

Plant Metabolomics



Innovative Metabolomics Insights for Better Health

Genes will tell you what may happen,
Metabolites tell you what is happening or has happened.



Artemisinin
-
Taxol
-
Ginsenoside



Dopamine
-
Serotonin
-
Neurotransmitter



Vitamin
-
Polyphenol
-
Fatty Acid

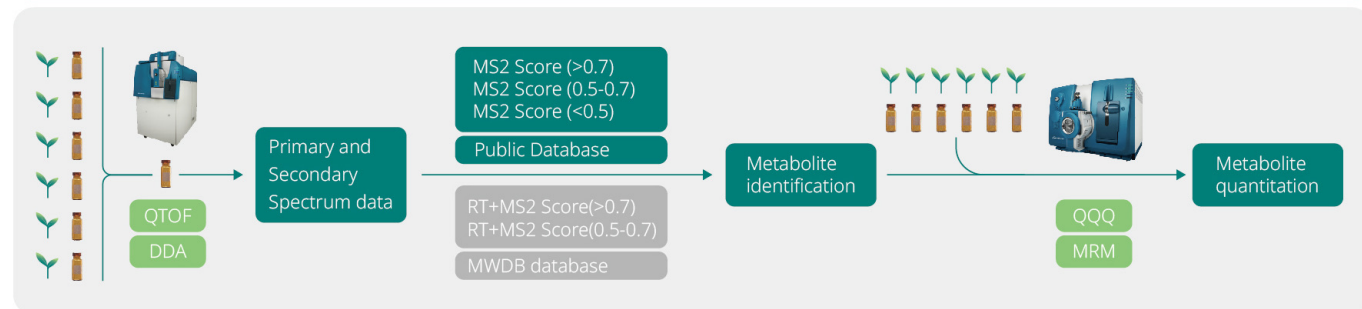


Epinephrine



Uric Acid
Blood Sugar
-
Blood Fat

The Power of Widely-Targeted Metabolomics Technology



Global Metabolite Profiling	Targeted Metabolomics	Lipidomics	Our Expertise
30000+ plant related metabolites	417+ metabolites	1747 lipid Database	100+ patents
3000+ mammalian metabolites			700+ publications
			20000+ projects

Comprehensive Identification Strategy

Accurate Identification based on our large-curated in-house database.


Integrated Public
Database
150,000+
metabolites


In-House Database
3000+
Biomedical
30,000+
Plants


AI Database
130,000+
metabolites

In-house Plant Metabolites Database

Types	Number	Representative compounds
Flavonoids	3700+	Rutin, Phloretin, Phelligrin A, Hesperetin, Pelargonidin-3-O-glucoside...
Phenolic acids	2100+	Chlorogenic acid, Momordicoside A, Oleuropein, Salvianolic acid A...
Alkaloids	7000+	α -Solanine, Verticine, Arecoline, DIMBOA, Lycorenine...
Terpenoids	8000+	Artemisinine, Genipin, Cucurbitacin B, Ecliptasaponin A...
Quinones	700+	Emodin, Obtusin, Lapachone, Shikonin, Tectograndone...
Steroid	1300+	Asparagoside C, Polyphyllin I, Tigogenin, Digitonin, Oleandrin...
Tannins	240+	Ellagic acid, Gemin D, Casuariin, Punicalin, Chebulagic acid...
Ligans	1000+	Honokiol, Syringaresinol, Arctigenin, Pinoresinol, Sesamin...
Glucosinolates	150+	Sulforaphane, Gluconasturtiin, Sinalbin, Sinigrin...
Coumarins	800+	Umbelliprenin, Psoralen, Glycy coumarin, Xanthotoxol, Scopolin...
Organic acids	270+	Succinic acid, Malic acid, Citric Acid, Quinic Acid, Shikimic acid...
Vitamins	50+	Vitamin C, Vitamin B2, Vitamin A1, Vitamin U, Nicotinic acid...
Amino acids and derivatives	540+	Tryptophan, Theanine, Beauvericin, Dencichin, γ -Glu-Cys...
Nucleotides and derivatives	120+	Adenine, Cytosine, Thymine, Inosine, Adenosine 5'-monophosphate...
Saccharides and Alcohols	340+	Glucose, Sucrose, Fucose, Xylitol, Maltose, Raffinose...
Lipids	500+	Linolenic acid, 4-Hydroxysphinganine, Lauric acid, Myristic Acid...
Others	3200+	Aflatoxin B1, Secoxyloganin, Kavain, Terreic acid, Mansonone E...
Total		30000+

