Research Article

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Insights in Analytical Electrochemistry
ISSN 2470-9867

2018
Vol.4 No.1:5

DOI: 10.21767/2470-9867.100029

High-performance Level of Magnetic Nanoparticles Core-Shell Mid Stabilization of Biomolecules by the Electrophoretic Detection

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Rec date: January 30, 2018; **Acc date:** February 22, 2018; **Pub date:** March 01, 2018

Citation: Binandeh M (2018) High-performance level of Magnetic Nanoparticles Core-Shell Mid Stabilization of Biomolecules by the Electrophoretic Detection. Insights Anal Electrochem Vol.4 No.1:5

Abstract

The project is based on extensive studies on applied nanoparticles in biology and medicine. So initially Fe_3O_4 magnetic nanoparticles (MNPS) with core/shell structure of silica coating were synthesized by chemical co-precipitation method. Which were synthesized in 100 nm in size and its structure was analyzed by tools such as SEM and FT-IR. The purpose of this production was to use nanoparticles in the absorption of biomolecules DNA-L, C (linear, convoluted) and protein (BSA), So that the amount of 1 ml with an optimal concentration of 25 μgml^{-1} of (DNA-L, C or BSA) was solved in 20 mg MNPS at room temperature and 0.5 hr of optimal time. After sampling, the samples were analyzed by an ultraviolet spectrophotometer (UV-Vis) and electrophoresis (base for the decrease of stains). The results showed that absorption and diffusion of DNAS-BSA at the surface of nanoparticles were 85% and 65% respectively, and their release rate in buffered solutions (i.e., In 1 ml of trisaminomethane HCl and PBS buffers) was found to be about 60-80%. So after review, linkage of electrostatic bonding between nanoparticles and biomolecules was obtained and the results of the EDX analysis confirm this study. With the endured studies, this project can be a way of stabilizing biological molecules by MNPS [(DNA-L, C) or protein] systems. So hope is that, in the future this method will be used to transport targeted proteins and DNAS and repair damaged cells to be used.

Keywords: Magnetic nanoparticles; Spectrophotometer; Electrophoresis analysis; Electrostatic absorption; Buffer trisaminomethane HCl; Buffer PBS; BSA protein

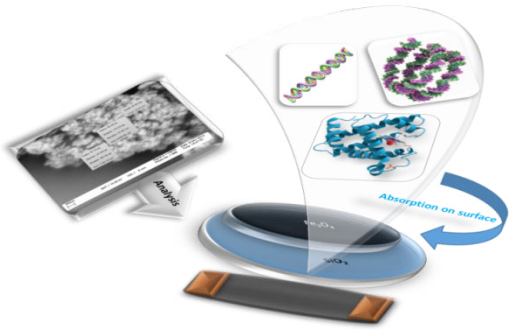
Abbreviations: MNPS-amp: Magnetic nanoparticles Fe_3O_4 and SiO_2-ampicillin; DNA-L: Deoxy ribonucleic Acid-Linear; DNA-C: Deoxyribonucleic Acid-Convoluted; SEM: Scanning Electron Microscope; FT-IR: Fourier Transform Infrared Spectroscopy; EDX: Energy-Dispersive X-ray Spectroscopy; TrisaminomethaneHCL: Tris-aminomethane Hydrochloric acid; PBS: Phosphate-buffered saline; BSA: Bovine Serum Albumin.

Introduction

Nanotechnology is a key element in understanding the nature of the coming decade. Interdisciplinary research collaboration, special training and transfer of ideas from people in the industry includes the benefits of nanotechnology in the future. Nanocatalysts and nanotechnology industry had been made significant progress. Nanocatalysts types are designed among them. Iron oxide nanoparticles (based on magnetic properties) have many applications especially in the field of drug delivery. The gene (DNA) and proteins are necessary. One of the most important and most widely used are magnetic nanoparticles, in which a variety of materials to create their own unique characteristics compared to other Nano-specific applications screwed. These particles are applied in various branches, but the role of them in life-medicine as mentioned are significant in terms of its delivery to the inherent magnetism gives them a lot of things including facilitating spotter and the delivery of these are very important [1].

