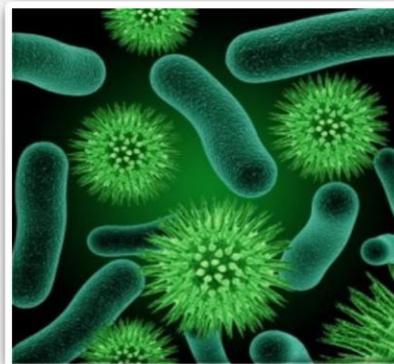


# **Big Data applications in Food Safety**

Prof. John O'Brien PhD  
Nestlé Research Centre

- Brief Introduction to Nestlé Research
- The Changing Reality Framing Food Safety
- What does success looks like?
- Data analysis for a New Game
- Summary



Nutrition & Healthcare

**11%**

Pet Care

**12%**

Confectionery

**11%**

Nestlé Waters

**8%**

Milk Products & Ice Cream

**20%**

Prep. Dishes & Cooking aids

**16%**

Powdered & Liquid Beverages

**22%**



**Turnover 2014: CHF 91.6 billion**

**>330'000 employees in 150 countries**

**>440 factories in 86 countries**

**>2,000 brands**

**OVER 1 BILLION  
PRODUCTS SOLD  
EVERY DAY**

## Science & Technology

- Scientific advances
- Agri-food technology
- Safety testing tools
- «Big Data»
- Analytical technology

## Social & Cultural

- More foodborne disease
- Distrust
- Consumer expectations
- Consumption patterns
- Media and Social Media
- NGOs
- Crowdfunding/sourcing
- Food Ethics

## Environmental

- Water
- Climate
- Dwindling bio-resources
- Soil integrity
- Contamination



## Business

- Increasing food & water crises
- Food Fraud
- Complexity
- Costs

## Regulatory

- Lack of harmonization
- Increasing complexity
- Increased product monitoring
- Limited understanding of complex food systems

## Science & Technology

- Anticipation of new advances
- Science => superior products
- Lower uncertainty
- Data sharing

## Social & Cultural

- Decrease in foodborne disease
- Food industry trusted
- High confidence in safety
- Innovations welcomed
- Food data accessible

## Environmental

- Sustainable practices
- Adaptation to climate change
- Increased efficiency
- Reduced waste



## Business

- Fewer recalls
- Few food crises
- Minimal food fraud,
- Innovation driven business

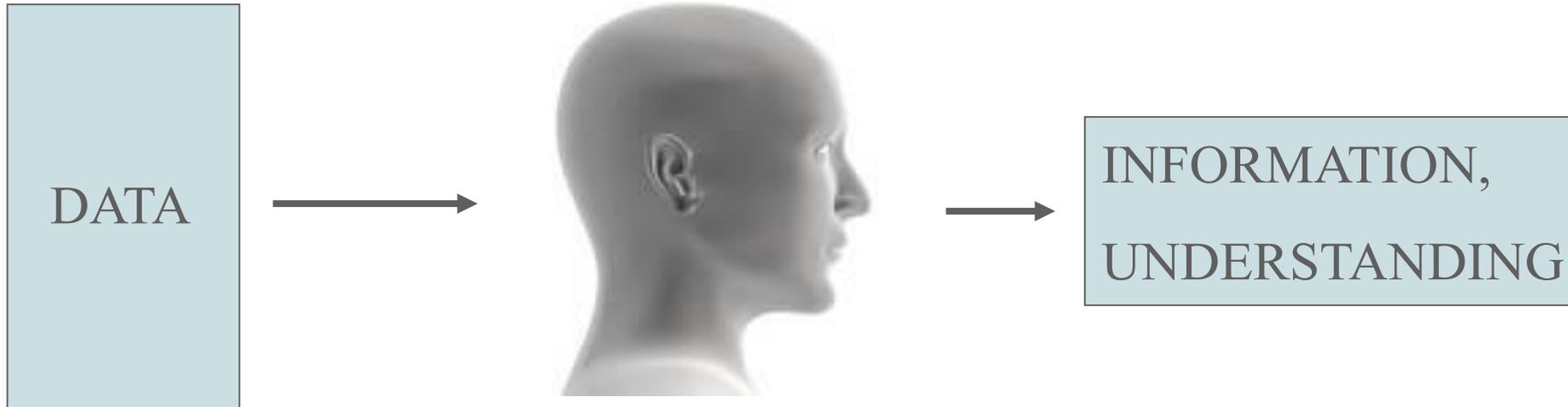
## Regulatory

- Internationally harmonized
- Secure international food trade
- Systems approach
- Targetted risk management
- Fewer crises and incidents

# First Rule: Get on top of the data technology revolution!



Good Food, Good Life



«Data» is not information!

