

Bioactive Standards

Stable isotope labeled analytical standards are playing an ever-increasing role in the research of biological systems. As mass spectrometric methods are developed to analyze specific biological samples, their utility depends on accurate data interpretation. The use of an internal standard enables compensation for matrix effects and ion suppression.¹

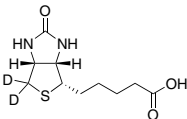
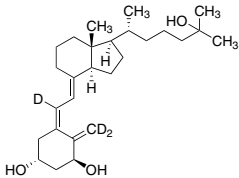
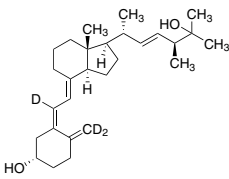
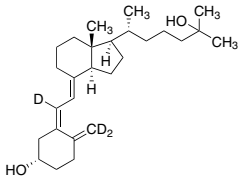
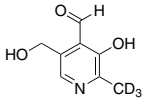
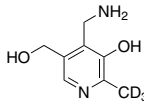
To facilitate this need, ISOTECH® Stable Isotopes offers a wide variety of ¹³C, ¹⁵N and D labeled bioactive compounds suitable for use as mass spectrometric internal standards. This selection

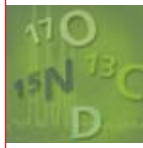
of products boasts of high purity and isotope enrichments and contains a significant portion of products labeled with ¹³C and/or ¹⁵N. This labeling pattern benefits from the inability of ¹³C and ¹⁵N to exchange within the mass spectrometer source.² This diverse collection includes vitamins, steroids and hormones, caffeine and caffeine metabolites, environmental contaminants, as well as a variety of products suitable for many other applications.

Vitamins

Vitamins are responsible for a wide range of essential functions including calcium homeostasis, fatty acid metabolism and blood clotting. Vitamin deficiencies can have wide ranging health consequences and therefore many nutritional studies have

been undertaken to study dietary intake and bioavailability,³ identification and concentration within complex samples⁴ as well as to further elucidate function.^{4b,4f}

Description	Structure	Cat. No.	Isotopic Purity
Biotin-ring-6,6-d ₂ , 97% CP		705268-5MG 705268-10MG	98 atom % D
1α,25-Dihydroxyvitamin D ₃ (6,19,19-d ₃), 96% CP		705942-1MG	97 atom % D
25-Hydroxyvitamin D ₂ (6,19,19-d ₃), 98% CP		705497-1MG	97 atom % D
25-Hydroxyvitamin D ₃ (6,19,19-d ₃), 98% CP		705888-1MG	97 atom % D
Pyridoxal-methyl-d ₃ hydrochloride, 98% CP		705187-1MG 705187-5MG	98 atom % D
Pyridoxamine-methyl-d ₃ dihydrochloride, 98% CP		705322-1MG 705322-5MG	98 atom % D

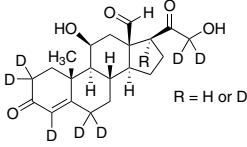
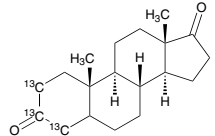
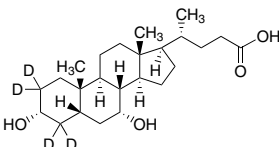
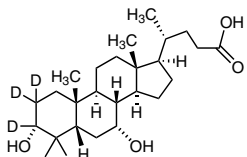
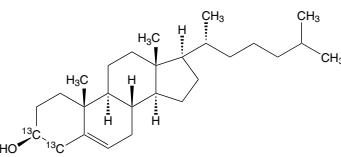
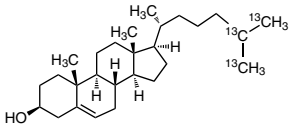
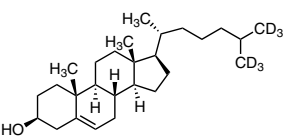
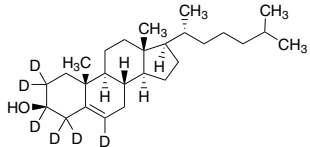


