

Agilent solution for food Authenticity

Laurent PASCAUD
GC&GCMS IDO product Specialist
December, 10th



Food Authenticity in Africa : Why it matters



Definition and Importance

Food authenticity ensures genuine products meet claims on origin, composition, and production methods, building trust.

Consumer Confidence and Health

Authentic foods protect public health and maintain consumer confidence by preventing adulteration and contamination.

Economic and Cultural Impact

Maintaining authenticity prevents economic losses and preserves traditional culinary heritage across African communities.

Strategic Sustainable Development

Prioritizing authenticity supports sustainable development, food security, and strengthens export potential in Africa.

What is Food Authenticity

Definition of Food Authenticity

Food authenticity ensures products match their claimed origin, ingredients, and production methods.

Global Importance

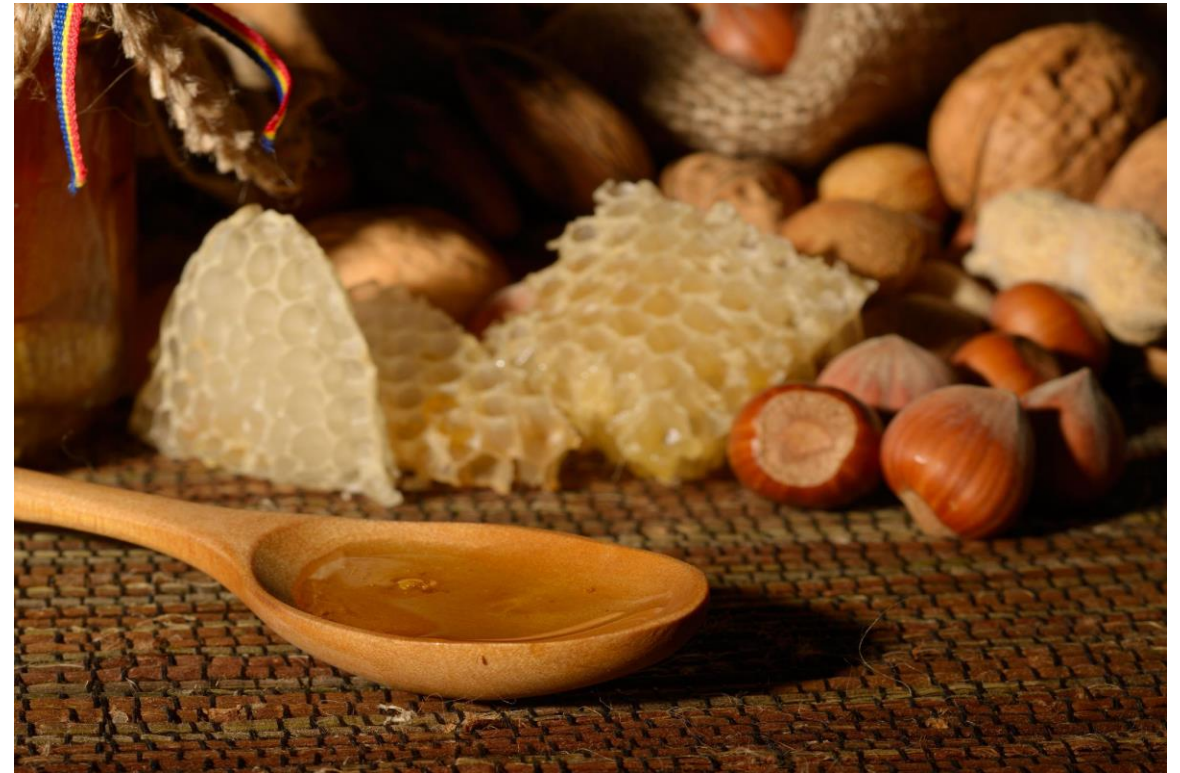
Consumers worldwide demand transparency and quality assurance in food products.

Significance in Africa

Authenticity preserves cultural and economic value of traditional African foods and supports exports.

Ensuring Authenticity

Labeling, certification, and traceability systems are key to preventing fraud and protecting consumers.



Exemple of Adulterated food commodities case in Africa



Honey – Addition of sugar or corn syrup (FAO Food Fraud Report, 2023)



Cocoa Powder – Mixed with starch or fillers (International Cocoa Organization, 2022)

Milk – Watered down or chalk powder added (WHO Food Safety Bulletin, 2023)



Spices (Turmeric, Chili) – Colored with harmful dyes (African Food Safety Network, 2024)



Fish – Cheaper species sold as premium (FAO Fisheries Report, 2023)

Vegetable Oils – Mixed with cheaper or recycled oils (Codex Alimentarius Guidelines, 2023)

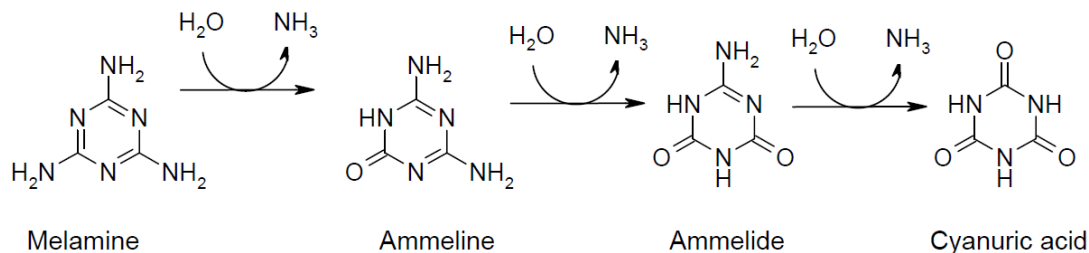


Fruit Juices – Artificial flavors and sugar instead of real fruit (African Consumer Protection Agency, 2024)



Nobody Dies in Economically Motivated Adulteration, Right?

