

# Food Fraud

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# Eurofins Group Overview



Eurofins is the **global leader in biological testing** with an unrivaled reputation for unbiased analysis



**200,000 reliable analytical methods** for characterizing the safety, identity, purity, composition, authenticity, and origin of products



Our **diverse laboratories** navigate seamlessly through a dynamic and ever-changing global marketplace



**50K+** EMPLOYEES



**800+** LABORATORIES



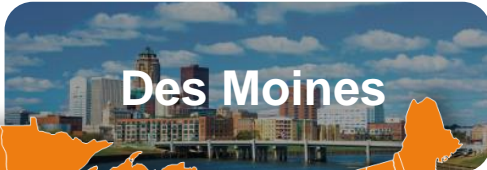
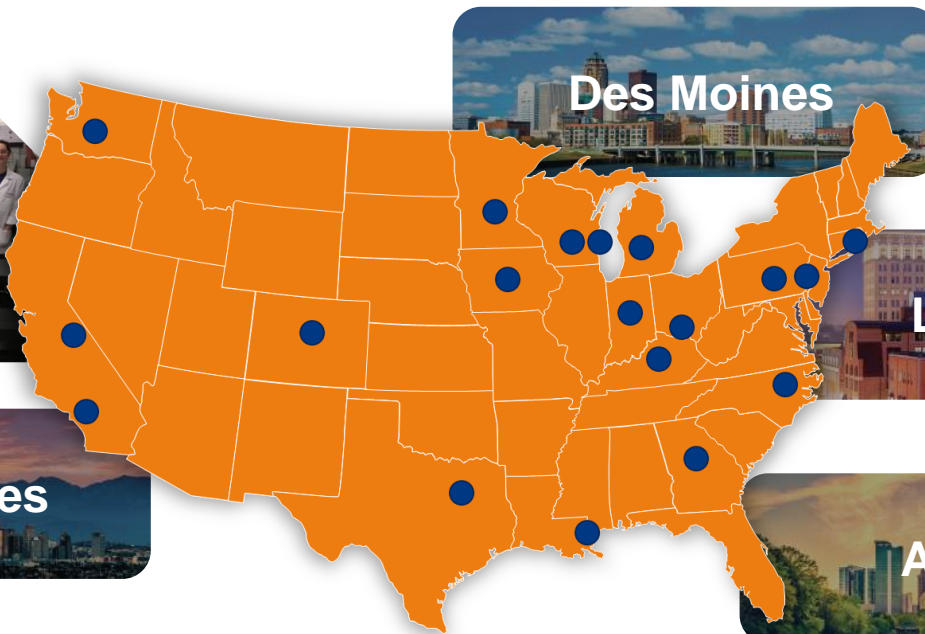
**50** COUNTRIES



**400M+** TESTS ANNUALLY

# Eurofins Food Testing Laboratories

29 Laboratories in 19 Cities across the US



# Origin of Eurofins

- **1981 Invention of the SNIF-NMR<sup>®</sup> method**  
**Site-Specific Natural Isotopic Fractionation –  
Deuterium Nuclear Magnetic Resonance**
- **First test to determine the botanical origin of alcohol**
- **Profs. G. and M. Martin, Nantes University, France**
- **1987 Creation of 1<sup>st</sup> EUROFINS Laboratory, specializing in the application of isotopic methods to food testing**
- **RMN-FINS is the French acronym for SNIF-NMR**



# Business Risk

- **Accidental or incidental contamination vs. intentional contamination**
- **Economically motivated fraud**
- **Sole-source ingredient supplier**
- **Anti everything campaigns**