Over the past few years, efforts have been devoted to the magnetic Functionalized nanoparticles as the level of cover will gain significant benefits from it. However, there are many types of materials available in magnetic coatings Nanoparticles, such as metal oxides, metal and plastic. Silica is still considered to be the best candidate surfaces functionalization because it is highly stable against degradation. In addition, silica is used to improve the biocompatibility, hydrophobicity profile as well as the availability of high-level performance Group silanol (-SiOH) on the surface [2], that makes a promise Materials for a variety of biological applications. Silica-coated magnetic nanoparticles are used for various applications in recent years, such as separation of nucleic acid [3], protein and enzyme immobilization [4,5], diagnosis, targeted therapy [6] and hyperthermia [7] have been studied.

One of the main techniques is that biomolecular techniques have now been established on magnetic nanoparticles. These biochemical molecules, biological biochemicals [8], DNA [9] and proteins [10] are important for treatment and stabilization of magnetic nanoparticles. Another type of DNA is DNA circular [8] where nucleotide strands are twisted together to form a twisted ring. In this project, biomolecules [8-10] (protein and DNAS) are discussed. One of the main issue is the creation of relationship between biomolecules [11] and catalyst stabilized with magnetic nanoparticles. Usually, an electrostatic bond between magnetic nanoparticles and biomolecules and in some cases [12-14], can also be a covalent bond depending on the magnetic nanoparticle ligands [15]. There are many papers and researchers to stabilize biomolecules on magnetic nanoparticles. The main goal of this project is to cover the SiO_2 activation of Fe_3O_4 magnetic nanoparticles for the stabilization of biomolecules (DNA-L, C or protein (BSA) (serum albumin)). In this study, they sought to stabilize and release them *in vitro* according to the result, the basic point is the stabilization of our electrostatic bond between them (by electrophoresis and EDX analyses) at room temperature (25°C) (**Scheme 1**).



Scheme 1 A representation of ampicillin-loaded with magnetic nanoparticles.

Experimental

Materials

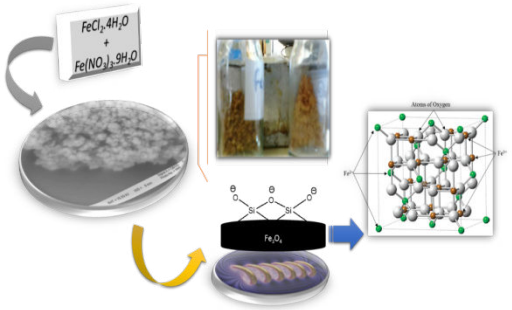
All solvents and chemicals are purchased from commercial Suppliers. The structure of materials was provided by Transmission electron microscope (Philips CM-200 and Titan Krios TEM, derivative from the University of Shahid mortgage Ardabil). BSA was obtained from Sigma (St. Louis, MO). Supercoiled DNA's Marker is from Takara Biotechnology (Dalian, China). Materials such as ferrous chloride tetrahydrate ($FeCl_2.4H_2O$) [16-19], ferric nitride Nona hydrate ($Fe(NO_3)_3.9H_2O$) and sodium hydroxide (NaOH) were purchased from Merck KGaA (Darmstadt, Germany) And Tris-(hydroxyl methyl) aminomethane (Tris-HCl buffer solution (0.01 $molL^{-1}$, pH=8)), phosphate buffered saline (PBS (pHs 6.0-8.0)), argon gas, HCl, methanol, TritonX100, EDTA, Boric acid, NaCl, glutaraldehyde and Salmon sperm (DNAS and protein) sodium salt is purchased from Sino-pharm Chemical Reagent Co. (Shanghai, China). TEOS (tetraethyl-orthosilicate), Hydrazine (34% by weight aqueous solution, reducer) were purchased from Sigma-Aldrich Co. (St Louis, MO, USA). DNA's and protein used in the lab are models (Maragheh, Iran). Deionized water was used in each experiment.

