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Live your best life

Authentication methods for Botanical Ingredients (Extracts/Powder) and Dietary Supplements

BOTANICALS IMPORTANCE

Plants have been used to cure and heal throughout human history and now.

In India, annual turnover of botanicals and plant extracts was valued at approximately US$ 56.6 million in 2019

Expected to reach US$ 188.6 million by 2026

(High Demand for Medicinal Plants in India, 2024)

www.asbestos.com

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PROBLEMS OR ISSUES IN BOTANICAL AUTHENTICATION

Three major problems with botanical ingredients

Lack of validation (evidence-based pharmacology)

Lack of toxicology

May often contains adulterants

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HERBALIFE APPROACH FOR BOTANICAL AUTHENTICATION

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BOTANICAL SCIENCE

- Herbalife has been engaged in botanical science development for many years. Over the period, Herbalife has established:

  - **Dedicated Scientific Team:** A group of experts committed to understanding and utilizing botanical ingredients in our products.
  - **Global Herbaria:** Showcasing our diverse botanical portfolio.
  - **Chemical and Genomic Profiles:** Comprehensive analyses for every botanical used in our products.

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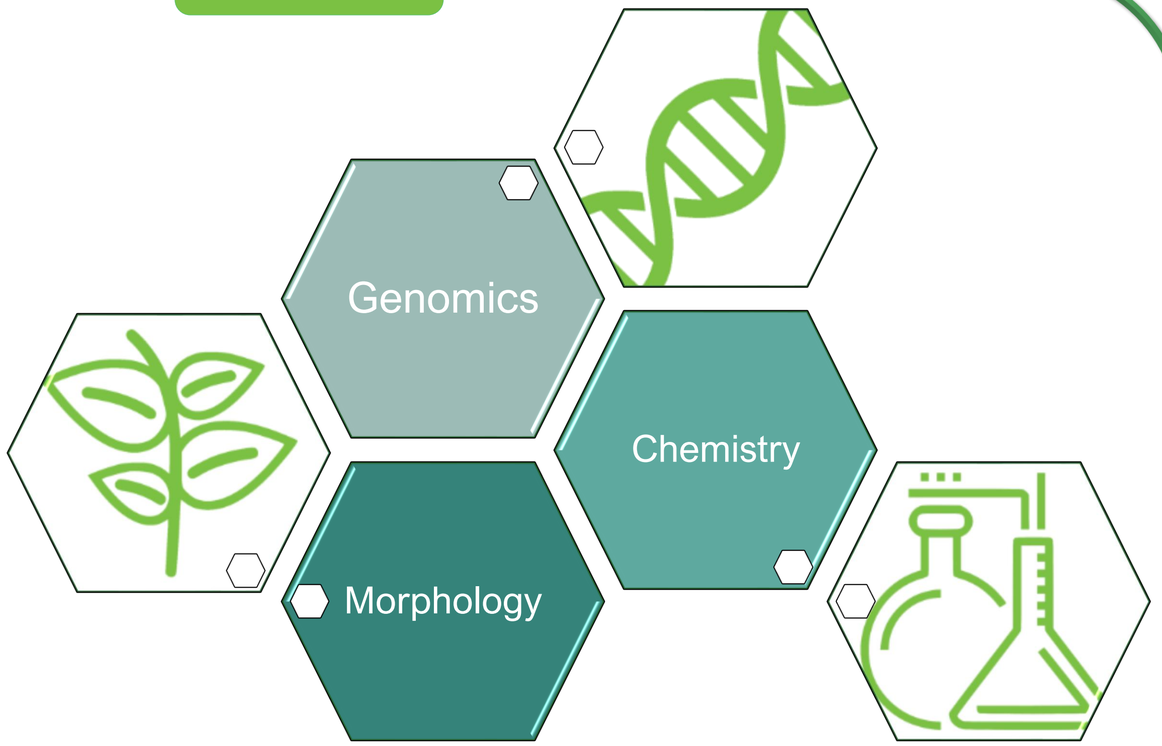
CURRENT AUTHENTICATION APPROACHES



To ensure authenticity with a high level of confidence, orthogonal analytical techniques are required to characterize botanicals