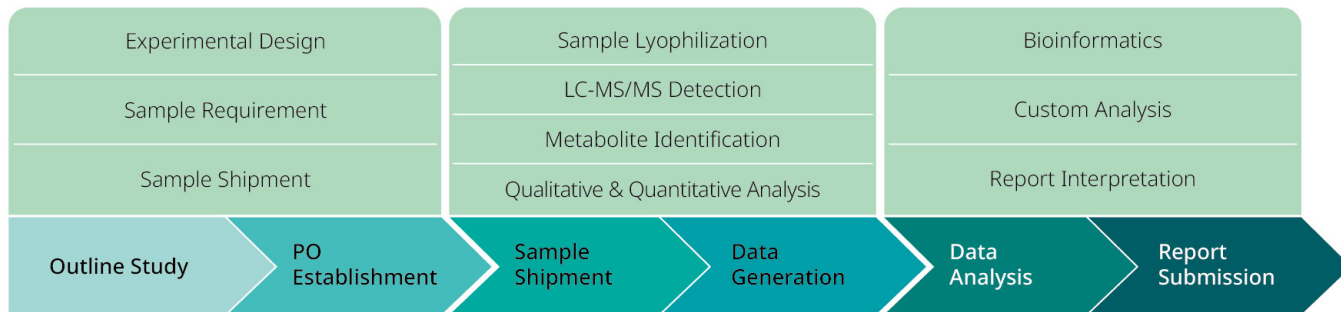
Precise Quantitation

- **Gold Standard for Quantitation**

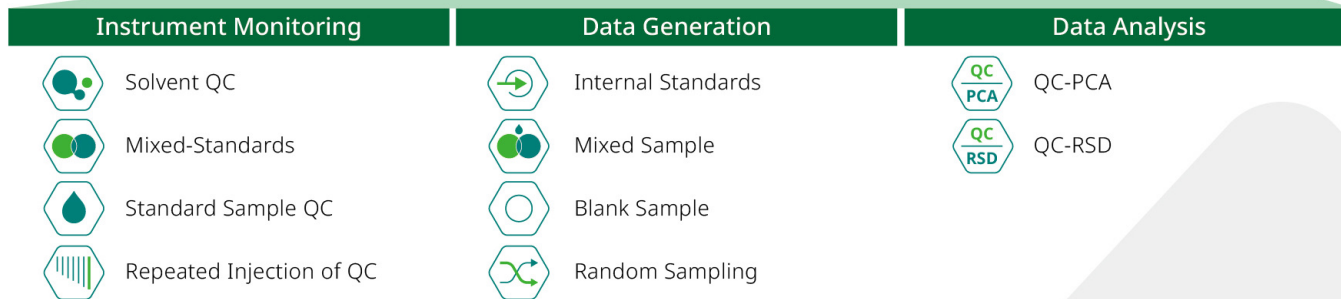
Using MRM mode from AB SCIEX Triple Quad 6500+

- **Rigorous Quality Control**

Monitoring all aspects of experimentation from sample preparation to data analysis.



Quality Control



Solutions for All Industries



Plant Science

- Plant growth and development
- Plant stress response
- Plant-microbe interactions



Agricultural & Breeding

- Agriculture
- Nutritional value
- Food quality



Medicinal Plants

- Mechanism of treatment
- Toxic side effect evaluation



Nutrition

- Food source
- Food processing



Animal Science

- Genetic breeding
- Feed nutrition
- Animal diseases

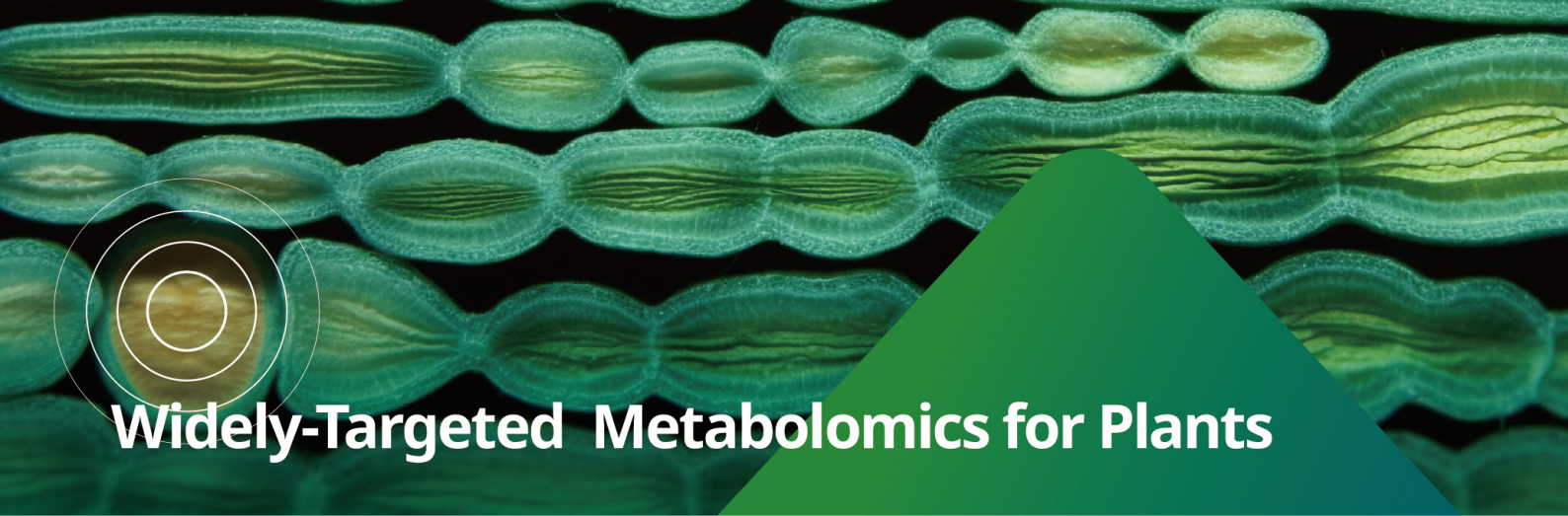


Environmental Science

- Environmental toxicology research

Comprehensive Analytical Portfolio

Global Metabolite Profiling	Targeted Metabolomics	Multi-Omics
Widely-Targeted Metabolomics for Plants	Phytohormone	Transcriptome
Quantitative Lipidomics for Plants	Anthocyanin	Microbiome
Flavonoids Metabolomics	Carotenoids	Proteomics
Primary Metabolome	Targeted Assay	Transcriptome+Metabolomics
Secondary Metabolome	Customized Services	Microbiome+Metabolome
		Genome+Metabolome



Widely-Targeted Metabolomics for Plants

Widely-Targeted Metabolomics is an innovative metabolomics method that combines the benefits of untargeted metabolomics and targeted metabolomics to achieve high-throughput identification and precise quantitation of large number of metabolites. This methodology is especially useful in plant metabolism research where the number of metabolites far exceeds those in animals. At Metwarebio, our Widely-Targeted Metabolomics approach stands out from many others with features such as:



Large Curated Database

Over **30,000** purified chemical standards from over **1000** plant species.