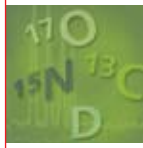
Description	Structure	Cat. No.	Isotopic Purity
Riboflavin-dioxypyrimidine- ¹³ C ₄ , ¹⁵ N ₂ , 97% CP		705292-1MG 705292-5MG	99 atom % ¹³ C 98 atom % ¹⁵ N
Thiamine (4-methyl- ¹³ C-thiazol-5-yl- ¹³ C ₃) hydrochloride, 98% CP		731188-2MG 731188-5MG 731188-10MG	99 atom % ¹³ C
α-Tocopherol- (ring-5,7-dimethyl-d ₆), 98% CP		731234-2MG 731234-5MG 731234-10MG	98 atom % D
Vitamin B ₅ (di-β-alanine- ¹³ C ₆ , ¹⁵ N ₂), calcium salt, 97% CP		705837-5MG 705837-10MG 705837-20MG	99 atom % ¹³ C 98 atom % ¹⁵ N
Vitamin D ₂ (6,19,19-d ₃), 98% CP		705489-1MG	97 atom % D
Vitamin-D ₃ (6,19,19-d ₃) solution, 1 mg/ml in ethanol, 97% CP		731285-1ML	97 atom % D
Vitamin E acetate (trimethyl-d ₉), 98% CP		615366	98 atom % D
Vitamin K-(5,6,7,8-d ₄ , 2-methyl-d ₃), 98 % CP (sum of E&Z isomers)		705470-1MG 705470-5MG	98 atom % D
Vitamin K ₃ -d ₈ , 97% CP		737836-50MG	98 atom % D

Steroids and Hormones

Steroids and hormones make up a complex group of bioactive compounds due to their therapeutic utility, their role in metabolic processes, their intricate reactivity profile and structural similarities. The same properties that raise interest in these biologically relevant molecules, however, are also those that make their study intensely challenging. The use of stable isotope labeled steroids and hormones has alleviated some of the difficulties surrounding identification, differentiation and analysis of these compounds.

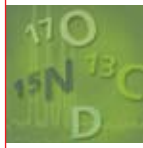
The labeled compounds shown below have been useful in a broad range of research topics, with an emphasis being applied to improving methods for identification, quantification and mixture analysis. Some of the interesting and important topics to be researched include environmental contamination due to hormone excretion,⁵ the quantification of therapeutic agents such as corticosteroids⁶ and identification of biomarkers for liver and intestinal disorders, dehydration and stress.⁷

Description	Structure	Cat. No.	Isotopic Purity
Aldosterone-2,2,4,6,6,21,21-d ₇ (variable deuteration on C ₁₇), 98% CP		706035-1MG 706035-2MG 706035-5MG	98 atom % D (based on d ₇)
4-Androstene-3,17-dione-2,3,4- ¹³ C ₃ solution, 0.1 mg/mL in 1,2-dimethoxyethane		730645-1ML	99 atom % ¹³ C
Chenodeoxycholic acid-2,2,4,4-d ₄		614122-500MG	98 atom % D
Chenodeoxycholic acid-2,2,3,4,4-d ₅		617024	98 atom % D
Cholesterol-3,4- ¹³ C ₂		488585	99 atom % ¹³ C
Cholesterol-25,26,27- ¹³ C ₃		707678	99 atom % ¹³ C
Cholesterol-26,26,26,27,27-d ₆ , 97% CP		679046	98 atom % D
Cholesterol-2,2,3,4,4,6-d ₆ , 98% CP		488577-100MG	97 atom % D

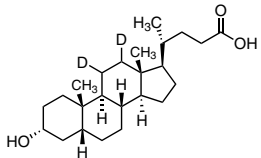
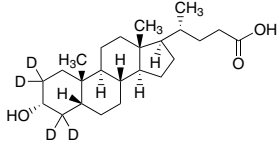
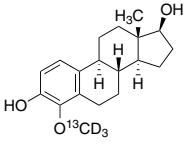
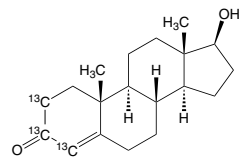


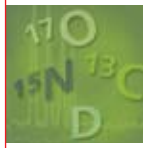
Description	Structure	Cat. No.	Isotopic Purity
Cholesterol-25,26,26,26,27,27-d ₇ , 98% CP		677574	99 atom % D
Cholesteryl linoleate- ¹³ C ₁₈ , 95% CP		729663	99 atom % ¹³ C
Cholesteryl-26,26,26,27,27-d ₆ linoleate, 97% CP		729515	98 atom % D
Cholesteryl-26,26,26,27,27-d ₆ linolenate, 97% CP		730238	98 atom % D
Cholesteryl oleate- ¹³ C ₁₈ , 95% CP		729523	99 atom % ¹³ C
Cholesteryl-26,26,26,27,27-d ₆ oleate-1,2,3,7,8,9,10- ¹³ C ₇ , 97% CP		729671	99 atom % ¹³ C 98 atom % D
Cholic acid-2,2,4,4-d ₄		614149-500MG	98 atom % D
Cholic-acid-2,2,3,4,4-d ₅		614106	98 atom % D
Cortisone-2,2,4,6,6, 9,12,12-d ₇ , 98% CP		705586-5MG	97 atom % D

