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Extended Abstract

The Temperature Effect on the Retention of Sildenafil under Reversed-Phase Liquid Chromatography †

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Generally, the temperature influence on the retention of compounds in liquid chromatography (LC) is described by the linear dependence between the natural logarithm (ln) of the retention factor k and the inverse value of the absolute column temperature (T^{-1}), known as the van't Hoff rule [1]. From this dependence, the variations of the standard enthalpy and the standard entropy can be calculated. In many situations, the linearity of the van't Hoff dependence is not obtained due to secondary equilibrium involving the eluted compound [2] or multiple retention mechanisms [3]. The deviation from linearity can be described by upper mathematical polynoms from which the contribution of enthalpy and entropy variation corresponding to the compound transfer from mobile to stationary phase can be estimated [4].

This study was carried out with a HPLC system having the following configuration: degasser, binary pump, auto sampler, column thermostat, and diode array detector. Two chromatographic columns were used, loaded with octyl or octadecylsilicagel. The mobile phase compositions were generated using two organic solvents (acetonitril or methanol) and aqueous buffers with controlled pH, between 2.5 and 7.5. The temperature interval used for the aim of this study was between 20 °C and 50 °C. The dead time value for calculating the retention factor was measured from the retention time of uracil, under the same elution condition with studied compound (sildenafil).

This study showed that the experimental dependence of ln k on T^{-1} is influenced by the pH of the aqueous component, as well as by the organic modifier used for the mobile phase. From the thermodynamic analysis of the non-linear van't Hoff plots, resulted two different contributions of the enthalpy and entropy to the retention process. In almost all situations, these plots have a maximum on the studied temperature interval, showing that the retention process can be entropy-driven within the interval of 25 °C and the temperature corresponding to the maximum retention, and then the retention process becomes enthalpy-driven.

Deviations from linearity of the van't Hoff dependence can be assigned to the possible structural modifications of sildenafil, under various eluting conditions and temperature. These structures may generate multiple interactions between analyte and the stationary phase, characterized by different values of the standard free enthalpy that are included in the relationship of partition equilibrium constant K on temperature.

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References

1. Vailaya, A. Fundamentals of Reversed Phase Chromatography: Thermodynamic and Exothermodynamic Treatment. *J. Liq. Chromatogr. Rel. Technol.* **2005**, 28, 965–1054.
2. Heinisch, S.; Puy, G.; Barrioulet, M.P.; Rocca, J.L. Effect of temperature on the retention of ionizable compounds in reversed-phase liquid chromatography: application to method development. *J. Chromatogr. A* **2006**, 1118, 234–243.
3. Horvath, C.; Melander, W. Reversed-phase chromatography. In *High Performance Liquid Chromatography Advances and Perspectives*; Horvath, C., Ed.; Academic Press: New York, NY, USA, 1980; pp. 199–201.
4. Galaon, T.; Anghel, D.F.; David, V.; Aboul-Enein, H.Y. Unusual Temperature-Retention Dependences Observed for Several Benzodiazepines in RP-HPLC Using Different Mobile Phase Compositions. *Chromatographia* **2013**, *76*, 1623–1630.