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A complex of perseitol and K⁺ ion from *Scurrula fusca* (Loranthaceae)

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Abstract—A complex of perseitol (D-glycero-D-galacto-heptitol) and K^+ ions in a molar ratio of 20:1 was isolated from the leaves of *Scurrula fusca* (Loranthaceae). The stereochemical structure of the complex was determined using several kinds of NMR techniques. © 2001 Elsevier Science Ltd. All rights reserved.

The leaves of a parasite plant, *Scurrula fusca* (BL.) G. DON. (Loranthaceae), locally called benalu alus and whose host-plant is *Ficus riedelii* MIQ. (Moraceae), are traditionally used for the treatment of cancer in Sumatra and the Sulawesi Islands, Indonesia.

The methanol extract of the dried leaves produced precipitates, which were then treated with purified water. The water-soluble phase was purified by HPLC with a gel partition resin, resulting in a complex (**1**), amorphous powder, mp 174–177°C, $[\alpha]_D$ −2.0° (H_2O), in 1.4% yield from the leaves. Acetylation of **1** with pyridine and acetic anhydride furnished a product which was identified as perseitol heptaacetate[1,2] by comparison of the physicochemical properties including the specific rotation $[\alpha]_D$ −14.8° (MeOH). Furthermore, fluorescence X-ray analysis and atomic absorption analysis indicated that complex **1** consisted of perseitol (**1a**) and K^+ ions in a molar ratio of 20:1,[3] and did not contain other metal ions. The ^1H NMR spectrum of the complex (**1**) gave a similar signal pattern to that for perseitol (**1a**), except the signal breadth.

To elucidate the stereochemical structure of **1**, a detailed NMR analysis[4] was performed. Changes in the signal breadth in the ^1H NMR spectrum of perseitol (**1a**) in H_2O were observed by adding regular amounts of KSCN as a potassium source to adjust the molar ratio of **1a** to the K^+ ion from 23:1 to 16:1 (Fig. 1). The proton signals of **1a** gradually broadened with increases in the amount of K^+ ions from 23:1 to 20:1, and the signal breadth is widest at a molar ratio of 20:1. Thereafter, the widening proton signals of **1a** again became sharper from 20:1 to 16:1. These findings indicated that the proton motions of **1a** were restricted due to complex formation with the K^+ ion. Furthermore, Fig. 2 shows that every methine and methylene proton signal at a molar ratio of 20:1 shifts upfield most prominently. These results indicated that 20 molecules of perseitol formed a complex with 1 mol of the K^+ ion in H_2O solution state. Therefore, the stoichiometry in complex **1** of perseitol with the K^+ ion was confirmed to be 20:1.

Based on the observed coupling constants[5] of the vicinal protons in H_2O, it was found that perseitol (**1a**) assumed a 'zigzag' conformation with a planar carbon chain.[6–8] There was no change in the coupling pattern of perseitol (**1a**) in the ^1H NMR spectrum observed during the formation of complex **1** with K^+ ions, indicating that the perseitol moiety in complex **1** similarly maintained a planar 'zigzag' conformation.

Changes in chemical shifts of the seven hydroxyl protons of **1a** in the ^1H NMR spectrum in DMSO-d_6 were observed by adding regular amounts of KSCN to adjust the molar ratio of the K^+ ions to **1a** from 0:1 to

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Keywords: *Scurrula fusca*; Loranthaceae; perseitol; potassium ion; complex.

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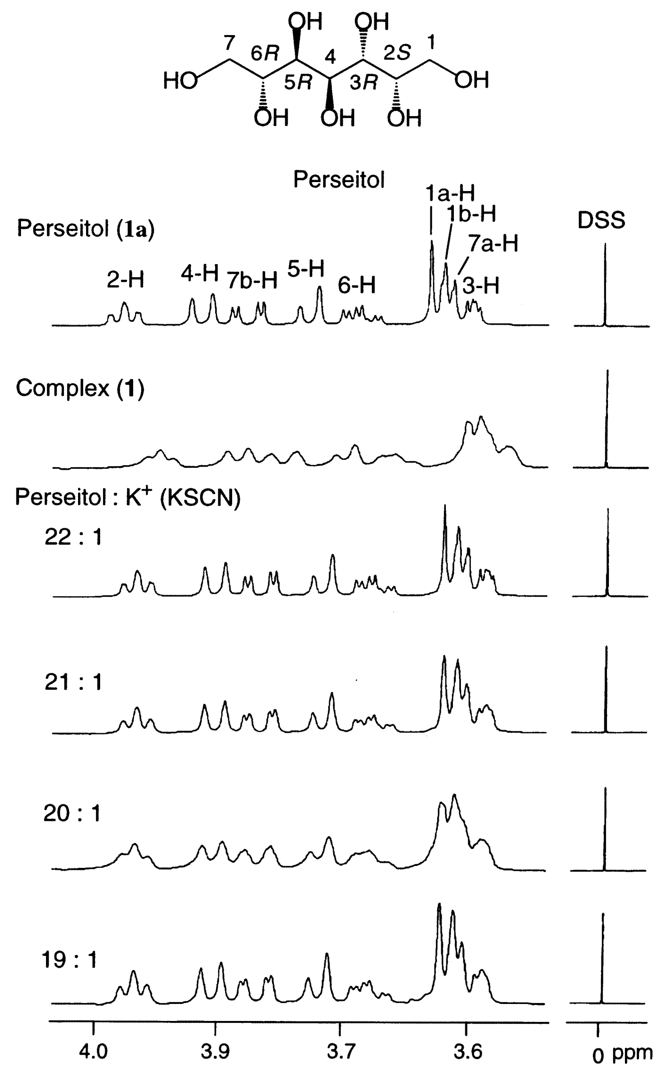