**GMOs**

**Sugar**

**Hormones**

**Go Local**

**Factory Farms**

**Minimally Processed**

**Organic**

**Carbs**

**Food Additives**

**All Natural**

**Free Range**

**Agricultural Chemicals**

**Gluten**

**Trans Fats**

**Clean Labels**

**Locavore**

**Raw Food**

**Fair Trade**

# Food Fraud Headlines

**One in five sausage samples subject to species substitution**

**Europol: False organic certification continues to be major problem for food industry**

**Food industry '\$49bn opportunity' for fraudsters**

**66 people arrested in trading horsemeat unfit for human consumption**

**Former exec sentenced in counterfeit cheese case**

**Kent police seize wine in fraud investigation**

**40% of oregano tested was adulterated**

**Greek police arrest seven for alleged olive oil fraud**

**Olive oil testing reveals problems with a third of samples**

**JRC finds 14% of honey samples to be adulterated**

# What is Food Fraud?

- **Food Fraud (Summary):** illegal deception for economic gain using food
- **Food Fraud (GFSI):** “A collective term encompassing the deliberate and intentional substitution, addition, tampering or misrepresentation of food, food ingredients or food packaging, labeling, product information or false or misleading statements made about a product for economic gain that could impact consumer health.”

# What is Economically Motivated Adulteration?

- **Food Authenticity (Elliott Review):** “is about ensuring that food offered for sale or sold is of the nature, substance and quality expected by the purchaser.”
- **Economically Motivated Adulteration – EMA (US FDA):** “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.”



# What is Economically Motivated Adulteration & Food Fraud?

- **Food Integrity (Elliott Review):** “can be seen as ensuring that food which is offered for sale or sold is not only safe and of the nature, substance and quality expected by the purchaser but also captures other aspects of food production, such as the way it has been sourced, procured and distributed and being honest about those elements to consumers.”
- **Food Crime (General):** “this has two common definitions of (1) incidents involving food that is a violation of a criminal statute and (2) Food Fraud incidents that are conducted on a larger scale.”

# Motives for EMA

- **Trans-shipped to avoid duties**
- **Trans-shipped to avoid inspections**
- **Port shopping to avoid inspections**
- **Diverted products for grey/black market**
- **Economic adulteration for potential gain or to maintain revenue**



# Why is Food Fraud so Easy?

- **The opportunity to make an illicit profit**
- **Presence of cheaper adulterants**
- **Premium foodstuff in short supply**
  - **Lack of raw material (EVOO/fruit/honey/agave) to fulfill an existing contract**
  - **High commodity prices**
- **Companies buying from unknown suppliers**
- **Lax supplier attitudes**
- **Likely to be more issues if there is a long supply chain**
- **Companies not testing their incoming materials**

# Is This EMA or Fraud?

Processed Cheese



Cheddar Cheese



No → both have U.S. Standard of Identity

# Is This EMA or Fraud?

## Product A Ingredients

- **Water**
- **Sweetener, 56 g/100 ml**
- **Malic Acid, 0.45 g/100ml**
- **Caramel Color, trace**



## Product B Ingredients



# High Risk Foods

- **Olive oil – EVOO, geographic origin, dilution/substitution**
- **Flavorings – essential oils, vanilla, fruit**
- **Sweeteners – honey, Stevia, agave**
- **Vinegar – wine, balsamic**
- **Juice & Wine**
- **Seafoods – species substitution**
- **Alcoholic beverages**
- **Dietary supplements**
- **Anything else where the reward to adulterate exceeds the risk of getting caught**

# Many Examples of Food Fraud

- Pet food
- Dog treats
- Vegetable proteins
- Tofu
- Cooking oils
- Olive oil
- Sunflower oil
- Apple juice
- Orange juice
- Grape juice
- Grapefruit juice
- Pomegranate juice
- Maple syrup
- Honey
- Milk
- Cream
- Dairy proteins
- Infant formula
- Cheese
- Shell eggs
- Liquid eggs
- Gums
- Vanilla extract
- Fish
- Shrimp
- Caviar
- Horseradish
- Wasabi
- Rice
- Wheat flour
- Fiber supplements
- Luncheon meats
- Ground beef – water
- Ground meat – species
- Tomato sauce
- Mushrooms
- Basil
- Oregano
- Alcoholic beverages
- Balsamic vinegar
- Bottled water
- Toothpaste
- Cough syrup

# Is EMA a Food Safety Issue?

- **EMA is not intended to cause public health harm**
  - **Casualties reduce the potential for repeat business, but perpetrators do make mistakes**
- **EMA is intentional**
- **EMA demonstrates the ability to evade:**
  - **Private sector quality assurance systems**
  - **Government inspection and surveillance systems**
- **If adulteration for profit is achievable, adulteration for harm is also**