Precise Quantitation

Using the **QQQ** gold standard detection mode (MRM) and 10 rigorous QC indicators



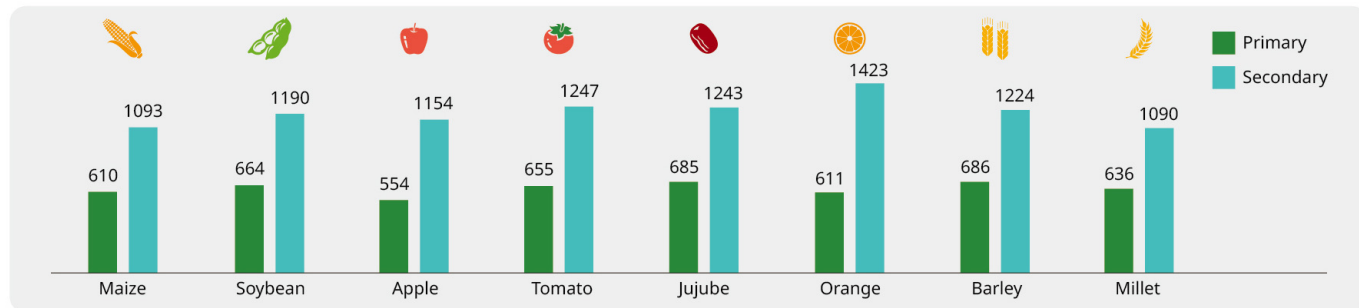
Accurate Identification

Combining AB SCIEX Q-TOF 6600 ultra-high resolution mass spectrum with our in-house curated database to achieve accurate metabolite identification.

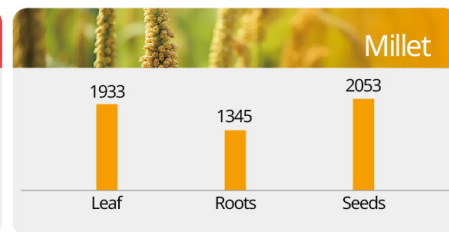
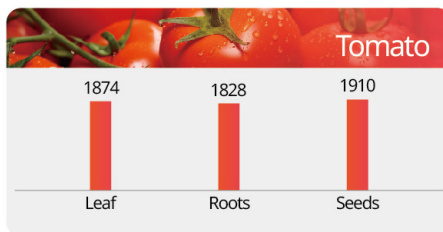
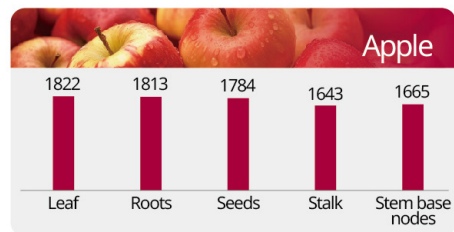
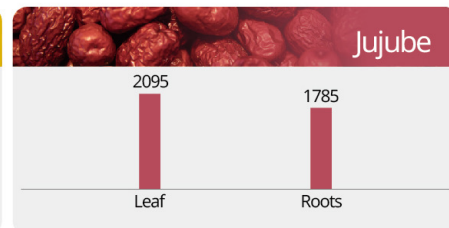
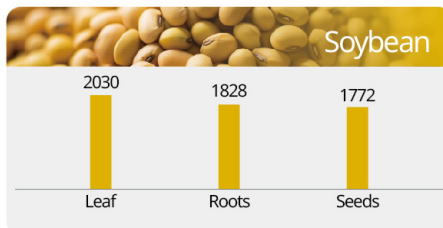
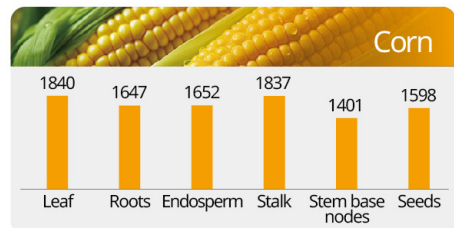


High Quality Data

Results of our services have been cited in over **500** publications.

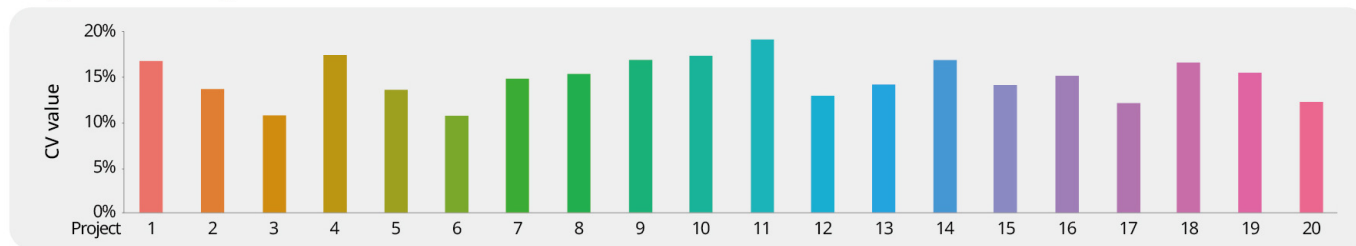


Average number of metabolites detected in different species.



Number of metabolites detected across various tissues.