The USDA took a relaxed approach until 2007. Then melamine showed up.



Triazines and other highly nitrogenous compounds were being added to food. Why?

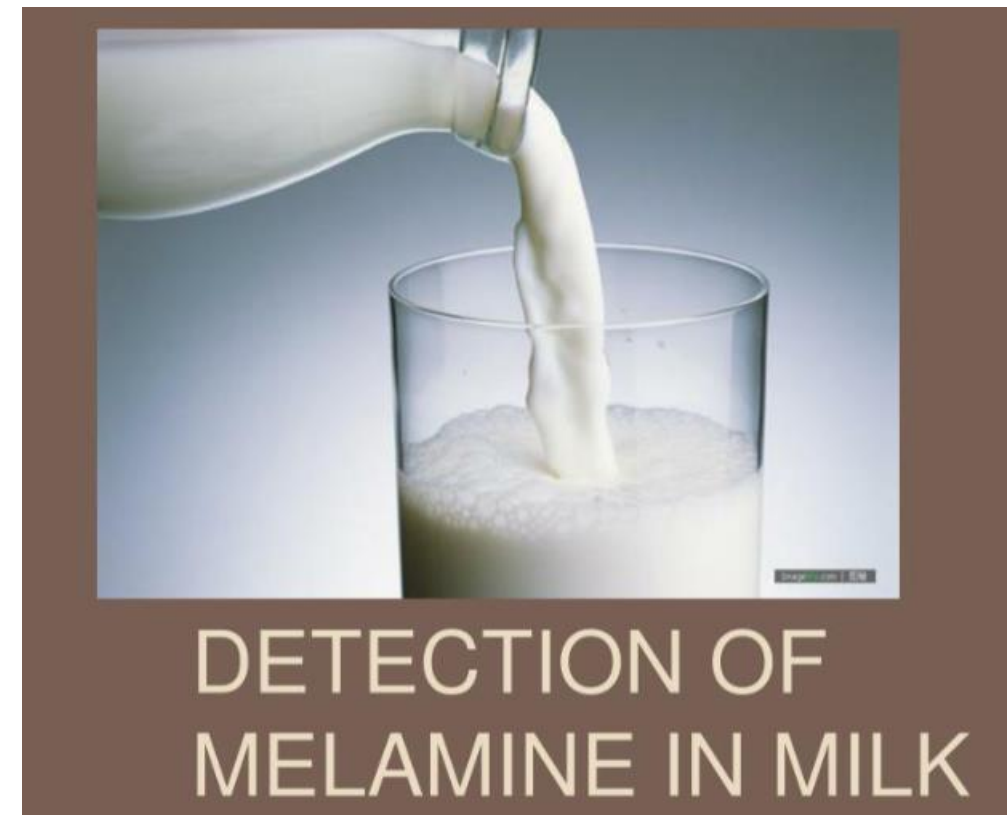
- To boost the nitrogen content in food to give the perception that the foods were rich in protein.

First, pets were poisoned by their food.

- The food was tainted by melamine and its triazine analogs (ammeline, ammelide, and cyanuric acid).

Then these triazines were detected in:

- Baby formula produced in the US.
- Cookies distributed in Canada.
- Chocolate sold in Asia and Australia.
- Condensed milk in Thailand.
- Eggs in Hong Kong.*



*Bhalla, V.; et al. Melamine Nephrotoxicity: an Emerging Epidemic in an Era of Globalization *Kidney International* 2009, 75, 774–779.

Economic & Trade Impact

Agricultural Exports Importance

Agricultural products like coffee, cocoa, and spices are vital for Africa's foreign exchange and economic stability.

Impact of Counterfeit Products

Counterfeit and adulterated goods harm Africa's trade reputation, reducing demand and causing financial losses.

Authenticity and Compliance

Ensuring product authenticity helps comply with international standards and secures fair trade certifications.

Benefits of Authentic Products

Authentic products fetch higher prices, supporting farmers financially and encouraging sustainable agriculture.



The Way Forward

Technological Solutions

Advanced testing, blockchain traceability, and digital certification ensure product integrity and verification.

