

# New Technologies in Botanical Authenticity Analysis

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# Questions to be Addressed

- Q1. Why is botanical authenticity important?
- Q2. Why did botanical adulterations occur?
- Q3. What identification methods can ensure authentication?



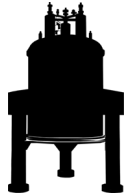
**Botanical  
Materials**



AND



**Regulation  
Guidelines**



## **New Technologies**

Taxonomy (Genomics)  
Chemistry (Phytochemical Analysis)  
Statistical Analysis (Chemometrics)

# Classification: Identification of Licorice Plant Materials

## Morphological Identification

### Macroscopic Observation

*G. glabra*



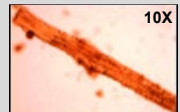
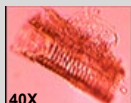
*G. uralensis*



*G. inflata*



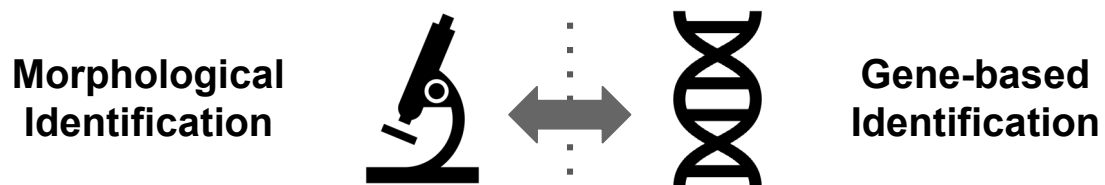
### Microscopic Observation



## Gene-Based Identification (DNA barcoding)

Among the 51 acquired licorice samples	Claimed Species	DNA authentication results
11 misidentified <i>Glycyrrhiza</i> species, 21.5% of all samples	<i>G. inflata</i>	<i>G. uralensis</i>
	<i>G. inflata</i>	<i>G. uralensis</i>
	<i>G. inflata</i>	<i>G. glabra</i>
	<i>G. glabra</i>	<i>G. uralensis</i>
	<i>G. uralensis</i>	<i>G. uralensis</i> X <i>G. glabra</i>
	<i>G. inflata</i>	<i>G. uralensis</i> X <i>G. inflata</i>
	<i>G. uralensis</i>	<i>G. uralensis</i> X <i>G. inflata</i>
	<i>G. inflata</i>	<i>G. uralensis</i> X <i>G. inflata</i>
	<i>G. inflata</i>	<i>G. uralensis</i> X <i>G. inflata</i>
	<i>G. inflata</i>	<i>G. uralensis</i> X <i>G. inflata</i>
	<i>G. glabra</i>	Mixture: <i>G. glabra</i> X <i>G. uralensis</i> and other plant species
Eight samples acquired as "licorice" or <i>G. glabra</i> but identified as mixture of <i>Glycyrrhiza</i> species, 15.7% of all samples	<i>G. glabra</i>	Mixture: <i>G. inflata</i> and <i>G. uralensis</i> or <i>G. glabra</i>
	<i>G. glabra</i>	Mixture: <i>G. glabra</i> and <i>G. uralensis</i>
	Licorice	Mixture: <i>G. inflata</i> and <i>G. uralensis</i> or <i>G. glabra</i>
	Licorice	Mixture: Three <i>G.</i> species are present
	Licorice	Mixture: Three <i>G.</i> species are present
	<i>G. glabra</i>	Mixture: <i>G. glabra</i> and <i>G. uralensis</i>
	<i>G. glabra</i>	Mixture: <i>G. glabra</i> with potentially <i>G. inflata</i>
	<i>G. glabra</i>	Mixture: <i>G. glabra</i> X <i>G. uralensis</i> and other plant species