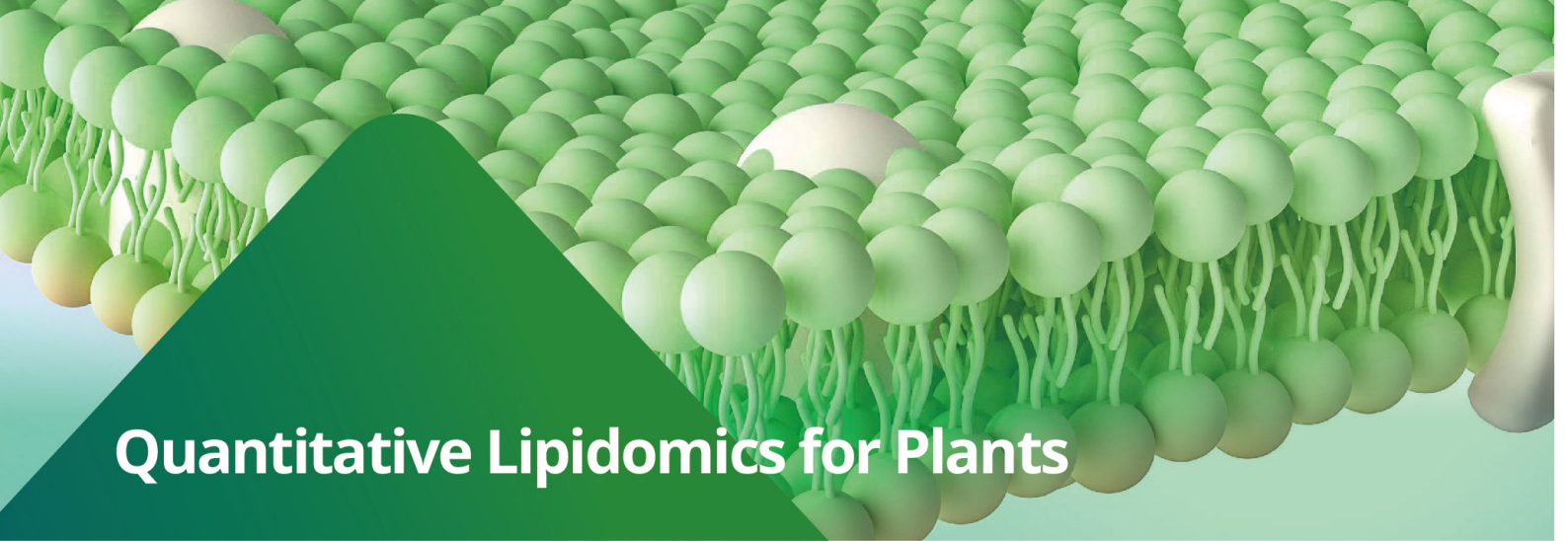
High Stability



Highly stable detection for the widely-targeted metabolic analysis.

Selected Publications

Year	Journal	Title	Species
2023	Ecotoxicology and Environmental Safety	Deciphering the toxicity mechanism of haloquinolines on <i>Chlorella pyrenoidosa</i> using QSAR and metabolomics approaches	<i>Chlorella</i>
2023	Food Research International	Widely targeted metabolomic analysis revealed the effects of alkaline stress on nonvolatile and volatile metabolites in broomcorn millet grains	Millet
2023	Food Chemistry	Impact of low temperature on the chemical profile of sweet corn kernels during post-harvest storage	Maize
2022	Foods	Comparative Analysis of Fruit Metabolome Using Widely Targeted Metabolomics Reveals Nutritional Characteristics of Different <i>Rosa roxburghii</i> Genotypes	<i>Rosa roxburghii</i>
2022	Food Chemistry	Comparative analysis of rice reveals insights into the mechanism of colored rice via widely targeted metabolomics	Rice
2022	Postharvest Biology and Technology	Widely targeted metabolomics analysis reveals the effect of exogenous auxin on postharvest resistance to <i>Botrytis cinerea</i> in kiwifruit (<i>Actinidia chinensis</i> L.)	Kiwi Fruit
2022	Food Research International	Comparative metabolomics of flavonoids in twenty vegetables reveal their nutritional diversity and potential health benefits	Vegetables
2021	Food Chemistry	Widely targeted metabolomics analysis reveals the effect of fermentation on the chemical composition of bee pollen	Honey
2021	LWT - Food Science and Technology	Widely targeted metabolomics characterizes the dynamic changes of chemical profile in postharvest peanut sprouts grown under the dark and light conditions	Peanut



Quantitative Lipidomics for Plants

Based on the Widely Targeted Metabolomics approach and a database of **1747** plant lipids, the Quantitative Lipidomics Service for Plants allows high throughput analysis of plant lipids in all types of plant materials.



