Talanta 83 (2011) 1601–1605

Contents lists available at ScienceDirect

Talanta

journal homepage: www.elsevier.com/locate/talanta

Simultaneous determination of potassium guaiacolsulfonate, guaifenesin, diphenhydramine HCl and carbetapentane citrate in syrups by using HPLC-DAD coupled with partial least squares multivariate calibration

Özlem Aksu Dönmez*, Bürge Aşçı, Abdürrezzak Bozdoğan, Sıdıka Sungur

Yildiz Technical University, Department of Chemistry, 34220 Davutpasa, Istanbul, Turkey

ARTICLE INFO

Article history:
Received 26 July 2010
Received in revised form
10 November 2010
Accepted 22 November 2010
Available online 30 November 2010

Keywords:
Partial least squares
HPLC-DAD
Potassium guaiacolsulfonate
Guaifenesin
Diphenhydramine HCl
Carbetapentane citrate

ABSTRACT

A simple and rapid analytical procedure was proposed for the determination of chromatographic peaks by means of partial least squares multivariate calibration (PLS) of high-performance liquid chromatography with diode array detection (HPLC-DAD). The method is exemplified with analysis of quaternary mixtures of potassium guaiacolsulfonate (PG), guaifenesin (GU), diphenhydramine HCl (DP) and carbetapentane citrate (CP) in syrup preparations. In this method, the area does not need to be directly measured and predictions are more accurate. Though the chromatographic and spectral peaks of the analytes were heavily overlapped and interferents coeluted with the compounds studied, good recoveries of analytes could be obtained with HPLC-DAD coupled with PLS calibration. This method was tested by analyzing the synthetic mixture of PG, GU, DP and CP. As a comparison method, a classsical HPLC method was used. The proposed methods were applied to syrups samples containing four drugs and the obtained results were statistically compared with each other. Finally, the main advantage of HPLC-PLS method over the classical HPLC method tried to emphasized as the using of simple mobile phase, shorter analysis time and no use of internal standard and gradient elution.

© 2010 Elsevier B.V. All rights reserved.

1. Introduction

Potassium guaiacolsulfonate (PG) and guaifenesin (GU) are expectorants which help loosen mucus. Diphenhydramine HCl (DP) is a first generation antihistamine mainly used to treat allergies and may act as an antiemetic, sedative and hypnotic. Carbetapentane citrate (CP) has atropine-like and local anaesthetic actions and effectively suppresses acute cough due to common upper respiratory infections. The combination of PG, GU, DP and CP is used to treat a cough caused by the common cold, infections or allergies.

Several methods are used for determination of these compounds singly or in combination with other drugs. But, no analytical method has been reported for the simultaneous determination of these compounds in their multicomponent mixture. A few analytical method has been reported for the determination of PG in pharmaceutical preparations by HPLC [1] and spectrophotometry [2]. GU has been recently determined by HPLC [3], micellar chromatography [4], liquid chromatography–tandem mass spectrometry [5], gas chromatography [6], principal component regression method (PCR) [7], ridge regression spectrophotometry [8] and other analytical techniques [9,10]. Various recent methods including the use of liquid chromatography and HPLC [11], spectrophotometry [12], flow injection [13], electrophoresis [14] and partial least squares (PLS)-principal component regressions [15–18] have been used for the determination of DP in pharmaceutical preparations and biological fluids. CP has been determined in some mixtures by colorimetry [19], by potentiometry [20] and by flow injection [21].

Chromatographic techniques are among the most powerful tools available for qualitative and quantitative determination of various components of a mixture. But in chromatographic analyses, poor chromatographic resolutions or partially separated peaks often occur, especially in the analysis of complex matrices. This problem becomes more important when the analyte is at a concentration level near the detection limit. Traditionally, this type of problem has been solved by modifying the experimental conditions by trial and error until the aforesaid errors are minimized. Thus, different mobile or stationary phases (columns) or even working techniques (e.g. isocratic, gradient elution), which are time-consuming and involve the consumption of expensive solvents, are tested. Nevertheless, complex multicomponent mixtures can in many cases be qualitatively and quantitatively resolved by means of chemometrics. Depending on their nature, data can be arranged in a two-way structure (a table or matrix), as in the case of collecting the absorbance spectra for many samples, or in a three-way structure, e.g. in HPLC-DAD, where spectra are recorded at

* Corresponding author. Tel.: +90 212 383 4147; fax: +90 212 383 4134.
E-mail address: oziaksu@yahoo.com (Ö.A. Dönmez).

0039-9140/$ – see front matter © 2010 Elsevier B.V. All rights reserved.
doi:10.1016/j.talanta.2010.11.054

several retention times for each sample. Such data arrangements in three- or higher way arrays can be handled using multi-way methods of analysis. In these cases, a number of chemometric methods which do not require complete separation of the analytes for the analysis of overlapping chromatographic peaks have been suggested. Examples of these methods are partial least squares and principal component regression (PLS-PCR) [22–25], cross-section technique linked PLS (CS-PLS) [26], two way, unfolded three-way and three mode PLS [27], artificial neural network (ANN) [28], second order calibration methods [29–32], principal component analysis (PCA) [33], multivariate curve resolution alternating least squares (MCR-ALS) [34], target factor analysis (TFA) [35].

