



# Stable Isotope Standards for Plant Metabolomics



Plant metabolomics is an important research area for studying phytochemicals and obtaining insight into their role in plant biology/physiology. The results can be used to improve agricultural efficiency and food quality, as well as to help pave crop genetic-engineering methods.

**Cambridge Isotope Laboratories, Inc. (CIL) is pleased to offer highly characterized stable isotope-labeled and unlabeled chemical standards for plant metabolomic studies.** The following table lists a condensed set of labeled metabolites (both primary and secondary) that span a collection of metabolic pathways (e.g., carotenoid, glycolysis, mevalonate, methylerythritol, shikimate, TCA cycle) and classes (e.g., alkaloids, amino acids, flavonoids, terpenoids, vitamins) that are documented to occur in the cytosol and plastids of plant cells.

## Alkaloids

Catalog No.	Description	Concentration
DLM-849	Acridine (D <sub>9</sub> , 98%)	neat
CLM-6651	Anabasine (2,2',3,4,5,6- <sup>13</sup> C <sub>6</sub> , 99%)	100 µg/mL in acetonitrile
CLM-6652	Anatabine (2,2',3,4,5,6- <sup>13</sup> C <sub>6</sub> , 99%)	100 µg/mL in acetonitrile
DLM-4529	Arecoline-HCl (O-methyl-D <sub>3</sub> , 98%)	neat
CLM-728	Caffeine (3-methyl- <sup>13</sup> C, 99%)	neat
CLM-514	Caffeine (trimethyl- <sup>13</sup> C <sub>3</sub> , 99%)	neat or 100 µg/mL in methanol
CLM-4892-MT	DL-Nornicotine (3',4',5'- <sup>13</sup> C <sub>3</sub> , 99%)	100 µg/mL in methyl <i>tert</i> -butyl ether
DLM-1158	Quinoline (D <sub>7</sub> , 98%)	neat or 2 mg/mL in methanol
CLM-6106	Ricinine (ring- <sup>13</sup> C <sub>5</sub> , 99%; cyano- <sup>13</sup> C, 99%)	100 µg/mL in acetonitrile
DLM-10436	Theobromine (3,7-dimethylxanthine) (7-methyl-D <sub>3</sub> , 98%)	neat

## Amino Acids

Catalog No.	Description	Concentration
CLM-8666	4-Aminobutyric acid ( <sup>13</sup> C <sub>4</sub> , 97-99%)	neat
CLM-2265-H	L-Arginine-HCl ( <sup>13</sup> C <sub>6</sub> , 99%)	neat
CNLM-539-H	L-Arginine-HCl ( <sup>13</sup> C <sub>6</sub> , 99%; <sup>15</sup> N <sub>4</sub> , 99%)	neat
DLM-407	Betaine (D <sub>11</sub> , 98%)	neat
CLM-2248-H	L-Isoleucine ( <sup>13</sup> C <sub>6</sub> , 99%)	neat
CNLM-561-H	L-Isoleucine ( <sup>13</sup> C <sub>6</sub> , 99%; <sup>15</sup> N, 99%)	neat
CLM-2262-H	L-Leucine ( <sup>13</sup> C <sub>6</sub> , 99%)	neat
CNLM-281-H	L-Leucine ( <sup>13</sup> C <sub>6</sub> , 99%; <sup>15</sup> N, 99%)	neat
CNLM-759-H	L-Methionine ( <sup>13</sup> C <sub>5</sub> , 99%; <sup>15</sup> N, 99%)	neat
CDLM-8885	L-Methionine (2,3,3,4,4-D <sub>5</sub> , 98%; methyl- <sup>13</sup> CH <sub>3</sub> , 99%)	neat

Chemical purity (CP) is ≥98%, unless otherwise specified. For research use only. Not for use in diagnostic procedures.

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Catalog No.	Description	Concentration
CLM-4724-H	L-Ornithine·HCl ( $^{13}\text{C}_5$ , 99%)	neat
DLM-2969	L-Ornithine·HCl (3,3,4,4,5,5- $\text{D}_6$ , 98%)	neat
CLM-1055	L-Phenylalanine (ring- $^{13}\text{C}_6$ , 99%)	neat
DLM-372	L-Phenylalanine ( $\text{D}_8$ , 98%)	neat
CLM-1574	L-Serine ( $^{13}\text{C}_3$ , 99%)	neat
DLM-582	L-Serine (2,3,3- $\text{D}_3$ , 98%)	neat
CNLM-2475-H	L-Tryptophan ( $^{13}\text{C}_{11}$ , 99%; $^{15}\text{N}_2$ , 99%)	neat
DLM-1092	L-Tryptophan (indole- $\text{D}_5$ , 98%)	neat
CLM-2263-H	L-Tyrosine ( $^{13}\text{C}_9$ , 99%)	neat
CNLM-439-H	L-Tyrosine ( $^{13}\text{C}_9$ , 99%; $^{15}\text{N}$ , 99%)	neat
CLM-2249-H	L-Valine ( $^{13}\text{C}_5$ , 99%)	neat
CNLM-442-H	L-Valine ( $^{13}\text{C}_5$ , 99%; $^{15}\text{N}$ , 99%)	neat