Wide Coverage

1747 lipids, covering 6 major lipid classes



Extensive Project Experience

Detected **500-800** lipids in over **100** species



Precise Quantitation

Quantitation using **23** isotopic internal standards

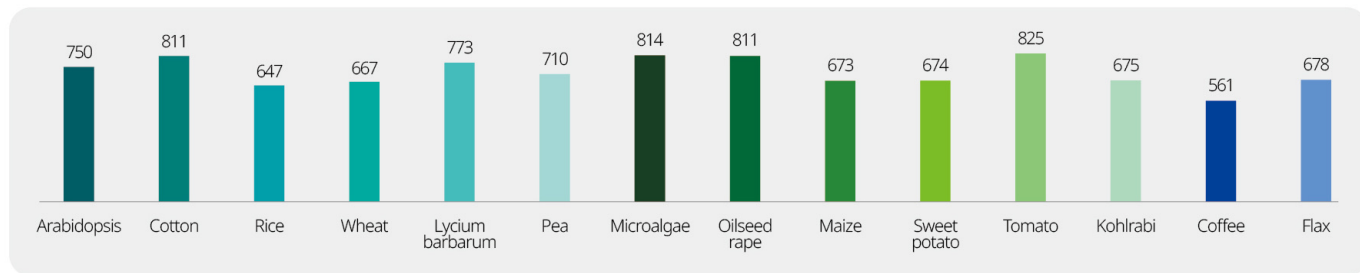


Comprehensive Data Analysis

Over **24** of analyses to fast track data exploration

Classes	Total number	Abbr.	Num	Abbr.	Num	Abbr.	Num
Class I 6							
Fatty acyls	51	FFA	51				
Glycerolipids	958	MG	19	DG	136	TG	490
		MGDG	73	DGDG	58	SQDG	38
		DGTS	81	LDGTS	22	DGGA	1
		ADGGA	7	DGCC	33		
Glycerophospholipids	530	LPA	13	LPC	33	LPE	25
		LPG	14	LPI	15	LPS	17
		PA	41	PC	96	PE	93
		PG	53	PI	69	PS	39
		PMeOH	22				
Sphingolipids	167	Sph	8	Cert	42	Cer	61
		HexCer	56				
Sterol lipids	38	CE	38				
Prenol lipids	3	CoQ	3				
Total 1747							

Project Experience



Average number of lipids detected in different species.

Flavonoids Metabolomics

Flavonoids are polyphenols produced through the phenylalanine metabolic pathway and it plays an essential role in plant physiological processes such as rhizogenesis, pollination, pathogenic bacterium stress, and ultraviolet stress response. Furthermore, it is a strong antioxidant widely used in human disease treatment and food supplements. Metwarebio's Flavonoid Metabolomics is based on our unique Widely-Targeted Metabolomics process to simultaneously detect more than 3700 flavonoids in plant samples.



Extensive and Wide-coverage

12 classes, 3700+ specific flavonoid compounds



Accurate Identification

Using a proprietary approach that matches project substances spectra data with MWDB spectra data



Improved Metabolic Maps

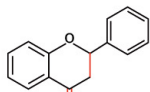
Improved upon the three flavonoid KEGG pathways maps



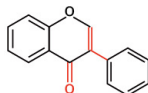
Precise Quantitation

Using the gold standard detection mode (MRM) based on QQQ for quantitation

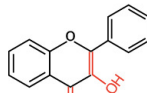
Six Flavonoid Classes



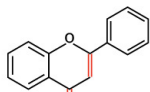
Flavanone



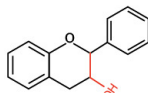
Isoflavone



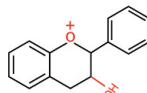
Flavonol



Flavone



Flavanol



Anthocyanin

Modifications

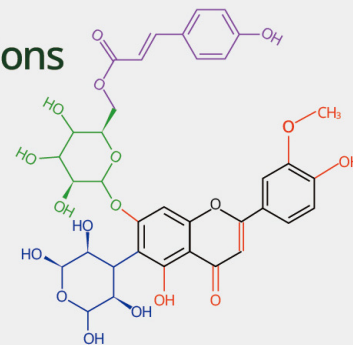
Hydroxylation

Methylation

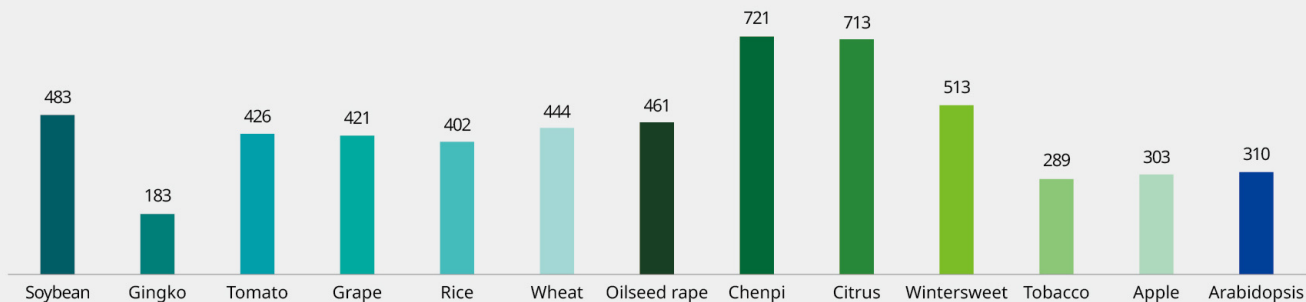
Glycosylation

Acylation

...



Project Experience



Average number of flavonoids detected in different species.

Anthocyanin Targeted Assay

Anthocyanidin is a class of water-soluble pigment compounds that widely exist in plants. Free anthocyanins are rare under natural conditions and mainly exist in the form of glycosides. MetwareBio's anthocyanin assay is a targeted LC-MS/MS method that will detect and obtain absolute and semi-quantitation of 108 compounds in the anthocyanin metabolic pathway.



Wide Coverage

108 anthocyanidin metabolites
over 8 different types.



