



**QUEEN'S
UNIVERSITY
BELFAST**

IGFS

**THE INSTITUTE
FOR GLOBAL
FOOD SECURITY**

HERB AND SPICE FRAUD: THE OREGANO STORY FOR MULTICOOP!

Professor Chris Elliott



Food security: when all people, at all times, have physical, social and economic access to sufficient, safe & nutritious **food** that meets their dietary needs and **food** preferences for an active and healthy life.





A Major Research Theme

Integrity of The Global Food Supply



Defining Food Integrity (Elliott's attempt)

Food integrity: when all people, at all times, have access to **food** which is safe, authentic and nutritious. The systems used to produce the **food** are sustainable, ethical, respect the environment and protect the human rights of all workers.



The Seven Key Principles of Food integrity:

1. The food we produce is safe
2. The food we produce is authentic
3. The food we produce is nutritious
4. The systems used to produce our food are sustainable
5. Our food is produced to the highest ethical standards
6. We respect and protect our environment
7. We respect and protect all those who work in our global food system



Our Ambition: To build a hub for Global Food Integrity









Commonly found in kitchens at home



Most peoples perception.....



.....but is it really Oregano?



Cultivation and Country of Origin

- There are many sub-species of Oregano
- Two major species marketed within the EU 
- Major sources of Mediterranean oregano are Turkey & Greece



Origanum vulgare



Origanum onites



Mediterranean Cultivated Oregano

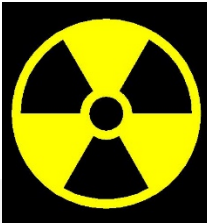


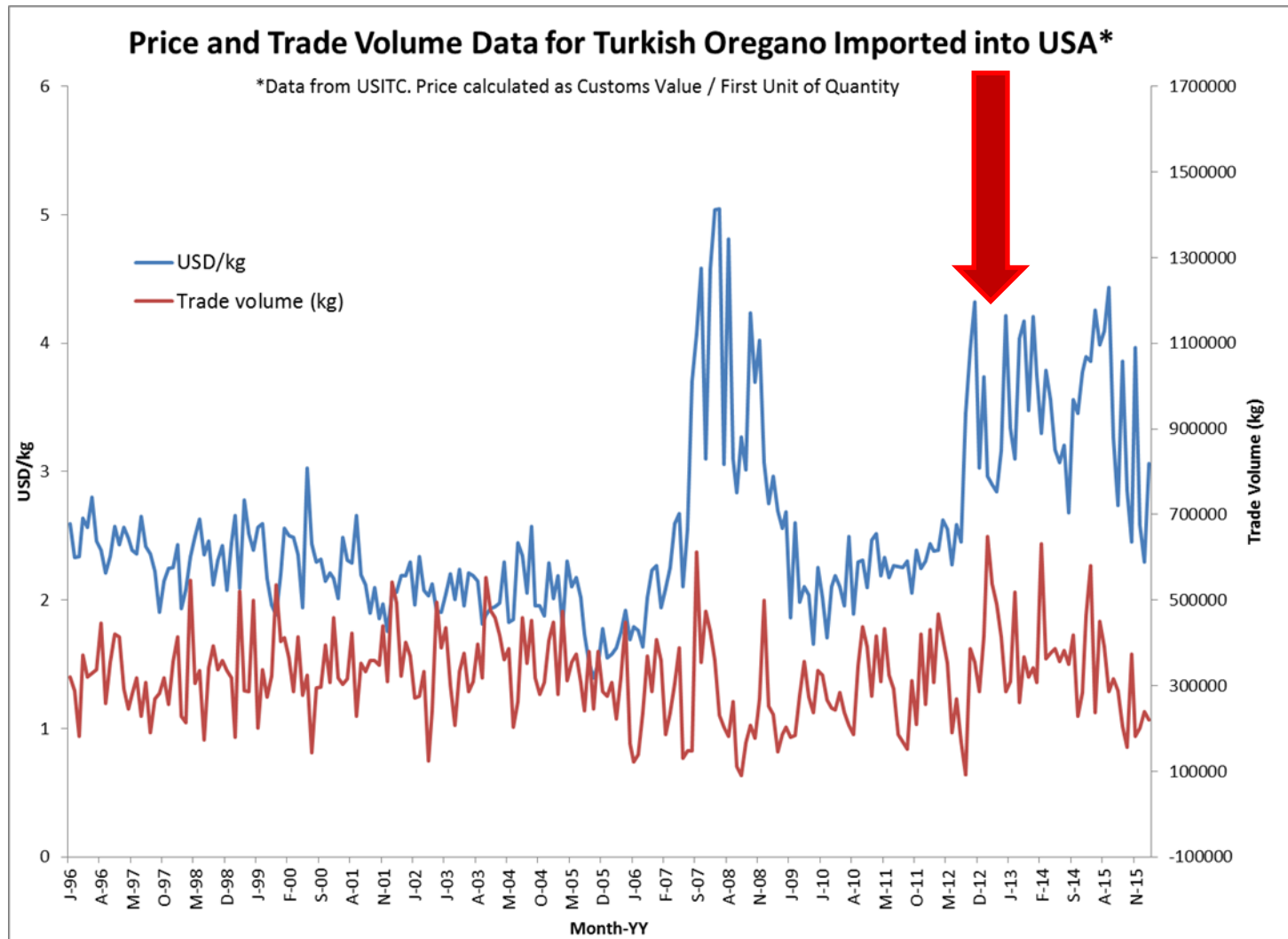
- Denizli Region in Turkey has become significant in the production of Oregano to the herb market.
- Oregano plants are perennials and will produce for about 7 - 8 years.
- In July, the harvesting, threshing, drying, and packaging of the Oregano for processing