Stakeholder Collaboration

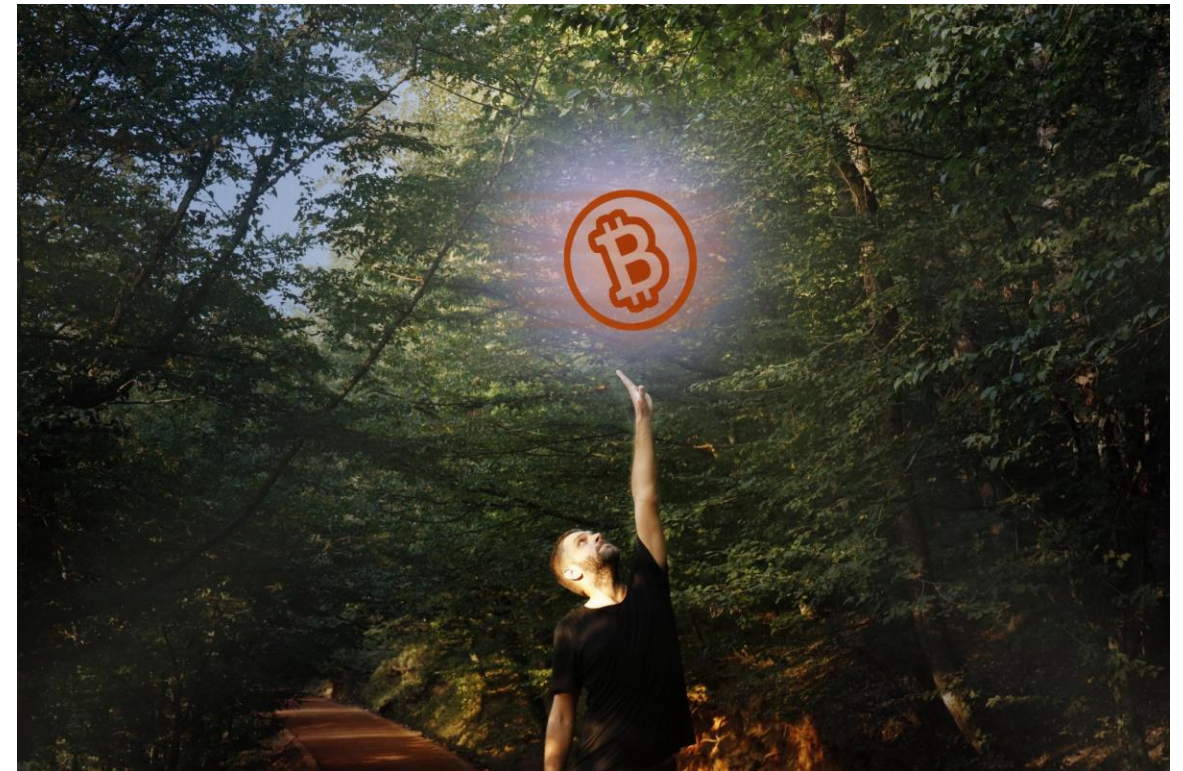
Governments, producers, and consumers must collaborate to build regulatory frameworks and promote awareness.

Education and Training

Education campaigns empower consumers and training programs improve standards compliance for producers.

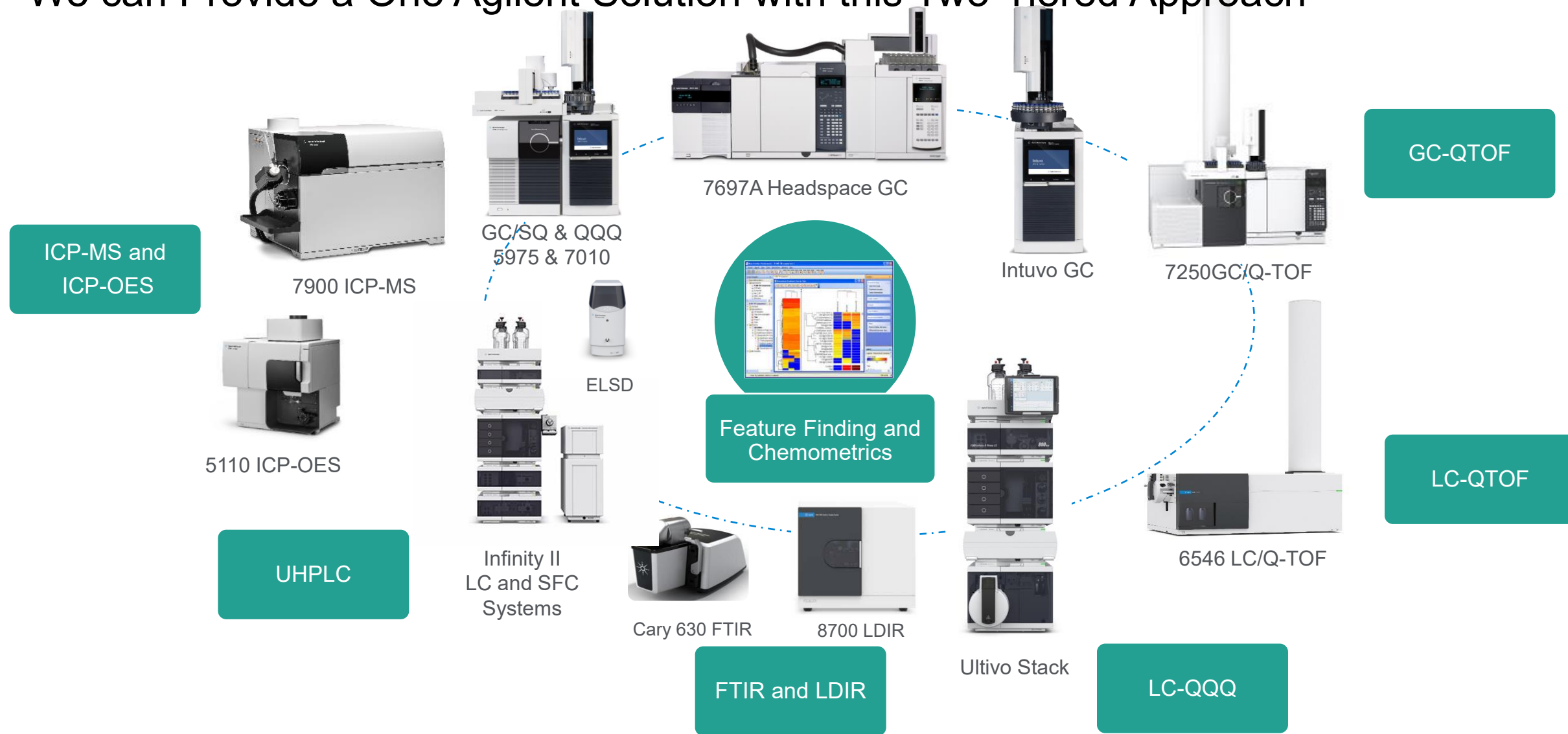
Transparent Food System

Creating a transparent system guarantees safe, authentic products and strengthens Africa's global market position.