We recently reported the simultaneous determination of mixtures of some components in pharmaceutical and food products by PLS-2 calibration method using UV-VIS spectrophotometer [36–41]. In this paper, PLS-2 calibration is employed to determine the concentration of PG, GU, DP and CP in syrup preparations from HPLC-DAD data. A simple mobile phase consisting of water and acetonitrile (ACN) was used. Though heavily overlapped chromatographic peaks of the analytes and interferences were obtained and the spectra of these species were also overlapped, the powerful PLS algorithm can resolve the overlapped peaks into corresponding chromatographic, spectral and concentration profiles even in the presence of interferences.

Table 1
PG, GU, DP and CP concentrations in calibration set.

Sample	PG (μg mL^{-1})	GU (μg mL^{-1})	DP (μg mL^{-1})	CP (μg mL^{-1})
1	1300	900	120	100
2	1300	700	80	140
3	1100	700	160	80
4	1100	1100	100	140
5	1500	800	160	100
6	1200	1100	120	80
7	1500	900	100	80
8	1300	800	100	120
9	1200	800	140	140
10	1200	1000	160	120
11	1400	1100	140	100
12	1500	1000	120	140
13	1400	900	160	140
14	1300	1100	160	60
15	1500	1100	80	120
16	1500	700	140	60
17	1100	1000	80	100
18	1400	700	120	120
19	1100	900	140	120
20	1300	1000	140	80
21	1400	1000	100	60
22	1400	800	80	80
23	1200	700	100	100
24	1100	800	120	60
25	1200	900	80	60

2. Experimental

2.1. Chemicals

PG, GU, DP and CP were obtained from Zeytas Pharmaceutical Ltd., Turkey. Analytical reagent-grade chemicals and milli-Q water were used. Stock solutions of PG (10,000 μg mL^{-1}), GU (10,000 μg mL^{-1}), DP (1000 μg mL^{-1}) and CP (1000 μg mL^{-1}) were prepared in water. Standard solutions and mixtures of drugs were freshly prepared by appropriate dilution of stock solutions with mobile phase water/ACN (60:40, v/v).

The "Gayaben®" commercial syrup samples containing 133 mg of PG, 100 mg of GU, 10 mg of DP and 8.3 mg of CP in 5 mL syrup formulation was acquired from Turkey pharmacies.

2.2. Chromatography conditions

The mobile phase, under isocratic conditions, was water/ACN (60:40, v/v). This mobile phase composition was used to reduce the time of analysis and avoid too much dispersion of peaks. Chromatographic analysis were performed using a Shimadzu LC-MS system consisting of LC-20 AD pump unit. C_{18} (150 mm × 4.6 mm) RP column was used. The flow rate was set at 0.8 mL min^{-1} and 5 μL of the solution was injected. UV detection was performed using a Model SPD-M 20. Photodiode array detector-UV spectra were collected in the range of 190–300 nm. The digital resolution was 0.64 s in time and 1.2 nm in wavelength. For all analysis, the data matrix for each individual run was set at 371 points in the time direction and 92 points in the wavelength direction.

2.3. Procedure

2.3.1. Calibration and validation sets

Mixtures with varying concentrations of PG, GU, DP and CP were analyzed by HPLC-DAD, and calibration and prediction data sets were constructed. A 25 set was built according to multilevel multifactor design [42] for calibration with PLS-2 (Table 1). The levels correspond to values in the range of 1100–1500 μg mL^{-1} for PG, 700–1100 μg mL^{-1} for GU, 80–160 μg mL^{-1} for DP and 60–140 μg mL^{-1} for CP. Duplicate analysis was performed for each sample, and HPLC-DAD was measured in random order according to the sample number. The validation set was prepared with three different levels of PG, GU, DP and CP in same conditions for calibration solutions. Three groups of all samples were prepared and analyzed in three times a day and four consecutive weeks. This procedure allowed us to assess intra- and inter-day assay accuracy and precision.

PLS-2 model was applied to HPLC-DAD data for determination of studied components.

2.3.2. Syrup samples

A volume of the syrup equivalent to 13.3 mg of PG, 10 mg of GU, 1 mg of DP and 0.83 mg of CP was diluted to 10 mL with water/ACN (60:40, v/v). Samples were homogenized, filtered through 0.45 μm membranes and injected into the chromatographic system. The studied components were determined as described in Calibration and test sets.

2.3.3. Classical HPLC

The determination of the contents of PG, GU, DP and CP in syrup preparations was also verified by classical HPLC at 200 nm with a stationary phase in the apparatus and software section. GU, DP and CP were determined with mobile phase of the pH 3 phosphate buffer containing 0.2% triethylamine and ACN (70:30, v/v). For determination of PG, mobile phase compositon was changed as a pH 3 phosphate buffer/ACN (90:10, v/v). The flow rate was 1 mL min^{-1}.

3. Method

The calibration involves the record of a series of detector responses (usually absorbance of compounds for HPLC) and related concentrations with them. A model is then built which can be subsequently used to predict concentrations of unknown compounds. Calibration can be performed in various modes namely: univariate; two-way PLS; three-way unfolded PLS; and three-mode PLS. In this work, three-way unfolded PLS was used. The raw data for all methods stored as a three-way tensor $\underline{\mathbf{Z}}$ of dimensions $M \times I \times J$ (M = number of training samples, I = number of elution time data points, J = number of digitized wavelengths) which can be rearranged to meet the dimensional demands of each method. Fol-

Download English Version:

https://daneshyari.com/en/article/10559569

Download Persian Version:

https://daneshyari.com/article/10559569

Daneshyari.com