Description	Structure	Cat. No.	Isotopic Purity
Dehydroepiandrosterone-2,2,3,4,4,6-d ₆ , 98% CP		709549-5MG 709549-10MG	85 atom % D
Dehydroepiandrosterone-2,2,3,4,4,6-d ₆ sulfate sodium salt, 98% CP		723266-1MG 723266-5MG 723266-10MG	85 atom % D (min. 5D/molecule)
Deoxycholic acid-2,2,4,4-d ₄		614130	98 atom % D
11-Deoxycortisol-2,2,4,6,6-d ₅		710784-1MG 710784-5MG	98 atom % D
Dihydrotestosterone-2,3,4- ¹³ C ₃ solution, 0.1 mg/mL in 1,2-dimethoxyethane		730637-1ML	99 atom % ¹³ C
3,3'-Diiodo-L-thyronine (T2), 98% CP		719536-1MG 719536-5MG 719536-10MG	Unlabeled
3,3'-Diiodo-L-thyronine-(phenoxy- ¹³ C ₆) (T2), 97% CP		719528-1MG 719528-5MG 719528-10MG	99 atom % ¹³ C
17β-Estradiol-2,3,4- ¹³ C ₃ , 98% CP		719552-1MG 719552-5MG 719552-10MG	99 atom % ¹³ C
17β-Estradiol-16,16,17-d ₃		491187-100MG	98 atom % D
17β-Estradiol-2,4,16,16,17-d ₅		613967	97 atom % D
Estriol-2,3,4- ¹³ C ₃ , 98% CP		731668-100UG 731668-250UG 731668-500UG 731668-1000UG	99 atom % ¹³ C



Description	Structure	Cat. No.	Isotopic Purity
Estrone-2,3,4- ¹³ C ₃ , 98% CP		719544-1MG 719544-5MG 719544-10MG	99 atom % ¹³ C
Estrone-2,4,16,16-d ₄		489204-100MG	95 atom % D
Estrone-2,4,16,16-d ₄ 3-sulfate sodium salt		524956-100MG	95 atom % D
Hydrocortisone-1α,2α-d ₂		614157	98 atom % D
Hydrocortisone-9,11,12,12-d ₄ , 98% CP		705594-5MG 705594-10MG	98 atom % D
18-Hydroxycorticosterone, 98% CP		710806-1MG	Unlabeled
18-Hydroxycorticosterone-9,11,12,12-d ₄ , 98% CP		710792-1MG	98 atom % D
16-α-Hydroxyestrone-2,3,4- ¹³ C ₃ , 98% CP		731641-100UG 731641-250UG 731641-500UG 731641-1000UG	99 atom % ¹³ C
17-α-Hydroxyprogesterone-2,3,4- ¹³ C ₃ , 98% CP		738093-1MG 738093-5MG	98 atom % ¹³ C
3-Iodothyronamine hydrochloride, 98% CP		709565	Unlabeled
3-Iodothyronamine-(ethylamino-1,1,2,2-d ₄) hydrochloride, 98% CP		709557-1MG	98 atom % D

Description	Structure	Cat. No.	Isotopic Purity
Lithocholic acid-11,12-d ₂		589292	97 atom % D
Lithocholic acid-2,2,4,4-d ₄		589349-500MG	98 atom % D
Lithocholic acid-2,2,3,4,4-d ₅		614033-100MG	98 atom % D
2-Methoxy- ¹³ C, ₃ -17β-estradiol, 98% CP		705829-1MG	99 atom % ¹³ C 98 atom % D
2-Methoxy-17β-estradiol-1,4,16,16,17-d ₅		614076	98 atom % D
4-Methoxy- ¹³ C, ₃ -estradiol, 98% CP		705713-1MG	99 atom % ¹³ C 98 atom % D
2-Methoxy- ¹³ C, ₃ -estrone, 98% CP		705705-1MG	99 atom % ¹³ C 98 atom % D
4-Methoxy- ¹³ C, ₃ -estrone, 98% CP		705691-1MG	99 atom % ¹³ C 98 atom % D
Progesterone-2,3,4- ¹³ C		737143-1MG 737143-5MG	99 atom % ¹³ C
Testosterone-2,3,4- ¹³ C ₃ solution, 0.1 mg/mL in 1,2-dimethoxyethane		730610-1ML	99 atom % ¹³ C



