# Infrared Evidence for Hydrogen Bonding in the Sodium Salts of Lasalocid A (X-537A)

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*Summary* I.r. absorption measurements on sodium salts of lasalocid A clearly demonstrate the presence of hydrogen bonding.

RECENTLY Phillies and Stanley[1] have investigated the Raman scattering spectrum of the ionophore, lasalocid A (X-537A). From assignment of the OH deformation mode at 1382 cm$^{-1}$, it was concluded that there is no hydrogen bonding of the two aliphatic hydroxy-groups in the sodium salt in contrast to conclusions based on much existing data[2–4] which are consistent with hydrogen bonding of these OH groups. We have now obtained new i.r. and Raman spectroscopic data.

Lasalocid A consists of a salicylic acid group attached to a hydrocarbon backbone terminating in a tetrahydropyran ring (Figure 1). In earlier crystallographic studies of several salts[2] the lasalocid anion always took a cyclical conformation in which the oxygen positions are consistent with the formation of hydrogen bonds between the tertiary and secondary OH and the $CO_2H$ groups (see Figure 1). Similarly in a recent *X*-ray study[4] of a 1:1 lasalocid–methanol complex in which all the hydrogen atoms were located, the usual circular conformation of the anion was found with both O(31) and O(40) involved as hydrogen-bond donors to the carboxylate group.

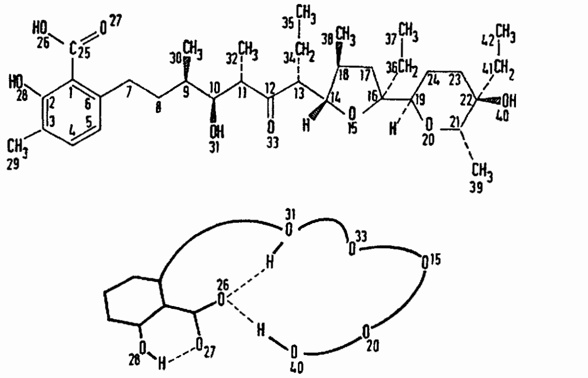

FIGURE 1. Top: molecular structure of lasalocid A free acid. Bottom: folded conformation of lasalocid A showing the hydrogen bonding scheme.

The Raman spectra of the sodium salt of lasalocid A and of the form in which the labile protons are deuteriated are shown in Figures 2A and 2B. Crystals, a few mm in dimensions, were obtained by slow evaporation from $CH_3OH$ or $CD_3OD$ and were used directly to obtain the spectra. The strong line near 1382 cm$^{-1}$ in the spectrum of the protio-species has been assigned by Phillies and Stanley[1] as resulting from an OH deformation mode and they reported its complete disappearance on deuteriation. However, in our spectra of the deuterio-species we observe a line at *ca.* 1365 cm$^{-1}$ which has an intensity consistent with the 1382 line in the spectrum of the protio-species. Because of its frequency,

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† Also at Department of Biochemistry, State University of New York at Stony Brook and supported by an N.I.H. grant.

