A Computational Study on Carboxymethylation Mechanism of Gluconate

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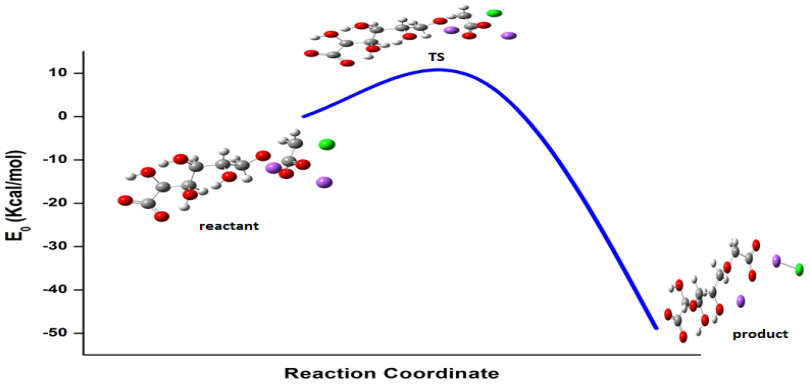
Pharmacologically active anticancer drugs reach to tumor tissue with low specificity; therefore they frequently damage healthy tissues. Nowadays, it is possible to reduce these harmful side effects by using nano particle containing drug delivery systems [1,2]. For example, when α-D-glucose coated iron oxide (magnetite) nanoparticles are loaded with doxorubicin, an anticancer drug, this drug loaded iron oxide nanoparticles can be directed to tumor tissues via an external magnetic field by mostly eliminating the side effects of classical oral treatment [3-5]. During the loading, the doxorubicin molecules must be somehow connected to gluconate molecules on the surface. The first step on this bonding passes through the carboxymethylation of gluconate.



In the present study, we have computationally investigated the carboxymethylation mechanism of gluconate bonded to the surface. The gluconate coated iron oxide nanoparticle systems are enormously large for quantum chemical calculations. Therefore, to model the system, the two oxygen atoms in carboxyl group of gluconate bonded to the surface were frozen instead of using whole gluconate coated iron oxide nanoparticle system. The semiempirical PM6 and DFT-M06-2X methods were employed in the reaction mechanism calculations. The results of the calculations are revealed that the reaction between gluconate and chloroacetate has one step mechanism passing through a low energy transition state while it is a highly exothermic reaction.

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