Pair a Fast, Simple Untargeted Screen with a Targeted Confirmation Method

We can Provide a One Agilent Solution with this Two-Tiered Approach



How to Help our Customers (and Ourselves) Combat Food Fraud

Pros and Cons of Various Analytical Solutions

There are a lot of choices:

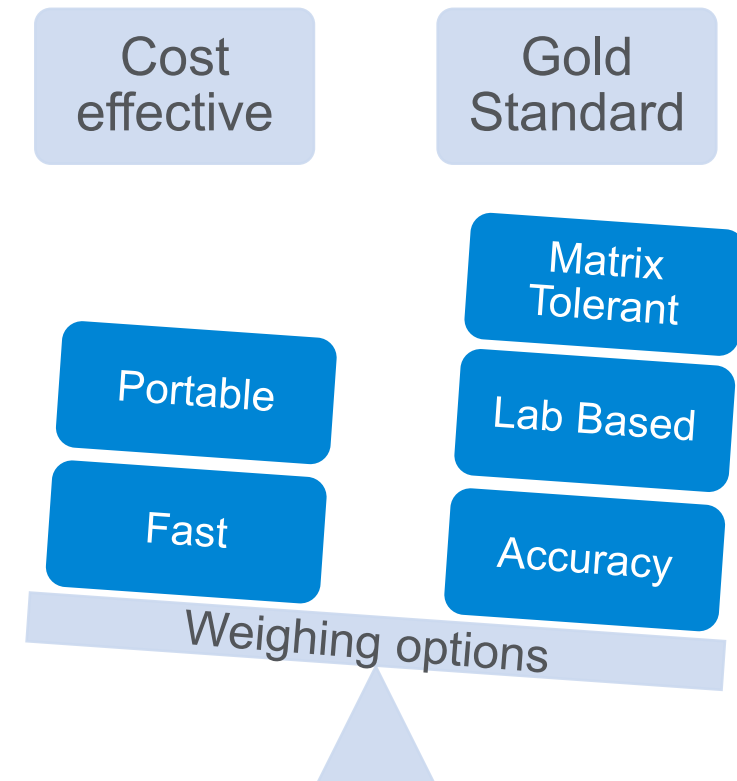
- Spectroscopy
- Genomic Testing
- Atomic
- Spectrometry
- Chromatography
- Mass Spectrometry

What is the customer's specific goal?

- Quick qualitative screen.
- Quantitative.
- Profiling.
- Regulated testing.
- Academic research.

What are the constraints?

- Funding.
- Space.
- Expectations.

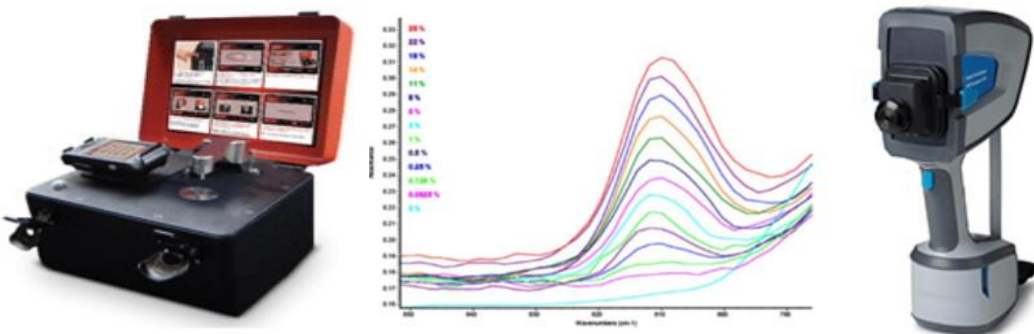


Agilent Offers Portable and Through Container Screening Tools

Portable FTIR Spectroscopy

4500 Series Portable FTIR

The Agilent 4500 Series Portable FTIR Spectrometers are portable analyzers that support efforts associated with at site analysis of incoming materials and outgoing finished products in the chemical, food and polymer industries. They are also ideal for proactive maintenance



4300 Handheld FTIR

The 4300 Handheld FTIR is the first of its kind employing lightweight ergonomics, ease of use, ruggedness, and flexibility into one system. The 4300 weighs in at approximately 2kg. With its lighter weight and new design, the ergonomics of the system make it ideal for field use and deployment into non-laboratory situations.