### Catecholamines

Catalog No.	Description	Concentration
DLM-2498	Dopamine·HCl (2-(3,4-dihydroxyphenyl)-ethylamine·HCl) (1,1,2,2- $\text{D}_4$ , 97-98%)	neat
CNLM-7889	DL-Epinephrine (1,2- $^{13}\text{C}_2$ , 99%; $^{15}\text{N}$ , 98%)	neat
DLM-2738	Homovanillic acid (phenyl- $\text{D}_3$ , 2,2- $\text{D}_2$ , 96-98%)	neat
COLM-376	Homovanillic acid (ring- $^{13}\text{C}_6$ , 99%; 4-hydroxy- $^{18}\text{O}$ , 90-95%)	neat
DLM-8820	DL-Norepinephrine·HCl (ring- $\text{D}_3$ , 1,2,2- $\text{D}_3$ , 99%)	neat
DLM-2993	2-Phenylethylamine (2,2- $\text{D}_2$ , 95%)	neat

### Fatty Acids

Catalog No.	Description	Concentration
DLM-1233	Arachidic acid ( $\text{D}_{39}$ , 98%)	neat
DLM-1661-N	Arachidonic acid (5,6,8,9,11,12,14,15- $\text{D}_8$ , 98%)	neat
DLM-1508	Butyric acid ( $\text{D}_7$ , 98%)	neat
CLM-1586	Lauric acid (1- $^{13}\text{C}$ , 99%)	neat
DLM-563	Lauric acid ( $\text{D}_{23}$ , 98%)	neat
CLM-6855	Linoleic acid (U- $^{13}\text{C}_{18}$ , 98%) CP 94% <10% <i>cis/trans</i> isomer	neat
CLM-3665	Myristic acid (1,2,3- $^{13}\text{C}_3$ , 99%)	neat
DLM-208	Myristic acid ( $\text{D}_{27}$ , 98%)	neat
CLM-2721	Octanoic acid (1,2,3,4- $^{13}\text{C}_4$ , 99%)	neat
CLM-460	Oleic acid (U- $^{13}\text{C}_{18}$ , 98%)	neat
DLM-1891	Oleic acid ( $\text{D}_{33}$ , 98%)	neat
CLM-409	Palmitic acid (U- $^{13}\text{C}_{16}$ , 98%)	neat
DLM-215	Palmitic acid ( $\text{D}_{31}$ , 98%)	neat
CLM-2241	Palmitoleic acid (U- $^{13}\text{C}_{16}$ , 98%) CP 97%	neat
CLM-6990	Stearic acid (U- $^{13}\text{C}_{18}$ , 98%) CP 97%	neat
DLM-379	Stearic acid ( $\text{D}_{35}$ , 98%)	neat

### Flavonoids and Isoflavonoids

Catalog No.	Description	Concentration
CLM-9256	(±)-Catechin (2,3,4- $^{13}\text{C}_3$ , 99%)	neat
DLM-4461	Daidzein (3',5',8- $\text{D}_3$ , 97%)	60 µg/mL in acetonitrile- $\text{D}_3$
CLM-9257	(±)-Epicatechin (2,3,4- $^{13}\text{C}_3$ , 99%) CP 97%	neat
CLM-9756	Galangin (2,3,4- $^{13}\text{C}_3$ , 99%) CP 95%	neat
CLM-10556	(±)-Gallocatechin (2,3,4- $^{13}\text{C}_3$ , 99%) CP 97%	neat
DLM-4460	Genistein (3',5',6,8- $\text{D}_4$ , 94%)	100 µg/mL in acetonitrile
CLM-11040	Kaempferol (U- $^{13}\text{C}$ , 98%)	neat
CLM-9754	Myricetin (2,3,4- $^{13}\text{C}_3$ , 99%) CP 95%	neat

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## Organic Acids

Catalog No.	Description	Concentration
CLM-9021	Citric acid ( $^{13}\text{C}_6$ , 99%) CP 97%	neat
CLM-9876	Citric acid (1,5,6-carboxyl- $^{13}\text{C}_3$ , 99%)	neat
DLM-3487	Citric acid (2,2,4,4- $\text{D}_4$ , 98%)	neat
CLM-4454	Fumaric acid (1,4- $^{13}\text{C}_2$ , 99%)	neat
CLM-1529	Fumaric acid ( $^{13}\text{C}_4$ , 99%)	neat
CLM-4442	$\alpha$ -Ketoglutaric acid, disodium salt (1,2,3,4- $^{13}\text{C}_4$ , 99%) CP 97%	neat
CLM-8077	Pyruvic acid (1- $^{13}\text{C}$ , 99%)	neat
CLM-1571	Succinic acid ( $^{13}\text{C}_4$ , 99%)	neat
DLM-584	Succinic acid ( $\text{D}_4$ , 98%)	neat

