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Syntheses of [^{13}C, ^{15}N]-Labeled Polyamines

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[1,4-$^{13}C_2$,1,4-$^{15}N_2$]butanediamine (1), a key compound in the syntheses of [5,8-$^{13}C_2$,1,4,8-$^{15}N_3$] spermidine (2) and [5,8-$^{13}C_2$,1,4,8,12-$^{15}N_4$]spermine (3), has been prepared as part of a 6-step process from 1,2-dibromoethane using potassium [^{13}C]cyanide and potassium [^{15}N]phthalimide . In the course of the syntheses, it was found that 1,4-dibromobutane was generated from tetrahydrofuran when bromination using triphenylphosphine and tetrabromomethane took place. A high-yield preparation of monobenzyloxycarbonyl(Z)derivative of 1, a precursor for 2, was obtained using a water-soluble Z reagent, Z-DSP, in a two-phase system of alkaline solution and chloroform. All the steps for 1, 2, and 3, were aimed at minimizing the loss of stable isotopes.