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A study the interaction forces between the bovine serum albumin protein and montmorillonite surface

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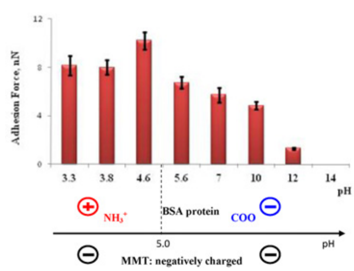
HIGHLIGHTS

- ► BSA coated tip was prepared and characterised.
- ► BSA–MMT adhesion forces were directly measured in liquid environment.
- ► BSA–MMT adhesion forces strongly depend on the solution pH.
- ► Addition of ethanol enhances the adhesion force.
- ► The BSA–MMT forces are due to electrostatic, hydrophobic, protein conformation.

GRAPHICAL ABSTRACT

The adhesion forces between the BSA protein and MMT surface were strongly dependent on solution pH and followed the behaviour of electrostatic force, hydrophobic force and the structure rearrangement of the protein.



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ABSTRACT

The interactions between Bovine Serum Albumin (BSA) protein and Montmorillonite (MMT) surfaces were investigated using an Atomic Force Microscope (AFM). The AFM tip was modified by coating with thin films of BSA on its surface while MMT surfaces were used as the substrates for analysis. The adhesion forces between them were measured at different pH values and ethanol concentrations. It was observed that protein–MMT surface adhesion forces strongly depended on the solution pH. Highest value of adhesion force was observed at the solution pH of 4.6 which is near the isoelectric point of protein (~5.0). The adhesion forces then linearly reduced with both the increase and decrease of the solution pH. Variations of ethanol concentration also affected the measured adhesion forces, but in lesser extent than the pH effect. The maximum protein adsorption at the wine pH of 3.8 occurred with the ethanol concentration of 20%. It was found that the adsorption of BSA protein on the MMT surface followed the behaviour of electrostatic, hydrophobic interactions and the rearrangement of the protein structure.

1. Introduction

The adsorption of protein onto a solid surface has been attracting much attention in a wide range of disciplines, from materials science, environmental sciences, geophysics, biomaterials science and technology to biomedical processes. Thus, much progress has been made to better understand the protein adsorption mechanism. It has been suggested that the interaction between the proteins and the solid surface is a very complex process and depends on different factors including the nature of both protein and solid surface, and the surrounding environment [1,2]. During the last decades, several methods have been used to study the interactions between the protein and solid surface and measure their interaction forces [3–5]. Recently, direct microscopic observations with high resolution have been extensively used to investigate the interactions between two surfaces. Atomic Force Microscopy (AFM) is an ideal tool for force measurements at high spatial resolution, at a molecular scale and in a flexible operating environment. The interaction between AFM tips and a solid sample surface can be monitored and the information obtained can be associated with different

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