Portable Raman Spectroscopy



RapID



Resolve



Cobalt Light Systems, now a part of Agilent, develops innovative products and technologies for non-invasive, through-barrier chemical analysis, for applications in the pharmaceutical industry, applied markets and public safety. With Agilent's strong position in HPLC, LC-MS, software, and spectroscopy solutions we are now building one of the industry's most complete portfolios

Agilent 8700 LDIR Chemical Imaging System

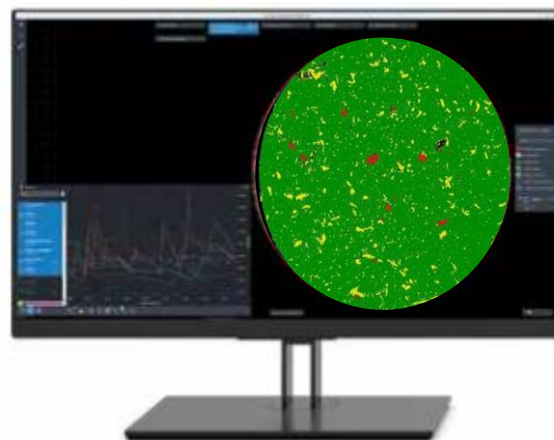
Automatic evaluation of 10-500 μm **dry blended** adulterants



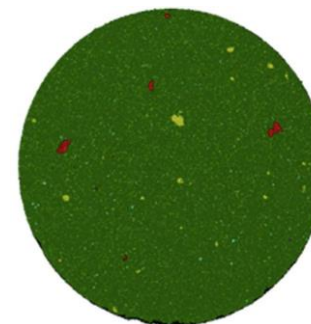
Agilent
Sample Planer



Agilent 8700 chemical
imaging system

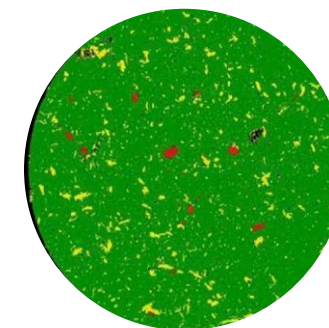
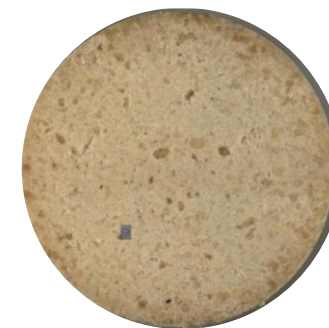


Agilent Clarity software



94.43% Skimmed milk powder
4.45% Talc
0.70% Glycoluril
0.35% N-methylurea
0.06% Guanidine

Skimmed milk powder



91.92% Chicken meat powder
6.72% Cellulose
0.77% Tyrosine
0.60% Urea

Adulterated meat powder

The Agilent 8700 LDIR Chemical Imaging System:

- ✓ LDIR showed promising results for screening analysis of economically adulteration (>5%) in food matrices.
- ✓ high sensitivity & selectivity for the detection of nitrogen-rich compounds and bulking agents from dry blending adulteration

Dry Blended = Adulterated After Spray Drying LDIR = Laser Direct Infrared

Determining Geographic Indication by Elemental Profiling

Trace Element Fingerprinting Works, it Works Really Well.



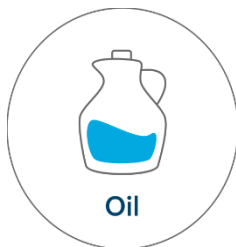
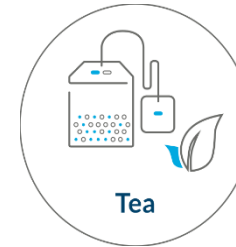
ICP-OES

Direct Analysis of 13 Trace Elements in Tea Infusions using ICP-MS with Integrated Sample Introduction System in Discrete Sampling (ISIS-DS)

Application Note
Food Testing and Agriculture



Elemental Techniques



ICP-MS



Determination of Metals in Wort and Beer Samples using the Agilent 5110 ICP-OES

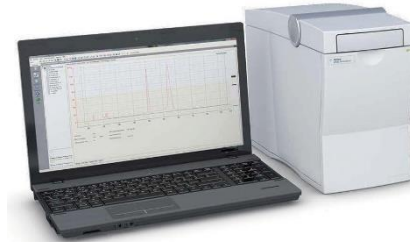
Application
Food and Beverages



We have numerous application notes, presentations, and articles demonstrating that **elemental profiles** correlate with the region of origin for all the listed matrices.

Fish Authenticity Testing, a Moving Target

No Fins, no Scales, Cooked Proteins, Still no Problem



Agilent 2100 Bioanalyzer Instrument

Traditional authenticity testing of fish has been based on visual inspection.

- Doesn't work when the scales and fins have been removed.
- An antibody-based solution could be used for field-based testing but proteins denature when cooked.
- DNA testing holds up to cooking but the genome is large and largely conserved.
- Mitochondrial DNA (mtDNA) has a relatively fast mutation rate, comes from a single parent, and is 100,000 times smaller.

Handy, S. M.; et al. Evaluation of the Agilent Technologies Bioanalyzer-Based DNA Fish Identification Solution. Food Control 2017, 73, 627–633

Targeted control

Pesticides, Solvent, COVs etc.

✓ Food Safety and Public Health

Detecting pesticide residues ensures that food products meet safety standards and do not pose health risks to consumers.