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COLLECTION AND CREATION OF BOTANICAL VOUCHERS

MORPHOLOGICAL AUTHENTICATION

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Herbaria

CHEMICAL TESTING

Alpinia galanga Rhizome

HPTLC analysis

TLC Automatic sampler-4

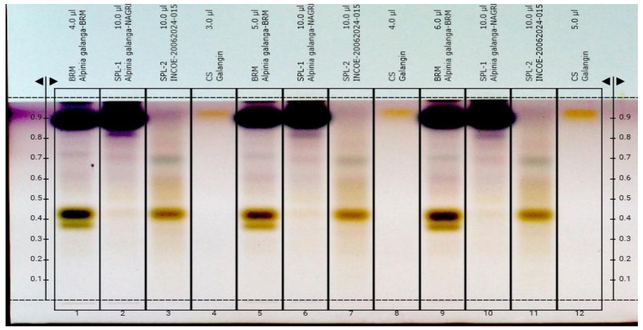
Sample applicator

Developing chamber

Chromatographic development

Visualizer

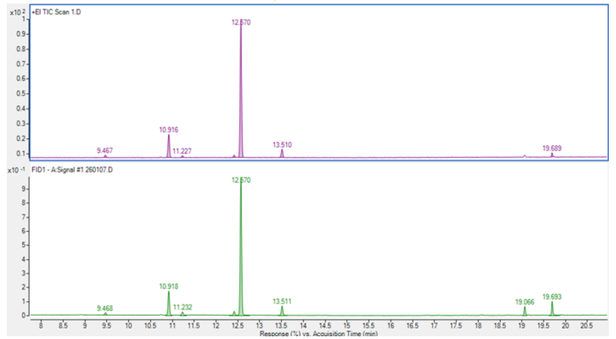
UV-Vis detection



HPTLC chromatograph

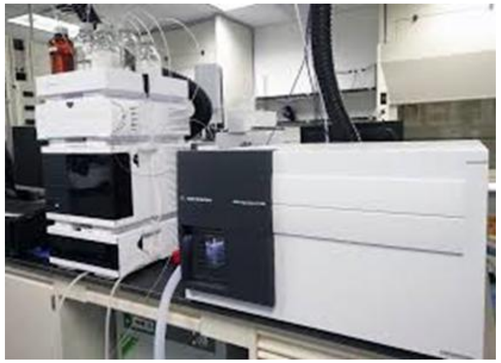
Mass analysis

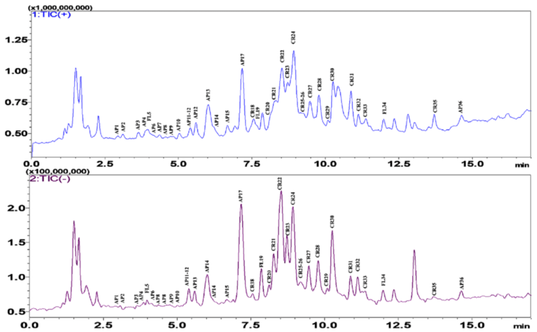
GC-MS/MS system



GC-MS/MS chromatogram

LC-MS/MS system





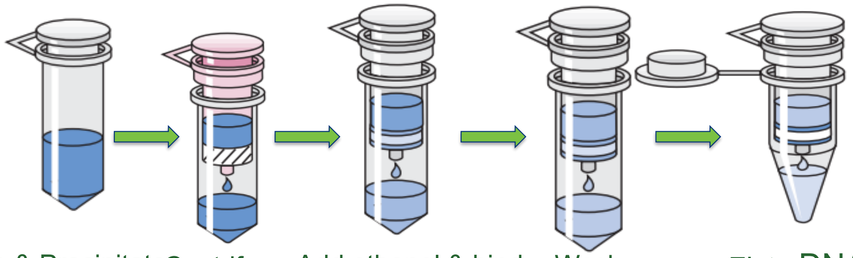
LC-MS/MS chromatogram

GENOMIC TESTING

1. Sanger Sequencing

Various sample forms

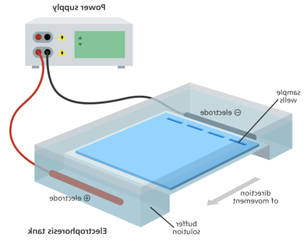
DNA extraction



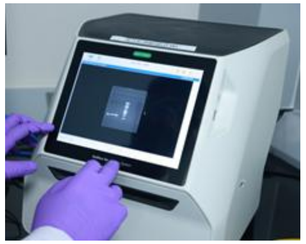
Lyse & Precipitate | Centrifuge | Add ethanol & bind DNA | Wash | Elute DNA

