



## BDG SYNTHESIS

### Certificate of Analysis

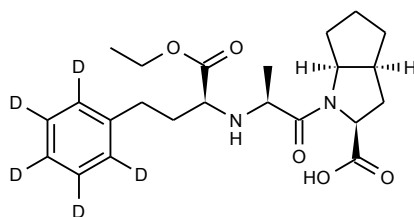
BDG Synthesis certifies that this reference material meets or exceeds the specifications stated herein.

*Barry Dent*

Barry R. Dent, PhD, Director  
4 February 2011

**Name:** Ramipril-d<sub>5</sub>  
**CAS Number:** 87333-19-5 (unlabelled)

**Structure:**



**Molecular Weight:** C<sub>23</sub>H<sub>27</sub>D<sub>5</sub>N<sub>2</sub>O<sub>5</sub> = 421.54

**Lot Number:** BDG 6635.1

**Appearance:** White, crystalline solid

**Purity By HPLC:** 99.6 %

**Isotopic Purity:** Under 0.5 % d<sub>0</sub>

**Re-test Date:** 4 February 2016

**Storage and Handling:** Temperature: ambient laboratory temperature; may be refrigerated.  
Humidity: not believed to be hygroscopic; may be handled in normal laboratory atmosphere.  
Light: protect from strong sunlight.  
Caution: only experienced laboratory personnel should handle the material.

## Identity and Purity

### Proton NMR Spectrum

Identity: the signals are consistent with the proposed structure and in accord with literature where available. The complexity of the spectrum indicates two conformers of the product are present in solution.

Isotopic Labelling: signals at the sites of deuteration are greatly diminished, compared with the spectrum of unlabelled material, indicating clean deuteration.

Residual Solvents: no residual solvents are observed.

Impurities: no significant impurities are evident in the spectrum.

### Carbon-13 NMR Spectrum

Identity: the signals are consistent with the proposed structure and in accord with literature where available. The majority of signals are duplicated indicating that two conformers of the product are present in solution.

Isotopic Labelling: signals at the sites of deuteration have collapsed to small multiplets compared with the spectrum of unlabelled material, indicating clean deuteration.

### High-resolution Mass Spectrum (FAB+)

Found  $m/z$  422.2717.  $C_{23}H_{28}D_5N_2O_5$   $[M+H]^+$  requires  $m/z$  422.2703. The deviation of 3.3 ppm is within normally accepted limits for the establishment of identity by HRMS. No signal for  $d_0$  material was seen (detection limit about 0.5 %).

### HPLC

A sharp, symmetrical peak is observed (99.6 %). Note: in the absence of reference materials for preparing calibration curves, it is assumed that all peaks have the same detector response. Where possible, the conditions of analysis follow a pharmacopeial or literature method, or have been adapted from same.

### Elemental Analysis

	Found:	C 65.80, H 6.59, D 2.44, N 6.64 %
$C_{23}H_{27}D_5N_2O_5$	Requires:	C 65.53, H 6.46, D 2.39, N 6.65 %

The elemental analyses fall within generally accepted limits for establishing the molecular formula given. The results may also be taken to imply the absence of significant quantities of water or inorganic salts (which have not been elsewhere tested for because of sample size limitations).

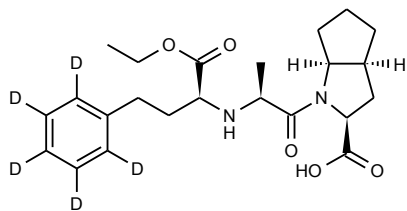
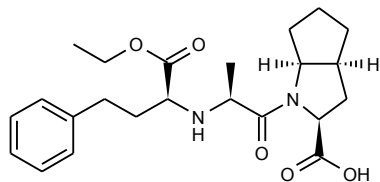
The available quantity of custom-synthesised material is always small, and this limits the extent and type of analytical data which can be obtained. This Certificate is presented in descriptive format for use by analytical chemists who are trained in the use of custom-synthesised materials. Custom materials often contain higher levels of residual solvents and/or water, and we urge you to use the corrected purity where needed rather than the raw HPLC purity. This compound is intended for use as an analytical reference material and it is not for human administration. Structures are shown with relative stereochemistry unless otherwise specified.

The re-test date is assigned from experience gained with the material in the laboratory and/or on storage. It is not possible to perform formal storage studies because of the small amount of material available.