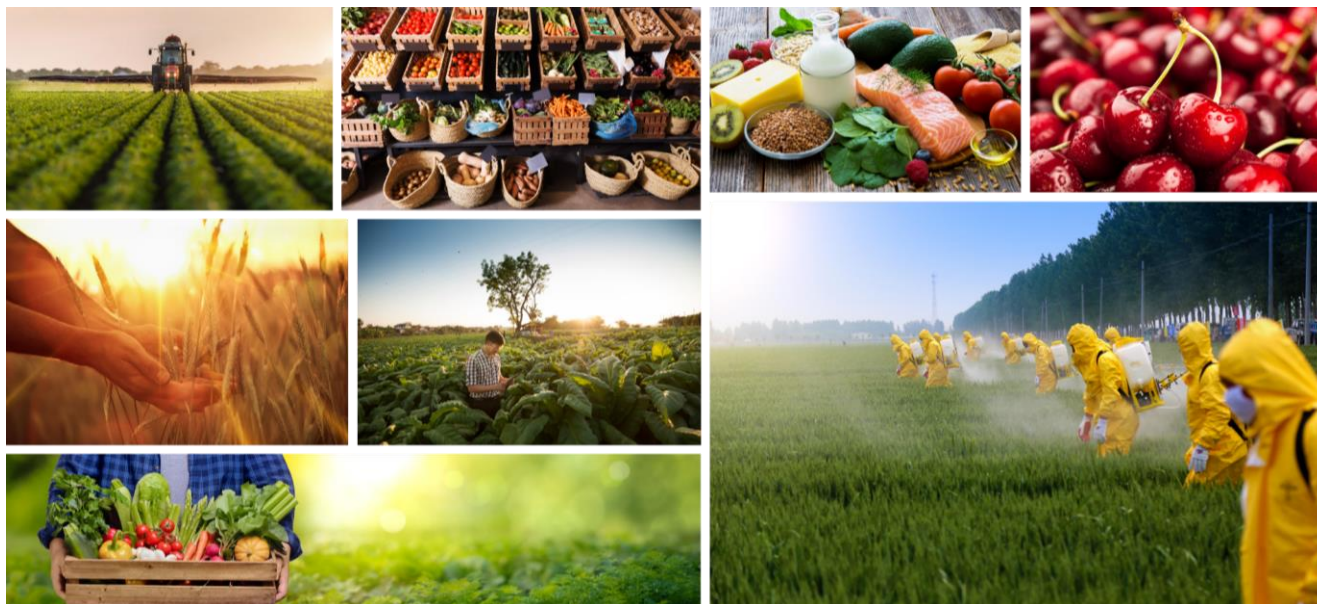
✓ Regulatory Compliance

Governments and international bodies set strict limits on pesticide levels; analysis helps producers comply with these regulations and avoid penalties.

GC/MS(MS)
Small non-polar compounds



LC/MS(MS)
Larger, polar & thermally labile compounds



✓ Environmental Protection

Monitoring pesticide levels in soil, water, and air prevents contamination and protects ecosystems from harmful chemical buildup.

✓ Consumer Confidence

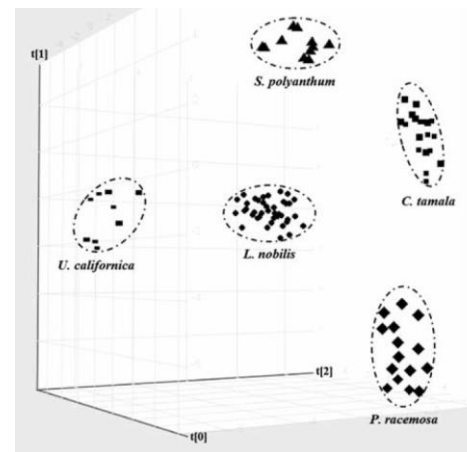
Verified pesticide-free or low-residue products build trust and support marketability, especially in organic and export markets.

✓ Risk Assessment and Research

Accurate analysis provides data for evaluating exposure risks, improving agricultural practices, and developing safer alternatives.

Bay Leaf Quality Control

N-Hexane Extraction with Backflush to Eliminate Late-Eluting Contaminants.