«*Information is not knowledge!*» (Einstein)

Knowledge is not action!

## *Caveats!*

*If a man's knowledge is not in order, the more of it he has the greater will be his confusion*

*Herbert Spencer*

*The illusion of understanding, or how everyone thinks he knows what is going on in a world that is more complicated (or random) than they realise*

*Nassim Nicholas Taleb*

# Challenge: Explosion of literature data

- 2X:** Annual growth in worldwide data creation
- 8 Zettabytes:** Estimated worldwide data creation in 2015
- 28,100:** English language peer-reviewed journals
- 2.5 million:** Papers per year (~5 per minute)
- 3.5-5%:** Annual increase in published papers
- 2.5 billion:** Full-text downloads per year
- 270:** Articles read by average scientist per year
- 30 minutes:** Average reading time per article (down from ~45 minutes in the mid-90s)

+

Peer-review process malfunctioning  
Increase in retraction rate

↓

Acute effect on multidisciplinary sciences like food safety

- Food safety early warning systems
- Search engine queries to detect disease outbreaks
- Whole genome sequencing data from environmental, food and clinical pathogen isolates
- Metagenomics data from food and environmental samples
- Non-target fingerprint data sets for food authenticity and adulteration
- Satellite imaging data to detect illegal fishing
- Meteorological data to predict mycotoxin risks in crops
- GIS data to detect food fraud
- Social media analysis to understand consumer concerns and preferences
- Traceability and RM/ingredient data
- Image analysis and automated processes
- Computational microbiology, chemistry and toxicology

Scientific /  
technical

Product quality  
control

Detection of  
defects

Reactive

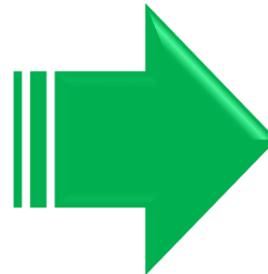


Consumer centric

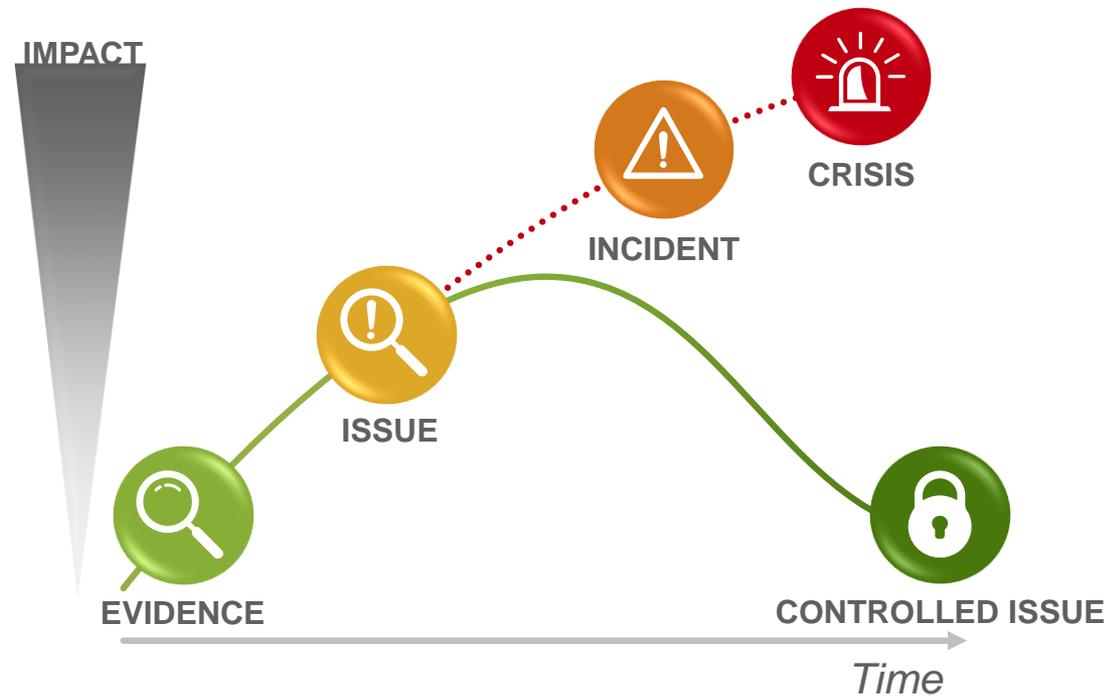
Quality  
management,  
entire supply chain,  
TQM