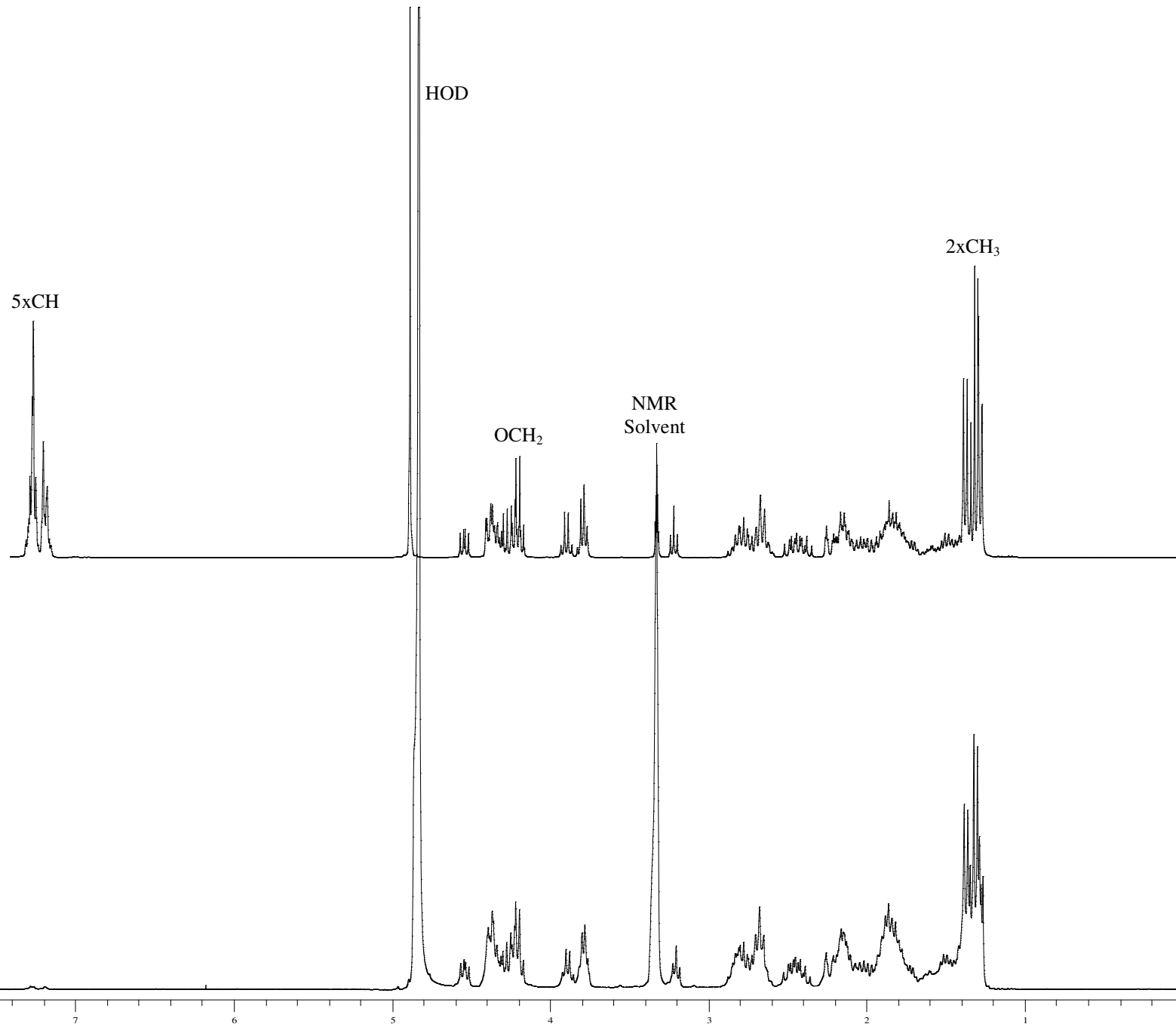


Proton NMR Spectrum of Ramipril (top) and Ramipril-d<sub>5</sub> (bottom) in Methanol-d<sub>4</sub>

**BDG SYNTHESIS**



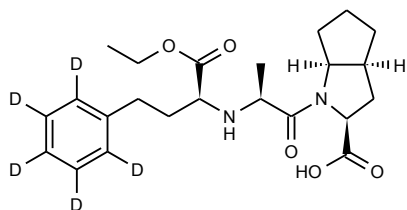
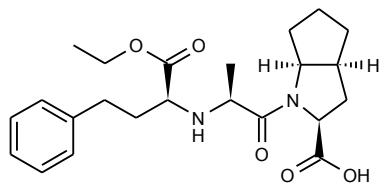
Lot Number: BDG 6635.1



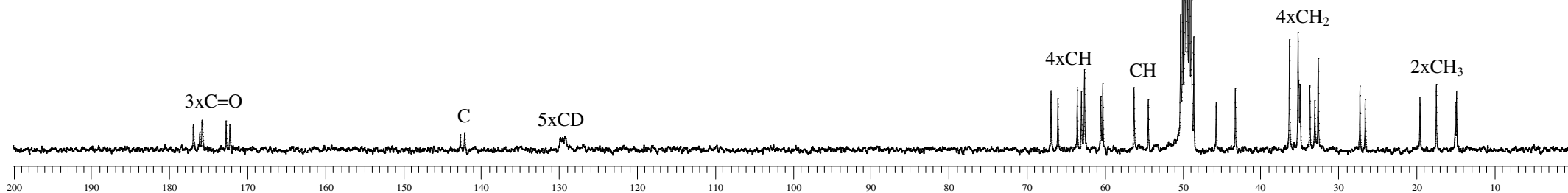


**BDG SYNTHESIS**

Carbon-13 NMR Spectrum of Ramipril (top) and Ramipril-d<sub>5</sub> (bottom) in Methanol-d<sub>4</sub>