Absolute Quantitation

41 absolute quantification, $r > 0.99$
67 semi-quantification



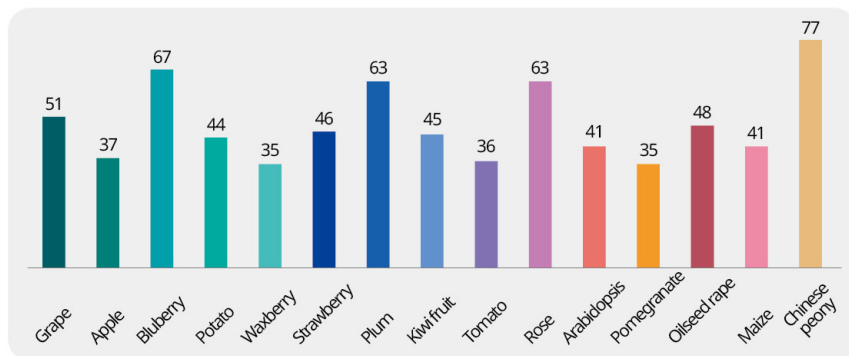
High Sensitivity

Detection at µg/g level

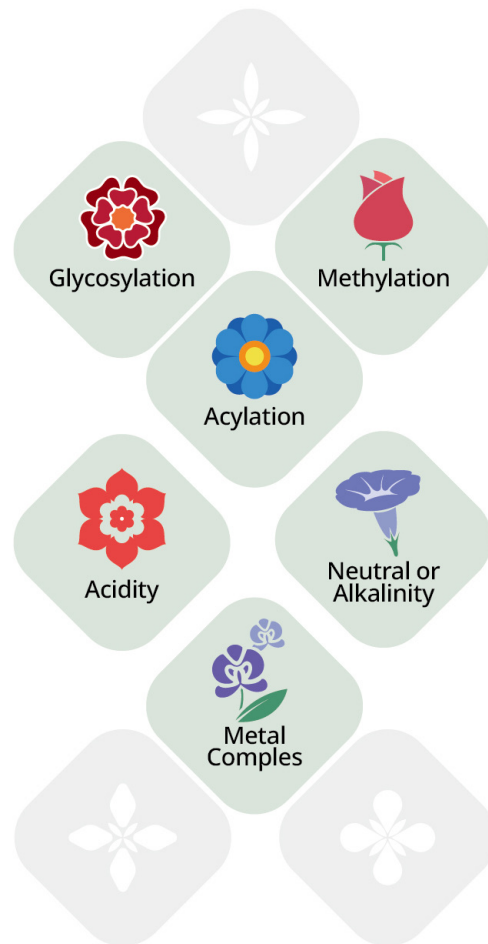
List of Metabolites

Category	No.	Representative substance
Cyanidins	17	Cyanidin-3-O-galactoside, Cyanidin-3-O-rutinoside...
Delphinidins	16	Delphinidin-3-O-glucoside, Delphinidin-3-O-arabinoside
Flavonols	9	Kaempferol-3-O-rutinoside, Rutin, Naringenin-7-O-glucoside...
Malvidins	13	Malvidin, Malvidin-3-O-arabinoside, Malvidin-3-O-galactoside...
Pelargonidins	19	Pelargonidin-3-O-arabinoside, Pelargonidin-3-O-glucoside...
Peonidins	17	Peonidin-3-O-galactoside, Peonidin-3-O-rutinoside...
Petunidins	11	Petunidin-3-O-sambubioside, Petunidin-3,5-O-diglucoside...
Procyanidins	6	Procyanidin A1, Procyanidin B1, Procyanidin C1...

Project Experience



Number of anthocyanins detected from various tissues.



Phytohormone Targeted Assay

Phytohormone is also known as plant natural hormone or plant endogenous hormone. It refers to some trace organic compounds produced in plants that can regulate (promote or inhibit) their own physiological processes. Based on LC-MS/MS technology, MetwareBio has developed a sensitive method for the plant hormone detection, covering **108** phytohormones including ABA, Auxin, CK, ACC, GA, JA, SA and SL.



Complete Variety

108 plant hormones



High Sensitivity

AB Sciex QTRAP 6500 LC-MS platform,
ng/g level



Extensive Experience

More than **2000** project experiences covering **500+** species



Quantitative Accuracy

External standard + Internal standard method, $r > 0.99$

List of Metabolites

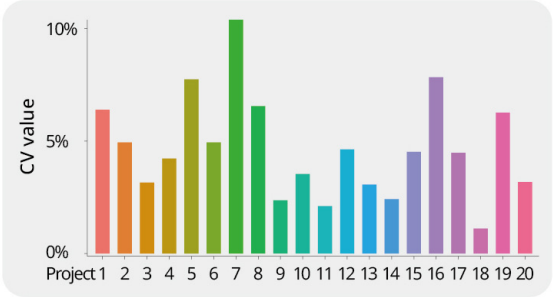
Products	Compounds List
Phytohormone family bucket (108 compounds)	Auxin (27) Jasmonates (11) Cytokinins (40) Absciscic Acid (3) Salicylates (6) ACC (1) Strigolactones (2) Gibberellins (18)
GAs (18 compounds)	GA ₁ /GA ₃ /GA ₄ /GA ₅ /GA ₆ /GA ₇ /GA ₈ /GA ₉ /GA ₁₅ /GA ₁₉ /GA ₂₀ /GA ₂₄ /GA ₂₉ /GA ₃₄ /GA ₅₁ / GA ₅₃ /GA ₁₂ -ald/GA ₄₄

Selected Publications

Year	Journal	Title	Species
2023	Journal of Experimental Botany	Transcriptomic and metabolic profiling of watermelon uncovers the role of salicylic acid and flavonoids in the resistance to cucumber green mottle mosaic virus	Watermelon
2023	Horticulture Research	Multifaceted regulatory functions of CsBPC2 in cucumber under salt stress conditions	Cucumber
2023	Nature Plants	Balanophora genomes display massively convergent evolution with other extreme holoparasites and provide novel insights into parasite–host interactions	Balanophora
2023	Nature Communications	UDP-glucosyltransferase OsUGT75A promotes submergence tolerance during rice seed germination	Rice
2023	Plant Physiology	Plant extracellular self-DNA inhibits growth and induces immunity via the jasmonate signaling pathway	Arabidopsis
2022	Nature Communications	Variation in the fruit development gene POINTED TIP regulates protuberance of tomato fruit tip	Tomato
2021	New Phytologist	Genetic variation in YIGE1 contributes to ear length and grain yield in maize	Maize
2020	Nature Communications	UDP-glucosyltransferase regulates grain size and abiotic stress tolerance associated with metabolic flux redirection in rice	Rice
2020	Cell	Genomes of the banyan tree and pollinator wasp provide insights into fig-wasp coevolution	Banyan tree

High Stability

The detected metabolites showed a coefficient of variation (CV) of less than11% in mixed QC samples.