Amplification

PCR amplification

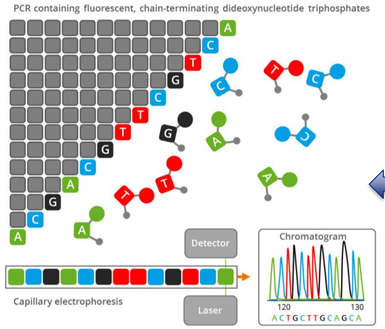


Gel Electrophoresis unit



GelDoc system

Sequencing

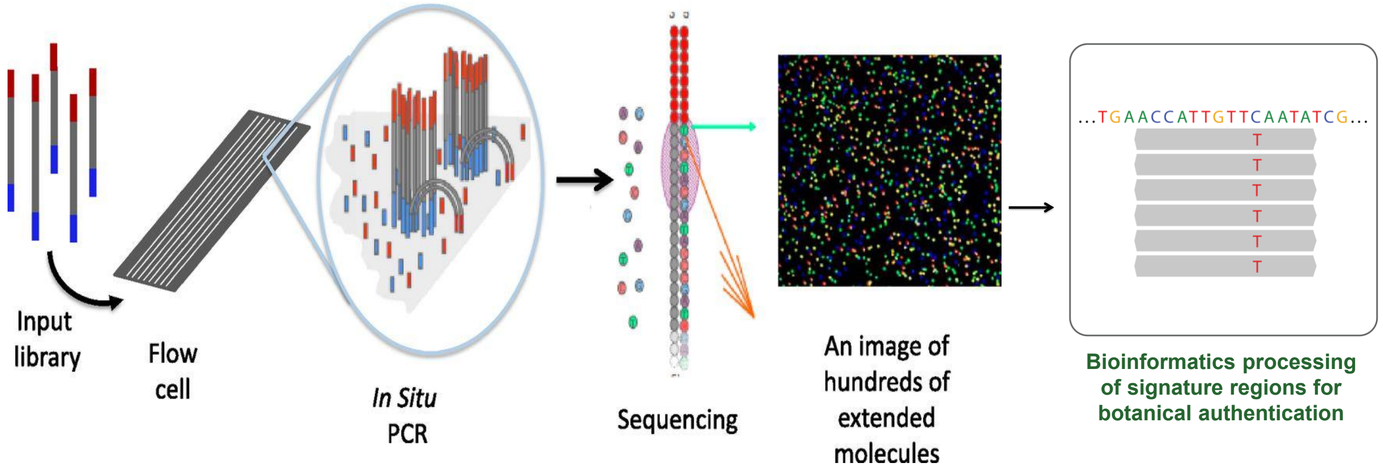


Sanger Sequencing

Herbalife database

3500 Genetic Analyzer

2. Next Generation Sequencing (NGS)

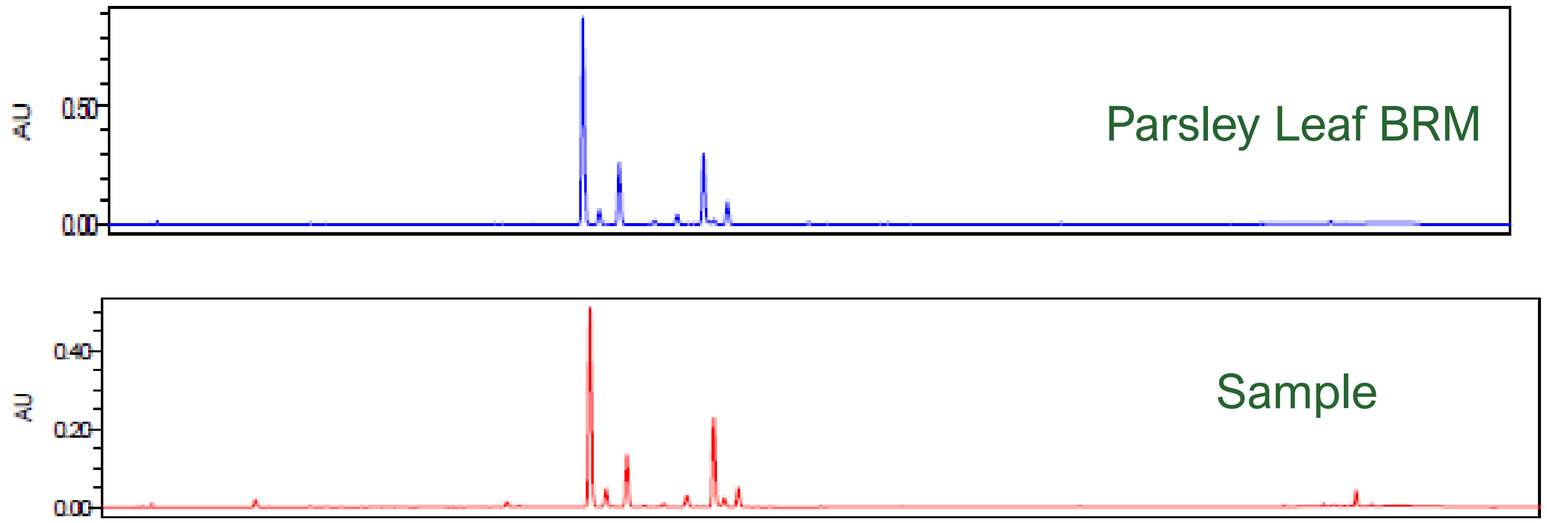


- We have our own internal Herbalife database and BRM system to qualify botanical raw materials.
- In our facility, we take pride in leveraging these two cutting-edge technologies to uphold the highest standards of quality and safety, while delivering genuine, effective, and safe products to our customers.