Description	Structure	Cat. No.	Isotopic Purity
Testosterone-d ₃ solution, 100 µg/mL in 1,2-dimethoxyethane		T5536	
L-Thyroxine-(ring- ¹³ C ₁₂), 97 % CP		699594	99 atom % ¹³ C
3,3',5'-Triiodothyronine-diiodophenyl- ¹³ C ₆ hydrochloride, 95% CP		709719-1MG 709719-5MG	99 atom % ¹³ C
3,3',5'-Triiodothyronine-tyrosine ring- ¹³ C ₆ hydrochloride, 95% CP		709611-1MG 709611-5MG	99 atom % ¹³ C

Caffeine and Metabolites

The prevalence of caffeine in foods, drinks and pharmaceuticals as well as the increased consumption of caffeinated products has led to a heightened interest in caffeine research.⁸ Although it is one of the most common, naturally occurring, bioactive compounds, there are still unanswered questions surrounding the properties of caffeine and its metabolites. The development

of analytical methods capable of analyzing caffeine in complex samples can aid pharmaceutical research as caffeine has been used to probe enzymes responsible for drug metabolism.⁹ With current caffeine research relying on the ability to quantitatively study caffeine, the below selection of internal standards is necessary for the advancement of this field.

Description	Cat. No.	Isotopic Purity
5-Acetylamino-6-amino-3-methyluracil-ring- ¹³ C ₄ , ¹⁵ N ₂ , amino- ¹⁵ N, 98% CP	705578-1MG 705578-5MG	99 atom % ¹³ C 98 atom % ¹⁵ N
Caffeic acid- ¹³ C ₉ , 97% CP	706337	99 atom % ¹³ C
Caffeine-trimethyl- ¹³ C ₃	485365-1G	99 atom % ¹³ C
Caffeine-trimethyl-d ₉	725625	99 atom % D
1,3-Dimethyluric acid-2,4,5,6- ¹³ C ₄ -1,3,9- ¹⁵ N ₃ , 98% CP	705632-1MG 705632-5MG	99 atom % ¹³ C 98 atom % ¹⁵ N
1,7-Dimethyluric acid-2,4,5,6- ¹³ C ₄ -1,3,9- ¹⁵ N ₃ , 98% CP	705640-1MG 705640-5MG	99 atom % ¹³ C 98 atom % ¹⁵ N
1,7-Dimethylxanthine-2,4,5,6- ¹³ C ₄ -1,3,9- ¹⁵ N ₃ , 98% CP	705381-2MG 705381-5MG	99 atom % ¹³ C 98 atom % ¹⁵ N
1,7-Dimethylxanthine-(dimethyl-d ₆), 98% CP	705373-2MG 705373-5MG	98 atom % D
3,7-Dimethylxanthine-(dimethyl-d ₆), 98% CP	705357-2MG 705357-5MG	98 atom % D

Description	Cat. No.	Isotopic Purity
1-Methyluric acid-2,4,5,6- ¹³ C ₄ , 1,3,9- ¹⁵ N ₃ , 98% CP	705608-2MG 705608-5MG	99 atom % ¹³ C 98 atom % ¹⁵ N
3-Methyluric acid-2,4,5,6- ¹³ C ₄ , 1,3,9- ¹⁵ N ₃ , 98% CP	705616-2MG 705616-5MG	99 atom % ¹³ C 98 atom % ¹⁵ N
7-Methyluric acid-2,4,5,6- ¹³ C ₄ , 1,3,9- ¹⁵ N ₃ , 97% CP	705624-2MG 705624-5MG	99 atom % ¹³ C 98 atom % ¹⁵ N
1-Methylxanthine-2,4,5,6- ¹³ C ₄ , 1,3,9- ¹⁵ N ₃ , 98% CP	705195-2MG 705195-5MG	99 atom % ¹³ C 98 atom % ¹⁵ N
1-Methylxanthine-methyl- ¹³ C, d ₃ , 97% CP	705209-1MG 705209-5MG	99 atom % ¹³ C 98 atom % D
3-Methylxanthine-2,4,5,6- ¹³ C ₄ , 1,3,9- ¹⁵ N ₃ , 98% CP	705217-2MG 705217-5MG	99 atom % ¹³ C 98 atom % ¹⁵ N
7-Methylxanthine-2,4,5,6- ¹³ C ₄ , 1,3,9- ¹⁵ N ₃ , 98% CP	705225-2MG 705225-5MG	99 atom % ¹³ C 98 atom % ¹⁵ N
1,3,7-Trimethyluric acid-2,4,5,6- ¹³ C ₄ -1,3,9- ¹⁵ N ₃ , 98% CP	705667-2MG 705667-5MG	99 atom % ¹³ C 98 atom % ¹⁵ N