Interpretation,  
understanding,  
insight, foresee,  
prevent

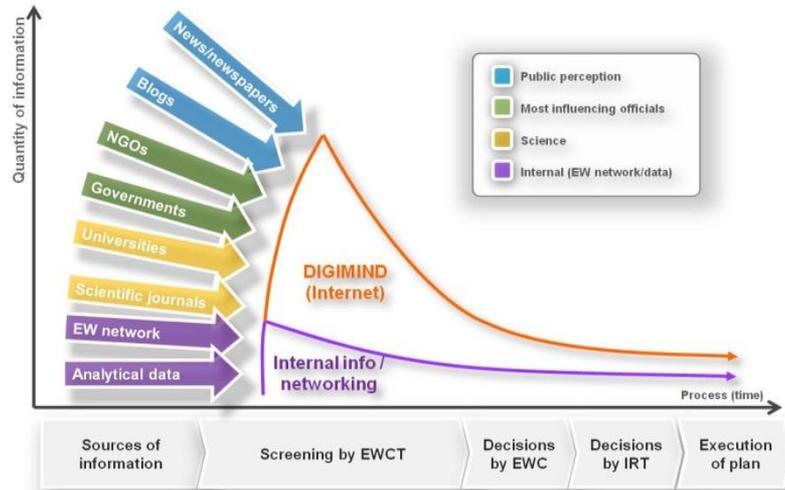
Proactive using  
foresight and early  
warning systems



## Early Warning Principles



Food safety challenges *continue to increase* and must *be addressed through multiple competencies*



## Early Warning Expert Network

- Global reach
- 150 people
- Multi-disciplinary
- R&D and Operations experts

## Webscouting

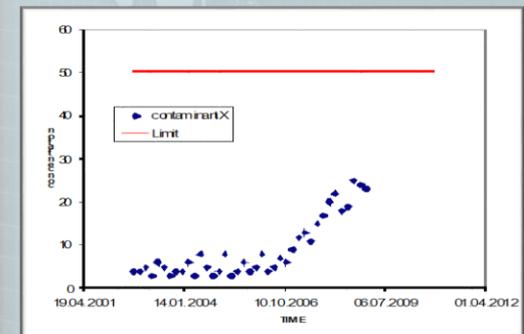
- 8000 websites per day
- 300,000 articles scouted per year
- 10,000 articles kept in a database for knowledge building
- 1000 RSS food safety flashes
- 12 Issue Round Table presentations





- 26 big laboratories
- 1000 people
- 3.3 million of data /year

- TREND ANALYSIS OF DATA ON CONTAMINANTS IN FOOD RAW MATERIALS
- DETECT ABNORMAL TRENDS
- ROOT CAUSE ANALYSIS TO FIND THE RIGHT ACTIONS



# Example: abnormal trends for arsenic in rice in Malaysia



Good Food, Good Life

Data Analysis



## THE PROBLEM

- Arsenic level in rice were getting higher in Malaysia
- We use rice to produce baby food
- Levels would potential have exceeded safe levels if we did nothing