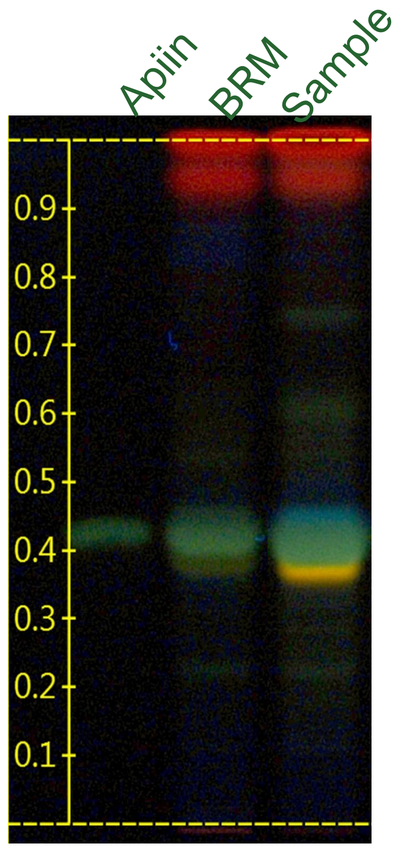
Herbalife database

CHEMICAL AUTHENTICATION – HPTLC APPLICATION

HPLC



HPTLC



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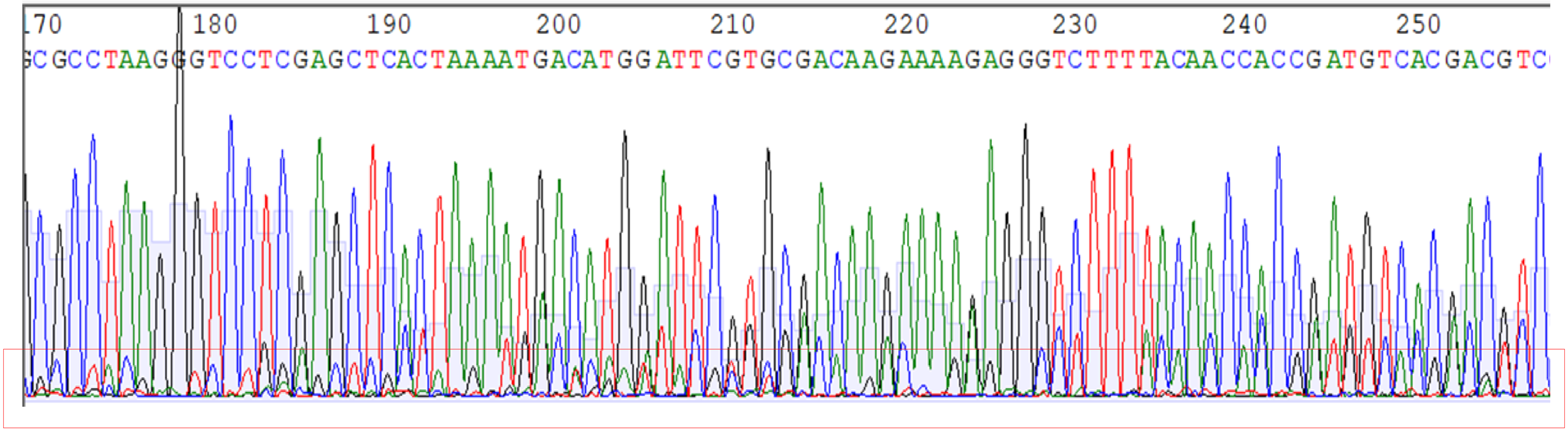
DNA AUTHENTICATION