Melamine and Bisphenol A

Of increasing interest, among this diverse set of products, are compounds identified as food contaminants. Two compounds that have recently been placed into this category include melamine¹⁰ and bisphenol A (BPA).

In response to several major controversies, absolute identification and quantification of these compounds is essential. Melamine¹⁰ has previously been used as a food additive to falsely increase the measured nitrogen and thus the protein content. The use of melamine in foods, however,

is prohibited and improving the specificity of analytical methods is crucial in the control of its use. BPA contamination is caused by leaching from plastics as opposed to direct addition to foods. BPA is a compound of increasing concern due to a number health risks thought to be directly related to exposure. With guidelines in place regarding acceptable levels of both melamine and BPA within consumable products, methodology designed to increase sensitivity and accuracy has become necessary.^{10,11}

Description	Cat. No.	Isotopic Purity
Ammelide- ¹³ C ₃ , 95% CP	708984	99 atom % ¹³ C
Ammeline- ¹³ C ₃ , 95% CP	709263	99 atom % ¹³ C
Cyanuric acid- ¹³ C ₃ , 97% CP	687820	99 atom % ¹³ C
Melamine- ¹³ C ₃ , 95% CP	707228	99 atom % ¹³ C
Melamine-triamine- ¹⁵ N ₃	592889	min 80 atom % ¹⁵ N (triamine) max 20 atom % ¹⁵ N (triazine)
Bisphenol A sulfate sodium salt, 95% CP	724246	Unlabeled

Description	Cat. No.	Isotopic Purity
Bisphenol A-(rings- ¹³ C ₁₂), 98% CP	720186	99 atom % ¹³ C
Bisphenol A-(rings-d ₆)	614025	98 atom % D
Bisphenol A-(methyl-d ₆)	588806-1G	98 atom % D
Bisphenol A-d ₁₆	451835-250MG 451835-1G	98 atom % D

Additional Products

Beyond the extensive selection described above, ISOTECH® Stable Isotopes also offers a wide range of labeled products suitable for a variety of applications. This group includes labeled antibiotics,

insecticides, herbicides, natural products and plant metabolites. These bioactive compounds can serve as internal standards in a number of analytical methods.

Description	Cat. No.	Isotopic Purity
Aldicarb (<i>N</i> -methyl- ¹³ C ₃ , carbamoyl- ¹³ C), 98% CP	733865-1MG 733865-5MG 733865-10MG 733865-25MG	99 atom % ¹³ C 98 atom % D
Aldicarb (<i>N</i> -methyl- ¹³ C ₃ , carbamoyl- ¹³ C) sulfoxide, 98% CP	733881-1MG 733881-5MG 733881-10MG 733881-25MG	99 atom % ¹³ C 98 atom % D
Aldicarb (<i>N</i> -methyl- ¹³ C ₃ , carbamoyl- ¹³ C) sulfone, 98% CP	733873-1MG 733873-5MG 733873-10MG 733873-25MG	99 atom % ¹³ C 98 atom % D
Arachidonic-5,6,8,9,11,12,14,15-d ₈ acid, 98% CP	735000-5MG 735000-10MG 735000-50MG 735000-100MG	7.45D/molecule
7-Azaindole-1- ¹⁵ N, 97% CP	699411	98 atom % ¹⁵ N
7-Azaindole-(pyridine- ¹⁵ N), 97% CP	699330	98 atom % ¹⁵ N
Azelaic acid- ¹³ C ₉ , 98% CP	691763	99 atom % ¹³ C