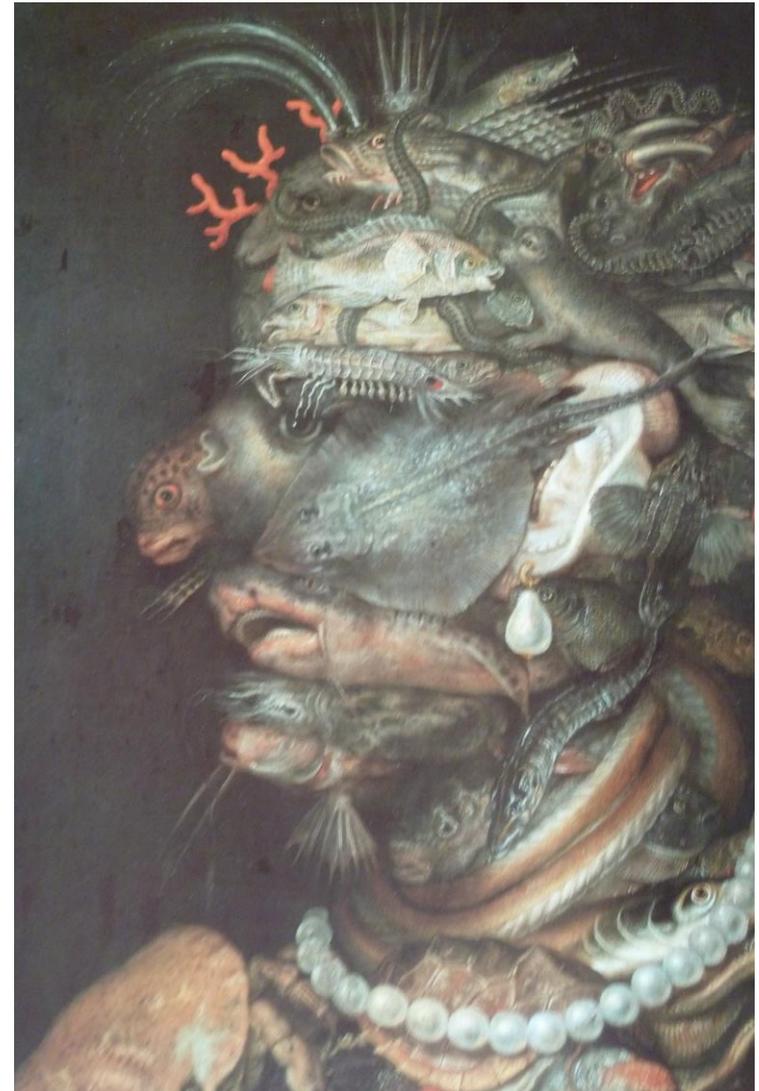
## THE ANALYSIS AND SOLUTION

- Root cause analysis
  - Correlation between the yield improvement made by farmers (they wanted to go from 2000 tons/hectar to 8000 tons/hectar and increasing levels of arsenic in rice
  - The main cause was identified to be the fertilizers
- Working with farmers allowed to still increase the yield while lowering the level of arsenic in rice by optimizing the usage of fertilizers