DNA barcoding



Small peaks indicate impurity

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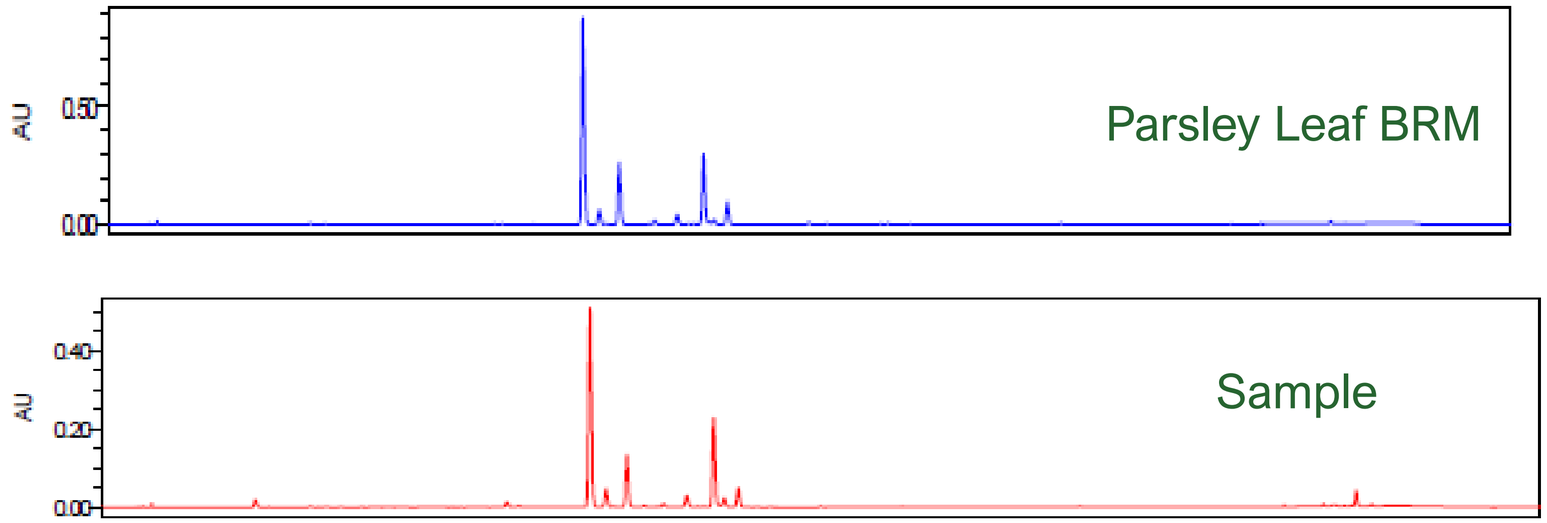
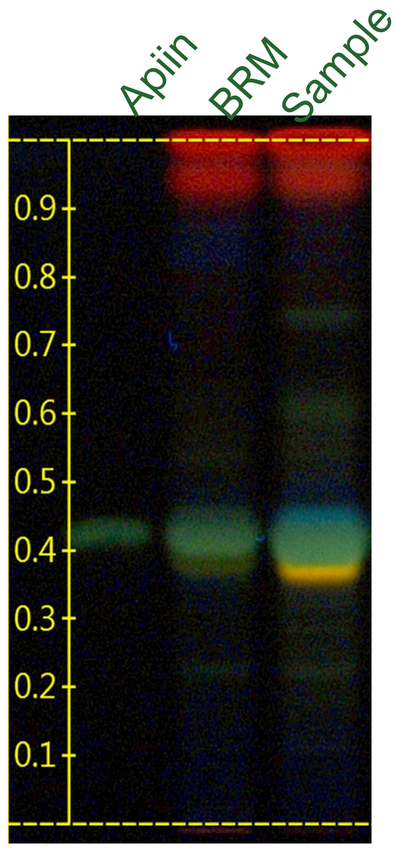
CHEMICAL AUTHENTICATION – HPTLC APPLICATION

