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Estimating the physicochemical properties of poly-substituted aromatic compounds using UPPER

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Abstract

The UPPER model (Unified Physicochemical Property Estimation Relationships) has been used to predict nine essential physicochemical properties of pure compounds. It was developed almost 25 years ago and has been validated by the Yalkowsky group for almost 2000 aliphatic, aromatic, and poly-halogenated hydrocarbons. UPPER is based on a group of additive and non-additive descriptors along with a series of well-accepted thermodynamic relationships. In this model, the two-dimensional chemical structure is the only input needed. This work extends the applicability of UPPER to hydrogen bonding and non-hydrogen bonding aromatic compounds with several functional groups such as alcohol, aldehyde, ketone, carboxylic acid, carbonate, carbamate, amine, amide, nitrile as well as aceto, and nitro compounds. The total data set includes almost 3000 compounds. Aside from the enthalpies and entropies of melting and boiling, no training set is used for the calculation of the properties. The results show that UPPER allows a reasonable estimation of all the considered properties

Introduction

Phase transition properties have a great impact on the development of pharmaceutical products. Early estimation of the properties of pure compounds can reduce the overall cost of drug production. It also aids in directing drug design and synthesis toward candidates with optimal physical characteristics and speed up the drug development process.

Predicting phase transition properties is not only important in the pharmaceutical field but also in environmental sciences. Melting points, boiling points, and vapor pressure are fundamental in predicting chemical distribution, transport, and accumulation in the environment[1]. They also play a significant role in estimating the aqueous solubility, octanol solubility, and octanol-water partition coefficient.

Popular statistical methods such as; multilinear regression, nonlinear regression, partial least square, artificial neural network, genetic algorithm, and support vector machines are