# Classification: Morphological & Genetic Identity Tests



Performed on raw plant materials

Identification of raw plant material

- ◆ Existence of characteristic features
- ◆ Physical aspect of the raw material

Species verification

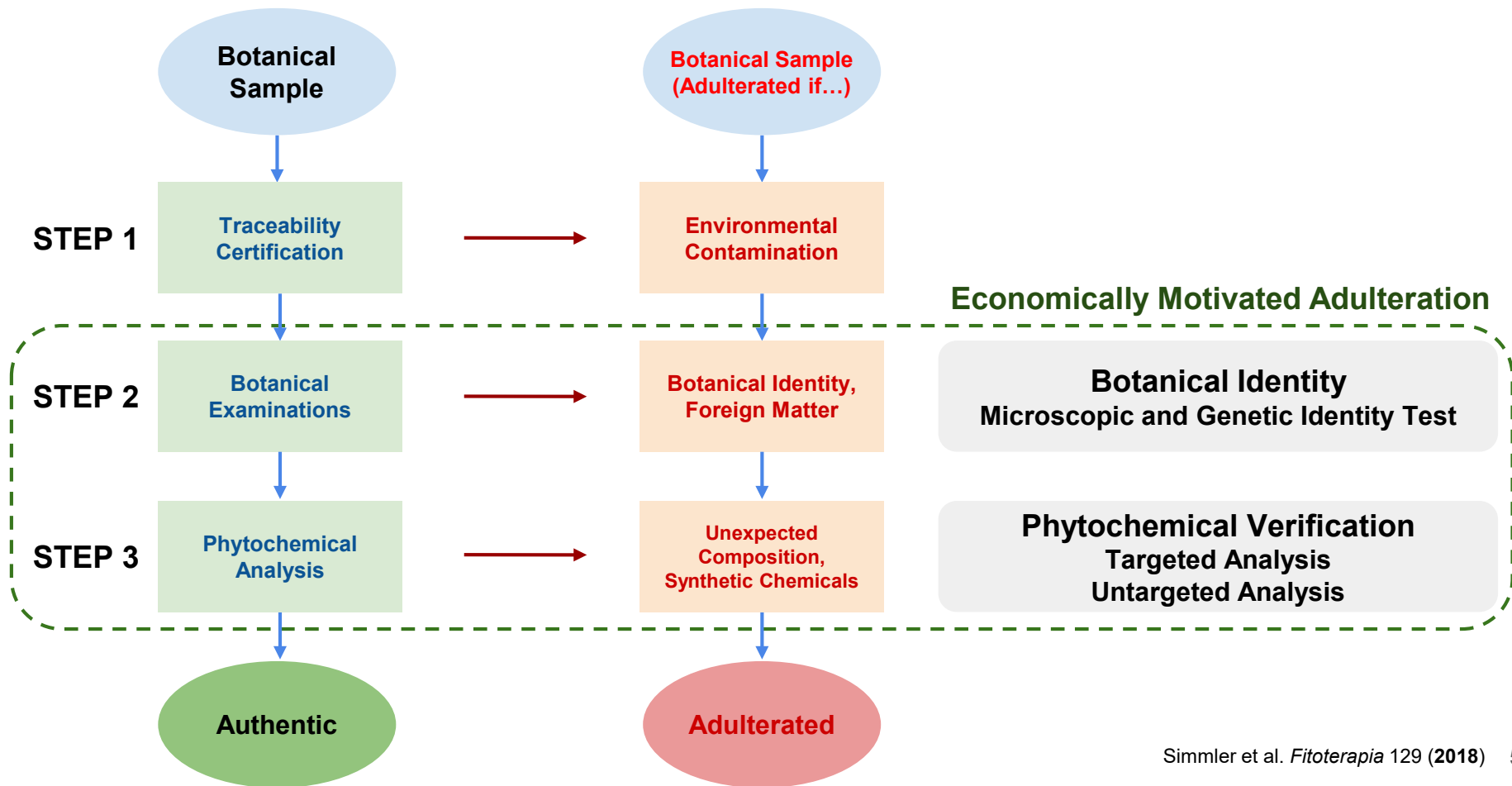
- ◆ Amplification of standardized region of chloroplast and nuclear ribosomal DNA