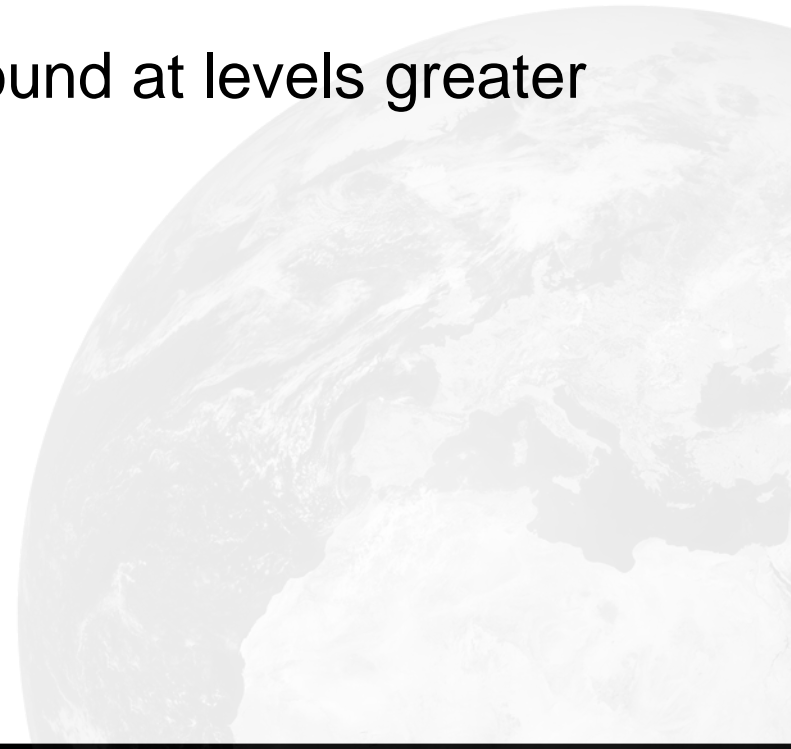
Oregano Adulteration

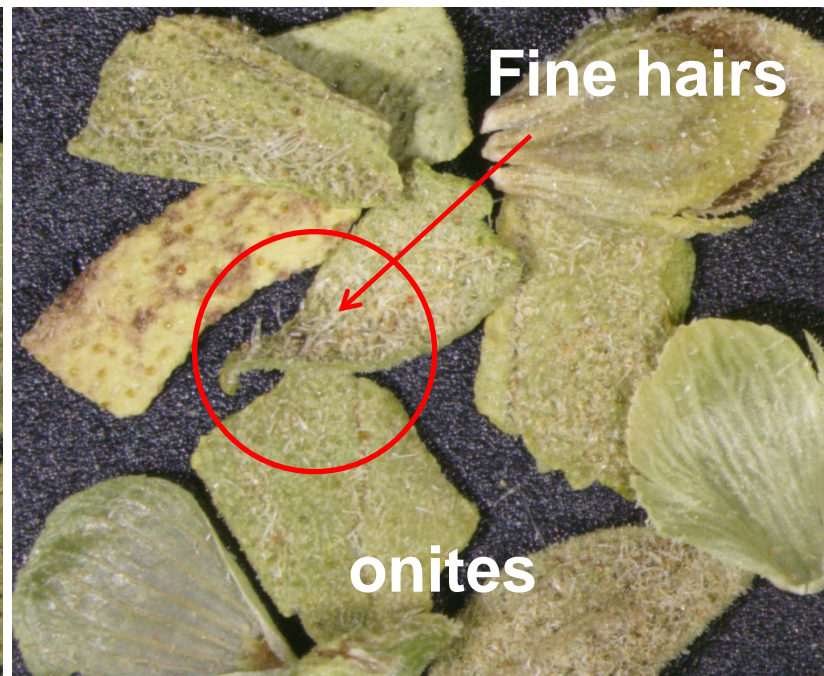
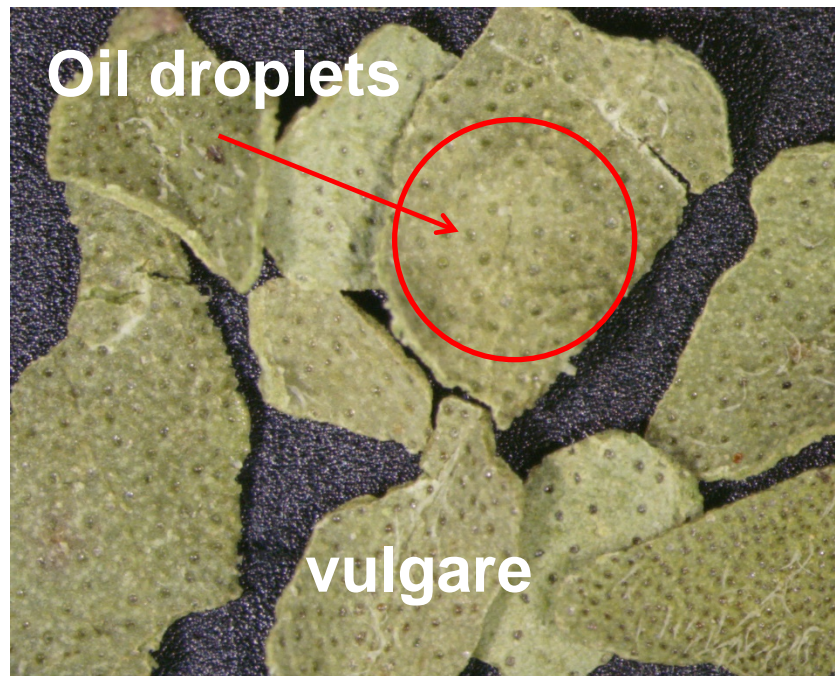
- Historically there has been numerous instances of oregano adulteration
- 1986; the Chernobyl nuclear reactor accident in the USSR had a devastating effect on leafy herbs (esp oregano) with majority of the crop contaminated by radiation and could not be used.
- Found that by adding other leafy material, which grew outside the area impacted by the radiation, that it was possible to reduce the detectable levels of radiation.
- Large profits made by adulterating contaminated material and selling it.
- However adulteration of oregano has persisted in many regions





- A variety of leafy materials are used to adulterate oregano – making it cheaper to produce and resulting in greater profits for fraudster.
- ASTA: Any non-oregano species found at levels greater than 1% is considered adulterated.
- ESA: 2% tolerated





Oregano Adulteration

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Food Security



Industry Standard: Microscopy

FT-IR- Thermo Nicolet iS5 (Thermo Scientific,
Dublin, Ireland)