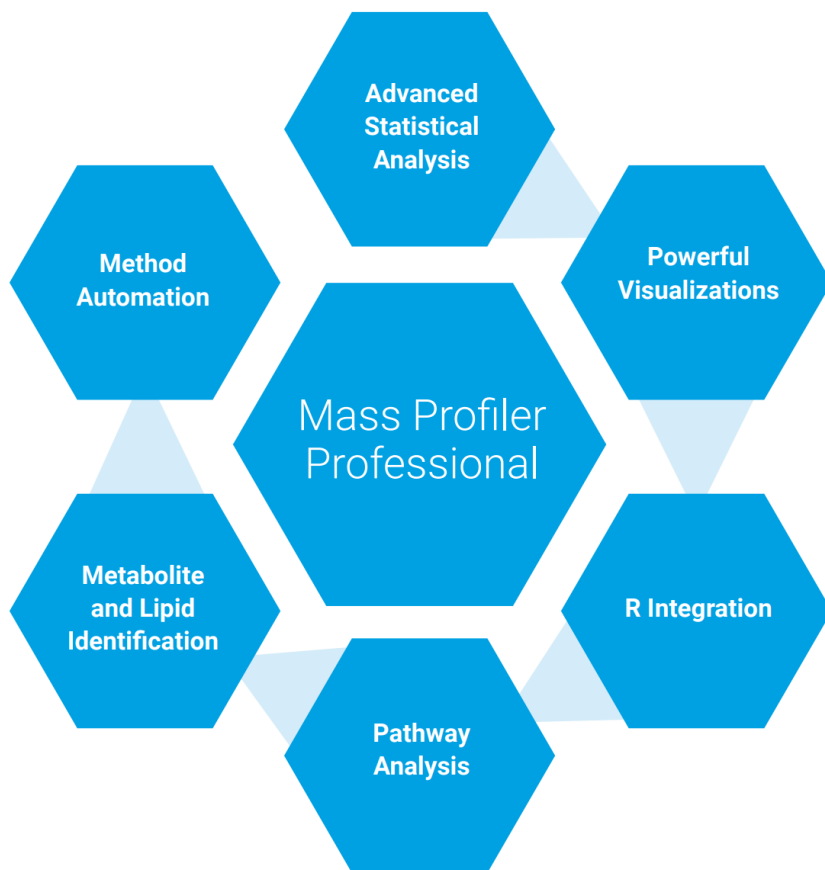


Start with 500 g of pulverized bay leaf. Vortex for 5min in 4mL n-hexane and then sonicated for an hour. The supernatant was filtered prior to analysis. n-Heptadecane was added as an internal standard at 75 ug/mL. **Inject 60:1 split injection** on an Agilent 7250 GC/QTOF instrument configured with **backflush to eliminate late eluting contaminants**. Process the data using Batch MFE (Profinder B.08 SP3) and multivariate statistics (MPP B.14.08).

Tentative identification was done using the NIST database (IDBrowser). A PLS-DA Sample Class Prediction Model was created. A subset of samples was left out of the model building exercise for model validation. **At least four markers were found for each bay leaf varietal.**

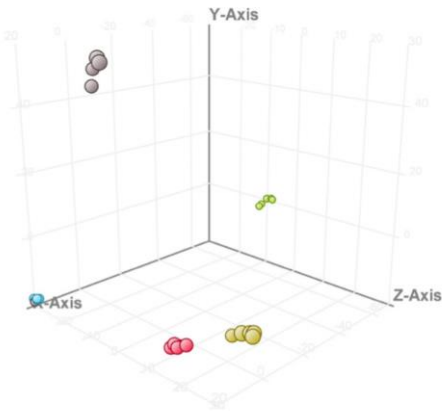
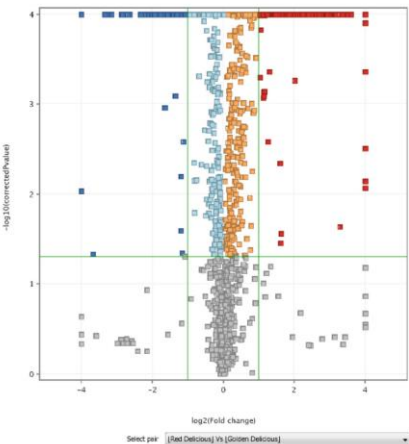
Kahn *et al*, Application of GC/Q-ToF combined with Advanced Data Mining and Chemometric Tools in the Characterization and Quality Control of May Leaves, *Planta Med* 2018, 84:1045-1054.

Mass Profiler Professional (MPP)



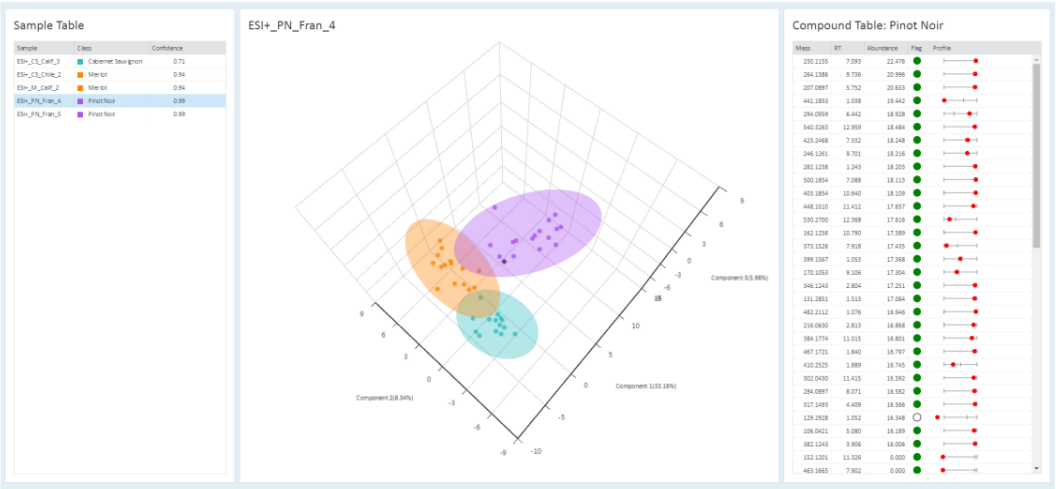
Student t-tests and Analysis of Variance (ANOVA)

- Paired and unpaired Mann-Whitney
- ANOVA: equal and unequal variance
- Kruskal Wallis non-parametric one-way ANOVA
- Friedman non-parametric two-way ANOVA
- Repeated Measures ANOVA

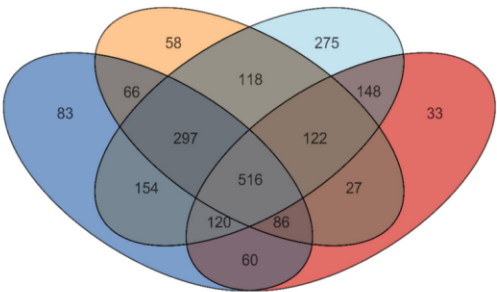


Principal Component Analysis (PCA) of metabolite data from biological replicate samples shows differences between several varieties of apples.

