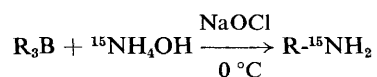


Synthesis of Nitrogen-15-labelled Primary Amines *via* Organoborane Reactions

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¹⁵N-Labelled primary amines are readily synthesized *via* the reaction of organoboranes with ¹⁵N-enriched ammonium hydroxide; functionally substituted organic amines are efficiently prepared *via* the new synthesis.

Nitrogen-15-enriched materials are becoming increasingly important in biological research with the advent of modern multinuclear n.m.r. spectrometers.¹⁻³ We report that ¹⁵N can be efficiently incorporated into primary amines *via* the reaction of organoboranes with ¹⁵N-enriched (up to 95%) NH₄OH in the presence of sodium hypochlorite.



In recent years, we have used organoborane technology to incorporate a variety of carbon,⁴ iodine,⁵ and bromine⁶ iso-

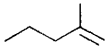
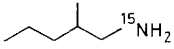

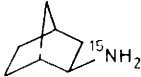
topes. We felt that our recently reported amination reaction would be an ideal method for incorporating ¹⁵N into functionally substituted organic molecules.

The amination reactions are carried out in a straightforward fashion; ¹⁵NH₄OH† (0.5 M) is mixed with the organoborane [0.5 M in tetrahydrofuran (THF), 1 equiv.] in a nitrogen-flushed flask. The mixture is cooled to 0 °C and sodium hypochlorite‡ (0.75 M, 1.2 equiv.) is slowly added; the mixture is stirred for 30 min while warming to room temperature. The product§ is isolated by extraction into dil. HCl which is then washed with diethyl ether; neutralization of the acid layer permits extraction of the product into diethyl ether. Our results are summarized in Table I.

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Table 1

Alkene ^a	Product	% Yield ^b	δ(¹⁵ N) ^c
Me[CH ₂] ₇ CH=CH ₂	Me[CH ₂] ₈ CH ₂ - ¹⁵ NH ₂	85	12.6
		71	8.4
		66	23.6
<i>p</i> -MeC ₆ H ₄ S-CH=CH ₂	<i>p</i> -MeC ₆ H ₄ S-CH ₂ -CH ₂ - ¹⁵ NH ₂	75	7.7
MeOC(=O)[CH ₂] ₈ CH=CH ₂	MeOC(=O)[CH ₂] ₉ CH ₂ - ¹⁵ NH ₂	79	10.6

^a The alkenes were converted into the corresponding trialkylboranes *via* hydroboration with BH₃·THF. ^b Isolated yields based on ¹⁵NH₄OH; all products exhibited physical and spectral characteristics identical to those of authentic samples (ref. 7). ^c N.m.r. spectra were run on a JEOL FX-90Q instrument; products were dissolved in dilute HCl and referenced to ext. ¹⁵NH₄Cl (2.9 M in 1.0 M HCl); the 2-amino-isomers resonated at higher chemical shifts.

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† The ¹⁵N-ammonium hydroxide was prepared by neutralizing ¹⁵NH₄Cl (30–95% enriched) with sodium hydroxide (1 equiv.).

‡ Commercial grade bleach was standardized and used directly.

§ The products contained small quantities of the 2-amino-isomers as a consequence of the incomplete regioselectivity of the hydroboration reaction.