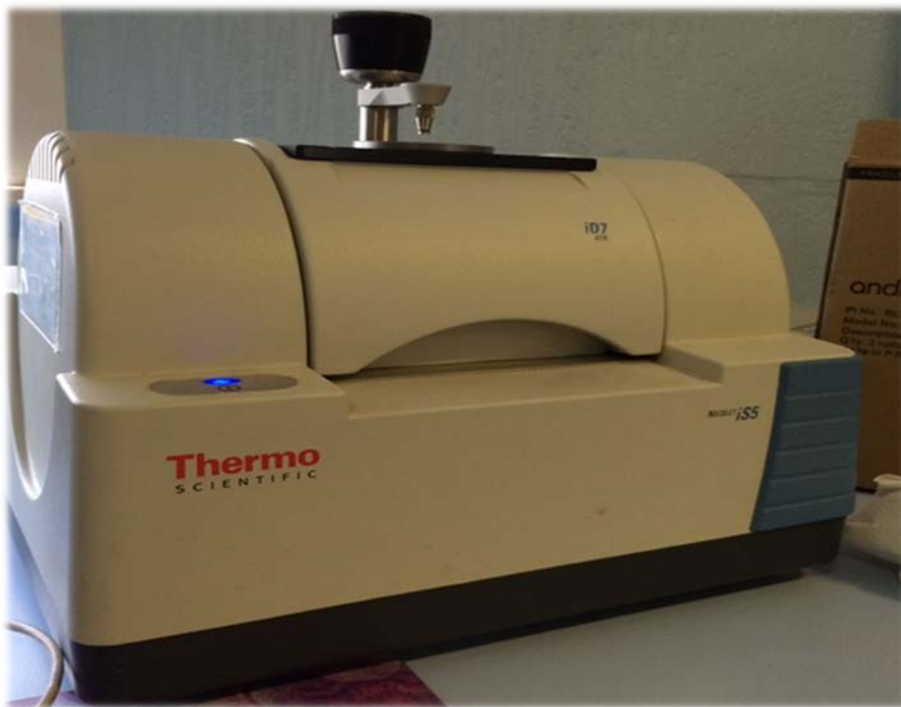
iD7 accessory -Diamond crystal

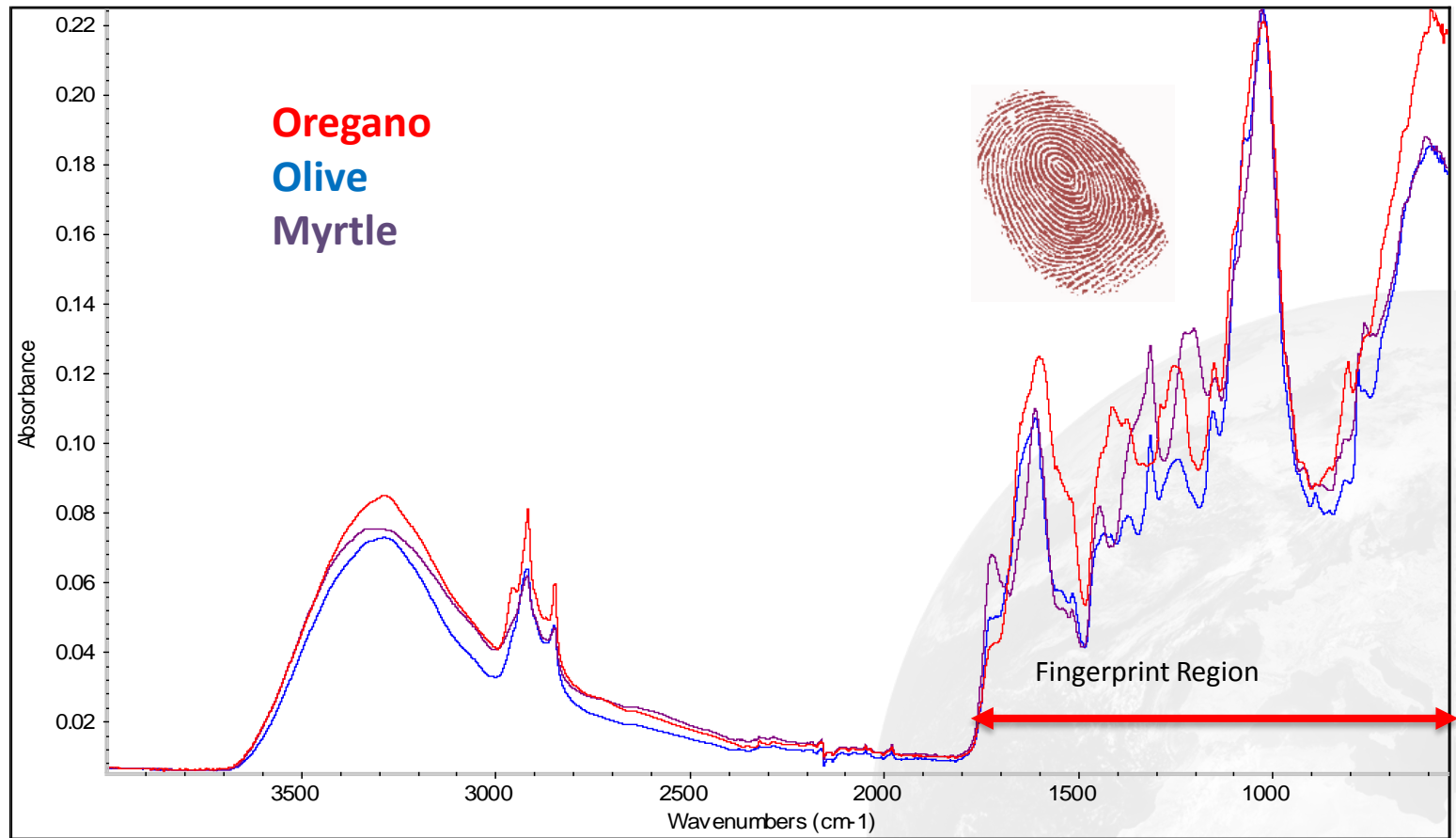
Samples milled

Samples run in triplicate

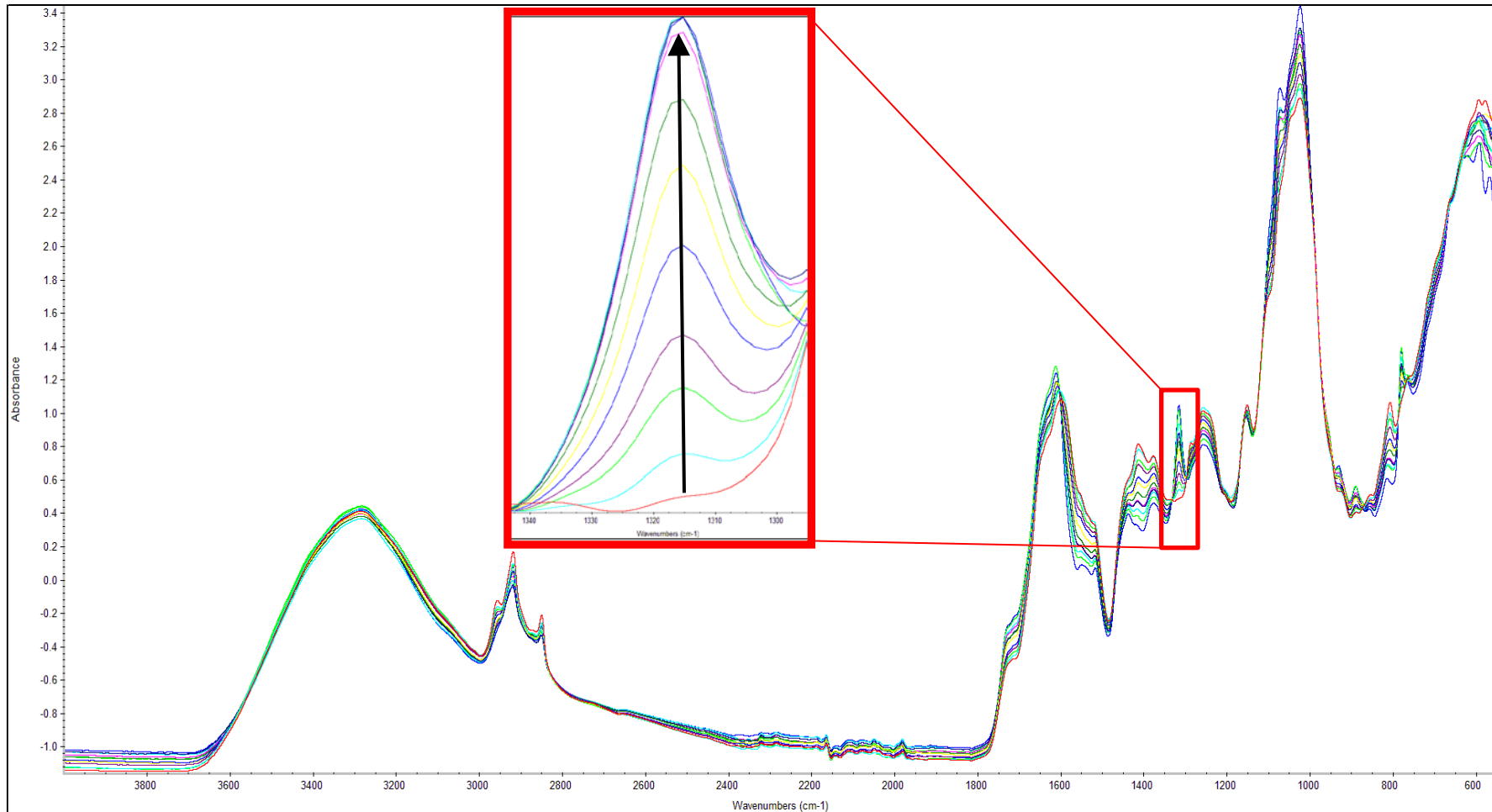