HPLC



HPTLC



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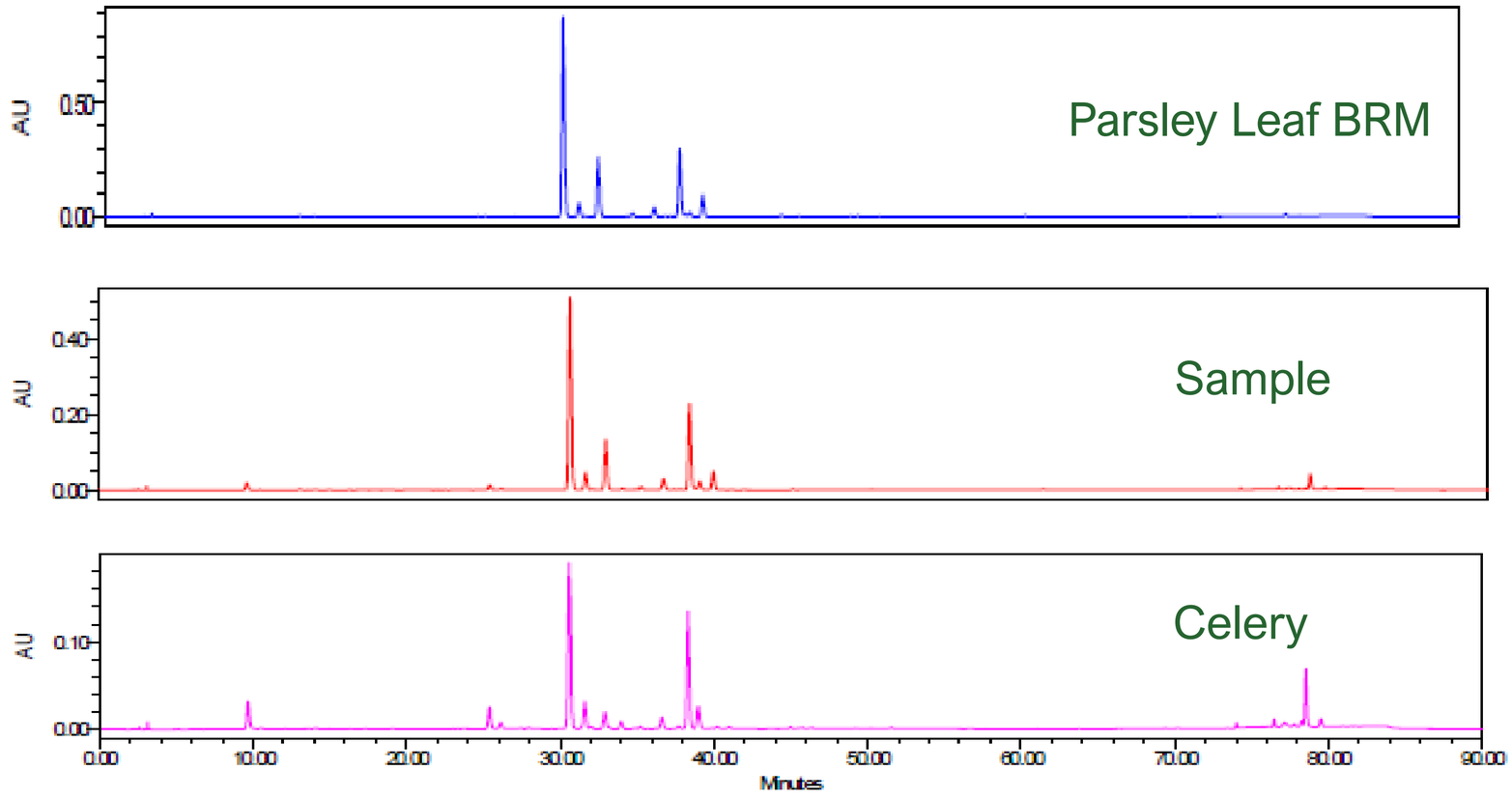
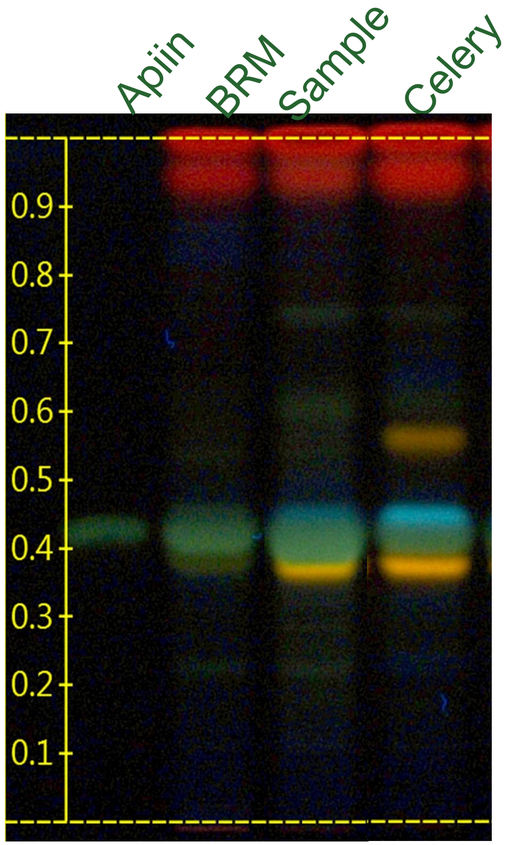
CHEMICAL AUTHENTICATION – HPTLC APPLICATION

HPLC



HPTLC



HERBALIFE IN-HOUSE BOTANICAL REFERENCE MATERIAL

HERBALIFE NUTRITION

Certificate of Authenticity
Herbalife Certified Botanical Reference Material

Botanical Nomenclature	*Zingiber Officinale*
Standard Common Name	Ginger
Plant Part	Root
Product Name	Ginger (*Zingiber Officinale*) Root, Botanical Reference Material
Catalog #	BHRM-0003
Lot #	ZO21-HRM0003-R01
Quantity	5g*40bags
Storage Condition	Room temperature
Recommended retest date	2022/11
Certificate #	2021-0003
Purpose	For Identification only

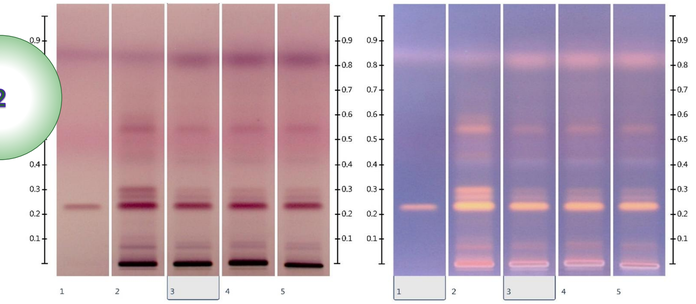
Method of Verification	Specification	Results	Method Reference	Notebook Reference
Morphological Description	Ginger root	Conforms	Flora of China	CSQC-052-21 Page.1
Chemical ID	Conform to Reference material	Conforms	QCL657	CSQC-030-21 p.87 to p.88
Genomic ID	Conform to Reference material	Conforms	QCL874	CSQC-017-21 p.20 to p.28