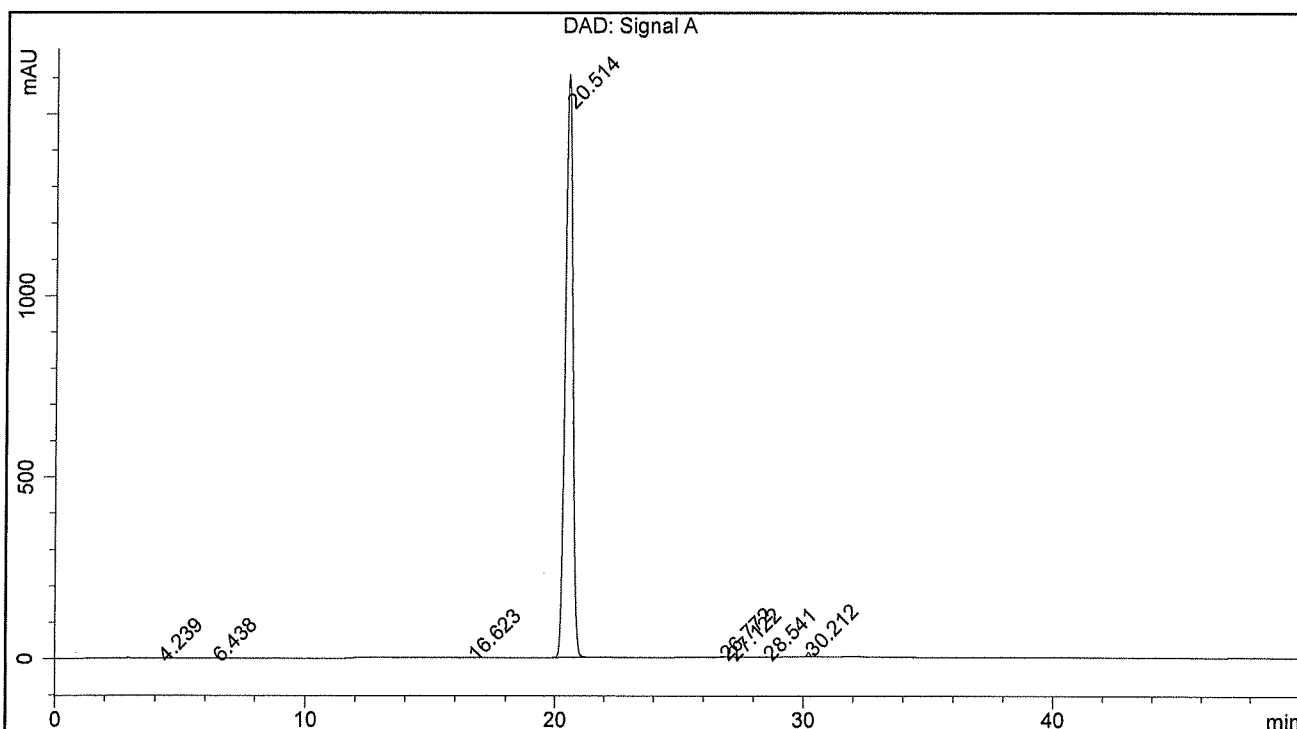
Lot Number: BDG 6635.1



BDG - Analysis of Ramipril-d5

Column : Phenomenex Luna C18 5um 250 x 4.6 mm  
 Guard : Phenomenex Security Guard C18 4 x 3 mm  
 Mobile Phase : 90:10 0.2% Sodium Perchlorate 0.05% Triethylamine pH=3.6 : Acetonitrile  
 Mobile Phase : 30:70 0.2% Sodium Perchlorate 0.05% Triethylamine pH=2.6 : Acetonitrile  
 Gradient ( A:B ) : T0=80:20, T20=50:50, T25=50:50, T27=80:20, T30=80:20  
 Flow Rate : 1.0 mL/min  
 Sample Solvent : Mobile Phase A  
 Column Temperature : 20C  
 Injection Volume : 10 uL  
 Detection : UV at 210 nm

Sample Name	BDG 6635.1	Instrument	AnalyticalLC01
Acquisition	04/02/2011, 18:08:42	Method (rev.)	LC10241b ( 9)
Sequence	BDG_04Feb2011c - Reprocessed	Vial Position	2
Operator	solvation010\cercityadmin	Injection	1 of 1



Area Percent Report

Peak#	RT	Peak Height	Peak Area	Width	Area %
1	4.24 min	0.4578	4.8394	0.1413 min	0.014 %
2	6.44 min	0.6714	6.3917	0.1331 min	0.018 %
3	16.62 min	0.8282	8.8675	0.1629 min	0.026 %
4	20.51 min	1605.8856	34472.7793	0.3384 min	99.590 %
5	26.77 min	1.9971	18.7279	0.1434 min	0.054 %
6	27.12 min	0.9401	12.2302	0.1858 min	0.035 %
7	28.54 min	0.6505	5.0319	0.1202 min	0.015 %
8	30.21 min	11.6843	85.8718	0.1157 min	0.248 %