Identification of the plant genus and/or species  
Validation of the plant part

- ◆ Detection of other plants
- ◆ Presence of foreign matter

- ◆ Presence of other species
- ◆ Identification of microbial elements

# Three Steps for the Assessment of Botanical Authenticity

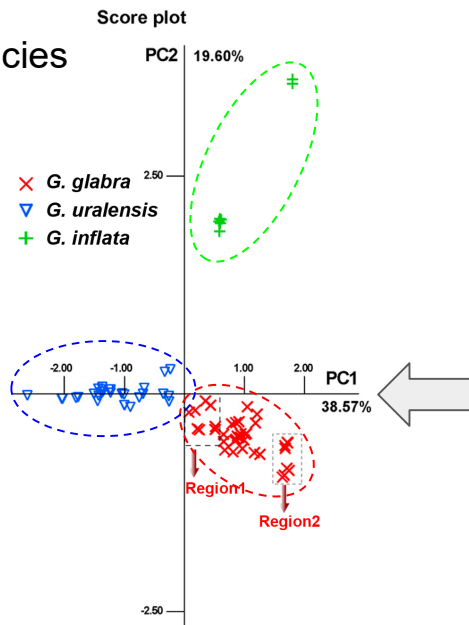


# Untargeted Analysis: Chemometrics of *Glycyrrhiza* spp.

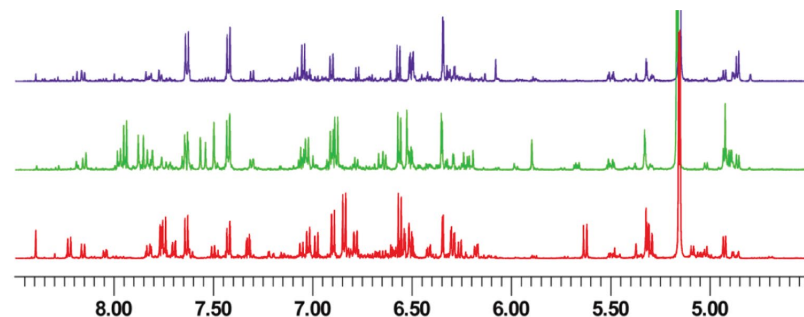
Pharmacopoeial *Glycyrrhiza* species

1. *glabra*
2. *uralensis*
3. *inflata*

NMR-based PCA of 37 DNA identified licorice botanicals



<sup>1</sup>H NMR spectra of standardized extracts

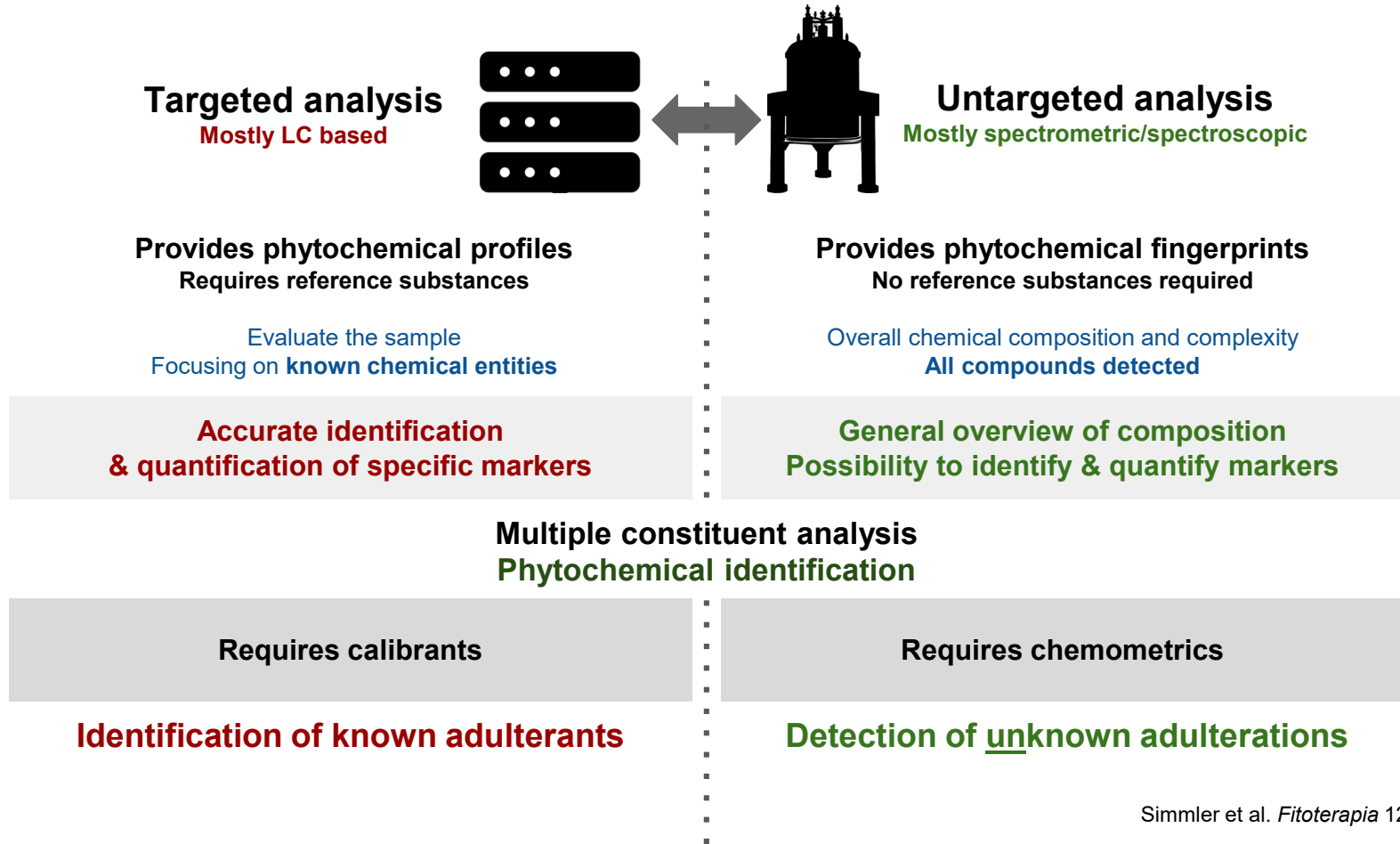


Further investigation of NMR fingerprints:

- Identify
- Quantitate
- Without identical reference materials

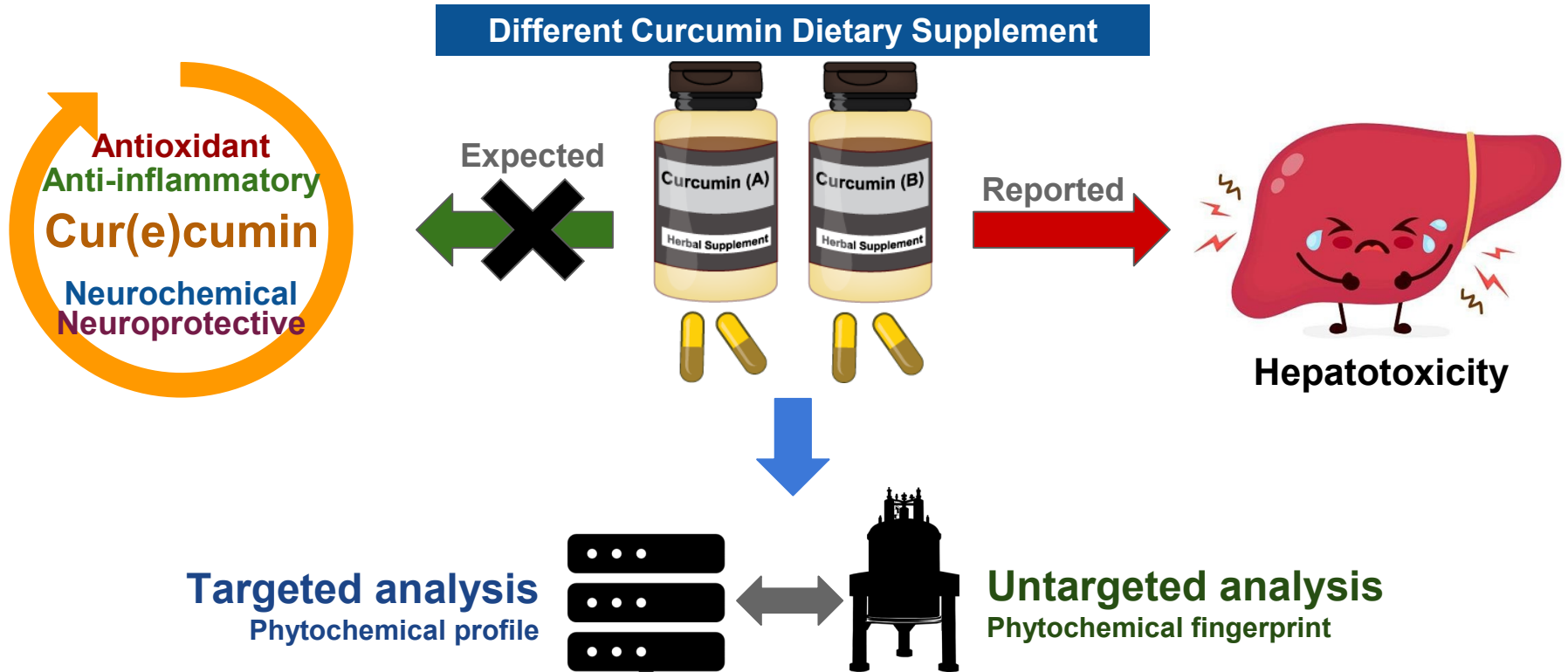
Build the model for further classification

# Phytochemical Analysis



# NEW CHALLENGE

## Phytochemical Analysis of Curcumin-Containing Dietary Supplements





The part of this presentation related to **the investigation of curcumin supplements** is pending publication and will be made available in due course.

# Summary

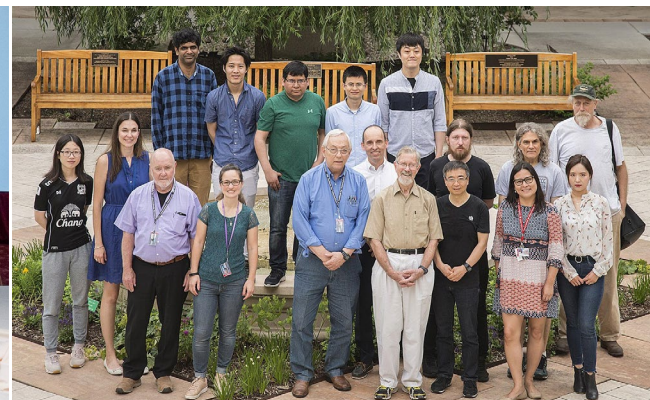
1. **New techniques** have significant impact on **authentication** of botanical materials
2. **DNA barcoding analysis** serves for the **classification** of **botanical materials** by species
3. **NMR spectroscopy** captures the **chemical complexity** of **botanical extracts**
4. **Analysis of phytochemical fingerprints** by **chemometrics/Principal Component Analysis (PCA)** enables the identification of certain markers in extracts
5. **Benchtop NMR** has a role in the **authenticity and adulteration analysis of botanicals** as it is **less costly, still effective**, while offering **attractive overall analysis times**

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**9 NMR**

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