smGROMOS: a force field for drug design and medicinal chemistry

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Techniques as docking and molecular dynamics have been applied around the world to rationally engineer molecules and to tackle different purposes. So far, force fields for organic compounds, like GAFF, have been designed to reproduce quantumly calculated parameters and, thus, do not take in account parameters for condensed phase conditions. One recent exception was OPLS/AA applied to organic molecules. With this in mind, the aim of this work is to create a small molecule force field based on GROMOS philosophy. Thus, bonded and non-bonded parameters of GROMOS53A5 were used to create organic compounds topologies. After, we have simulated their properties using GROMACS 5.1.1, applying the same protocol as Caleman et al. 2011. Therefore, properties like density, enthalpy of vaporization, isothermal compressibility, thermal expansion coefficient, dielectric constant, isothermal heat capacity and isobaric heat capacity were calculated for each compound, along with absolute error in relation to experimental values. Absolute error values were used to determine whether the quality of each topology was acceptable or not. So far, 36 molecules were successfully parameterized, leading to absolute errors below 15% for density, enthalpy of vaporization, isothermal heat capacity and isobaric heat capacity. Also, correlation functions of these properties indicate a high reliance between the performance of our models and experimental values. Moreover, other molecules are being built in order to expand our database. These preliminary results suggest the potential use of GROMOS53A5 parameters to create organic molecules with good agreement with their physical-chemical properties. Also, it sheds light upon the conformational profile of organic compounds, an extremely challenging task nowadays. With these descriptors at hand, we aim for a rich database for drug design and medicinal chemistry purposes.

Palavra chave: molecular dynamics, drug design, GROMOS, medicinal chemistry
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