Study of the Fluorine- and Boron-10 Containing Compounds toward MRI and BNCT

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Magnetic resonance imaging (MRI) and boron neutron capture therapy (BNCT) are quite attractive techniques for diagnosis and treatment of cancer, respectively. In order to develop practical tools both for MRI and BNCT, the novel compounds containing both 19F and 10B atoms in a single molecule were designed and synthesized. In the present paper the syntheses and the internalization rates into tumor cells of these compounds are elucidated. Furthermore, their 19F NMR measurements are also reported.

Keywords: boron neutron capture therapy (BNCT), 3-(4-boronophenyl)alanine (Bpa), 3-(4-borono-2,6-difluorophenyl)alanine [Bpa(F2)], 3-(4-borono-2,6-difluorophenyl)alaninol [Bpa(F2)-ol], magnetic resonance imaging (MRI)

Introduction

According to our preliminary elucidation, the magnetic resonance imaging (MRI) based on the 19F NMR measurement of the dipeptides containing 3-(4-fluorophenyl)alanine [Phe(F)] internalized into tumor cells may be accessible as a promising means for diagnosis of cancer.

From the standpoint of a treatment of brain and skin cancers, the boron neutron capture therapy (BNCT) based on the interaction of 10B isotope and thermal neutron has been highly noted in recent years [1-3]. In order to develop practical tools for BNCT, we designed and synthesized the novel compounds containing both 19F and 10B atoms in a single molecule.

Results and Discussion

At present 3-(4-boronophenyl)alanine (Bpa) (1) [4] and 3-(4-boronophenyl)alaninol (Bpa-ol) (2) [5] enriched with 10B isotope seem to be good candidates for BNCT as the 10B carrier. In the present study we carried out the synthesis of...
two novel compounds containing both $^{19}$F and $^{10}$B atoms in a single molecule such as 3-(4-borono-2,6-difluorophenyl)alanine [Bpa(F$_2$)-$^{10}$B] (3) and 3-(4-borono-2,6-difluorophenyl)alaninol [Bpa(F$_2$)-$^{10}$B-ol] (4); these compounds may be useful for not only MRI but also BNCT (Fig. 1).

*Fig. 1.* Bpa-$^{10}$B (1) and the related compounds 2 ~ 4.

*Fig. 2.* Synthetic scheme of Bpa(F$_2$)-$^{10}$B (3) and Bpa(F$_2$)-$^{10}$B-ol (4).

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References


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B molecular compounds suitable for Boron Neutron Capture Therapy (BNCT) are tagged with a Gd(III) paramagnetic ion. The newly synthesized molecule, Gd-BPA, is investigated as contrast agent in Magnetic Resonance Imaging (MRI) with the final aim of mapping the boron distribution in tissues. An important step in the BNCT planning is the measurement of the boron concentration in the tissue samples, both tumour and healthy. When the tumour is spread through the healthy tissue, as in the case of metastases, the knowledge of the different kinds of tissues in the sample being analysed is crucial.