# History of Fraud Harm

- **1981 Spain – rapeseed oil intended for industrial use affects 20,000 and kills between 370 and 835**
- **1999 Belgium – dioxin found in food resulted in massive economic losses**
- **2008 China – milk and infant formula adulterated with melamine affects 50,000 babies resulting in 6 fatalities**
- **2012-2014 Czechia and Poland – methanol in illegal spirits kills 59**
- **2013 EU – horse meat in beef products with potential for phenylbutazone contamination**
- **2017 EU and Asia – insecticide fipronil found in eggs at concentrations >100 times the MRL and little more than 100 times less than presumed lethal dose**

# Undeclared Food Allergens

- **>170 foods known to cause human allergies when consumed by susceptible consumers**
- **Allergens are proteins**
- **Resistant to heat, can't "kill" allergens by cooking**
- **Sensitive individuals exposed to food allergens can experience respiratory distress potentially leading to death!**
- **Regulatory action level is usually zero tolerance – peanut allergy can occur with exposure to 0.1 mg peanut (a single peanut weighs ~2,500 mg)**
- **Leading cause of recalls – too many inherit supplier declaration failures**

# Joint Europol-INTERPOL Operation OPSON V Results

- Ran from November 2015 - February 2016 across 57 countries
- Investigated shops, markets, airports, seaports and industrial estates
- Looked for either counterfeit or substandard food and beverages
- >3,500 criminal cases, 41 arrests
- Resulted in seizure of:
  - >11,000 metric tons of food
  - >1,400,000 liters of beverages
  - >5,500,000 products



# OPSON V Top Problem Products

1. **Condiments – vegetable oils, vinegar, salt, pepper, spices, variety of sauces and seasoning products, such as fake olive and palm oils**
2. **Fruits and vegetables – major problem with look and feel adulterants, such as copper sulfate in olives**
3. **Alcoholic beverages – beer, wine, & distilled spirits, such as sparkling wine containing propylene glycol**
4. **Seafoods – species substitution**
5. **Sugar and sweets – sugar bulked with fertilizer**

**→ 19% of seizures had food safety implications!**

# FDA Peanut Allergy Warning

2015 – ground cumin from Turkey contained peanut protein, why?

1. Unintentional adulteration – common growing areas, common harvesting equipment, common processing equipment
2. Intentional adulteration – ground peanut shells (waste product) look like ground cumin

Which is it?



# Food Fraud Consequences for You

- Economic loss – £11 billion annual loss in the UK alone
- Long-term damage to brand reputation
- Potential consumer health issues and death
- All food processors who use SQF, BRC, and FSSC as a food safety certification scheme **MUST** conduct a food fraud vulnerability assessment



# EMA Vulnerability Assessment

- **Has the product ever been associated with an outbreak, recall, or economic fraud?**
- **Has the industry ever had an incidence of EMA?**
- **Are there any regulatory considerations?**
- **Is the starting material for an ingredient difficult to source?**
- **Is the product easily substituted?**
- **Are there tests that can detect EMA in the product?**
- **Is the product sourced from a suspect region?**
- **Is the supplier open to facility inspection?**

# Appropriate Supplier Verification Activities

- Conduct one or more of the following verification activities before using and periodically thereafter:
  - Review supplier's records for the ingredient
  - Onsite audit
  - **Sampling and testing – by the supplier or the receiving facility**

