Fluorodeoxyglucose

Fluorodeoxyglucose (also called fludeoxyglucose, 2-deoxy-2-fluoro-α-D-glucopyranose, or 2-fluoro-2-deoxy-D-glucose) (Figure 1) is the non-radioactive analog of the positron-emitter 2-[18F]fluorodeoxyglucose (18FDG). 18FDG is a radioactive imaging agent that is used clinically along with positron emission tomography (PET) to evaluate glucose metabolism. To date, 18FDG-PET has proven to be useful in situations where glucose metabolism is markedly altered e.g., in oncology to detect malignancy (since malignant cells show increased glucose metabolism) (Scott (2001, 2002); Wahl (2003)); in infection and autoimmune diseases (Schirmer et al., (2003)), in altered brain activity (e.g., epilepsy Casse et al., (2002)), mood disorders (Nofzoinger et al., (1999)) and neurodegenerative disorders (Demetriades (2002)), and in cardiovascular disease (Vallejo (2002)).

The measurement of FDG uses ion exchange chromatography in combination with an electrochemical (EC) approach - pulsed amperometric detection (PAD). Due to the improved sensitivity and selectivity of PAD this technique overcomes the lengthy sample procedures often required for other detectors including refractive index, ultraviolet absorbance and evaporative light scattering. A mobile phase with basic pH favors the ion exchange separation of FDG and its detection (Larew and Johnson (1989)). When sodium hydroxide is used in the mobile phase, FDG carries a negative charge, allowing its separation from other analytes.

Figure 1. Fluorodeoxyglucose Stereo-pair.

Analysis of FDG by PAD is performed on a gold working electrode with an ESA Model 5040 Analytical Cell (Figure 2). This analytical cell is also equipped with a solid-state palladium reference electrode that, unlike many wet reference electrodes, is not affected by high concentrations of sodium hydroxide. Furthermore, the palladium reference electrode is maintenance-free.

Figure 2. Schematic of Model 5040 Analytical Cell.

Figure 3. A Four Pulse Wave Form Consisting of Four Different Potentials (E1, E2, E3 and E4) for Four Separate Time Intervals (T1, T2, T3 and T4).
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free (Bowers (1991); D’Eril et al., (1992)). In PAD, multiple potentials are applied for selectable time spans. The current is measured as shown in Figure 3. The acquisition delay prior to the measurement of sample current is adjustable, resulting in enhanced sensitivity. Low-mid pg sensitivity can be readily achieved by this technique.

Materials and Methods

The isocratic system consisted of a pump, an autosampler, a Coulochem III electrochemical detector with PAD option equipped with a Model 5040 Analytical Cell, and gold target electrode.

LC Conditions
Pump: ESA Model 582 HPLC.
Column: Carbohydrate RCX-30.
Mobile Phase: 200mM Sodium Hydroxide (semiconductor grade, 99.99% pure).
Flow Rate: 1.0 mL/minute.

Detector and Conditions
Detector: Model 5300, Coulochem III.
Cell: Model 5040, Amperometric cell.

PAD Conditions:

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<th>Time</th>
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<tr>
<td>E1</td>
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<tr>
<td>E2</td>
<td>-1000 mV</td>
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<tr>
<td>E3</td>
<td>600 mV</td>
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<tr>
<td>E4</td>
<td>-100 mV</td>
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Acquisition Delay: 300 mSec

Figure 4. Linearity for FDG.

Figure 5. Typical Chromatogram for FDG (44.6ng on column).
Results and Discussion

The advanced design of the ESA Model 5040 Analytical Cell coupled with PAD provides unsurpassed sensitivity and stability. The assay has a limit of detection of ~200pg on column (s/n 3:1) and is linear over the range tested (0-89.2 ng) (Figure 4). A typical chromatogram showing separation of FDG in under 11 minutes is presented in Figure 5. The Coulochem III, with its four pulse waveform, is the detector of choice for routine high sensitivity measurement of FDG.

References


Ordering Information

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Fluorodeoxyglucose

Application note

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