Range $550\text{-}4000\text{cm}^{-1}$

32 scans



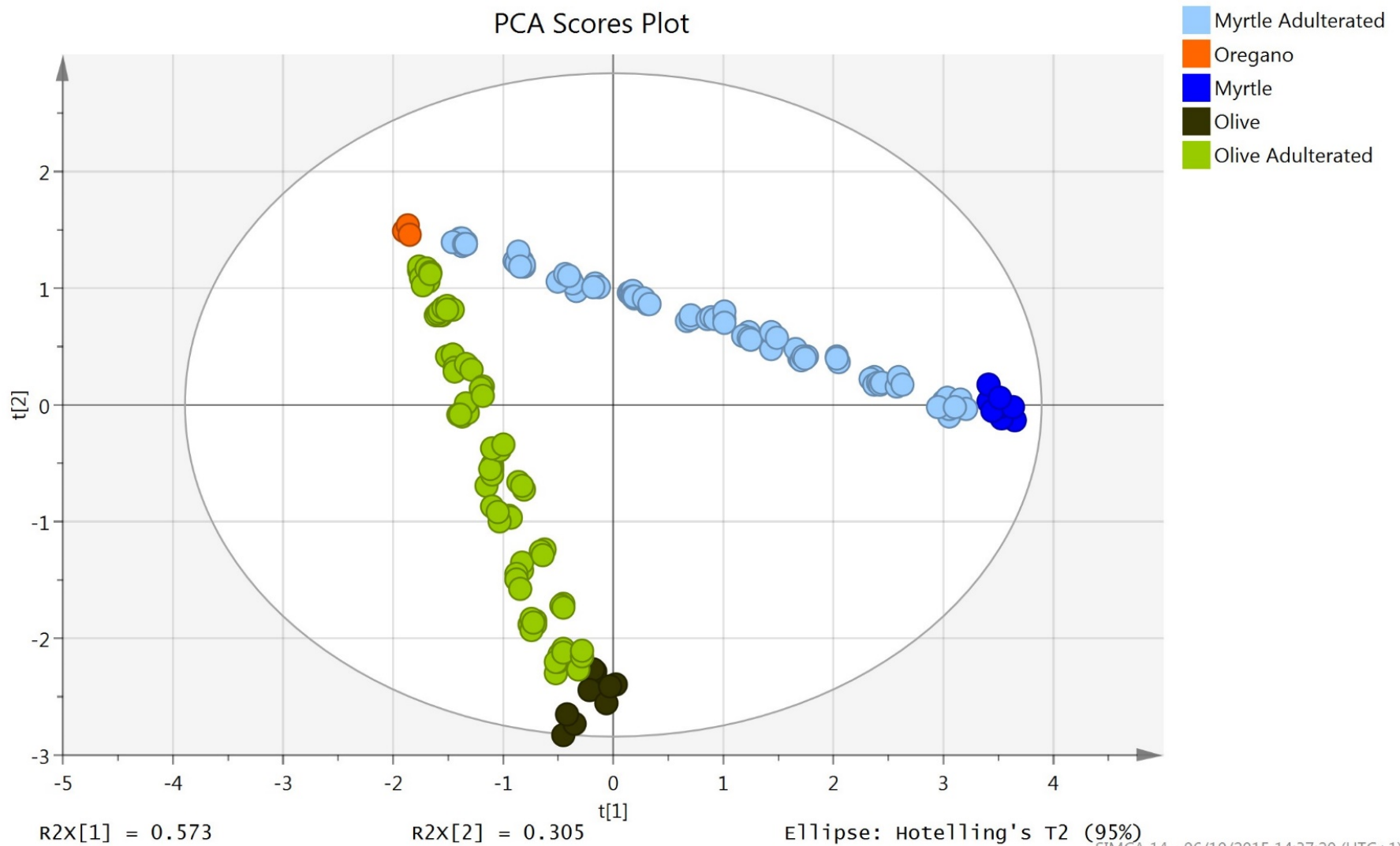


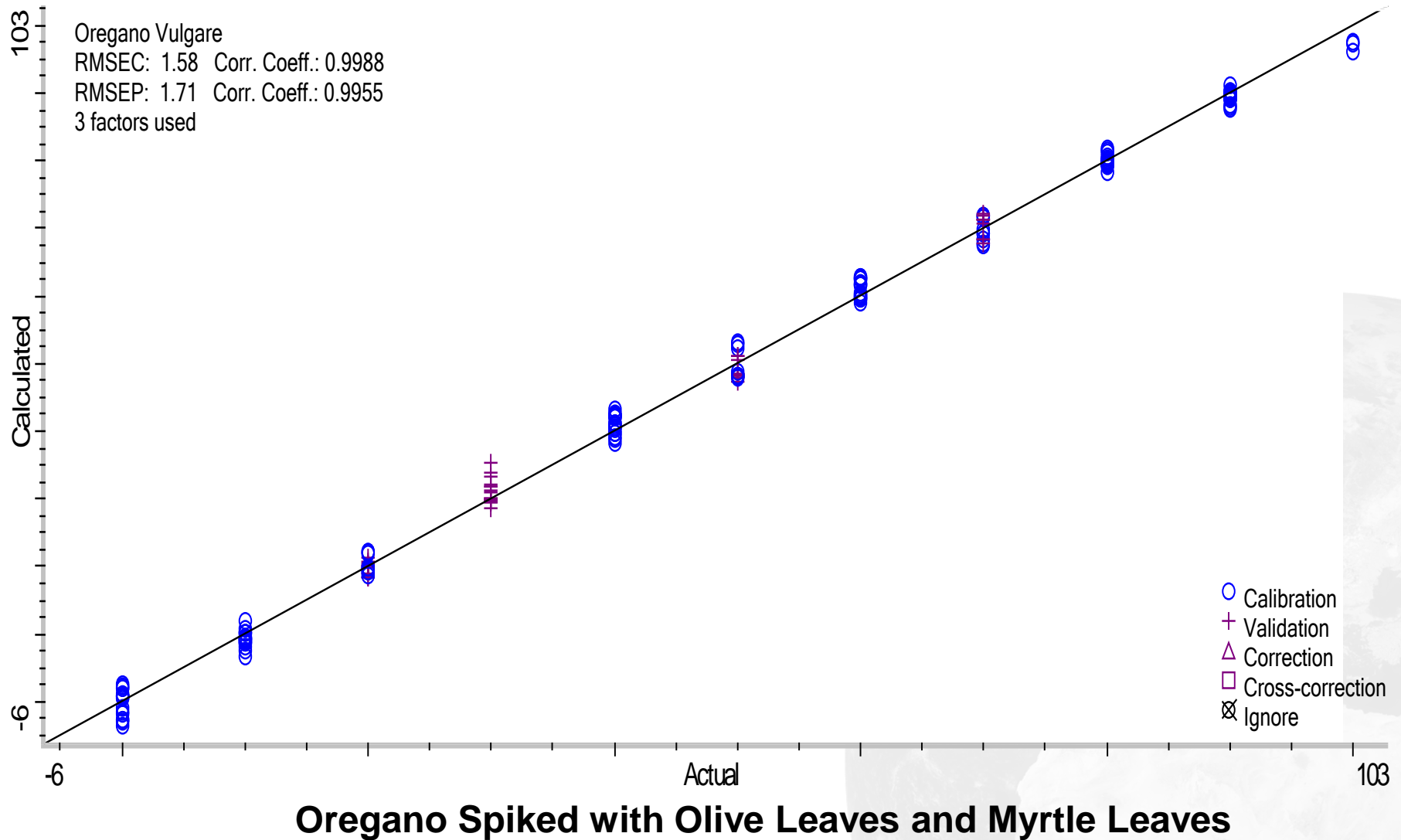
Adulteration of oregano with olive leaves at 10% increments