**Not this →**





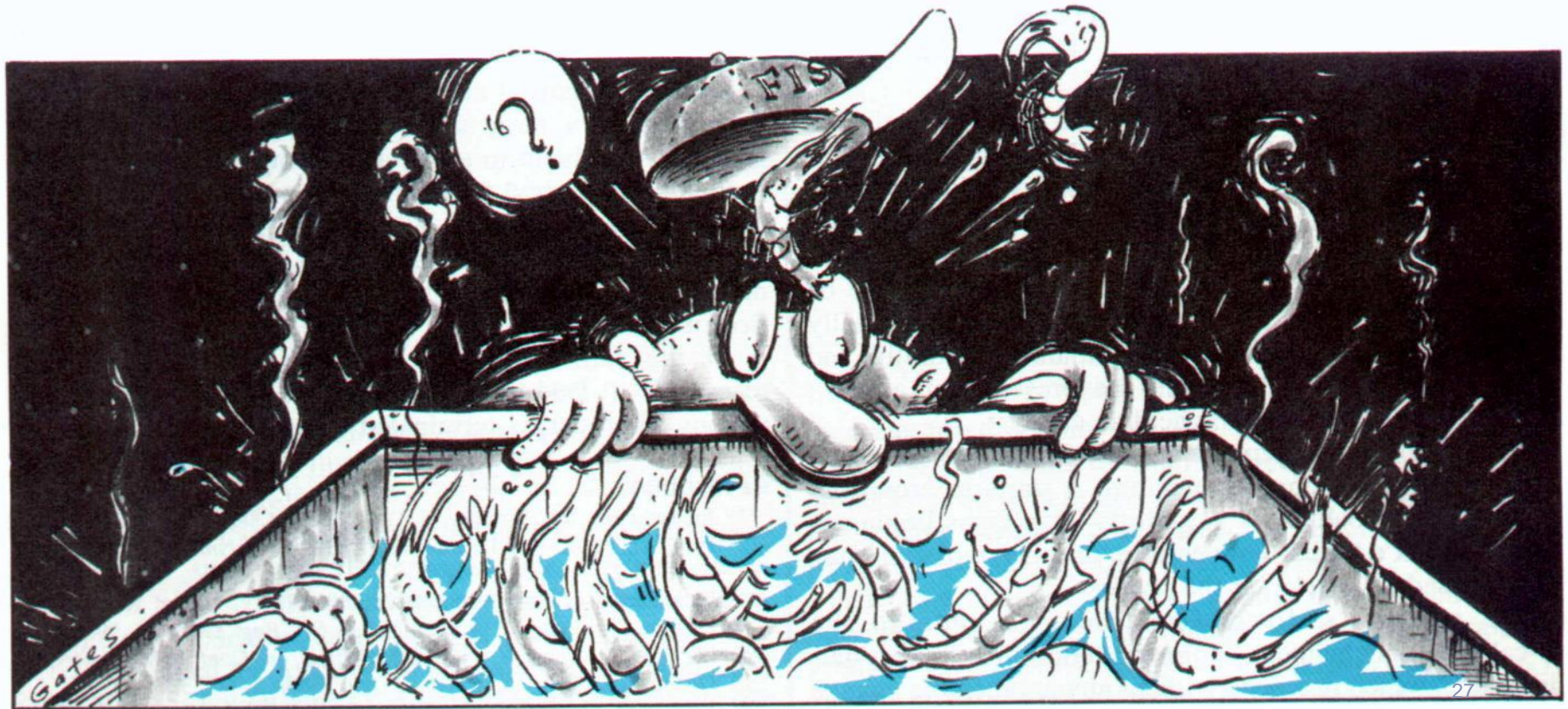
# Considerations for Appropriate Verification

- **What does the fraud event suggest about the nature of the adulterant?**
- **Are preventive controls applied by the supplier or the supplier's supplier?**
- **What are the supplier's procedures, processes and practices related to authenticity control for the ingredient or raw material?**
- **Has FDA issued warning letters or import alerts related to the supplier's compliance?**
- **Do your historical test or audit results for the supplier indicate a trend – positive or negative?**
- **Have the supplier's corrective actions to past issues been appropriate and timely?**
- **Are the supplier's storage or transportation practices appropriate?**

# Supply-Chain Program Review

- **Compare findings from verification and non-conformance activities to spec and contract requirements**
- **Key points to consider:**
  - **Do the supplier contract and specifications clearly convey your product safety and EMA requirements?**
  - **Have past EMA issues been corrected?**
  - **Have changes or innovation at the supplier level impacted EMA? Any changes within your company?**
- **Adjust the program as needed to enhance integrity**

# Nobody's nose knows



Gates

27

DON GATES

# Authenticity Test Methods

- Targeted and non-targeted testing is available for composition, purity, origin, and production practices
- **Targeted methods** – the food or feed sample is examined for a very specific adulteration that will either be confirmed or refuted. Ex., milkfat levels, protein levels, freezing point depression, lactose removal.
- **Non-targeted methods** – the entire profile or specific characteristics of a food or feed sample are determined as using physical-chemical or molecular fingerprints that can be compared with reference data from a previously created database. If the measured profile matches the reference profile, the sample is considered authentic

