CHAPTER I
INTRODUCTION

Nowadays, magnetite nanoparticles are widely used in medical and pharmaceutical applications such as hyperthermia therapy (Kawai *et al.*, 2008), magnetic resonance image (MRI) (Berry *et al.,* 2003; Neuberger *et al.*, 2005), and biomolecule separation (Šafařík *et al.*, 2004) due to their biocompatible, non-toxic and superparamagnetic properties. However, the magnetite nanoparticles tend to form aggregation in media because of their high surface energy. This point has to be considered because the magnetic properties, dispersability, and cell penetration will decrease. Therefore, these nanoparticles have to be coated with other molecules to retain their properties for example, sodium oleate and polyethylene glycol (Sun *et al.*, 2006), silane (Randy *et al.*, 2007) and polymers such as *N*-carboxyethylchitosan and poly(2-acrylamido-2-methylpropanesulfonic acid) (Mincheva *et al.*, 2008). In addition, magnetic nanoparticles for biomaterials are another important point to be considered.

It is known that chitosan is widely applied for pharmaceutical and medical fields because it has biological (biocompatibility, biodegradability, low toxicity, haemostatic, anticancerogen, and anticholestermic) and chemical (active amino, and hydroxyl groups) properties. In the past, chitosan coated on magnetite nanoparticles via physisorption such as electrostatic, hydrophilic or hydrophobic-van der Waals interaction, and via covalent bonds such as amide linkage (Yuan *et al.*, 2008; Alejandro *et al.*, 2009) were reported.

Considering specific molecular design, it is known that "click" chemistry is an approach to obtain triazole linkage which provides hydrogen bond and/or metal coordination networks and these networks are frequently involved with biosystem (Schilling C. *et al.*, 2009). Therefore, chitosan conjugated with magnetite nanoparticles via triazole group is another possible structure for biomaterial chitosan magnetite.

The present work, therefore, proposes a molecular design for chitosan-magnetite nanoparticles through silane coupling agent based on "click" chemistry. Chitosan is considered as an organic species to be modified to present alkyne groups.

Silane coupling agent is applied for magnetite nanoparticles modification with azide groups. A simple conjugation between both species leads to 1,2,3-triazole linkage as a consequent of "click" chemistry.