Prediction Model



The results view includes principal component analysis plot that shows the Hotelling ellipses for the different classes in the model and the position of the test sample with respect to the similarity with the sample classes in the model.



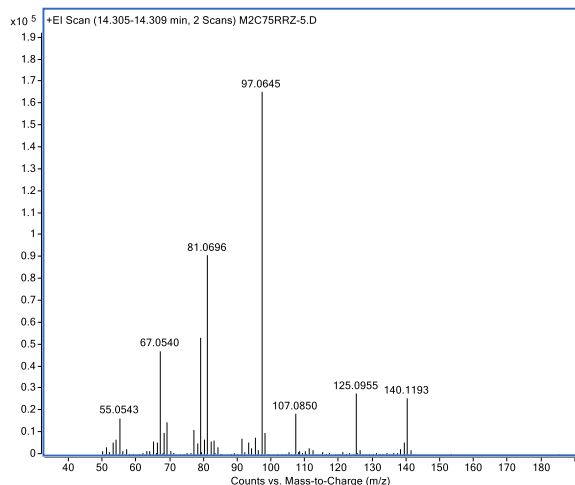
Venn Diagram

Metabolic activities can be explained by the metabolites that are uniquely present or shared across different biological conditions. MPP allows N-way Venn diagram to quickly identify such metabolites as well create metabolite lists of choice for any downstream analysis.

Venn Diagram of metabolite data from different varieties of apples. The diagram shows number of metabolites uniquely present in a particular variety as well the ones shared across multiple varieties of apples.

Determine Molecular Formulas of EI Fragments

...and Build a Mass Spectral Tree



Empirical Formula	Exact Mass	Loss
C ₉ H ₁₆ O	140.1196	
C ₈ H ₁₃ O	125.0961	-CH ₃
C ₆ H ₉ O	97.0648	-C ₃ H ₇
C ₆ H ₉	81.0699	-C ₃ H ₇ O (C ₃ H ₅ + H ₂ O)
C ₈ H ₁₁	107.0855	-CH ₅ O
C ₅ H ₇	67.0542	-C ₄ H ₉ O

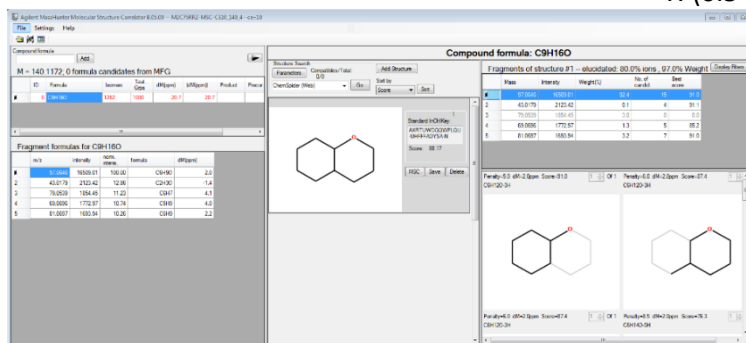
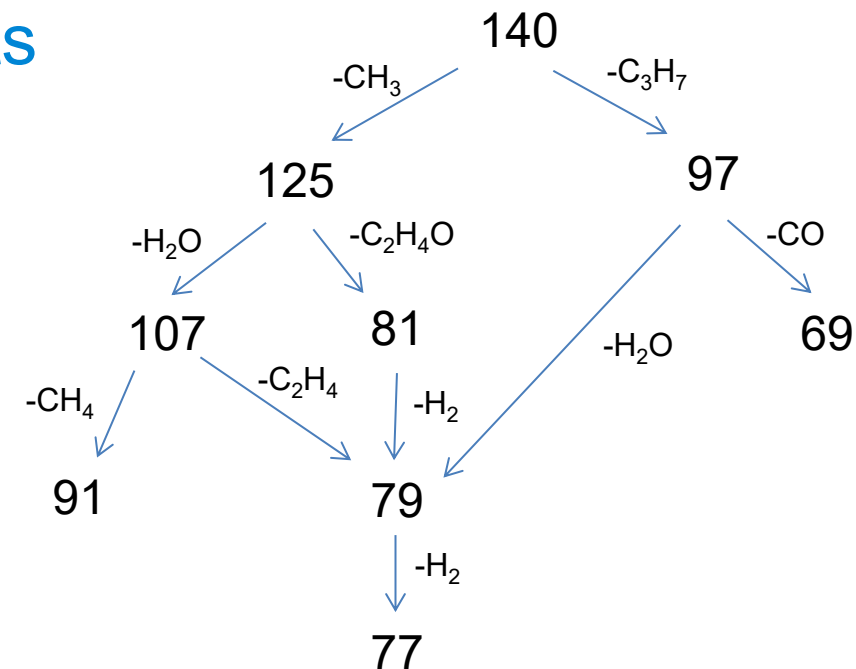
Rings + Double Bonds

$$= 2$$

x= Carbon

Y= Hydrogen

$$= X - (0.5 * Y) + 1$$



Mass structural elucidation of true unknown compounds

- ✓ Molecular mass identification
- ✓ MSMS experimentation
- ✓ Use of SW tools for structural identification

Summary

- Food authenticity is crucial to protect African economical and cultural interest
- Control request numerous different instrument from low end to high end
- Instrument choice must be a balanced between costs and risks
- Internal control & external control needs different strategies
- Food fraud is critical to increase exportation to non-African countries

TRUST TAKES TIME TO BUILD, BUT CAN BE LOST VERY QUICKLY