# Advantage of Targeted Methods

## Test for very specific characteristics

- Discriminatory parameters
- Single molecule targets
- Targeting known fraud

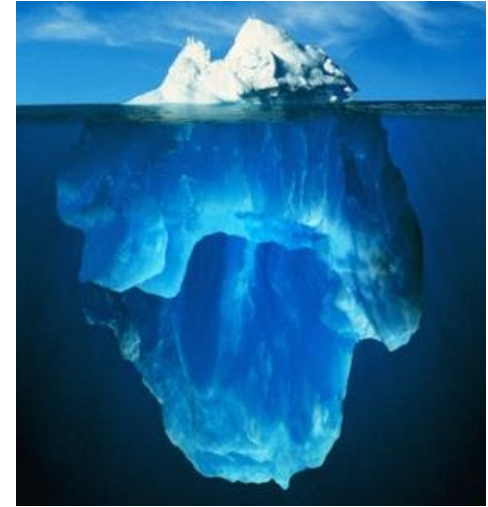
## Analytical methods

- Many methods available depending on nature of target
- Many methods use standard procedures, which allows for normalization and accreditation



# Non-Targeted Methods: Ultimate Weapon Against Food Fraud

- Broad range of coverage
- Whole matrix analysis
- Potentially detect new/emerging fraud activity
- Usually based on high-resolution spectroscopic methods
- Multivariate statistics are required



# Authenticity Test Methods

- **Physical-chemical methods** – testing for composition and purity, identification and quantification of defined compounds; detection of reconstitution, dilution, grade substitution
- **Molecular biology methods** – GMOs, identification of species, varieties, maize or grass silage
- **Fingerprinting/profiling** – comparison of the sample profile/spectrum with a reference material, flavoring ID (natural fruit/vanilla vs. synthetic), dilution
- **Stable isotope analysis** – geographic origin
  - **Site Specific Natural Isotope Fractionation Studied by Nuclear Magnetic Resonance (SNIF-NMR®)**
  - **Isotope Ratio Mass Spectrometry**

# Adulteration Test Methods

- **SNIF-NMR for isotopic geographic origin**
- **PCR for species ID**
- **Chromatography and spectroscopy for purity, artificial colors**
- **Organic acid profile**
- **Sugar profile**
- **Polyphenols and anthocyanins fingerprint**
- **Polymethoxylated flavones for lemon juice adulteration with lime juice**
- **Oligosaccharide profile for addition of inulin syrup, invert sugar and HFCS addition**
- **Patulin for apple and pear juice verification**



# Authenticity Test Methods

- **Organic vs. Non-Organic – detection of pesticides**
- **GMOs – detection by PCR**
- **Undeclared allergens – Lateral flow and ELISA tests**
- **Sale of dangerous materials – contaminated with dioxins, PCBs, POPs, alkaloids, veterinary drug residues, heavy metals, forbidden additives, mycotoxins, radioactive nucleotides, pathogens, natural toxins, etc. Detect by multiresidue screens**
- **Process contaminants – acrylamide, 3-MCPD-ester, furans, PAH, mineral oils (MOSH/MOAH), detergents, disinfectants, solvents, bisphenol A. Detect by multiresidue screens**
- **Particle size mimetics – powders, plastic grains. Detect by spectroscopy, microscopy**

# Extra Virgin Olive Oil Example

## International Olive Oil Council Accredited Testing

- **Organoleptic testing (EEC legislation No 2568/91 with 8 – 12 tasters)**
- **Fatty acid composition, including trans fatty acids**
- **Triglyceride composition – seed oil adulteration**
- **Sterol composition**
- **Geographic origin by  $^1\text{H-NMR}$  spectroscopy**

# Refrigerated Food Case Study

- Dipping sauce manufacturer
- Manufactured several large lot sizes over a week
- Consumer complaints came pouring in – product turned to a playdough-like viscosity
- What went wrong?