Description	Cat. No.	Isotopic Purity
Barbituric acid- ¹³ C ₄ , ¹⁵ N ₂ , 97% CP	705101-5MG	99 atom % ¹³ C 98 atom % ¹⁵ N
(+/-)-Catechin-2,3,4- ¹³ C ₃ , 98% CP	719579-1MG 719579-5MG	99 atom % ¹³ C
Clenbuterol-(<i>t</i> -butyl-d ₉)	696927	98 atom % D
Chlorpromazine-(dimethyl-d ₆), 97% CP	696935	98 atom % D
Chlorzoxazone-2- ¹³ C-hydroxy- ¹⁸ O, 97% CP	701726	99 atom % ¹³ C 95 atom % ¹⁸ O
<i>m</i> -Coumaric acid-1,2,3- ¹³ C ₃ , 98% CP	722839-1MG 722839-5MG	99 atom % ¹³ C
<i>p</i> -Coumaric acid-1,2,3- ¹³ C ₃ , 98% CP	722812-1MG 722812-5MG	99 atom % ¹³ C
Desethylamodiaquine-ethyl-d ₅ , 98% CP	705349-2MG 705349-5MG	97 atom % D
Dicamba-ring- ¹³ C ₆ , 98% CP	705306-5MG 705306-10MG	99 atom % ¹³ C

Description	Cat. No.	Isotopic Purity
Dichlofenthion (ring-d ₃), 97% CP	718432	97 atom % D
3,6-Dichloro-2-hydroxybenzoic acid-ring- ¹³ C ₆ , 98% CP	705810-5MG 705810-10MG	99 atom % ¹³ C
cis-4,7,10,13,16,19-Docosahexaenoic-21,21,22,22-d ₅ acid (partial deuteration on C ₂₀), 98% CP	733326-1MG 733326-5MG	5D/molecule
cis-5,8,11,14,17-Eicosapentaenoic acid-19,19,20,20-d ₂ (partial deuteration at C ₁₈), 98% CP	734322-1MG 734322-5MG	5D/molecule
(+/-)-Epicatechin-2,3-4- ¹³ C ₃ , 97% CP	719560-1MG 719560-5MG	99 atom % ¹³ C
Ferulic acid-1,2,3- ¹³ C ₃ , 98% CP	722820-1MG 722820-5MG	99 atom % ¹³ C
Isophorone-2,4,4,6,6-d ₅ , 95% CP	738085-10MG 738085-25MG 738085-50MG 738085-100MG	97 atom % D
3-Methyl- ¹³ C-glutaconic acid-2,4- ¹³ C ₂ , 98% CP	702250	99 atom % ¹³ C
Metronidazole-(ethylene-d ₄), 97% CP	696951	98 atom % D
4-Nitrophenyl- ¹³ C ₆ -hydrazine, 97% CP	704385	99 atom % ¹³ C
2-Nitro-L-tyrosine- ¹³ C ₉ , 97% CP	652296	98 atom % ¹³ C
ProbucoI-propanyl- ¹³ C ₃ , 98% CP	705802-10MG 705802-50MG	99 atom % ¹³ C
Resorufin-d ₆ , 98% CP	705128-10MG 705128-50MG	98 atom % D
Resveratrol-(4-hydroxyphenyl- ¹³ C ₆), 97% CP	711004-1MG 711004-10MG	99 atom % ¹³ C
Spermidine-butane-d ₈ trihydrochloride, 95% CP	709891-5MG 709891-10MG	98 atom % D
Spermine-butane-d ₈ tetrahydrochloride, 95% CP	705330-5MG 705330-10MG	97 atom % D
cis-Urocanic acid-1,2,3- ¹³ C ₃ , 98% CP	709638-1MG 709638-5MG	99 atom % ¹³ C
Yohimbine-(methyl- ¹³ C ₃ d ₃ ester), 98% CP	731242-5MG 731242-10MG	99 atom % ¹³ C 99 atom % D