CC1=C(C(CCC1)=C)C=CC(=C)C=CC(=C)C=CC(=C)C=CC(=C)C=CC(=C)C=C2C(C)C(C)C(C)C2

Quantitation using external standard method, linear standard curve > 0.99



Detection at $\mu\text{g/g}$ level



68 carotenoids, including lycopene, β -carotene, octahydrolycopene, lutein, etc. Contact us for a full list



Participated on more than 1000 projects covering 300+ species and published in Nature Communications, The Plant Journal, Food Chemistry and others

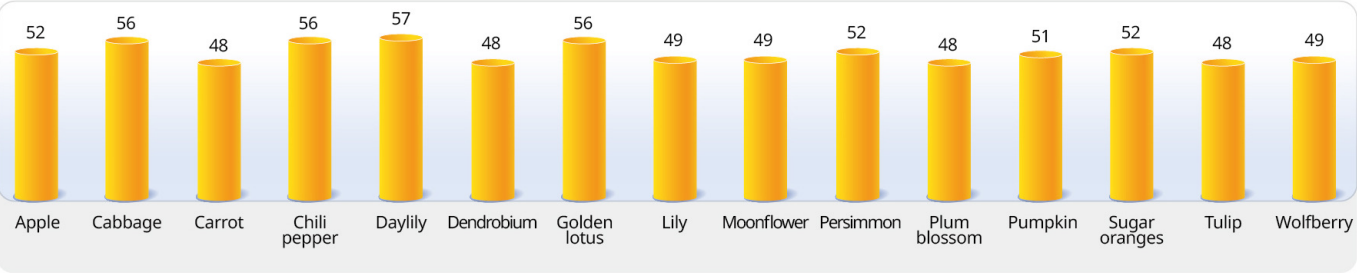
List of Metabolites

No.	Carotenoids Panel	No.	Carotenoids Panel
1	α-carotene	10	β-cryptoxanthin
2	antheraxanthin	11	astaxanthin
3	lycopene	12	phytofluene
4	zeaxanthin	13	capsanthin
5	violaxanthin	14	(E/Z)-phytoene
6	γ-carotene	15	ε-carotene
7	neoxanthin	16	α-cryptoxanthin
8	β-carotene	...	...
9	lutein	68	capsorubin

Contact for a full list.

Project Experience

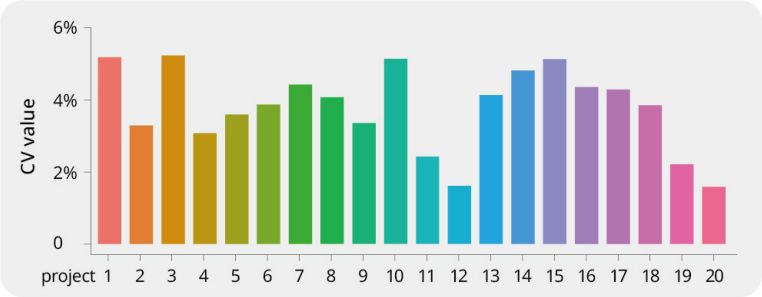
A total of 68 carotenoids could be detected from different species, with an average detection of 50 carotenoids.



Average detected carotenoids in different species.

High Stability

The detected metabolites showed a coefficient of variation (CV) of less than 6% in mixed QC samples.



Coefficient of Variation of energy metabolites detected over 20 projects.

Transcriptome + Metabolome

In systems biology research, biological processes and gene regulatory networks are complex and dynamic. It is often insufficient to use a single dataset to study systems biology. Correlating transcriptomic data that has a large number of differentially expressed genes with differential metabolites detected by metabolomics can pinpoint key genes, metabolites, and metabolic pathways that are closely associated with internal changes in the system, and thereby explain biological problems in a more holistic approach.



