CONFORMATIONAL ANALYSIS AND ^{13}C NMR CHEMICAL CALCULATIONS OF 2',6'-DIHYDROXY-4',4-DIMETHOXYDIHYDROCHALCONE

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Abstract

In this work, we present a application of a new scale factor protocol for calculating ^{13}C NMR chemical shifts (GIAO-mPW1PW91/3-21G//mPW1PW91/3-21G) of flexible organic molecules [1]. For evaluated the accuracy of this protocol was selected 2',6'-dihydroxy-4',4-dimethoxydihydrochalcone molecule [2]. Thus, in order to select the most stable conformer of flexible molecules, will be applied Monte Carlo simulations. So, a randomized conformational search of the 2',6'-dihydroxy-4',4-dimethoxydihydrochalcone molecule using the Monte Carlo method with a search limit of 200 structures, and employing the Merck molecular force field, by means of 10,000 simulations, as implemented in the Spartan'08 software package, considering an initial energy cutoff of 10 kcal.mol^{-1} was performed. In the first step the 43 more significant conformations of 2',6'-dihydroxy-4',4-dimethoxydihydrochalcone molecule, accounting for more than 99.99% of the total Boltzmann population in the first 10 kcal.mol^{-1}, were saved. This was, followed by single-point energy calculations at the PM6 and level of theory. The 31 more significant conformations within the range of 0.0–3.0 kcal.mol^{-1}, were selected to energy minimization calculations carried out at the mPW1PW91/3-21G level of theory. The 13 more significant conformations within the range of 0.0–2.5 kcal.mol^{-1}. Frequency calculations carried out at the mPW1PW91/3-21G level of theory confirmed the optimized geometries to be local minima and delivered values of free energy at 298 K and 1 atm. In the last step the 7 more significant conformations within the range of 0.0–2.0 kcal.mol^{-1} were selected. Finally the lowest-energetic conformer was used to obtain the scaled chemical shifts. All HDFT calculations were carried out using Gaussian09 software. For 2',6'-dihydroxy-4',4-dimethoxydihydrochalcone molecule Mean Absolute Deviation and Root Mean Square before (after) application of the scale factor are: 9.65 (1.30) and 11.02 (1.67). It means that using the equation 1 it was possible to cancel the systematic errors, even using modest basis set. In conclusion, the conformational analysis protocol and the ^{13}C NMR chemical shifts obtained and scaled at the GIAO-mPW1PW91/3-21G//mPW1PW91/3-21G, is a very attractive tool as an alternative to more computationally demanding approaches, which are usually applied in order to achieve ^{13}C NMR chemical shift calculations.

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