Direct Carbohydrate Analysis in Beverages and Foods Using Pulsed Amperometric Detection or Charged Aerosol Detection
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Overview

Methods: Three HPLC-PAD methods were developed using on-exchange ion exclusion chromatography and two HPLC-CAD methods using charged aerosol detection (HPLC-CAD) and redox fructose determination. Methods for simultaneous analysis of carbohydrates and electrolytes in different types of beer, foods, beverages, and sports drinks are presented.

Results: The HPLC-CAD method for lactose and lactulose analysis allows for separation of lactose and lactulose up to DP13-15, as well as separation of some other sugars such as glucose, fructose, sorbitol, and xylitol. This method enables carbohydrate profiling of different types of beer. Three different beers were analyzed, including a double-isolo-nes Economic beer, a fizzy beer, and an eth-al free beer, and their carbohydrate profiles are depicted in Figure 6.

Conclusions: All methods for carbohydrates determination are highly effective and selective. Sample preparation can be as simple as dilution in water. Electrochemical detection in the PAD mode can be used for other food components such as antioxidants, amino acids, and vitamins. Charged aerosol detection is an excellent means for detecting carbohydrates, and can be used for characterization of carbohydrates in foods, beverages, and sports drinks.

General Considerations for Pulsed Amperometric Detection

The Thermo Scientific Dionex Acclaim Trinity P2 column was used. The method utilizes a Thermo Scientific Dionex UltiMate 3000 LC system with PAD platform consisting of a Thermo Scientific Dionex Dionex E2-2000 with Thermo Scientific Dionex E2-2000 EC-3000RS with 6041RS sensor and gold target. Carbohydrates were separated using an on-exchange and on-exchange ion exclusion conditions, and in high-performance liquid chromatography (HPLC-PAD) conditions.

Results and Discussion

Direct Carbohydrate Analysis with HPLC-PAD

HPLC-PAD Method for Simple Sugar Analysis in Fruit Juice, Cola, and Syrup

Mobile phase: 80 mM sodium hydroxide
Flow rate: 1.0 mL/min
Injection volume: 25 µL
Temperature: 30 °C
EC detector: EC-3000RS with 6041RS sensor and gold target

HPLC-CAD Method for Carbohydrate Analysis in Beer

Mobile phase: 20 mM NaOH
Flow rate: 1.0 mL/min
Injection volume: 25 µL
Temperature: 75°C
EC detector: EC-3000RS with 6041RS sensor and gold target

HPLC-CAD Method for Carbohydrate Analysis in Fruit Juice

Mobile phase: 8% 280 mM ammonium formate, 8% acetic acid, 7% Eq-Water
Flow rate: 1.0 mL/min
Injection volume: 25 µL
Temperature: 30°C
EC detector: EC-3000RS with 6041RS sensor and gold target

HPLC-CAD Method for a Sport Beverage

Mobile phase: 20% 280 mM ammonium formate, 80% Eq-Water
Flow rate: 1.0 mL/min
Injection volume: 25 µL
Temperature: 85°C
EC detector: EC-3000RS with 6041RS sensor and gold target

The Thermo Scientific Dionex Acclaim Trinity P2 column is used for separation of carbohydrates in various types of beer, foods, beverages, and sports drinks. This column provides excellent resolution and speed of separation of the various carbohydrate species when using decreased amounts of water along with elevated column temperatures. This provides the complete analysis of carbohydrates in various beverages within a few minutes of only 6 replicate. Other food products such as honey and different types of wines and bread have been successfully analyzed representing good resolution of the carbohydrates that possess weak or no carbohydrates using very simple analytical conditions with no sample pre-treatment.

Figure 1 shows a general HPLC-PAD method for profiling carbohydrates in beer. This method uses sodium acetate as an eluent to ion-pair the hydrolysate to increase the mobile phase strength to reduce the retention of oligosaccharides. This method allows for separation of maltodextrins up to DP13-15, as well as separation of some other sugars such as glucose, fructose, sorbitol, and xylitol. This method is for the determination of carbohydrates in milk and other dairy products. It can be used as an indicator of the quality of milk and dairy products.

Figure 2 shows the separation of seven common simple carbohydrates commonly found in foods and beverages is shown in Figure 1. Simple sugars were completely separated within 12 minutes. The HPLC-PAD method for the determination of carbohydrates in various types of beer, foods, beverages, and sports drinks is presented.

Conclusions

Both HPLC-PAD and HPLC-CAD provide simple, direct methods for carbohydrates analysis without the need for sample derivatization. The HPLC-PAD methods using ion exchange chromatography for carbohydrate analysis in fruit juice, cola, syrup, and wine provide an effective method to analyze carbohydrates in a simple and elegant manner.

Direct analysis of carbohydrates in foods and beverages can be accomplished using a simple HPLC-PAD method, which allows for the detection of carbohydrates in a wide range of food and drink products. This method is highly selective and sensitive, enabling the determination of carbohydrates in low concentrations without the need for sample derivatization.

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