Supporting Information

Experimental. Experiments were carried out using a quadrupole ion trap mass spectrometer (Finnigan LCQ, San Jose, CA), equipped with an ESI source and operated in the positive ion mode as follows: spray voltage, 5.00 kV; capillary voltage, 20 V; heated capillary temperature, 150°C; tube lens offset voltage, 20 V; sheath gas (N_2) flow rate, 30 units (roughly 0.75 L/min). In the full scan MS^2 and MS^3 modes, the parent ion of interest was first isolated by applying an appropriate waveform across the endcap electrodes of the ion trap to resonantly eject all trapped ions, except those of the m/z ratio of interest. The isolated ions were then subjected to a supplementary ac signal to resonantly excite them and to cause CID. Values of the dimensionless Mathieu parameter q_z during resonance excitation and resonance ejection were 0.25 and 0.83, respectively. The ion excitation time for CID was 30 ms with the amplitude of the excitation signal being optimized for each experiment, but being kept constant for the measurements of each pair of two isomers or for mixtures of various ee. (Nominal CID amplitudes in this instrument range from 0 to 100 %, corresponding to 0 to 2.5 V zero-to-peak.) The CID activation level was optimized so as to allow the largest selectivity (small values) while still allowing an accurate abundance ratio measurement (favored by large values). Typically, the CID energy used was such that both product ions had a relative abundance of at least 5%, expressed relative to the base peak. Spectra shown represent the average of about 50 scans, each requiring 200 ms. Mass/charge ratios (m/z) are reported using the Thomson unit (1 Th = 1 atomic mass per unit positive charge). We have checked several representative cases and found that profile spectra give similar accuracy to centroid spectra. To save file space, most of data were therefore measured using the centroid mode.

Pure D- and L-FMAU samples were obtained from Triangle Pharmaceuticals, Inc. All other chemicals were purchased from Sigma Chemical Co. (St. Louis, MO) and used without further purification.

Sample solutions were prepared by dissolving four equivalents of the chiral compounds and one equivalent of the transition metal salt in a 50:50 v/v aqueous methanol solvent to a final concentration of 100 μM for analyte and reference compound, and 25 μM in the metal ion. The sample was infused via a syringe pump at a flow rate of 2-3 μL/min.

Results and Discussion. Dimeric, trimeric and tetrameric cluster ions were observed in these experiments (see, for example, Figure S1). We examine trimeric cluster ions since their dissociation results in the formation of diasteromeric fragment ions. In contrast, dissociation of dimeric ions results in the loss of small neutrals such as CO_2 and H_2O and no significant chiral. We have not investigated the behavior of the tetrameric cluster ions, but there is no particular reason to study them.

To ensure that instrumental conditions do not affect accuracy, we suggest that calibration curves be constructed on the day of the measurements, even though we have found that calibration curves are valid for a week and more. The standard error for the measurement of *R* values is approximately 2%.

Note that a particular analyte can be examined using any of a number of chiral reference compounds. For example, FMAU is examined using the reference compounds N-acetyl-L-proline and N-acetyl-L-phenylalanine, in Figures 1 and S1, respectively.

Table S1. Enantiomeric Excess (*ee*) of L-FMAU: Calculated and Experimental Values

Sample	Enantiomeric Excess (*ee*) of L-FMAU		
	Actual (%)	Experimental[a,b] (%)	error (%)
I	50	49.8	0.02
II	70	69.8	0.19
III	80	78.6	1.37
IV	90	90.2	0.19
V	96	94.9	1.14

[a]Each experimental value is the average of three sample injections.
[b]The experimental ee% values were calculated using the calibration curve in Figure 2.

Legend to Figure

Figure S1. ESI mass spectrum of a solution of $CoCl_2$, N-Acetyl-L-Phenylalanine and L-FMAU ($CoCl_2$, 25 μM, N-Acetyl-L-Phe and L-FMAU are 100 μM each).