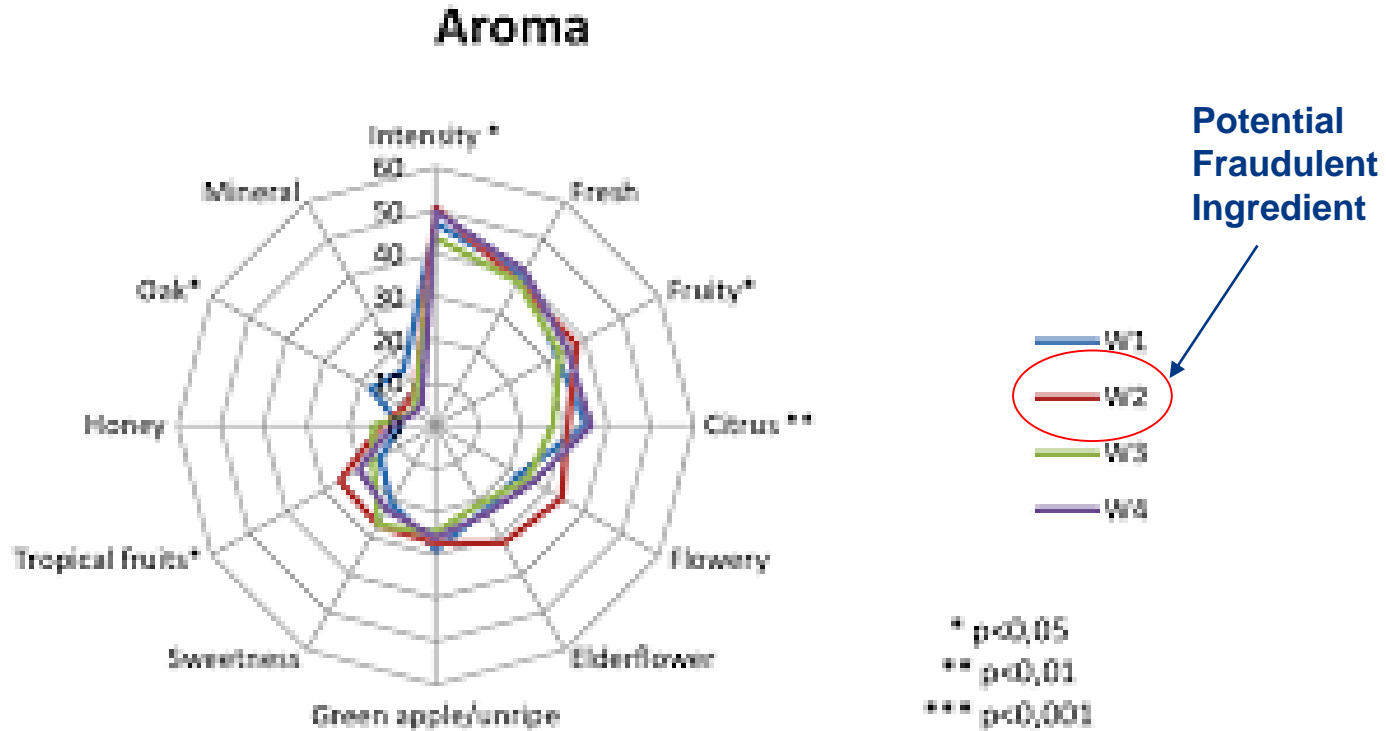


# Refrigerated Food Case Study

- Only change discovered was that purchasing found a new, cheaper supplier of ground garlic
- Production and food quality staff not informed of change
- Garlic contained flour/starch that gelatinized during processing and formed a firm set after cooling in filled containers
- Was the garlic fraudulently adulterated or was the other ingredient added as a flow aid?