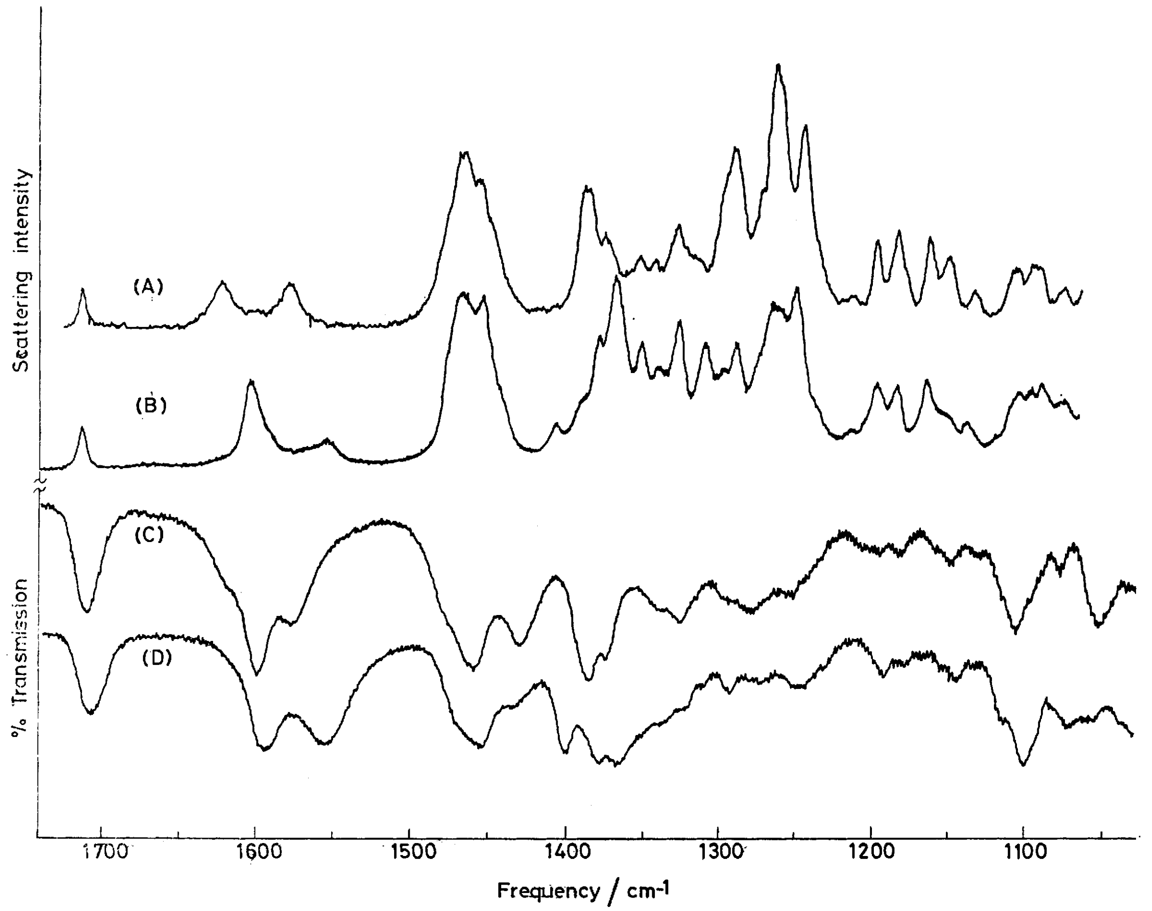

FIGURE 2. Raman scattering and i.r. absorption spectra of sodium lasalocid A. (A): Raman spectrum of protio-crystal. (B): Raman spectrum of deuterio-crystal. (C): I.r. spectrum of a protio-microcrystalline sample. (D): I.r. spectrum of a deuterio-microcrystalline sample.

its high intensity, and its shift on deuteriation, we assign it as the symmetric carboxylate stretching frequency rather than the OH deformation frequency.

Spectra C and D in Figure 2 show i.r. spectra of microcrystalline samples of the sodium salt of lasalocid A. The samples were prepared by placing a saturated solution of the sodium salt in $CH_3OH$ or $CD_3OD$ on an AgCl substrate and allowing it to evaporate to dryness. This gave a microcrystalline layer appropriate for obtaining good quality spectra. In the deuteriated sample the 1430 $cm^{-1}$ band shifts to 1400 $cm^{-1}$ and the 1340–1325 doublet is substantially weaker although we cannot conclusively pinpoint its shift. The general positions of these lines and their shifts on deuteriation are consistent with the behaviour of bands in this region seen in spectra of associated alcohols.[5,6] However, it is difficult to assign these modes since, as pointed out by Krimm, *et al.*,[6] coupling between the OH deformation and other modes (a CH deformation for example) occurs, making unambiguous assignments in even simple systems almost impossible.

The strong band at 3300 $cm^{-1}$ in the i.r. absorption spectra (Figure 3) is characteristic of hydrogen-bonded OH groups. The lack of the characteristic free OH absorption in the 3600 $cm^{-1}$ region indicates the absence of free OH groups.

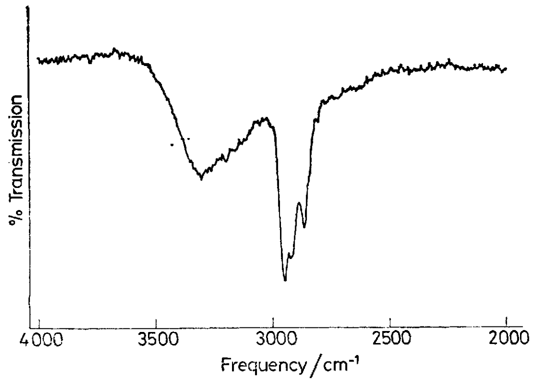

FIGURE 3. I.r. absorption spectrum of sodium lasalocid A in the OH stretching frequency region.

Based on the existing data[2–4] and the new spectroscopic data reported here in this paper, we conclude that it is hydrogen bonding that stabilizes the cyclical structure of lasalocid rather than metal complexation alone as suggested by Phillies and Stanley.[1]

We thank Dr. Julius Berger of Hoffman-LaRoche for gifts of the samples and Dr. D. J. Patel of Bell Laboratories for helpful discussions. The work at the University of Illinois was supported by a grant from the N.I.H.

(*Received*, 1*st June* 1977; *Com.* 544.)

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