Synthesis of silica-coated with Fe_3O_4 magnetic nanoparticles

Different mechanisms have been designed for the synthesis of hollow magnetite microspheres [20-24]. Chemical Co-precipitation is also one of the easiest and most convenient methods of synthesis of magnetic nanoparticles with core/shell structure. The method is determined by the following formula M the same amount of iron salts (II).

$$M^{2+}+8OH^{-}+2Fe^{3+}\rightarrow MFe_2O_4+4H_2O$$

So, in this way, sample container iron salts with amounts of 1 to 2 (150 moles of $FeCl_2.4H_2O$ and 300 moles of $Fe(NO_3)_3.9H_2O$) were dissolved in distilled water. The reaction temperature was 25 degrees Celsius and high-intensity spinning under inert nitrogen gas. After 3 hours to prevent additional oxidation and increasing the absorption of biomolecules and biological targets, 2 ml tetraethyl-orthosilicate was used. Finally, the yellowish-brown product was obtained in the same magnetic nanoparticles. In the read more, the solution was washed repeatedly with methanol and water and then dried in the oven and powder was gathered (**Scheme 2**).



Scheme 2 General route for the synthesis of Fe_3O_4 and SiO_2 magnetic nanoparticles.

DNA-L, C adsorption studies

20 mg of the magnetic nanoparticles (Fe_3O_4, SiO_2) is added to 1.0 ml of DNA-L or C solution and the mixture is shaken vigorously for 15 min to facilitate the adsorption of DNA-L or C. After separation by a permanent magnet, the supernatant is collected to quantify the DNA-L or C content remaining in the original solution by monitoring the Sore band absorbance of DNA-L, C at 280 nm. After DNA-L or C adsorption, the magnetic Nanocomposites are mixed with each one of DNA-L and DNA-C is oscillated for 15 min to facilitate desorption of the absorbed

DNA's from the magnetic nanoparticles. The supernatant is finally collected after magnetic separation for the ensuing investigations.

BSA adsorption from aqueous solution

BSA adsorption experiments were carried out in batch-wise. Approximately 20 mg of magnetic silica nanoparticles were mixed with 1 ml of various concentrations of BSA solution in water. The mixture was shaken at room temperature for 0.5 h, which proved to be a sufficient period to reach equilibrium. Then the magnetic particles were separated with the help of a permanent magnet and the supernatant was assayed for remaining protein concentration by the UV–Vis spectrophotometer at 595 nm. The adsorbed amount of protein was calculated by mass balance.

Regeneration studies

BSA desorption experiments were performed in a binding buffer containing various concentrations of imidazole. BSA adsorbed particles were placed in the desorption medium and stirred at 25°C for 0.5 h. The ratio desorption was calculated from the BSA, adsorbed and the amount of BSA desorbed.

Results

Synthesis and characterization of magnetic nanoparticle coated with silica

For the preparation of magnetic nanoparticles of magnetite (Fe_3O_4) to iron metal oxide from the oxide, Fe^{+2}, Fe^{+3} were chemical co-precipitation way. After preparation of magnetic nanoparticles, the particles of silica (SiO_2) which covers the extra addition to prevent oxidation of magnetite magnetic nanoparticles by oxidizing the vicinity, such as outdoors, as a functional surface coating for chemical reactions Medical, accelerating forgiven. In the range of 1-100 nm magnetic nanoparticles should be made, such as the size of the magnetic nanoparticles in chemical reactions and medical procedures are important. To investigate and establish the structure of the magnetic nanoparticles is used in a series of analyzes, including; TEM, SEM, XRD, FT-IR, TGA and so on. The project analyzed by SEM and FT-IR was used to stabilize the structure of magnetite magnetic nanoparticles. Analytical SEM, analysis of a series of images of the structure of the magnetic core/shell nanoparticles provides. The structure of magnetic nanoparticles coated with silica by analytical SEM is shown in **Figure 1**.

