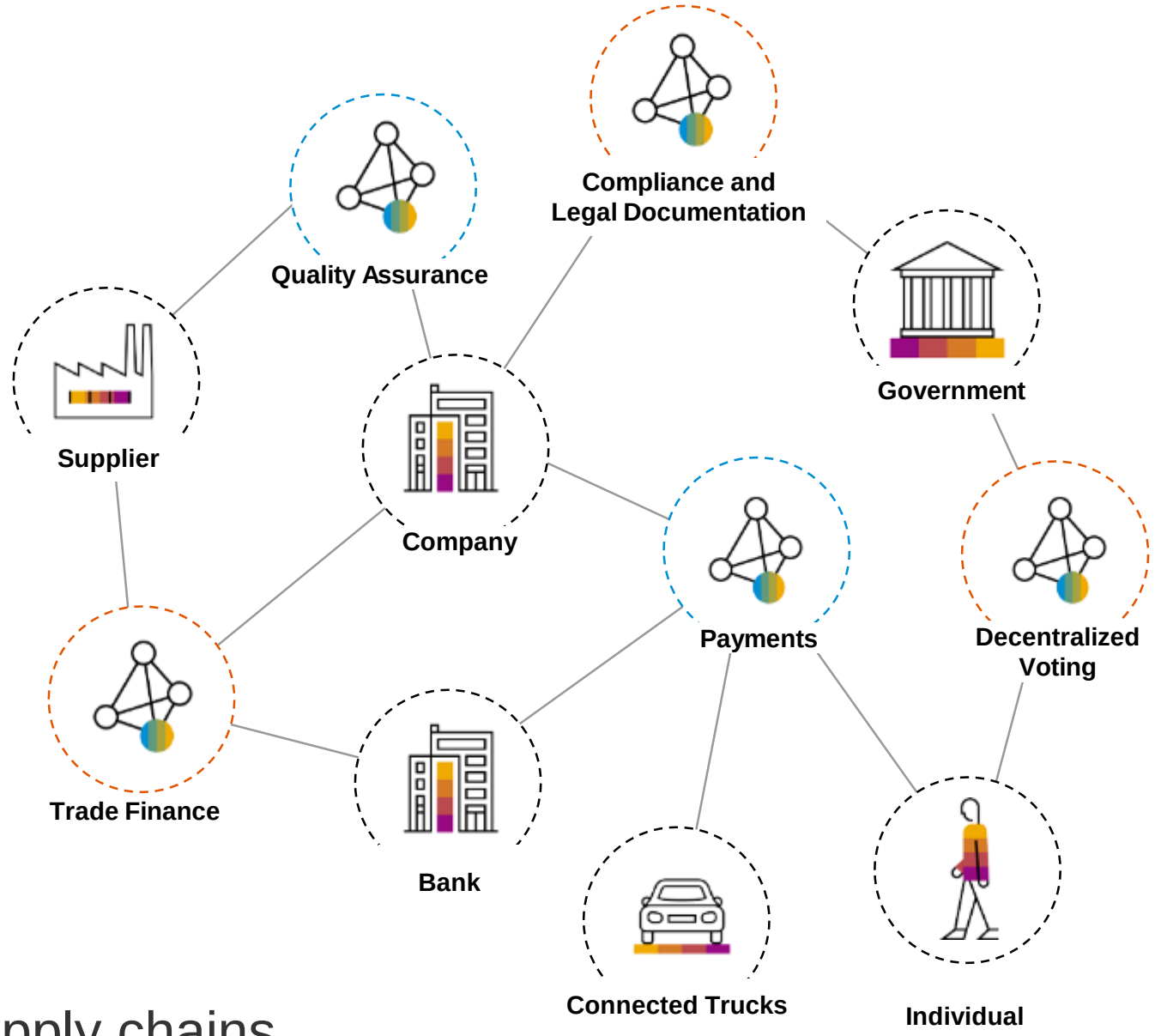
Thermo Fisher Connect…Point of view Blockchain is:

- Data Connect
- Instrument Connect
- Application Connect
- Workflow Connect
- Service Connect
- eCommerce Connect
- Peer Connect