Figure 1. Changes in ^{1}H NMR signals of perseitol (**1a**) (10.61 mg, 0.051 mmol) by addition of KSCN.

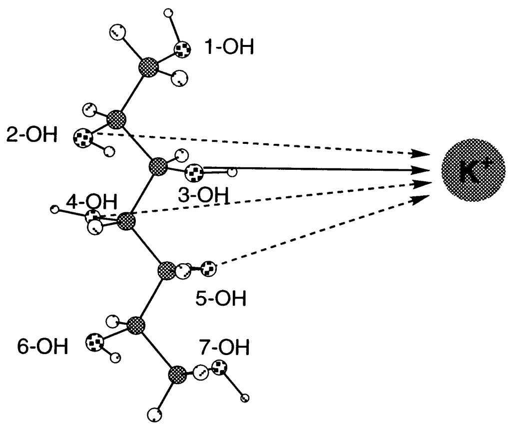

Figure 3. Interaction of perseitol (**1a**) with K^{+} ions.

1:1. The 3-hydroxyl proton signal shifted downfield most prominently, before the 2-, 4- and 5-hydroxyl proton signals shifted. The downfield shifts of 1-, 6-, and 7-hydroxyl proton signals were not as prominent as those of other hydroxyl proton signals. These facts indicated that the 3-hydroxyl group of perseitol (**1a**) most strongly attracted the K^{+} ion in forming complex **1**, while the 2-, 4- and 5-hydroxyl groups attracted such ions more strongly than the 1-, 6- and 7-hydroxyl groups (Fig. 3).

As a result, it may be presumed that 20 molecules of perseitol (**1a**), while maintaining a planar 'zigzag' conformation, associate with the surrounding K^{+} ion by the above-mentioned interaction to form a complex (**1**) having a spherical stereochemical structure in H_2O solution.[9]

Finally, it should be noted that complex **1** exhibits an inhibitory effect (at 10^{-4} M, 40.3% inhibitory) on [^{3}*H*]-leucine incorporation in the Ehrlich ascites tumor cells in mice, whereas perseitol (**1a**) did not show such activity.

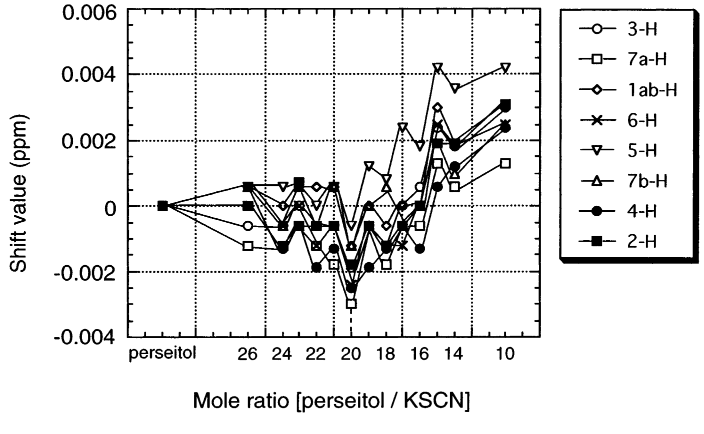

Figure 2. Shifts in ^{1}H NMR signals of perseitol (**1a**) (10.61 mg, 0.051 mmol) by addition of KSCN.

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3. We reported preliminary data in a previous paper (Shibuya, H.; Ohashi, K.; Kitagawa, I. *Pure Appl. Chem.* **1999**, *71*, 1109–1113), in which the molar ratio of perseitol and K^+ in a complex **1** was assumed to be 27:1. By the detailed analysis described in this paper, it has been clarified to be 20:1.
4. A double sample tube was used. Inside: an NMR sample tube (ϕ 3 mm) contained D_2O (200 μl) for a field-frequency lock and sodium 2,2-dimethyl-2-silapentane-5-sulfate (DSS, 1 mg) was used as the internal reference. Outside: an NMR sample tube (ϕ 5 mm) contained H_2O (300 μl) as the solvent and a sample (0.05 mmol).
5. Coupling constants (Hz) of perseitol are as follows: $J_{1a,2}=5.8$, $J_{1b,2}=2.7$, $J_{2,3}=8.8$, $J_{3,4}=1.0$, $J_{4,5}=9.5$, $J_{6,7a}=5.8$, $J_{6,7b}=6.5$.
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9. The molecular weight of the complex (**1**) was not detected by several kinds of MS techniques (EI, FAB, ESI and TOF).