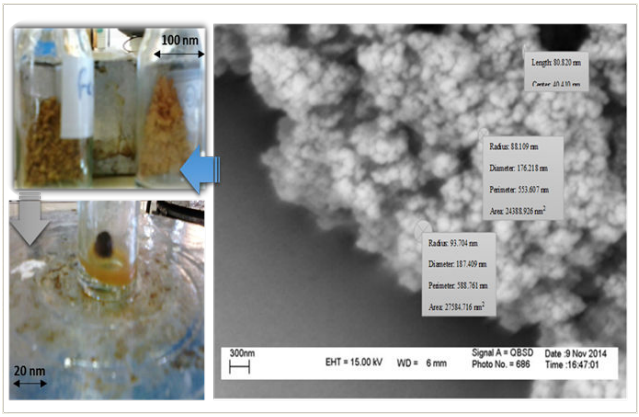


Figure 1 SEM picture of Fe_3O_4 and SiO_2 magnetic nanoparticles.

FT-IR Analysis: The analysis is to show that operating groups also established a covalent bond between functional groups. It values in terms of frequency from 500 to 4000 cm^{-1} are based on. The FT-IR spectra of as-prepared hollow magnetite microspheres **(Figure 2a)** and SiO_2 hollow magnetite microspheres **(Figure 2b)** were characterized by a high absorption band at 802 cm^{-1} imputed to the typical band of Fe_3O_4, equivalent to the stretching vibration modes of Fe-O [17,18]. Afterward coating by a silica layer, a new band appeared at about 1122 cm^{-1} **(Figure 2b)** being determined to stretch of Si-O-Si bands on the surface of the SiO_2 with hollow magnetite microspheres. By comparing the two images **(Figures 2a and 2b)**, it can be concluded that the Fe-O bond peak gradually sharped and represented crystallization of the nanoparticles. Thus the structures of magnetite magnetic nanoparticles coated with silica layer are preventing additional oxidation and increase the reactivity of nanoparticles. Magnetic nanoparticles can also cause regular crystalline structure. Results for identifying the structure of magnetic nanoparticles by functional groups are shown in **Figure 2**.

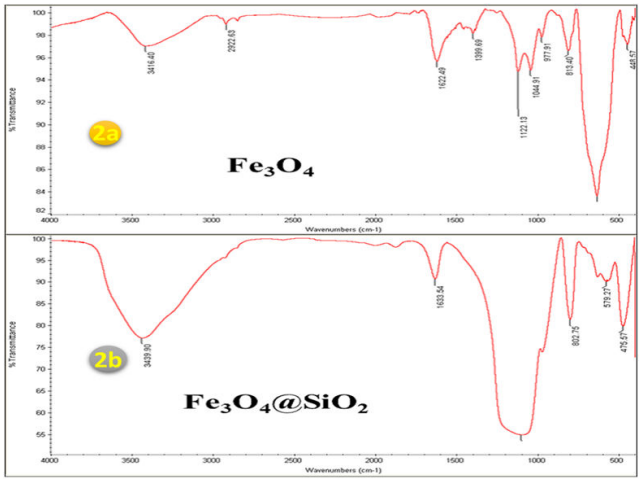


Figure 2 a) FT-IR analysis of magnetite nanoparticles and b) with coated silica.

Adsorption studies

As the project title suggests: I have tried to stable biomolecules such as DNAS and protein on magnetic nanoparticles Fe_3O_4 and SiO_2. So I just have to expand other researchers in this area, that I have achieved a basic conclusion. As you know, the magnetic nanoparticles and their magnetic properties are able to be controlled remotely by an external magnetic field. Before must, biomolecules of interest (DNAS, protein) in response to MNPS that, to be a link between them. The most important thing is the phenomenon of absorption of (DNA-L, C, protein) on MNPS. It was bonding, an electrostatic bond which was taken of the EDX analysis [25].

Discussion

Results of DNAS and protein loaded onto magnetic nanoparticles Fe_3O_4 and SiO_2 by spectrophotometry

