Emerging Analyses in Clinical and Food Industries Using Electrochemical Detection

Recently, new applications have been developed based on Electrochemical Detection (ECD) in high-performance liquid chromatography (HPLC) such as: 1. Fluorodeoxyglucose analysis for the clinical/diagnostic market 2. Lactose measurement in lactose-free products for the food/dairy industry

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1.Fluorodeoxyglucose (FDG) tracer for PET scan imaging

In PET imaging, the radio-labelled tracer 2-[18F]fluoro-2-deoxy-D-glucose ([18F]FDG) can be used for the assessment of glucose metabolism in the heart, lungs, and the brain as well as for imaging tumors in oncology. The 109.8 minute half-life of 18F makes rapid and automated chemistry necessary; therefore [18F]FDG is produced in a cyclotron in close vicinity of the PET facility. Prior to injection of [18F]FDG into a patient, it is necessary to perform a purity check and determine the actual concentration of the unwanted by-products: 2-fluoro-2-deoxy-D-mannose (FDM) and 2-chloro-2-deoxy-D-glucose (CDG). HPLC-ECD is the industry standard for this important test due to its ability to selectively detect [18F]FDG, FDM and CDG at very low concentration levels. Compendial methods based on ECD are described in both the U.S Pharmacopeia (USP) and European Pharmacopoeia (EP). These EP and USP methods are to a large extent similar and based on High Performance Anion-Exchange Chromatography (HPAEC) in combination with Pulsed Amperometric Detection (PAD).

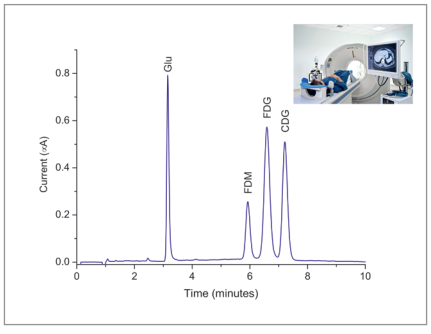

Figure 1: Chromatogram of a standard mixture consisting of 25 µg/mL FDG, FDM, CDG & 2.5 µg/mL Glucose (Glu) in water (20 µL injection). HPAEC-PAD using the ALEXYS™ Carbohydrate Analyzer equipped with SenCell™ (Antec Scientific), www.AntecScientfic.com

2. Lactose content in lactose-free labelled products (lactose intolerance)

Lactose is a disaccharide that occurs naturally in the milk of mammals and is generally found to be around 5% (w/w). Other dairy products (like yoghurt and cream), and processed foods like sausages and cookies often contain lactose in detectable amounts. Lactose intolerance is a condition where a person cannot digest the normal levels of lactose present in the dairy/food products due to low levels of lactase in their intestine. Lactase deficiency results in various degrees of abdominal discomfort after consuming the products, depending on the amount of intake and lactase levels. As a result, the food industry has started producing various 'lactose-free' labeled products which contain decreased levels of lactose for consumers who would otherwise suffer from their intolerance.

In the past 'lactose-free' labeled products had levels of lactose below 100 mg/100 g product (0.1%), but nowadays it more generally indicates a lactose level below 10 mg/100 g product. These low levels of lactose in 'lactose-free' products require analytical methods with sufficient sensitivity. Current methods to detect lactose as described by the standardization agencies ISO (method 22662:2007; HPLC-RI) and AOAC (method 984.15; enzymatic/VIS) are not suited to test for such low levels; also here, the high sensitivity and selectivity of electrochemical detection makes HPAEC-PAD the technique of choice at lowered costs of operation and ownership (unlike LC/MS/MS).

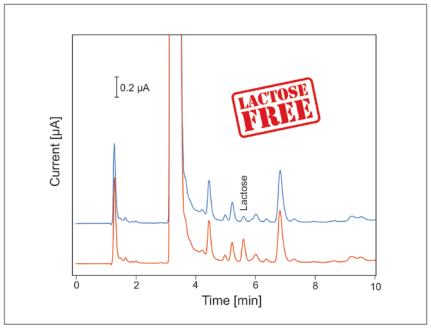

Figure 2: Top: Chromatogram of a 2.5 µL injection of a lactose-free milk sample (blue curve). Bottom: Chromatogram of lactose-free milk spiked with 3.3 µM Lactose (red curve). HPAEC-PAD using the DECADE™ Elite Electrochemical detector equipped with SenCell™ (Antec Scientific), www.AntecScientfic.com