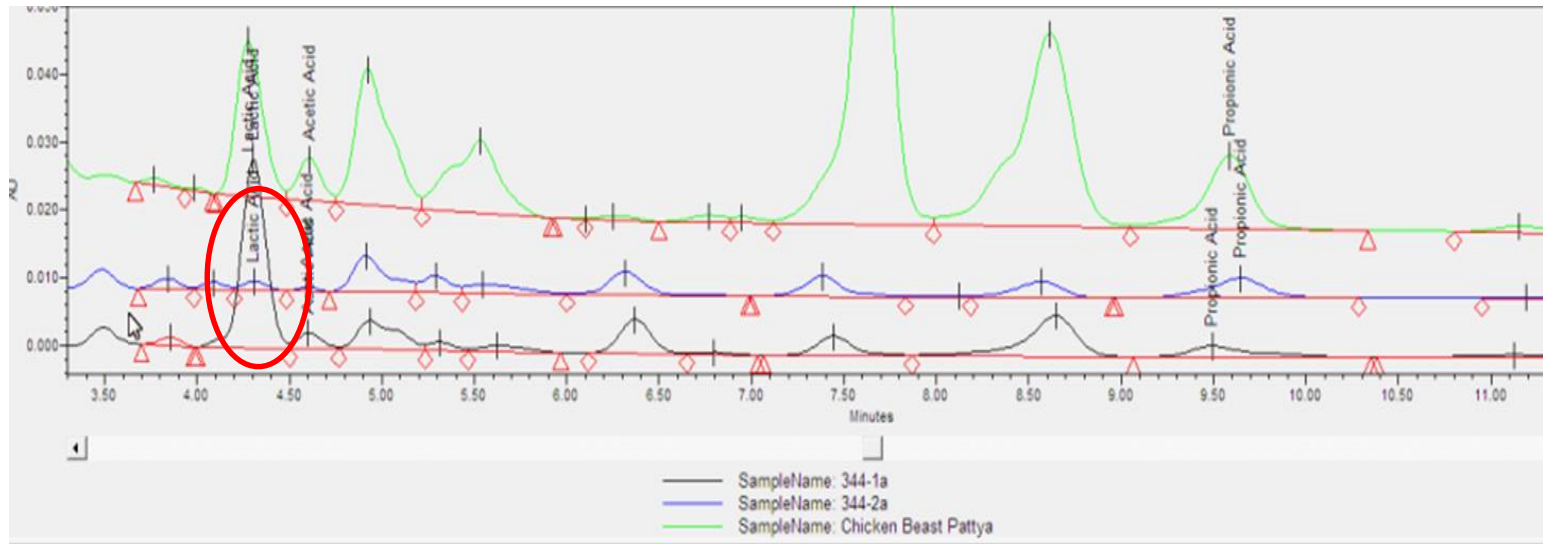


# Ingredient Verification by Sensory Analysis

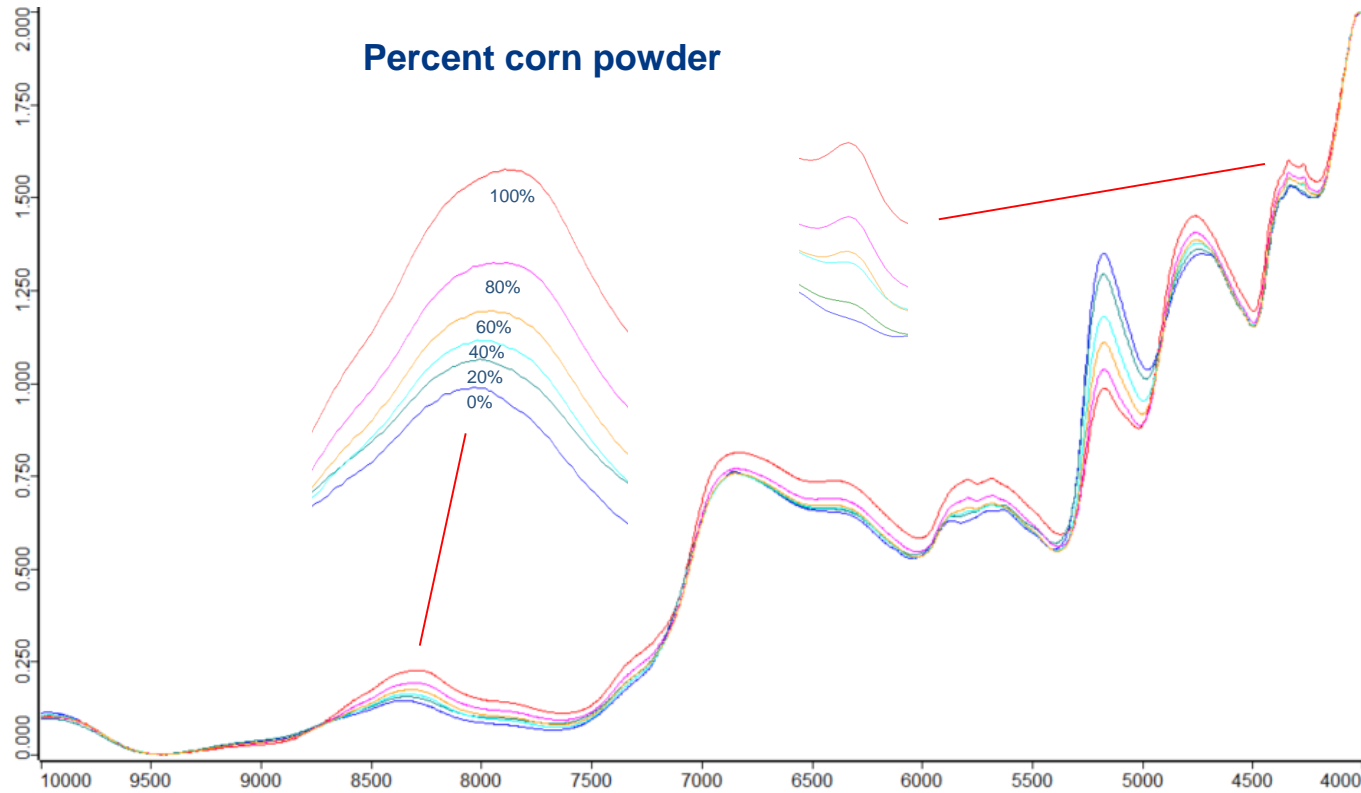


# Ingredient Supplier Fraud by HPLC

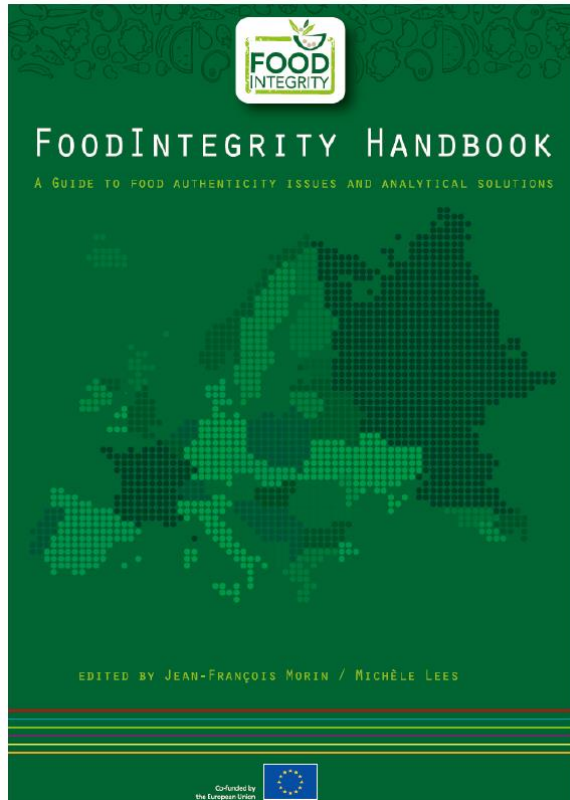
- Processor uses 2 suppliers of key ingredient
- Processor relies on supplier-provided COA to verify receipt and use of ingredient
- Customer complaint forces investigation
- HPLC spectral fingerprint identifies one supplier with ingredient anomalous peak



# Adulteration of Tumeric by NIR



# Want More Information on Testing?



Downloadable, in extenso or by chapter <https://doi.org/10.32741/fihb>



# Science at Your Service – Give Us a Call

## Eurofins Risk Assessment

- Onsite vulnerability assessment
- Employee training classes
- Supply chain ingredient testing screens
- Supplier audits
- Recommended mitigation strategies

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# Thank You!

Questions?

[www.eurofinsUS.com/food](http://www.eurofinsUS.com/food)