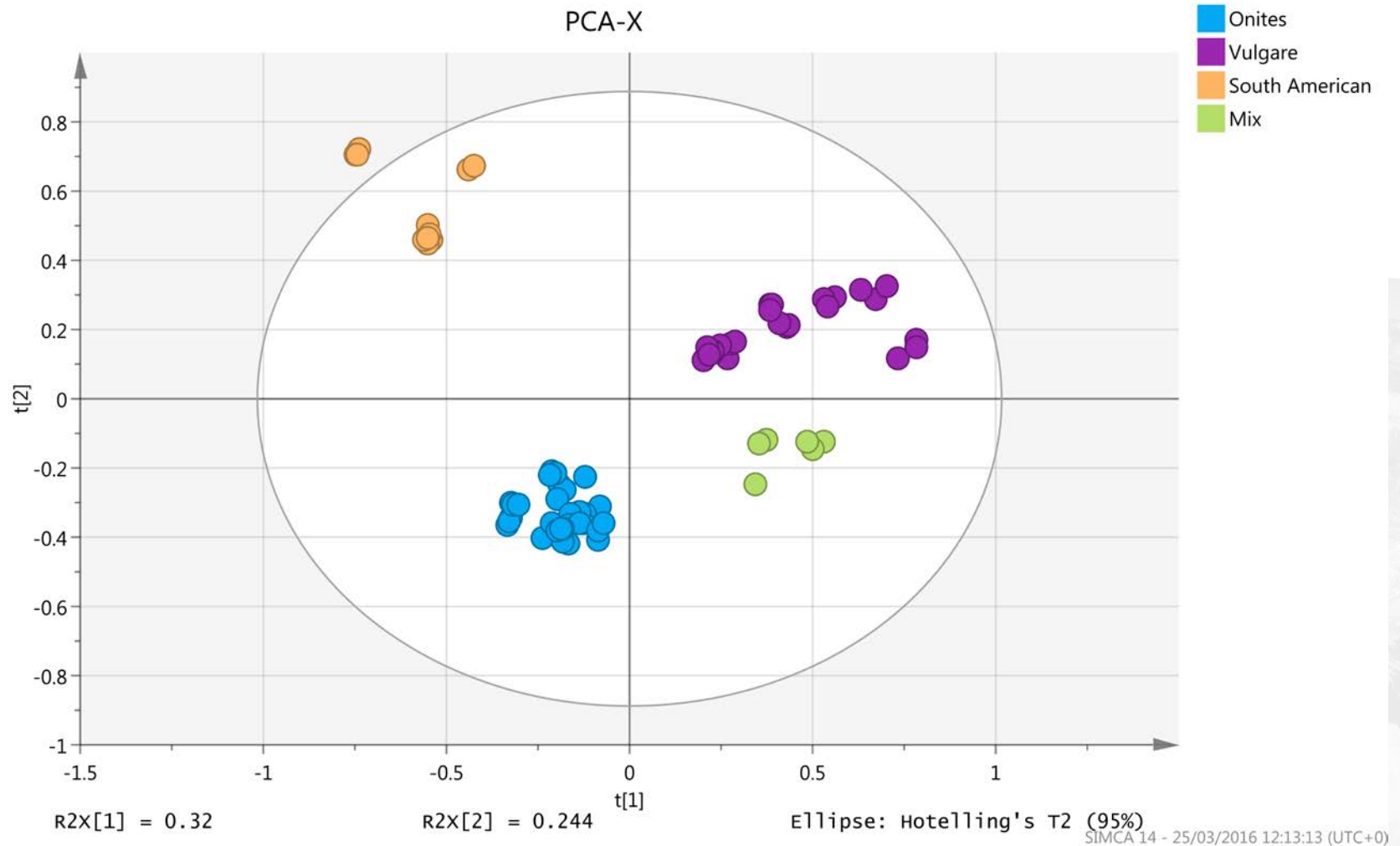


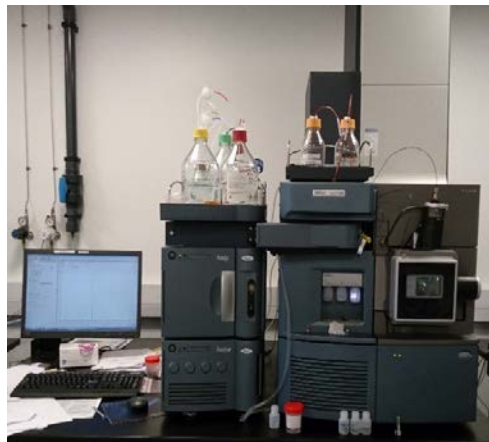


PCA Scores Plot





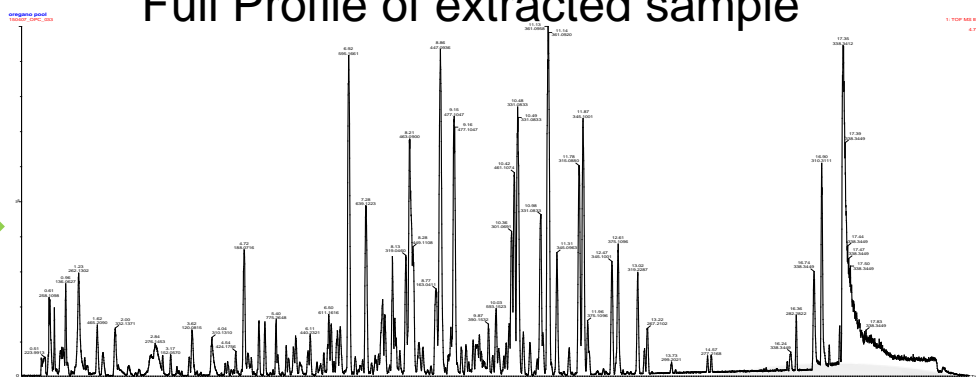




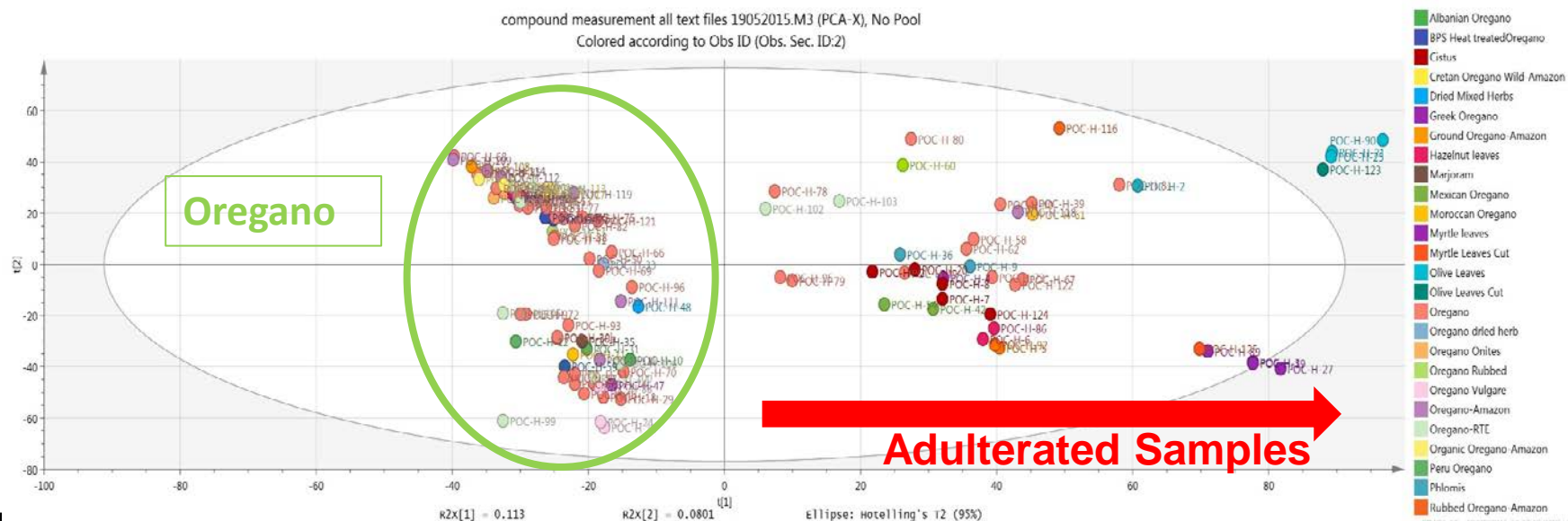
Untargeted
Analysis



Full Profile of extracted sample



Data Mining &
Chemometric Analysis



Targeted, confirmatory LC-MS/MS method for detection and quantification of oregano adulteration

Institute for Global
Food Security



Waters Acquity I-Class UHPLC
coupled with Waters Xevo TQ-S mass
analyser.

Sample Collection & Preparation

Oregano samples collected
from retail, service and internet
sources.

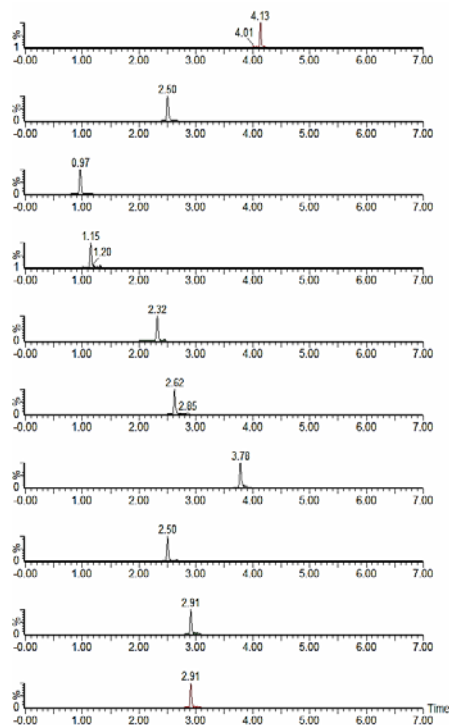
Targeted LC-MS/MS analysis (Waters TQ-MS)1

50mg (+/-1%) of milled herb extracted
with methanol/water (1:1), mixed,
sonicated, centrifuged and filtered
ready for LC-MS analysis.

