

¹³C-NMR Study of the Dynamics of Oil Molecules in Soy Bean Products

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Traditionally, selection for chemical composition of plants has been accomplished by methods that destroy the sample. Consequently, in plant breeding programs, selections normally are made on the basis of population averages. Nondestructive methods to identify variant individuals permit specific choices in breeding for a desired trait. Nuclear magnetic resonance (NMR) spectroscopy is a powerful tool for the analysis of single seeds for total oil content and dynamic behavior of oil molecules (1).

In this study, we examined the dynamic behavior of soy bean products, soy bean, soy bean powders, and tofu by ¹³C NMR for the quality control of these products. We can observe fine structure in the spectra of intact soy bean and tofu (soy bean curd), which means the long relaxation time of these signals (Fig. 1). However, the signals of baked soy bean, intact soy bean powder, baked soy bean powder are broad as shown in Fig. 1.

Plant seeds contain oil which exists in a liquid like form. From the NMR point of view, it can be treated as a viscous fluid in small droplets surrounded by a solid structure which spoils homogeneity of the magnetic field and affects relaxation. Sharp signals of intact soy bean and tofu reveals that oil droplets are homogeneous in these materials. On the other hand, explanation of the broad signals of baked soy bean, intact soy bean powder, and baked soy bean powder are difficult. Precise definitions and measurements of relaxation times are complicated, because oil contains a large number of nonequivalent ¹³C spins with different chemical shifts and intrinsic mobilities. Since carbon nuclei in other constituents (carbohydrates, proteins, etc.) belong to the solid part, only oil remains "NMR visible" in experiments which are designed to detect signals of liquids.

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References

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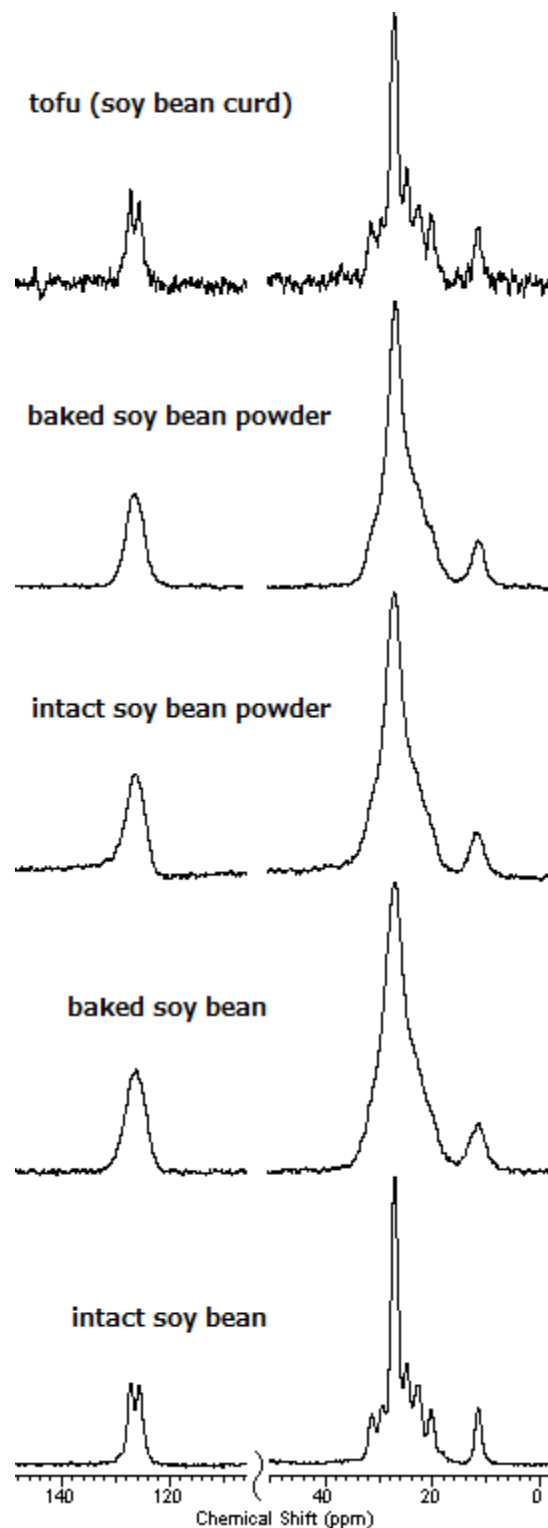


Fig. 1 ¹³C NMR spectra of soy bean products.