The effect of increasing the concentration of DNA's was studied and the results were obtained **(Figure 3)**. Based on repeated, accurate and based on the spectrophotometric analysis results, it can be said that increasing the concentration of DNA's gradually increases the amount of DNA-L or C in the magnetic nanoparticles, which can be said to be that all DNAS are absorbed on the surface of the magnetic nanoparticles. So, this is when the amount of 1 ml with a concentration of 25 µg/ml DNA-L or C in 20 mg MNPS is dissolved in the interval of 0 to 30 minutes. Even the moment when a portion of the DNA-L or C solution was added to the container at the time of zero minutes to the dissolved magnesium nanoparticles without any catalytic activity, the specimen was analyzed in a spectrophotometer and the result of 15% absorption showed that this result for the protein was also the same way. So at an optimum concentration of 25 µg/ml of DNA-L or C, the absorption rate is approximately 90% absorbed, which is close to 100% at the end and the absorption results for the two types of DNA's showed that the amount of absorption in the annular type was far more than the linear one. The isomerism of the DNA's sample on the surface of the magnetic nanocomposites is shown in **Figure 3**. The proteins are similar to those of DNA's, with the highest absorption of 25 µg/ml. The results of protein intake are shown in **Figure 3**. As already mentioned, the electrostatic interaction is the main absorption force. So the absorption is dedicated to the single-layer coating and the experimental data then corresponds to the Langmuir model as follows:

$$Q^* = \frac{Q_m \times C^*}{K_d + C^*}$$

C*(µgml^{-1}) is the DNA-L or C concentration in aqueous solution and Q*(µg.mg^{-1}) denotes the amount of DNA-L or C retained by the composites. Qm (µg.mg^{-1}) represents the maximum adsorption capacity and Kd is the dissociation constant.

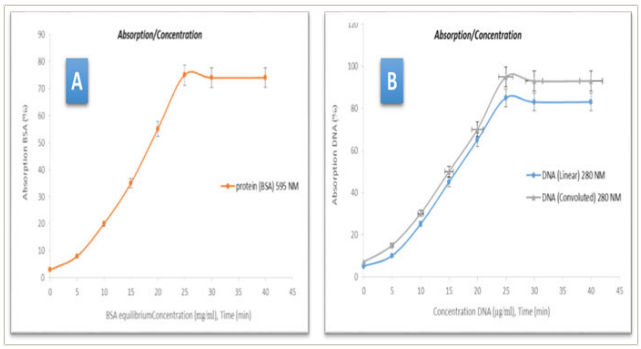


Figure 3 Adsorption of A) BSA (protein) on magnetic charged silica nanoparticles (20 mM PBS, pH=8.0). Solid line represents the fit of Langmuir model. B) DNAS (L.C); Magnetic nanocomposite: 20 mg, DNA: 1.0 mL, TrisaminomethaneHCl: 1.0 ml adsorption time: 15 min.

The effect of time in absorption

Reaction time for absorption is 0.5 hr in this test, as the standard time for this research is very important. At the beginning of the reaction, patterns were to study the magnetic nanoparticles containing silica-DNA's-protein. Absorption studies conducted showed that the uptake of DNA's concentration (25 µg/ml) **(Figure 4)** in The wavelength of 280 nm for 15 min (absorption wavelength DNAS) is 85-90% and the uptake protein the concentration (25 µg/ml), in the wavelength of 595 nm for 30 min (absorption wavelength protein) is 65%, and after 0.5 hr absorption be stable over time because the absorption process of DNA's and protein was complete on the surface of magnetic nanoparticles. The absorption of biomolecules (DNA's, protein) within a half-hour episodes were tested and the results were observed in **Figure 5**. According to the results, we find that uptake is gradually increased and is been stable after 0.5 h.

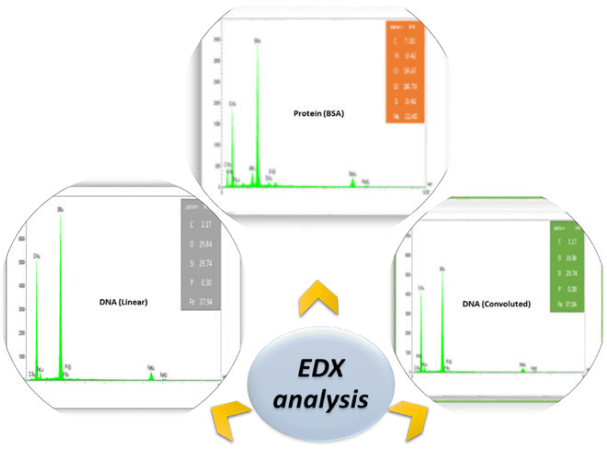


Figure 4 Results of analysis EDX showed the percentage of absorption Protein and DNAS with link by magnetic nanoparticles.