TOTAL ANALYSIS TIME : 25min

Exclusive adulterants' markers:

Olive leaves – 2
Myrtle – 2
Sumac – 2
Hazelnut – 3
Phlomis – 1



Methods' Validation

QUALITATIVE
(5 adulterants)

Selective /specific for all 10 markers (n=50)

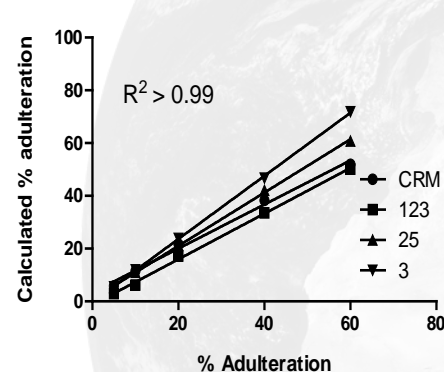
QUANTITATIVE
Olive leaves

CC α 1.3% (n=54)
CC β 2.2% (n=54)
Repeatable (RSD 6.4%)
Accuracy (115%)

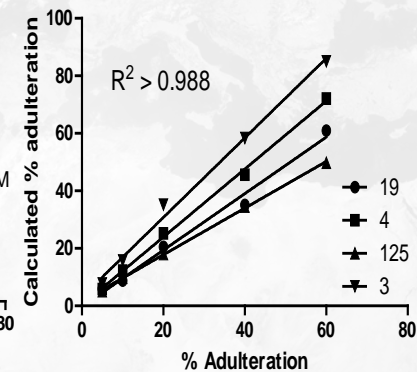
QUANTITATIVE
Myrtle Leaves

CC α 1.2% (n=54)
CC β 2.0% (n=54)
Repeatable (RSD 5.6%)
Accuracy (81%)

Linearity in olive leaves matrix



Linearity in myrtle leaves matrix





Contents lists available at ScienceDirect

Food Chemistry

journal homepage: www.elsevier.com/locate/foodchem



A comprehensive strategy to detect the fraudulent adulteration of herbs: The oregano approach



Connor Black, Simon A. Haughey*, Olivier P. Chevallier, Pamela Galvin-King, Christopher T. Elliott

Institute for Global Food Security, Advanced ASSET Centre, School of Biological Sciences, Queen's University Belfast, Northern Ireland, United Kingdom

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Development of a comprehensive analytical platform for the detection and quantitation of food fraud using a biomarker approach. The oregano adulteration case study

Ewa Wielogorska^{a,*}, Olivier Chevallier^a, Connor Black^a, Pamela Galvin-King^a, Marc Delêtre^b, Colin T. Kelleher^b,
Simon A. Haughey^a, Christopher T. Elliott^a

^a Institute for Global Food Security, Advanced ASSET Centre, School of Biological Sciences, Queen's University Belfast, Northern Ireland, United Kingdom



Oregano Sample Survey

Oregano Survey	UK/Ireland	Internet/Other
Samples Tested	53	25
Samples Adulterated	13	6
Samples Adulterated %	24.5%	24%
Level of Adulteration ^c	~30 to >70%	~30 to >70%
Most Common Adulterants	1. Olive leaves	1. Olive leaves
	2. Myrtle leaves	2. Myrtle leaves
Presence confirmed by MS analysis	Yes	Yes

**Results also passed on to UK
Food Standards Agency**

Does your spice rack contain fake oregano?

25% of oregano tested contained other ingredients

23 July 2015

A cutting-edge food fraud study – revealed exclusively to Which? – found that 25% of 78 samples of dried oregano bought from a range of retailers contained ingredients other than oregano.

These ingredients, most commonly olive and myrtle leaves, were found to make up between 30% and 70% of the product. So in some cases, less than a third was actually oregano.

The snapshot investigation used oregano samples bought from a range of shops in the UK and Ireland and from online retailers, and was led by food fraud expert Professor Chris Elliott.

You can help stop food fraud - click to sign up to our [Food Fraud Campaign](#).

Food fraud study

The test, using mass spectrometry which identifies compounds by their atomic composition, was conducted by Professor Elliott, Director of the Institute for Global Food Security, and author of the independent review into food crime commissioned by the government in the wake of the horsemeat scandal.

Professor Elliott said: 'Clearly we have identified a major problem and it may well reflect issues with other herbs and spices that enter the British Isles through complex supply chains.'

'Much better controls are needed to protect the consumer from purchasing heavily contaminated products.'

We've teamed up with Professor Elliott in the past to reveal that 40% of the lamb takeaways we tested contained other meat and, on the back of this, launched our Food Fraud campaign.

Fake food

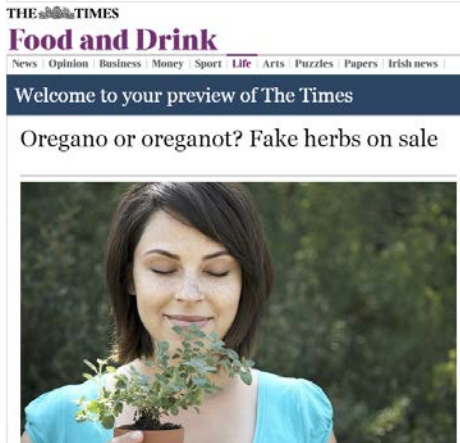
We think it's unacceptable that you don't know what you're adding to your food. We want the government, food safety regulator the Food Standards Agency and local authorities to stop food fraud.

Which? executive director Richard Lloyd, said: 'It's impossible for any shopper to tell, without the help of scientists, what herbs they're actually buying. Retailers, producers and enforcement officers must step up checks to stamp out food fraud.'

We are sharing the results from this study with the Food Standards Agency.



Which?



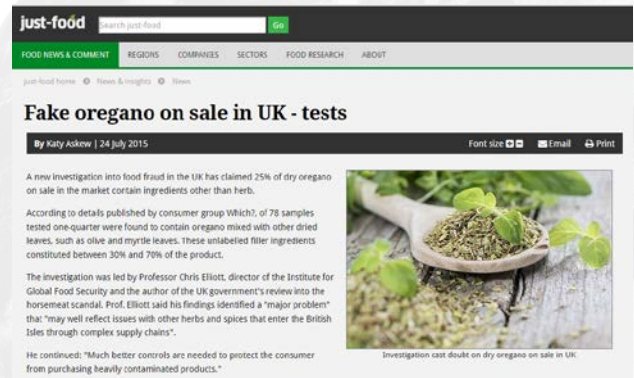
MailOnline



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Oregano being bulked up with cheaper leaves: Quarter of packets in supermarkets found to contain other ingredients including olive or myrtle leaves

- Nineteen of 78 products tested by Which? experts had other ingredients
- Researchers say it raises suspicions over other dried herbs and spices jars
- Tests were carried out by author of report into horsemeat scandal of 2013
- Which? didn't identify brands but passed them to Food Standards Agency



33 media outlets had reported the story within one day of the WHICH? article appearing, making a global impact

OREGANO SPOT CHECK

CHOICE.COM.AU/OREGANO

50%
OREGANO



40%
OREGANO



36%
OREGANO



35%
OREGANO



26%
OREGANO



11%
OREGANO



<10%
OREGANO



choice
CHOICE.COM.AU

WE TESTED ONE SAMPLE OF A SINGLE BATCH FROM EACH BRAND. OTHER BATCHES OF OREGANO FROM BRANDS FOUND TO BE AFFECTED BY ADULTERATION IN OUR SPOT CHECK MAY BE FINE.