# FISH

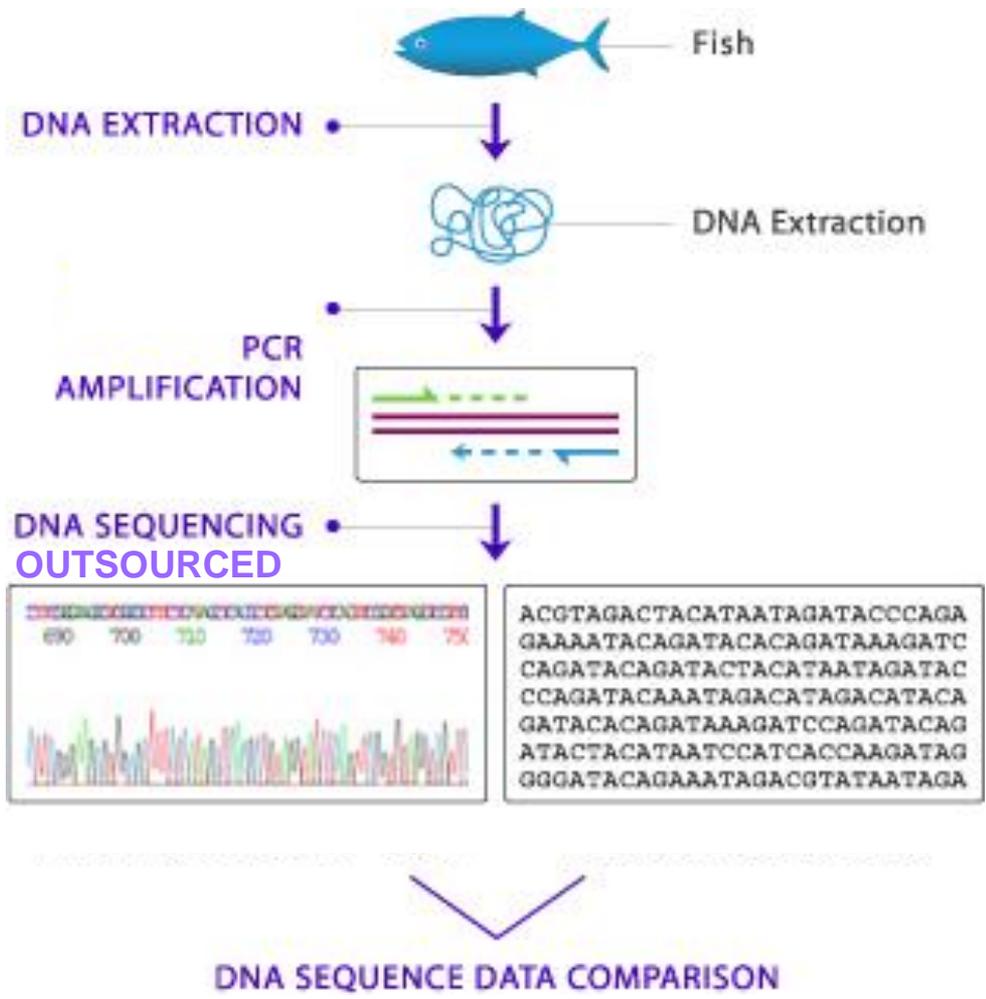
- One in five fish eaten in the world is caught illegally
- USD 10-23 Billion
- Seafood fraud: 25-70%
- Potential for food safety implications
- Fish stocks are depleted
- Waste associated with non-target catch: ~1 million tonnes pa; >USD 1 billion.
- Preventive approaches based on «big data» applications
- New analytical tools show promise



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# Fish DNA Barcoding is based on PCR and DNA sequencing



Initiated in 2003 by taxonomists to create a genetic database of all living organisms