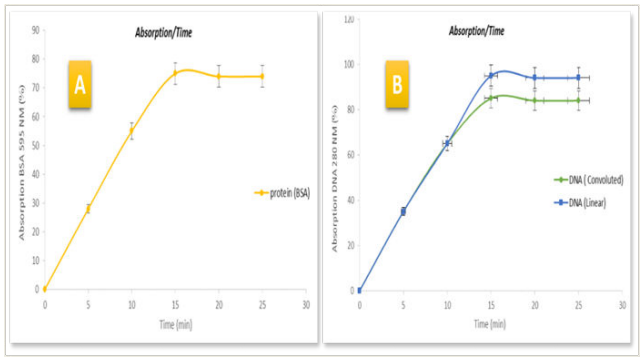


Figure 5 Effect of the time for absorption Protein and DNA's.

Stabilization and release process of DNAS and protein on MNP's

The absorption evaluation of DNA's and protein on magnetic nanoparticles in the amount of 1 µg. ml^{-1} (DNAS and protein) is standard and was developed by Bradford formula (A=2, C=1 $µgml^{-1}$). Where it is defined as follows

C=50.OD/100: In the formula 50 and 100, there are fixed numbers and OD (absorbance). OD (absorbance value as well as Beer-Lambert law [26]) can be calculated and measured by spectrophotometer analysis. The law of beer Lambert states that part of the light after coloring with glass solution, absorption, and other passes. Continue to work with the device by a spectrophotometer. 20 mg of magnetic nanoparticles were added to a 1 mL (DNA's or protein) solution, and finally, the absorbance (DNA's and protein) on the surface of the magnetic nanoparticles was measured by samples in optical tubes separated and analyzed within 0 to 30 minutes. For this purpose of examining, the absorbance results on silica-coated MNPS, 50 µl of DNA's or protein with concentration (50 $µgml^{-1}$) (in the presence of each buffers) with 20 mg of magnetic nanoparticles in the presence of 2 ml dissolved distilled water was prepared in 400 µl samples at a time interval of 0-30 minutes, All of these experiments were extracted in different samples and at 3 different times. All samples were isolated from the solution at the desired time collected and prepared for analysis. For each biomolecule (DNA's or protein), the adsorption rate at different concentrations (10-50 µg/ml) was analyzed by the spectrophotometer. All samples were taken and ready for use in a device with a wavelength (280 nm for DNA's, 595 nm for protein), absorption rate was measured. The analysis results are presented by a spectrophotometer **(Figure 3)**. According to data, absorption of DNA's and protein on magnetic nanoparticles is 85% and 65%, respectively. Each of the DNA's and protein are respectively, in each (TrisaminomethaneHCl (Buffer solution (0.01 $molL^{-1}$, pH=8) and PBS buffer solution (buffer containing 20 mM phosphate buffer (PBS) differently) pHs 6.0-8.0) were dissolved in 1 M NaCl to remove them from the surface of the magnetic nanoparticles. The results showed that more than 90% of the total (DNA's or protein) was removed from the nanoparticles. So all the quantities shown in **Table 1** are evidence that adsorption or release at a concentration of 25 µg/ml is absorbed or definitely released to 65%, which is highlighted in **Table 1** with red and green colors.

The results of the discussion: Absorption gradient at 25 µg ml is maximum and above this value of 50 µg/ml, the absorption gradient has not been altered. The data shown in the following **(Figure 3)** and the measured values of the standard scale are considered. In **Figure 6** the absorption of DNA-L, C and protein by decomposition and spectrophotometric analysis of UV-Vis was carried out. In the first analysis, the apparatus was adjusted to zero using distilled water and then calibrated with a solution containing DNA's at 280 nm and a protein at 595 nm. The decrease in the absorbance of the peaks (at the frequency of capture) showed that the absorbed DNA's and protein were stable. Thus, using the obtained data, it can be concluded that the optimum concentration is 25 µg ml^{-1}, which is stabilized at the nanoparticle level in 15 min for DNA-C, L and 30 min for protein, and its release rate is higher than 90%, which is due to the corresponding buffers (TrisaminomethaneHCl buffer for DNAS and PBS buffer for protein). As a result, its adsorption and release rates are roughly 65% higher, indicating that the purge and propagation process has been fully implemented.

