

SHORT COMMUNICATION

Interaction of oligonucleotides with benzo[c]phenanthridine alkaloid sanguilutine

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Benzo[c]phenanthridine alkaloid sanguilutine was extracted and purified from the dried roots of *Sanguinaria canadensis*. The interaction of the positively charged iminium form of alkaloid with double-stranded DNA oligonucleotides was studied using luminescence spectroscopy. The results showed that the interaction with various double-stranded oligonucleotides was not specific to A–T or G–C base pairs; also, no preference was found for either homogeneous or heterogeneous base composition of strands. The association constants were calculated to be in the range of $(1.31\text{--}14.36) \times 10^5 \text{ M}^{-1}$. The luminescence intensity response at 610 nm to low concentrations of double-stranded DNA was found to be linear and can potentially be used for the fluorometric quantification of DNA. The limit of detection was estimated to be 120 ng mL^{-1} of DNA (calculated by 3σ method).

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Sanguilutine (SL; Fig. 1) belongs to a family of quaternary benzo[c]phenanthridine alkaloids (QBAs). The alkaloid was first identified and described by Slavík and co-workers at Masaryk university (Brno, Czech Republic) (Slavík et al., 1968). Its name is derived from the plant *Sanguinaria canadensis* L., the main source of the alkaloid, and from its typical colour (luteus = yellow). QBAs belong to a group of isoquinoline alkaloids present in plants from the families: *Papaveraceae*, *Fumariaceae*, *Ranunculaceae*, and *Rutaceae* (Hossain et al., 2012). QBAs share the *N*-methylbenzo[c]phenanthridinium skeleton and differ in substituents in positions C-2, C-3, C-7, and C-8 (two methoxy groups or one bridging methylenedioxy group), C-10 and C-12 (hydrogen or methoxy group). QBAs exist in two forms depending on pH – a positively charged iminium form in acidic and neutral solutions and an uncharged alkanolamine form

in an alkaline environment. The best-known alkaloids from this group are commercially available sanguinarine and chelerytrine (Bai et al., 2006; Hossain & Kumar, 2009; Janovská et al., 2010). Other alkaloids of this type have to be extracted from plant material.

Besides the various biological effects on cells (Bhadra & Kumar, 2011a; Dvorak et al., 2006; Hammerová et al., 2011; Kosina et al., 2011), QBAs in iminium form are reported to interact with double-stranded DNA (dsDNA) (Bhadra & Kumar, 2011b; Ji et al., 2012; Paul et al., 2011), DNA bulges (Bai et al., 2008a), and G-quadruplexes (Bai et al., 2008b). This interaction leads to change in their fluorescent properties (Urbanová et al., 2009). As a result of this change, they could be used as fluorescent DNA probes.

As SL is not commercially available, it was obtained by extraction and purification from plant material. It is our understanding that the roots of

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