ACCC Ruling:

Two companies have to prove authenticity of all their Herbs and Spices

Smaller companies have analyse oregano on a yearly basis to prove authenticity



PASSED SPOT CHECK

CHOICE.COM.AU/OREGANO

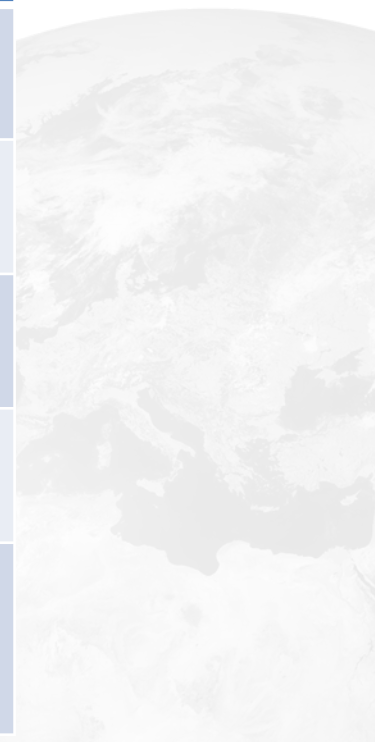


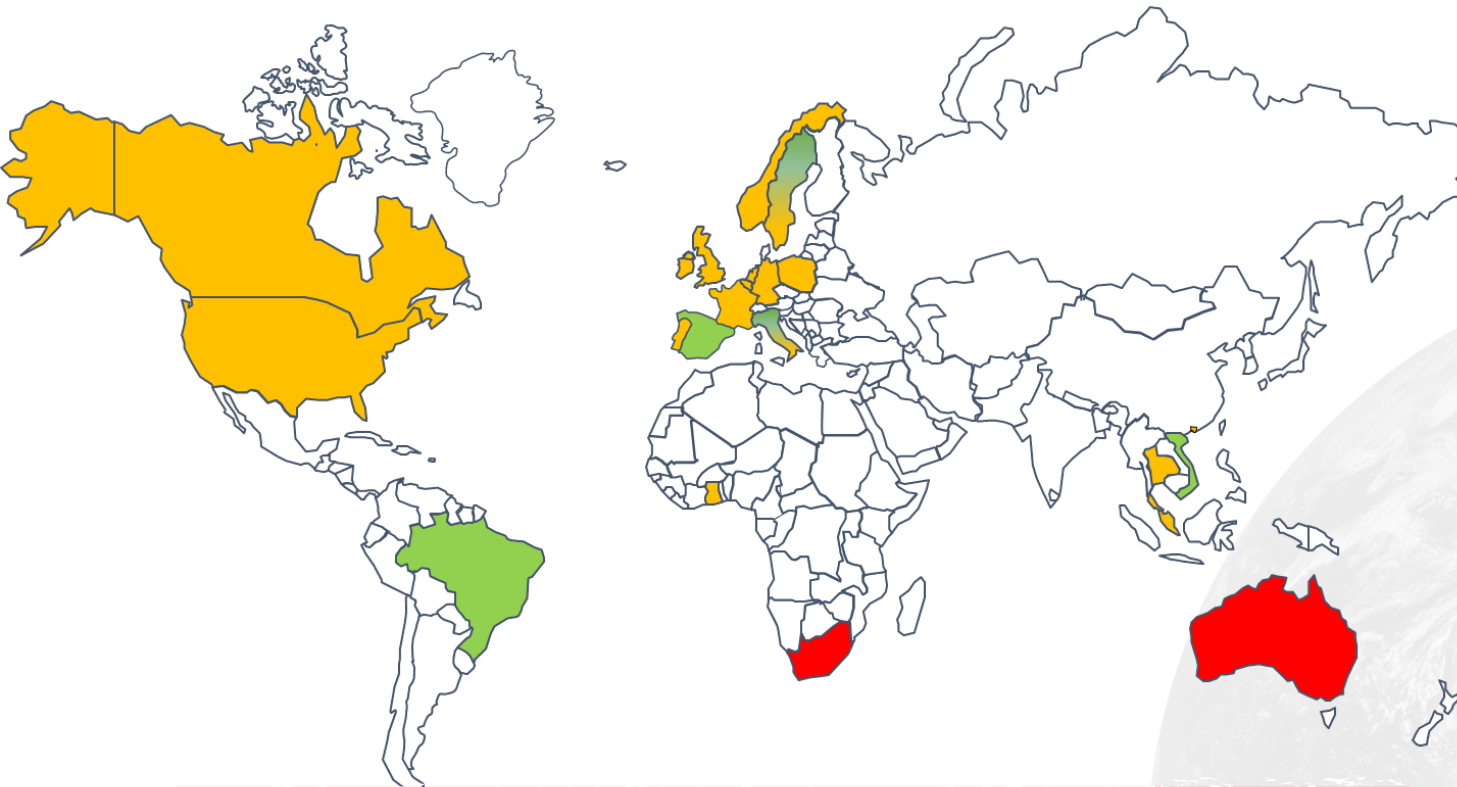
WE TESTED ONE SAMPLE OF A SINGLE BATCH FROM EACH BRAND. OTHER BATCHES OF OREGANO FROM BRANDS FOUND TO BE AFFECTED BY ADULTERATION IN OUR SPOT CHECK MAY BE FINE.

choice
CHOICE.COM.AU

- Sampling occurred during 1st half of 2016
- Samples transported intact to Queen's University Belfast
- All samples screened using spectroscopy and those found to be adulterated were subjected to mass spectrometry to confirm.

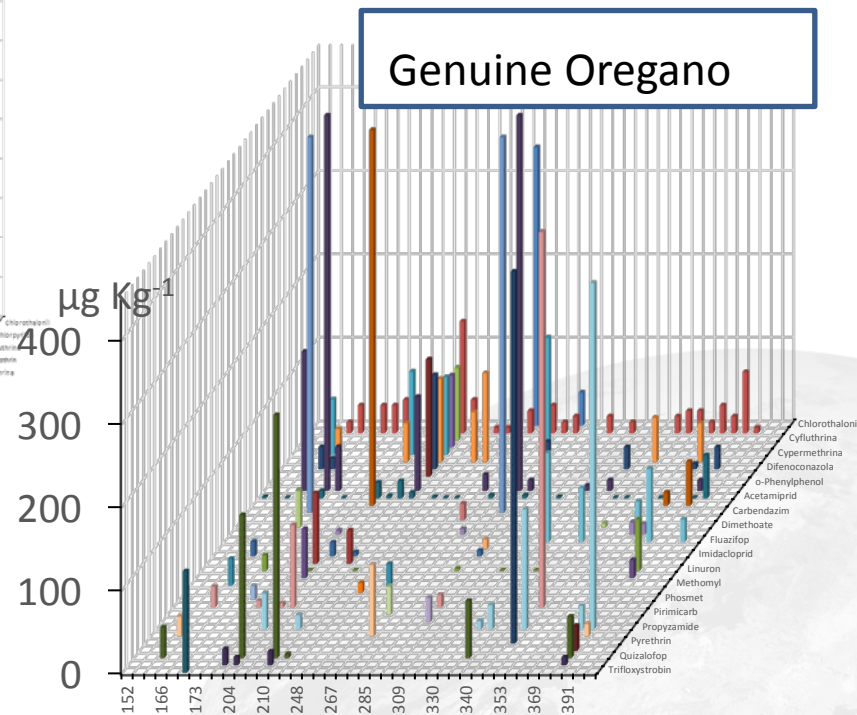
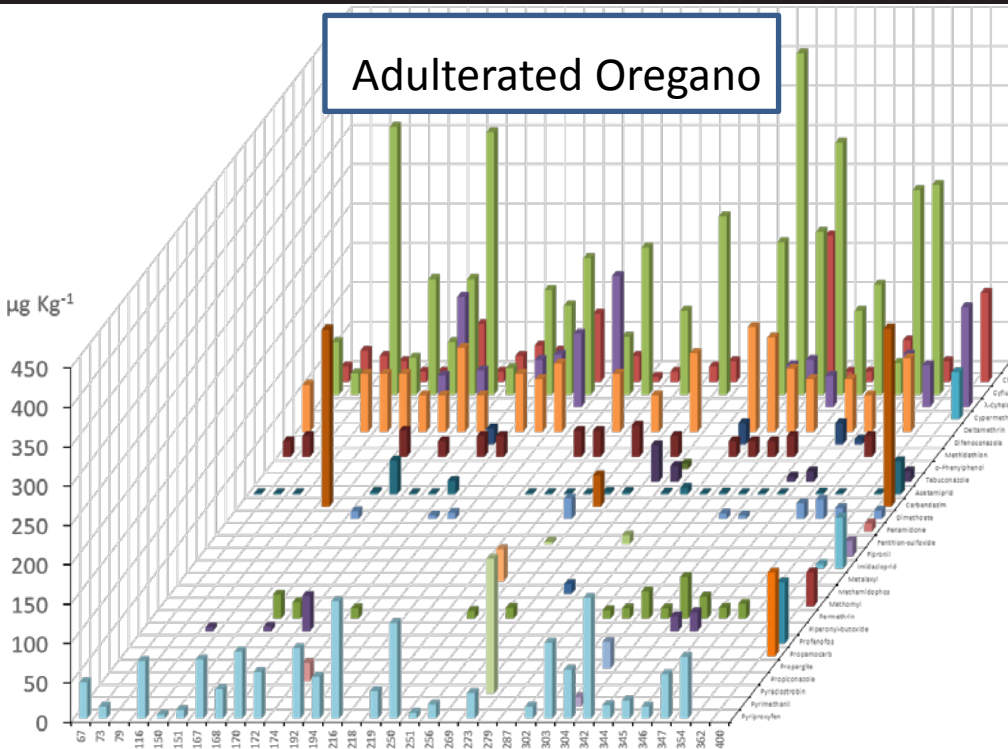
US Oregano Survey	2016
Samples taken	28
Level of adulteration found	7 (25%)
Adulterants identified	Sumac, olive and myrtle leaves
Range of adulterants found	22% to 78%
Price range of adulterated products	From \$245/kg to \$30/kg