Coexpressed transcriptome and metabolome



Converged metabolic pathway

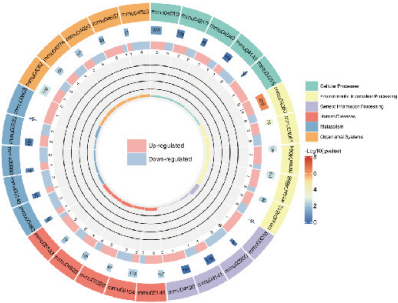


Enable major regulation networks construction

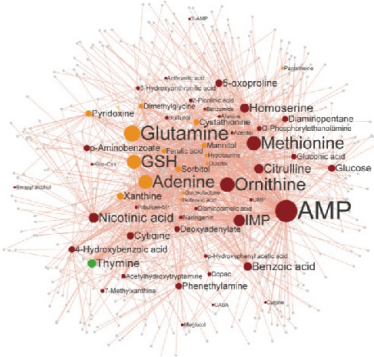


Gain holistic view of biological systems

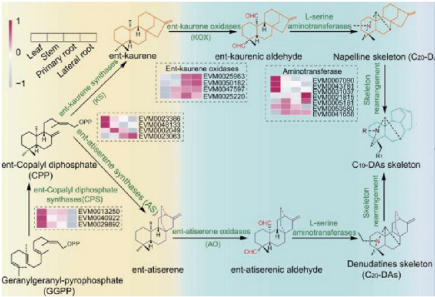
Data Analysis



Gene enrichment circle map



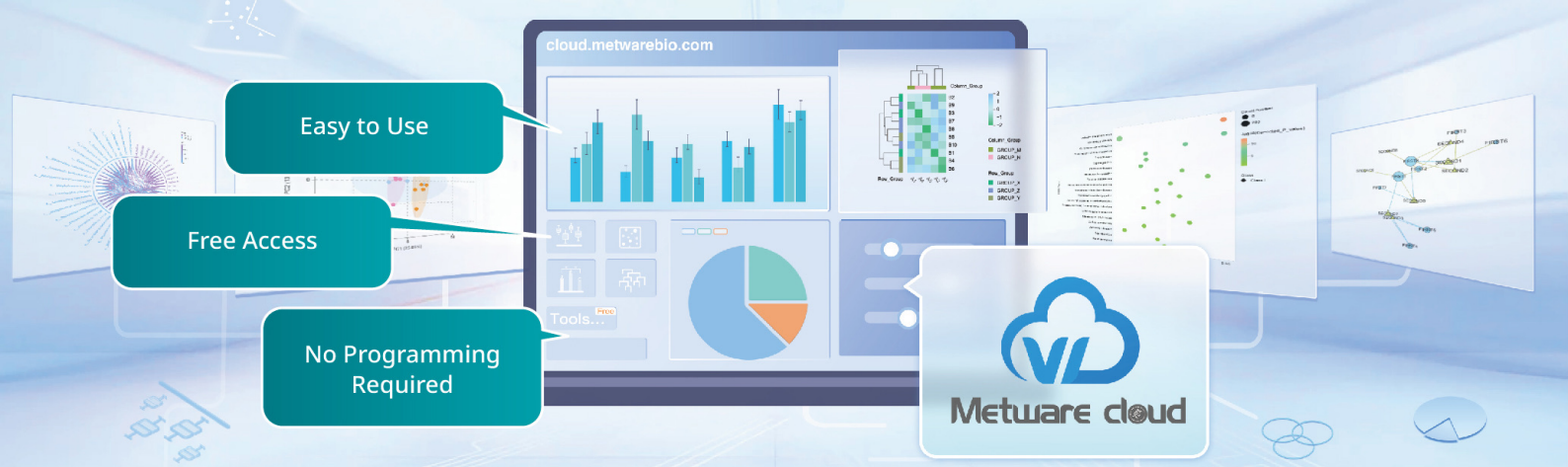
Correlation network



Converging metabolic pathway

Selected Publications

Year	Journal	Title	Species
2023	New Phytologist	A comprehensive metabolic map reveals major quality regulations in red flesh kiwifruit (<i>Actinidia chinensis</i>)	Kiwifruit
2023	Plant Physiology	Transcriptomic and metabolomic analysis reveals a protein module involved in preharvest apple peel browning	Apple
2023	Plant Biotechnology Journal	The miR156b-GmSPL2b module mediates male fertility regulation of cytoplasmic male sterility-based restorer line under high-temperature stress in soybean	Soybean
2022	PNAS	A multiomic study uncovers a bZIP23-PER1A-mediated detoxification pathway to enhance seed vigor in rice	Rice
2021	Science Advances	Low ABA concentration promotes root growth and hydrotropism through relief of ABA INSENSITIVE 1-mediated inhibition of plasma membrane H ⁺ -ATPase 2	Arabidopsis
2020	Molecular Plant	MicroTom Metabolic Network: Rewiring Tomato Metabolic Regulatory Network throughout the Growth Cycle	Tomato



Analyze Metabolomics Data With Ease

Cloud Tools

Data Processing

Difference Analysis

Functional Enrichment Analysis



Multi-omics Association Analysis

Gene Sequence Analysis

File Format Conversion

Cloud Process

Customize analysis parameters

Get started today!

<https://cloud.metwarebio.com/>

Metabolomics Sample Requirements

Tissues	Sample type	Recommended sample size	Minimum sample size	Applicable product
Plant Tissue	Stem, Shoot, Node, Leaf, Root, Flower, Fruit, Callus	300mg	600mg	Widely-Targeted Metabolomics for Plants, Quantitative Lipidomics, Flavonoids, Anthocyanin, Phytohormone and Carotenoids
Liquid Sample	Root Exudates	10mL	3mL	Plant Widely-Targeted Metabolomics

Transcriptomics Sample Requirements

Sample Type	Minimum sample saize	Storage and transportation	
Whole Blood	2ml	For LC-MS • Snap freeze in liquid nitrogen. • Store in -80°C. Delivery with dry ice.	For RNAseq • Prepare whole blood with 3x Trizol • Resuspend cells with 1ml TRIzol for every 5x10⁶ cells. • Snap freeze materials in liquid nitrogen and store all materials in -80°C.
Tissue	200mg		
Cultured Cells	5 x 10 ⁶ cells		
Plant Materials	300mg		

If your samples are not listed above, contact us please!

Innovative Metabolomics Insights for Better Health

Metware Biotechnology Inc. (MetwareBio) is a metabolomics CRO focusing on developing and applying innovative metabolomics technologies to life science and health research. Based on the high-throughput, ultra-sensitive and patented 'widely targeted metabolomics' technology, as well as large-curated metabolite database, MetwareBio offers 'one-stop metabolomics and multi-omics research and analysis services' for research institutes, hospitals and pharmaceutical companies.

MetwareBio's technical achievements have been presented and published in over 700 publications, including Cell, Nature Genetics, PNAS, Nature Communications, National Science Review, and many other international peer-reviewed journals. Working with MetwareBio means you have all the metabolomics expertise supporting your research and development.

10

Data QC Indicators

3000+

Verified Biomedical
Metabolites Database

30,000+

Purified Plant Metabolites
Database

METWARE BIO



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