## Phytohormones and Steroids

Catalog No.	Description	Concentration
DLM-7841	( $\pm$ )-2- <i>cis</i> ,4- <i>trans</i> -Abscisic acid (ring-3,5,5- $\text{D}_3$ , 2-methyl- $\text{D}_3$ , 98%)	neat
CLM-9135	4-Androstene-3,17-dione (2,3,4- $^{13}\text{C}_3$ , 98%)	neat or 100 $\mu\text{g}/\text{mL}$ in methanol
CLM-1813	Benzoic acid (ring- $^{13}\text{C}_6$ , 99%)	neat
DLM-9906	Campesterol ( $\text{D}_7$ , 98%) mix of diastereomers	neat
CLM-9587	Cholesterol (23,24,25,26,27- $^{13}\text{C}_5$ , 99%)	neat or 100 $\mu\text{g}/\text{mL}$ in methanol
DLM-3057	Cholesterol (25,26,26,26,27,27,27- $\text{D}_7$ , 98%)	neat
CLM-9148	Estrone (2,3,4- $^{13}\text{C}_3$ , 99%)	neat or 50 $\mu\text{g}/\text{mL}$ /100 $\text{mg}/\text{mL}$ in methanol
CLM-415	Ethylene (1,2- $^{13}\text{C}_2$ , 99%)	neat
DLM-347	Ethylene- $\text{D}_4$ ( $\text{D}$ , 98%)	neat
CLM-8730	Salicylic acid (2-hydroxybenzoic acid) (ring- $^{13}\text{C}_6$ , 99%)	neat
DLM-3624	Salicylic acid (2-hydroxybenzoic acid) ( $\text{D}_6$ , 97%)	neat
CLM-9164	Testosterone (2,3,4- $^{13}\text{C}_3$ , 99%)	neat or 100 $\mu\text{g}/\text{mL}$ in methanol
DLM-6224	Testosterone (16,16,17- $\text{D}_3$ , 98%)	neat or 100 $\mu\text{g}/\text{mL}$ in methanol

## Sugars, Sugar Phosphates, and Their Polysaccharides

Catalog No.	Description	Concentration
CLM-8757	Cellulose (high DP from maize) ( $\text{U-}^{13}\text{C}$ , 97%)	neat
CLM-8616	D-Fructose-6-phosphate- $2\text{Na}^+\cdot x\text{H}_2\text{O}$ ( $\text{U-}^{13}\text{C}_6$ , 99%) may contain up to ~10% $^{13}\text{C}_6$ glucose-6-phosphate	neat
CLM-1396	D-Glucose ( $\text{U-}^{13}\text{C}_6$ , 99%)	neat
DLM-349	D-Glucose (6,6- $\text{D}_2$ , 99%)	neat
CLM-8367	D-Glucose-6-phosphate, disodium salt (hydrate) ( $\text{U-}^{13}\text{C}_6$ , 99%)	neat
DLM-2725	<i>myo</i> -Inositol (1,2,3,4,5,6- $\text{D}_6$ , 98%)	neat
CLM-3398	Potassium phosphoenolpyruvate (2,3- $^{13}\text{C}_2$ , 99%)	neat
CLM-8529	D-Sorbitol ( $\text{U-}^{13}\text{C}_6$ , 98%)	neat

## Terpenoids

Catalog No.	Description	Concentration
CLM-7613	<i>trans</i> -Lycopene (8,8',9,9',10,10',11,11',19,19'- $^{13}\text{C}_{10}$ , 99%)	neat
DLM-4412	(-)-Menthol (1,2,6,6- $\text{D}_4$ , 98%)	neat
CLM-6650	( $\pm$ )-Menthone (isopropyl- $^{13}\text{C}_3$ , 99%)	neat
DLM-2279	$\alpha$ -Terpineol (propyl methyl- $\text{D}_3$ , 98%) contains 10% isomer	neat