Prepared by	Reviewed by	Reviewed by	Approved by
Title: Sr. Chemist	Title: Sr. Supervisor	Title: Principal scientist	Title: Assistant director
Date: 04/12/22	Date: 04/13/22	Date: 04/13/2022	Date: 04/20/22
Signature: Suki Chen	Signature: Mosun Zou	Signature: Yujia Zhang	Signature: Jen

1

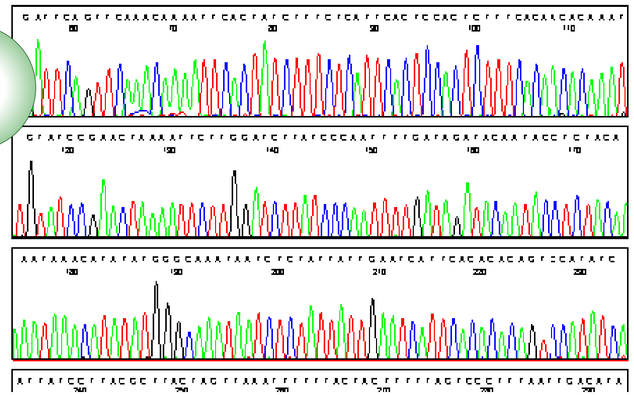
2

Test Date: 10/30/2021, **Test by:** Rock Huang
Chromatograms:



Track	Description	Volume (µL)
1	6-Gingerol	4.0
2	Zingiber officinale Rhizome BRM	2.0
3	Raw Ginger Root-W2000103	2.0
4	Raw Ginger Root-W2000103	2.0
5	Raw Ginger Root-W2000103	2.0

3



- **Challenges and limitations..**
  - Powder (extract) samples and multiple botanical ingredient mixture products.

- **Solutions…**
  - Recommend to maintain the Digital herbarium and raw botanicals depository
  - Recommend multiple and suitable methods to analyze botanical samples.
  - Try to adopt DNA based approaches to authentication of botanical ingredients.
  - Revise and improve the new regulations: botanical ingredients authentication.

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Future directions

- Future research should focus on incorporating cutting edge molecular techniques, including metabolomics and spectroscopic techniques
- Development of standardized authentication protocols
- Utilization of molecular biology techniques
- Global collaboration and data sharing
- Automation and Artificial intelligent
- Regulatory framework enhancement
- Education and training programs

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TAKE HOME MESSAGES

- Botanical ingredients/dietary supplements testing facilities are available focusing multi dimensional approach.
- Interdisciplinary methods developed for authenticating botanicals and its extracts.
- Authenticity in dietary supplements to be ensured to address adulteration.
- Use of advanced analytical techniques that offer a promising future for botanicals and plant extracts authentication to ensure uniform quality, safety and efficacy, in global supply chain.

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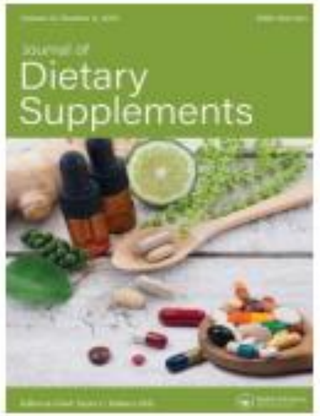

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Authentication Methods for Phytochemicals (Botanicals) in Plant Extracts and Dietary Supplements

Santhosh Kumar J. Urumarudappa , Vijay Bommuluri , Saravanan J , Smita Chaturvedi , Ashutosh Kumar Mittal , Yanjun Zhang , Peter Chang & Gary Swanson

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Thank You

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