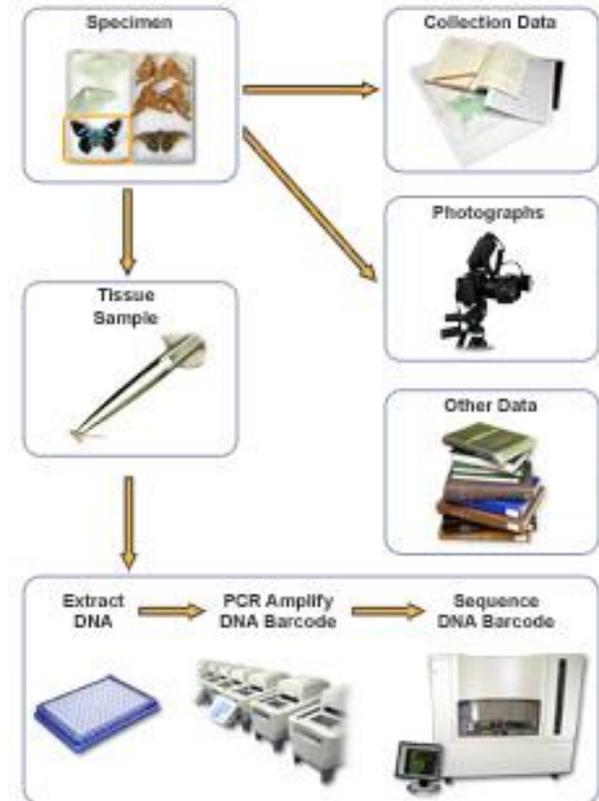
Sponsored by 25 nations

- National Institutes
- Museums
- Universities

~ 100000 species recorded

~ 10000 fish species

international  
BARCODE  
OF LIFE



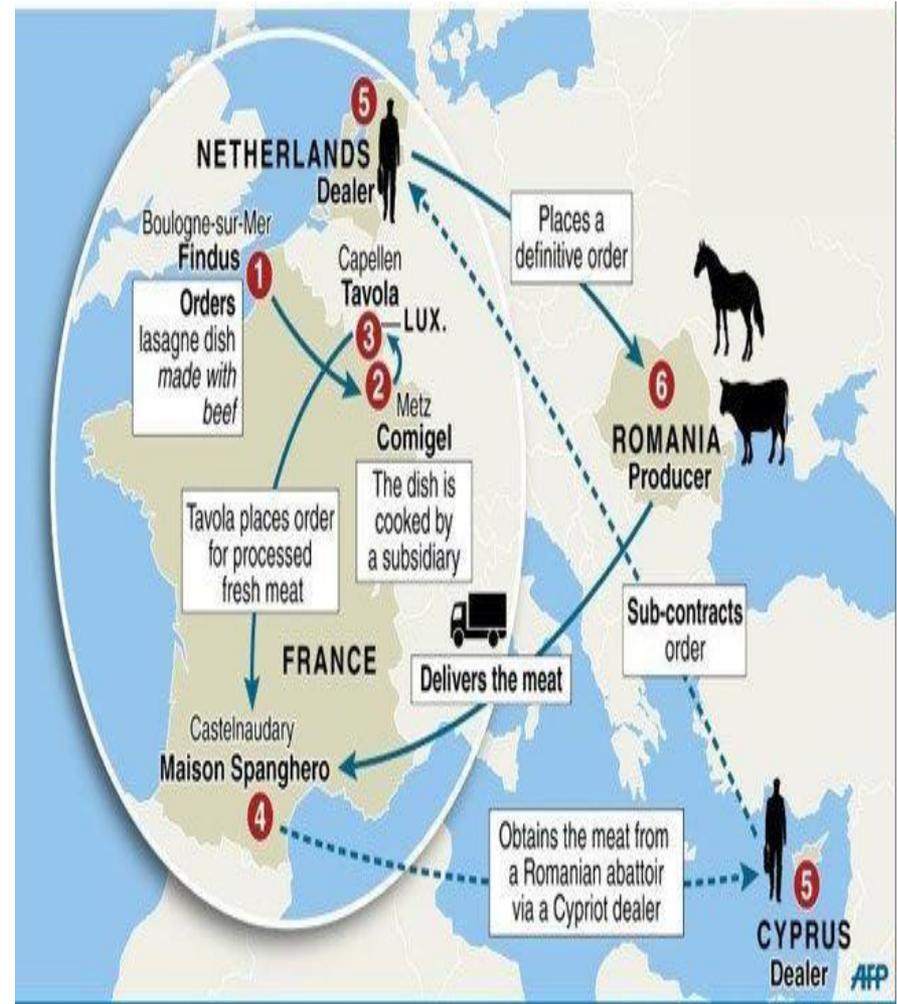
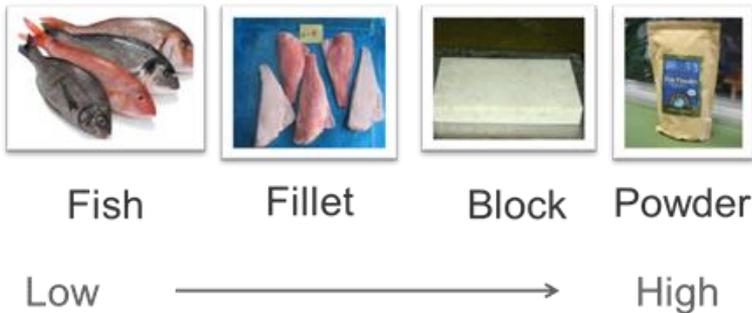


