Separation of Glucose in Solution for Parenteral Nutrition

Authors

K. Buchholz, J. Struß, E. Freese-Willms, S.O. Kruse
Diapharm Analytics GmbH, Würzburger Strasse 3, 26121 Oldenburg, Germany

I. Garaguso
Omnilab-Laborzentrum GmbH & Co.KG, Robert-Hooke-Str. 8, 28359 Bremen, Germany

Abstract

Pure glucose and a parental nutrition solution have been separated on a RCX-30 anion exchange column from Hamilton and on a competitor column of similar specifications. The obtained chromatograms demonstrate that the Glucose is well separated in both matrices on both columns with a slightly higher retention on the Hamilton column.

Introduction

Parenteral nutrition is important for all patients where an enteral nutrition is not possible for more than three days, e.g. due to illness of gastrointestinal tract, relocation of abdominal connections or other diseases. The parenteral nutrition solution is introduced intravenously and contains mostly water, carbohydrates, amino acids, electrolytes, vitamins and micronutrients [1]. Carbohydrates are the major component of such a solution since 50-60% of the energy demand of the human body should be covered by these nutrients [2]. The total amount needed depends on the person and the kind of diseases. For this reason the total content of glucose in parenteral solutions has to be determined very frequently. Anion exchange chromatography is a viable technique for carbohydrate separation and quantification in complex matrices. For this reason the two anion exchange columns which were specially designed for carbohydrate analysis have been tested with the aim to identify at least two columns which are well suited for establishing of a standard analysis method.

Material & Methods

The separation of the sample was conducted on a Metrohm Compact ion chromatograph equipped with an amperometric detector. Data recording and processing was done with Metrohm IC Net software. Two different anion exchange columns of the same geometry (4.6x250, PEEK) have been used for separation: Hamilton RCX-30 and Comp. 1. The packing material was polystyrene-divinylbenzene functionalized with trimethylammonium anion exchange groups in both cases. The particle size was 5 µm for Comp. 1 and 7 µm for the Hamilton column .

The sample was prepared by weighing out 1000 mg of the diluted parenteral or glucose solution into a 100 mL volumetric flask. The substance was then dissolved in 80 mL water, filled to the line at 20°C and thoroughly shaken. Twenty five milliliters of this solution was diluted into a 100 mL volumetric flask which was then filled to the line at 20°C. The glucose concentration was 2.5 mg/mL = 2500 ppm after this procedure. Prior to injection this solution was diluted to 50 ppm and filtered through a 0.2 µm filter.

The injection volume was 10 µL and the flow rate was 1 mL/min and 100 mM HPLC grade NaOH-solution was used as mobile phase. The column temperature was 35°C for all experiments.

Results & Discussion

In Figure 1 results from the separation of the pure glucose solution are overlaid for both columns. A good retention of the pure glucose was obtained with both products.

Sample	Column	Retention Time [min]	Relative Peak Height*	Pressure [MPa]
Pure Glucose	RCX-30	16.45	0.89	6.7
	Comp. 1	14.74	1.00	10.0
Glucose in nutrition solution	RCX-30	16.41	0.89	6.7
	Comp.1	14.65	1.00	10.0

*Highest peak was taken as 100% at top of peak

Table 1: Peak parameters and pressure conditions obtained in the different experiments.

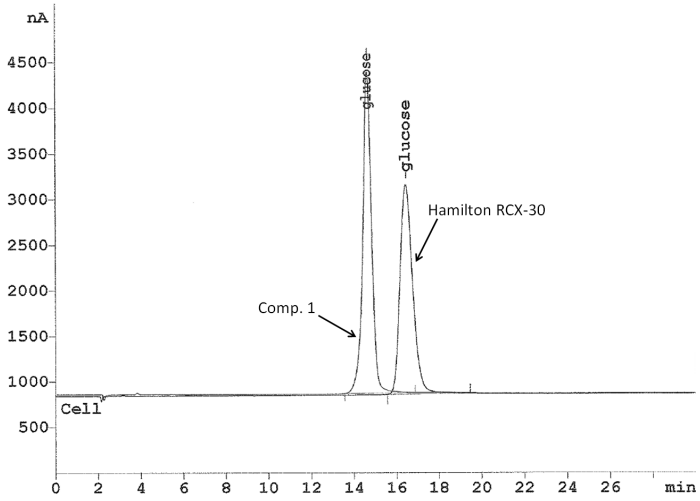

Fig. 1: Separation of Glucose Solution with Hamilton RCX-30 and Comp. 1 column.