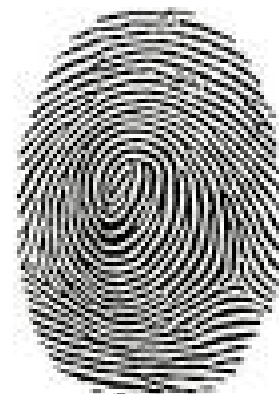
GLOBAL AVERAGE: 25%

Country	Samples Adulterated	
South Africa	6/10	60%
Australia	7/12	58%
Canada	5/14	36%
Portugal	2/6	33%
Ghana	2/6	33%
Germany	3/10	30%
Poland	3/10	30%
USA	7/28	25%
UK/Ireland	19/78	24%
Belgium	2/9	22%
Hong Kong	1/5	20%
Thailand	1/5	20%
France	2/12	17%
Norway	1/6	17%
Malaysia	1/6	17%
Netherlands	2/18	11%
Italy	1/12	8%
Sweden	1/12	8%
Spain	0/5	0%
Brazil	0/3	0%
Vietnam	0/2	0%



Cyfluthrin, Cyhalothrin I and Deltamethrin are mainly present in adulterated samples, as well as Methidathion, Permethrin and Pyriproxyfen.

Pesticide residue profile: a potential fingerprint of adulteration of oregano?



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Food Chemistry

journal homepage: www.elsevier.com/locate/foodchem



Food fraud in oregano: Pesticide residues as adulteration markers

Lucie Drabova^a, Gerardo Alvarez-Rivera^b, Marie Suchanova^a, Dana Schusterova^a,
Jana Pulkrabova^a, Monika Tomaniova^a, Vladimir Kocourek^a, Olivier Chevallier^b,
Christopher Elliott^b, Jana Hajslova^{a,*}

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^b Institute for Global Food Security, School of Biological Sciences, Queen's University Belfast, Northern Ireland, United Kingdom



Tacking Herb & Spice Fraud

Institute for Global
Food Security

Industry Sponsored Research Programme



QUEEN'S
UNIVERSITY
BELFAST



Sainsbury's



- Collaboration with Herb & Spices companies and Retailers
- Identify other high risk commodities e.g. paprika, garlic, sage
- Develop additional methods of analysis based on the Oregano Model
- Explore possibility of using portable instrumentation for use in the field.

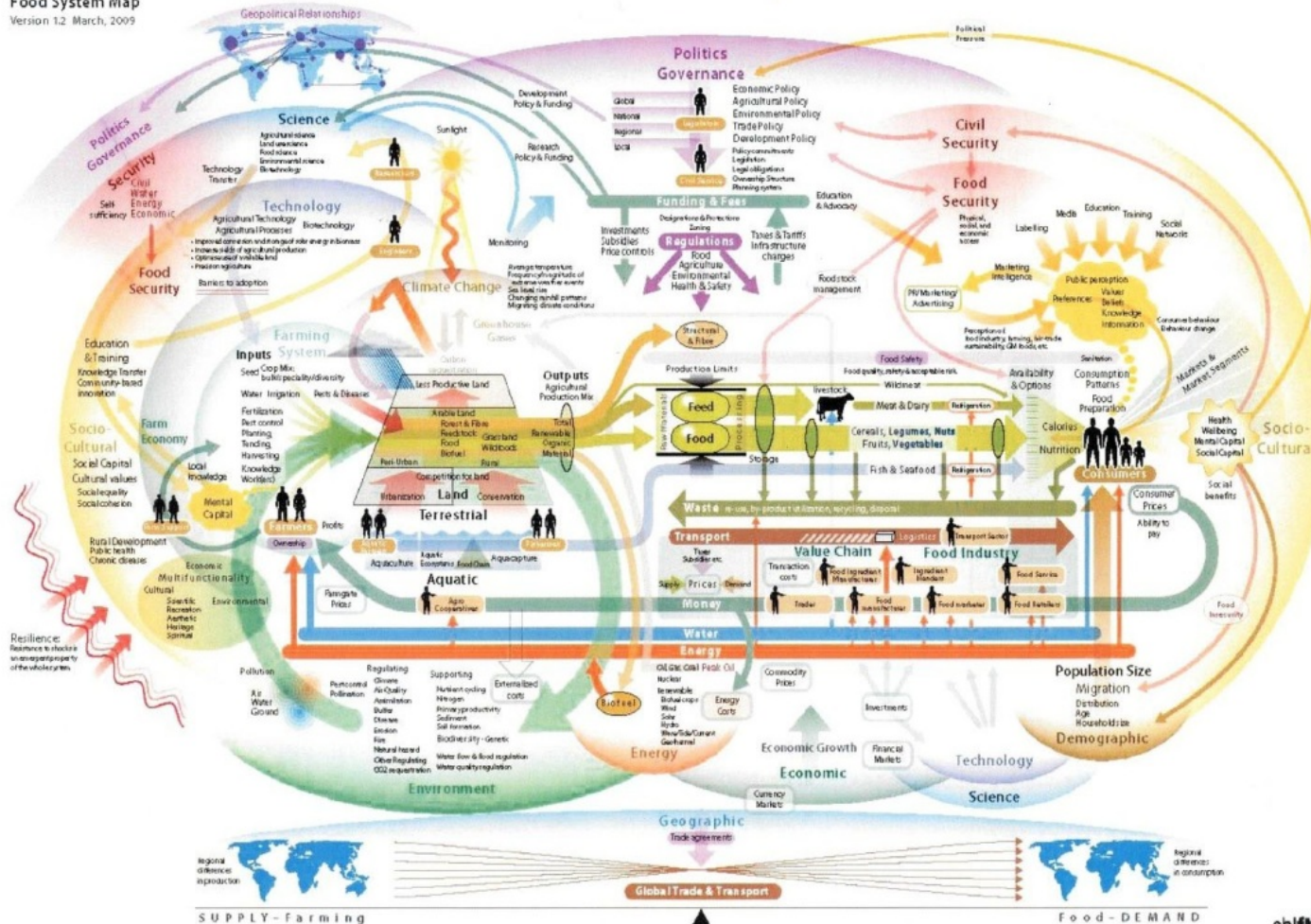






The Global Food System

Food System Map
Version 1.2 March, 2009



Acknowledgements

- **Institute for Global Food Security Team**

- Simon Haughey
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- Jana Hajslova & team UCT!!

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UK Herb and Spice Consortium

Multicoop

EIT-Food