**MEAT**

# Data enables the application of Systems Thinking to prevent food contamination and fraud

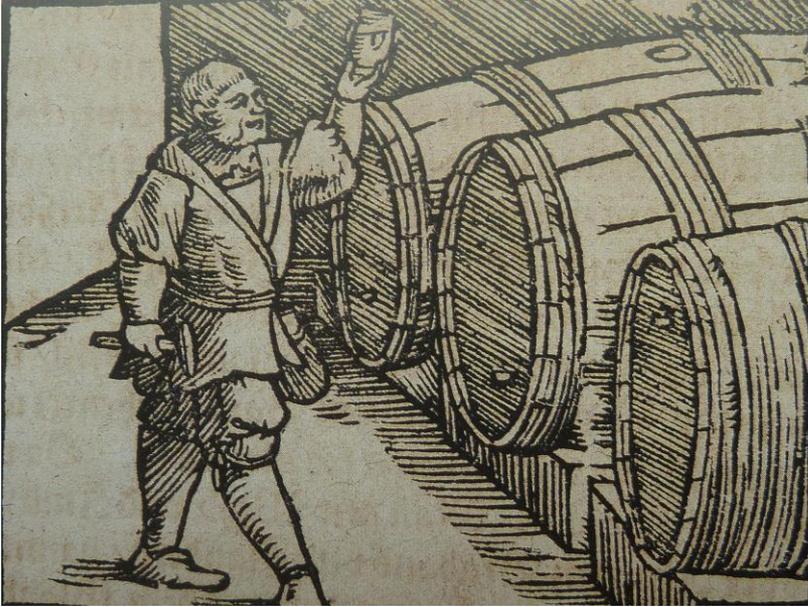
- Recent crises highlighted the **complexity** of food supply networks
- **International food trade** increases the possibility of food fraud

Understand and map vulnerabilities

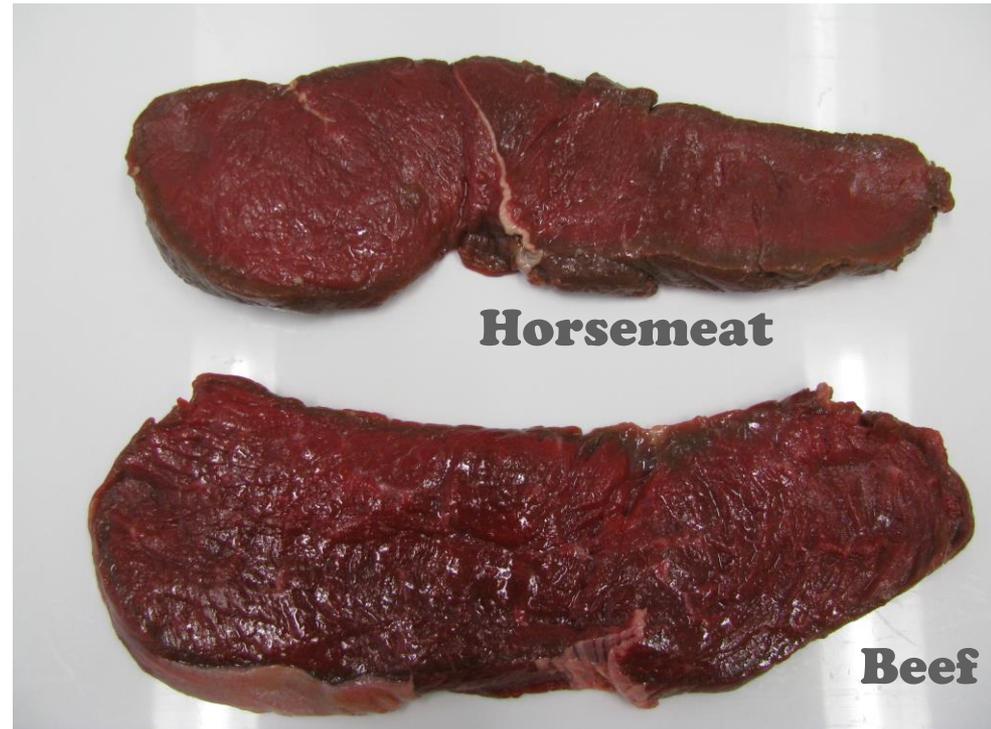


Source: [www.thenewstribes.com](http://www.thenewstribes.com)

# Detection of food adulteration: Don't forget to start with visual inspection!



It worked for the Ale Conner!



**THANK YOU!**