References

1. a) Annesley, T.M.; *Clin. Chem.* **2003**, *49*, 1041-1044. b) Woolf, I.F. E.J.; Matuszewski, B.K.; *J. Pharm. Biomed. Anal.* **1998**, *18*, 347-357.
2. Wang, S.; Cyronak, M.; Yang, E.; *J. Pharm. Biomed. Anal.* **2007**, *43*, 701-707.
3. a) Goldschmidt, R.J.; Wolf, W.R.; *Anal. Bioanal. Chem.* **2010**, *397*, 471-481. b) Chen, P.; Ozcan, M.; Wolf, W.R.; *Anal. Bioanal. Chem.* **2007**, *389*, 343-347. c) Bruno, R.S.; Leonard, S.W.; Park, S. Zhao, Y.; Traber, M.G.; *Am. J. Clin. Nutr.* **2006**, *83*, 299-304. d) Leonard, S.W.; Good, C.K.; Gugger, E.T.; Traber, M.G.; *Am. J. Clin. Nutr.* **2004**, *79*, 86-92.
4. a) Trenerry, V.C.; Plozza, T.; Caridi, D.; Murphy, S.; *Food Chem.* **2011**, *125*, 1314-1319. b) Tai, S. S.-C.; Bedner, M.; Phinney, K.W.; *Anal. Chem.* **2010**, *82*, 1942-1948. c) Huang, M.; LaLuzerne, P.; Winters, D.; Sullivan, D.; *J. AOAC Int.* **2009**, *92*, 1327-1335. d) Blum, M.; Dolnikowski, G.; Seyoum, E.; Harris, S.S.; Booth, S.L.; Peterson, J.; Saltzman, E.; Dawson-Hughes, B.; *Endocr.* **2008**, *33*, 3390-3394. e) Nelson, B.C.; Sharpless, K.E.; Sander, L.C.; *J. Agric. Food Chem.* **2006**, *54*, 8710-8716. f) Rychlik, M.; *Anal. Chim. Acta.* **2003**, *495*, 133-141.
5. a) Duong, C.N.; Ra, J.S.; Schlenk, D.; Kim, S.D.; Choi, H.K.; Kim, S.D.; *Arch. Environ. Contam. Toxicol.* **2010**, *59*, 147-156. b) Rice, S.L.; Hale, R.C.; *Anal. Chem.* **2009**, *81*, 6716-6724.
6. Ionita, I.A.; Fast, D.M.; Akhlaghi, F.; *J. Chrom. B.* **2009**, *877*, 765-772.
7. a) Taylor, P.J.; van Rosendal, S.P.; Coombes, J.S.; Gordon, R.D.; Stowasser, M.; *J. Chrom. B.* **2010**, *878*, 1195-1198. b) Taylor, P.J.; Cooper, D.P.; Gordon, R.D.; Stowasser, M.; *Clin. Chem.* **2009**, *55*, 1155-1162. c) Soldin, O.P.; Sharma, H.; Husted, L.; Soldin, S.J.; *Clin. Biochem.* **2009**, *42*, 823-827. d) Guo, T.; Taylor, R.L.; Singh, R.J.; Soldin, S.J.; *Clin. Chim. Acta.* **2006**, *372*, 76-82. e) Burkard, I.; von Eckardstein, A.; Rentsch, K.M.; *J. Chrom. B.* **2005**, *826*, 147-159.
8. a) Ptolemy, A.S.; Tzioumis, E.; Thomke, A.; Rifai, S.; Kellogg, M.; *J. Chrom. B.* **2010**, *878*, 409-416. b) Morlock, G.; Ueda, Y.; *J. Chrom. A.* **2007**, *1143*, 243-251. c) Köfeler, H.C.; Gross, M.L.; *J. Am. Soc. Mass Spectrom.* **2005**, *16*, 406-408.
9. Caubet, M.-S.; Comte, B.; Brazier, J.-L.; *J. Pharm. Biomed. Anal.* **2004**, *34*, 379-389.
10. a) Wu, Y.-T.; Huang, C.-M.; Lin, C.-C.; Ho, W.-A.; Lin, L.-C.; Chiu, T.-F.; Tang, D.-C.; Lin, C.-H.; Tsai, T.-H.; *J. Chrom. A.* **2009**, *1216*, 7595-7601. b) Tyan, Y.-C.; Yang, M.-H.; Jong, S.-B.; Wang, C.-K.; Shiea, J.; *Anal. Bioanal. Chem.* **2009**, *395*, 729-735.
11. a) Deorge, D.R.; Twaddle, N.C.; Vanlandingham, M.; Fisher, J.W.; *Toxicol. Appl. Pharmacol.* **2010**, *247*, 158-165. b) Kawaguchi, M.; Hayatsu, Y.; Nakata, H.; Ishii, Y.; Ito, R.; Saito, K.; Nakazawa, H.; *Anal. Chim. Acta* **2005**, *539*, 83-89.

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