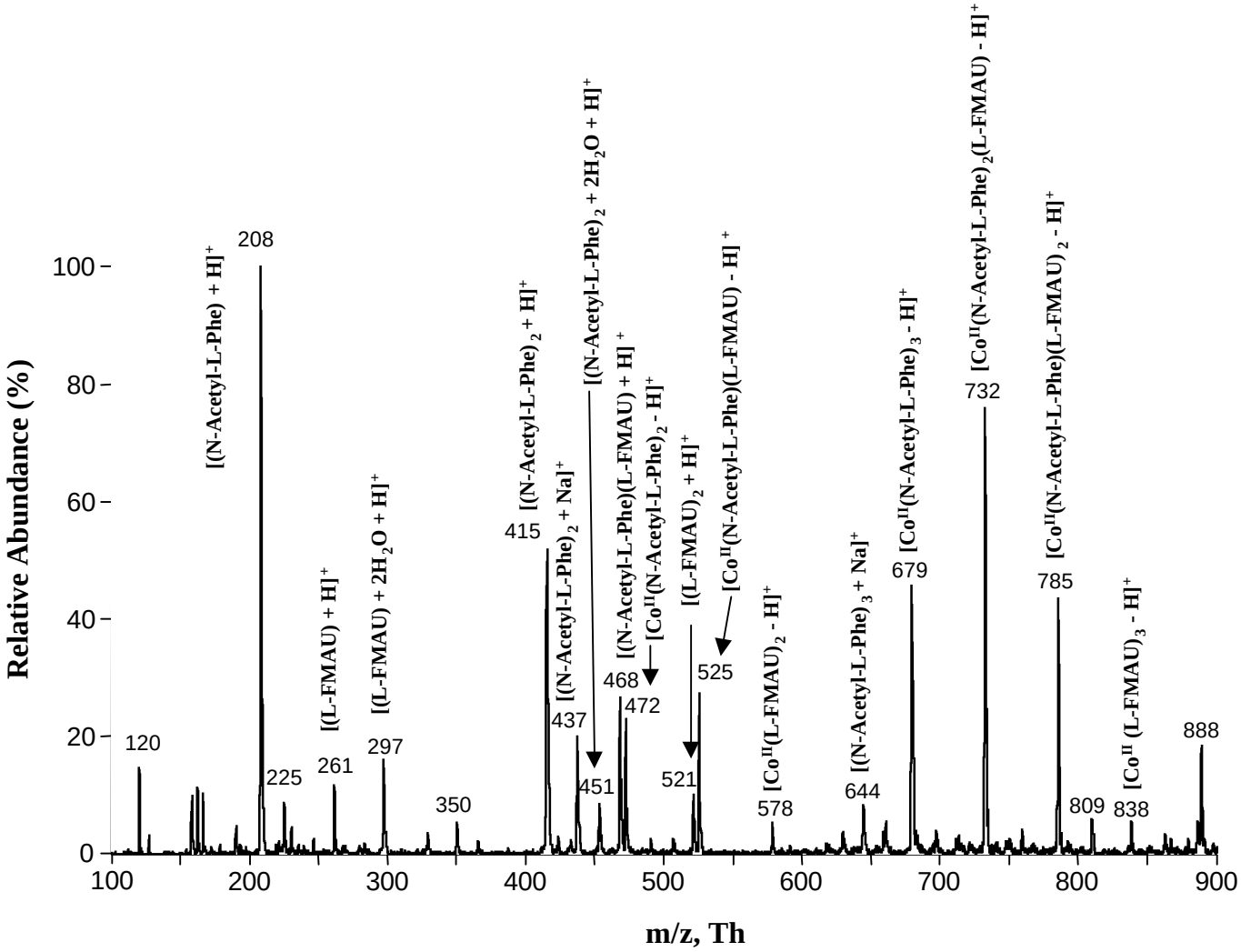
Relative Abundance (%)
m/z, Th
[(N-Acetyl-L-Phe) + H]+
208
[(L-FMAU) + H]+
[(L-FMAU) + 2H2O + H]+
[(N-Acetyl-L-Phe)2 + H]+
[(N-Acetyl-L-Phe)2 + Na]+
[(N-Acetyl-L-Phe)2 + 2H2O + H]+
[(N-Acetyl-L-Phe)(L-FMAU) + H]+
[CoII(N-Acetyl-L-Phe)2 - H]+
[(L-FMAU)2 + H]+
[CoII(N-Acetyl-L-Phe)(L-FMAU) - H]+
[CoII(L-FMAU)2 - H]+
[(N-Acetyl-L-Phe)3 + Na]+
[CoII(N-Acetyl-L-Phe)3 - H]+
[CoII(N-Acetyl-L-Phe)2(L-FMAU) - H]+
[CoII(N-Acetyl-L-Phe)(L-FMAU)2 - H]+
[CoII (L-FMAU)3 - H]+
120
225
261
297
350
415
437
451
468
472
521
525
578
644
679
732
785
809
838
888

Figure S1