Powered by **Thermo Fisher** Cloud

Technology + **Business processes** + **New networked-based business models**

Blockchain is a new protocol for **distributed ledgers** in multi-party business processes

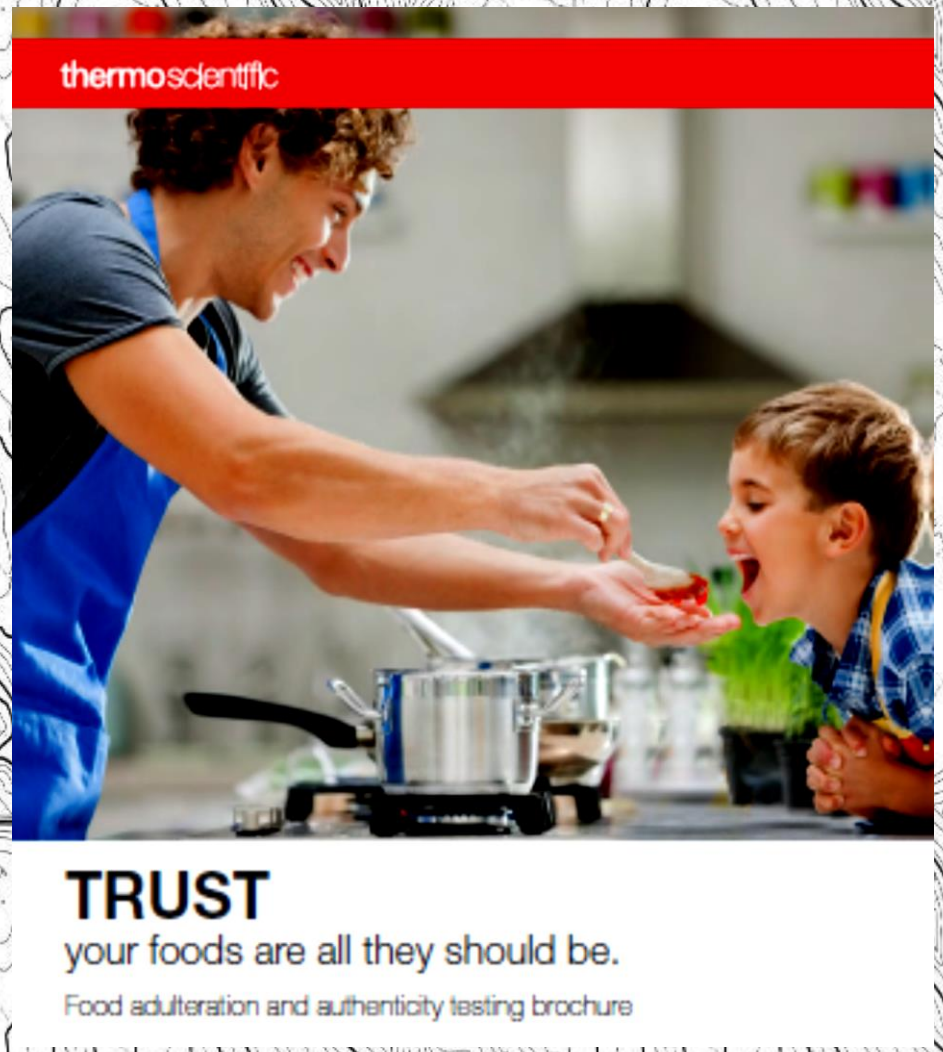


Shines a light of transparency into supply chains

Investigate more…

- Thermo Fisher Food Authenticity Resources: LINK

- ISO CEN Standard Projects:
  - ISO TC 34/SC 16 ISO 22949-1 LINK
    - Molecular biomarker analysis – Detection and identification of animal species by DNA sequencing methods
  - ISO TC 307
    - Blockchain and distributed ledger technologies LINK
- AOAC Food Fraud Initiative LINK
- GFSI Food Fraud LINK
- Decernis Food Fraud Database LINK



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Questions?

Questions should be submitted to the presenters during the presentation via the **Questions section** at the right of the screen.

Slides and a recording of this webinar will be available for access by IAFP members at www.foodprotection.org within one week.

International Association for Food Protection