## Vitamins

Catalog No.	Description	Concentration
CLM-7667	Vitamin $\text{B}_1$ HCl (thiamine HCl) (4,5,4-methyl- $^{13}\text{C}_3$ , 99%) CP 97%	neat
CNLM-8851	Vitamin $\text{B}_2$ (riboflavin) ( $^{13}\text{C}_4$ , 99%; $^{15}\text{N}_2$ , 98%) CP 97%	neat
CNLM-9757	Vitamin $\text{B}_3$ (nicotinamide) (2,6,carbonyl- $^{13}\text{C}_3$ , 99%; ring-1- $^{15}\text{N}$ , 98%)	neat
DLM-6883	Vitamin $\text{B}_3$ (nicotinamide) ( $\text{D}_4$ , 98%)	neat
CLM-7861	Vitamin $\text{B}_9$ (folic acid) (glutamic acid- $^{13}\text{C}_5$ , 95%) contains ~10% $\text{H}_2\text{O}$	neat
DLM-9126	Vitamin E ( $\alpha$ -tocopherol) (5-methyl- $\text{D}_3$ , 7-methyl- $\text{D}_3$ , 98%)	neat
DLM-7702	Vitamin $\text{K}_1$ (phylloquinone) (ring- $\text{D}_4$ , 98%)	neat

## Other Compounds

Catalog No.	Description	Concentration	Metabolite Class
NLM-390	Ammonium nitrate ( $^{15}\text{N}_2$ , 98%)	neat	Inorganic salt
CLM-9900	Caffeic acid (U- $^{13}\text{C}_9$ , 98%)	neat	Phenolic acid
OLM-186	Carbon dioxide ( $^{18}\text{O}_2$ , 95%)	neat	Inorganic oxide
CLM-9641	$\beta$ -Carotene (12,12',13,13',14,14',15,15',20,20'- $^{13}\text{C}_{10}$ , 99%)	neat	Carotenoid
DLM-3829	$\beta$ -Carotene (19,19,19,19',19',19'-D <sub>6</sub> , 98%)	neat	Carotenoid
CLM-9771	Chlorophyll A ( $^{13}\text{C}$ , 96%) CP 95%	neat	Chlorophyll
CLM-7498	<i>trans</i> -Cinnamic acid (ring- $^{13}\text{C}_6$ , 99%)	neat	Cinnamic acid
CLM-10642	<i>p</i> -Coumaric acid (propyl- $^{13}\text{C}_3$ , 99%)	neat	Cinnamic acid
CLM-9260	Ferulic acid (4-hydroxy-3-methoxycinnamic acid) (1',2',3'- $^{13}\text{C}_3$ , 99%)	neat	Hydroxycinnamic acid
CLM-1019	Guanine (8- $^{13}\text{C}$ , 98%)	neat	Nucleobase
CNLM-3990	Guanine (8- $^{13}\text{C}$ , 98%; 7,9- $^{15}\text{N}_2$ , 98%)	neat	Nucleobase
CLM-10468	Hippuric acid (glycine, <i>N</i> -benzoyl) (ring- $^{13}\text{C}_6$ , 99%)	neat	Phenolic acid
DLM-7703	Hippuric acid (glycine, <i>N</i> -benzoyl) (benzoyl-D <sub>5</sub> , 98%)	neat	Phenolic acid
CLM-8042	Hypoxanthine ( $^{13}\text{C}_5$ , 99%)	neat	Nucleobase
CNLM-4786	Indole ( $^{13}\text{C}_8$ , 98%; $^{15}\text{N}$ , 96-99%)	neat	Indole and derivatives
CLM-1896	Indole-3-acetic acid (phenyl- $^{13}\text{C}_6$ , 99%)	neat	Indole and derivatives
DLM-8040	Indole-3-acetic acid (D <sub>7</sub> , 98%)	neat	Indole and derivatives
CLM-9181	Inulin (from chicory) (U- $^{13}\text{C}$ , 97%) CP 97%	neat	Fructan
CLM-8758	Lignin (from maize) (U- $^{13}\text{C}$ , 97%)	neat	Polymer
DLM-7101	Melatonin (acetyl-D <sub>3</sub> , 98%)	neat	Indole and derivatives
CLM-10671	Nicotinamide adenine dinucleotide (NAD <sup>+</sup> ), NH <sub>4</sub> salt (ribose- $^{13}\text{C}_5$ , 98%) CP 96%	neat	Cofactor
NLM-765	Potassium nitrate ( $^{15}\text{N}$ , 99%)	neat	Inorganic salt
CLM-9259	Resveratrol (4-hydroxyphenyl- $^{13}\text{C}_6$ , 99%)	neat	Stilbenoid
CLM-441	Sodium bicarbonate ( $^{13}\text{C}$ , 99%)	neat	Inorganic salt
OLM-4400	Sodium sulfate ( $^{18}\text{O}_4$ , 95%)	neat	Inorganic salt
CLM-1867	Vanillic acid (ring- $^{13}\text{C}_6$ , 99%)	neat	Phenolic acid
CLM-1515	Vanillin (ring- $^{13}\text{C}_6$ , 99%)	neat	Polyphenol

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