In Figure 2 the same separation is shown for the parenteral nutrition solution which contains the same amount of glucose as the pure solution in Figure 1 but in addition a high amount of amino acids is contained as by-product. The glucose peak shows a similar behavior as the pure glucose in Figure 1. This result indicates that the matrix of the parenteral nutrition solution does not affect the separation quality of either column. In addition to the glucose also a high amount of amino acids was contained in the solution which is visible as a small peak very close to the void peak (see circle in Figure 2). The amino acid peak is only weakly retained on both columns under the chosen conditions and gives only a poor response by amperometric detection.

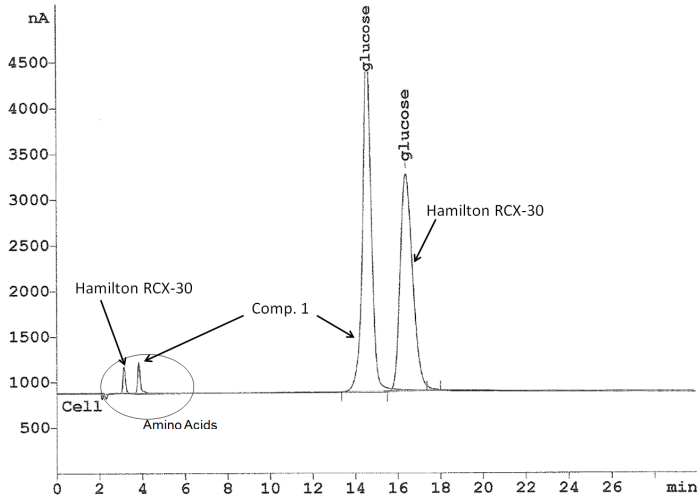

Fig. 2: Separation of parenteral nutrition solution with Hamilton RCX-30 and Comp. 1 column.

Conclusion

Both columns showed a good separation of both samples the dissolved glucose and the parenteral nutrition solution. The amino acid sample matrix was not interfering with the analytes. However, a significant advantage of the Hamilton column is the lower backpressure (see Table 1) which is related to the slightly higher particle size of 7 µm. Both columns yield comparable retention times and peak widths. However, the pressure of the Hamilton column was significantly lower which would allow to further increase the flow rate without the risk of exceeding the pressure limit of the ion chromatograph. A shorter analysis time would be the consequence. Due to the proper results both validated columns were recommended by Diapharm Analytics GmbH for chromatographic analysis of parental nutrition solutions.

References

[1] M. Brandstätter, Parenterale Ernährung: Indikationen, Techniken, Organisation, Elsevier, 2002 (1), Munich.
[2] O. Nehren, DGEM-Leitlinien Enterale und Parenterale Ernährung: Kurzfassung, Thieme, 2007, Stuttgart.

Lit. No. 691119/00 — 08/2012

HAMILTON

Web: www.hamiltoncompany.com
USA: 800-648-5950
Europe: +41-81-660-60-60

Hamilton Americas & Pacific Rim
4970 Energy Way
Reno, Nevada 89502 USA
Tel: +1-775-858-3000
Fax: +1-775-856-7259
sales@hamiltoncompany.com

Hamilton Europe, Asia, & Africa
Via Crusch 8
CH-7402 Bonaduz, GR, Switzerland
Tel: +41-81-660-60-60
Fax: +41-81-660-60-70
contact@hamilton.ch

To find a representative in your area, please visit hamiltoncompany.com/contacts.