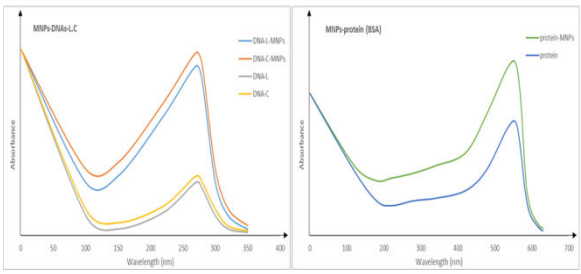


Figure 6 UV-Vis spectrophotometry analysis for absorption increasing patterns by different concentration for DNA and protein on MNPS.

Table 1 Amounts of absorption and releasing data.

Pattern (µl/ml)	Time (min)	Adsorption (µg/ml)%	Releasing (µg/ml)%	Extraction buffer (50 µl (buffer+MNPS-(DNA-L, C or protein))/wavelength (nm)
DNA-L	15	85	80	TrisaminomethaneHCl/280
DNA-C	15	90	85	TrisaminomethaneHCl/280

protein	30	65	60	PBS/595

Recovery of the retained DNA-L, C and protein from the MNPS

The results of the magnetic nanoparticles with silica coating for DNA-L, C, or BSA adsorption were analyzed by spectrophotometric analysis over a period of 12-120 h for 10 periods and the results showed that the efficiency of nanoparticles in the application again and again the stabilization of biomolecules, MNPS-DNAS-BSA even decreased by 10 percent over the course of 15 percent. The results are shown in **Figure 7**.

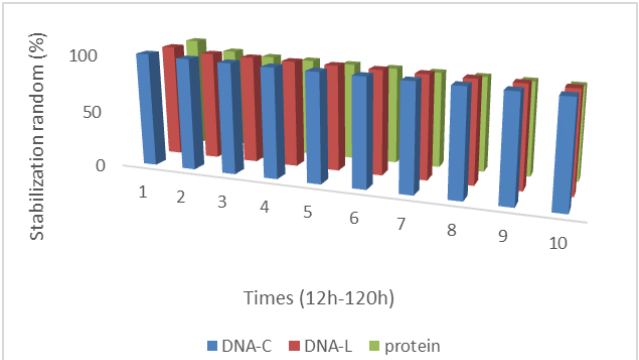


Figure 7 The DNA-L/C and protein resistance loaded MNPS over time in 10 cycles.

In this discussion, by W% of elements perceived whichever were dependent to reactants of DNA-L, C and protein and magnetic nanoparticles Fe_3O_4, SiO_2 and EDX analysis showed that both of the reactants bonded together in this product. Also elements of Fekα and Fekβ with elements Si (with strong peak) and O are shown in Fe_3O_4 and SiO_2 product. This analysis may be a demonstrative bond between magnetic nanoparticles Fe_3O_4, SiO_2 and DNA-L,C or BSA. The results of the EDX analysis show that binding of agent N in 750 keV and agent of O 1100 keV because they are in a line, so it may be stated that this approaching and electrostatic bonding are same. Element O is in the agent group O_2 of coated silica (SiO_2) and element N of the agent NH_2 of DNA-L, C or protein. Evidence of EDX analyses is a Spectrophotometer seconder for this tissue. The result of absorption is the link between magnetic nanoparticles and DNA-L, C or BSA protein by EDX analysis, shown in **Figure 4**.

The results of the absorption of protein and DNA-L, C by electrophoresis

In this section, protein, DNA-L and C are analyzed by electrophoresis. Electrophoresis analysis is based on absorption at absorption time. Here, horizontal electrophoresis was used to measure DNA's absorption and vertical electrophoresis to measure protein absorption. With respect to **Figure 8**, it can be seen that the amount of stained specimens are in the range of 0 to 15. The absorption of DNA (L, C) and 0 to 30 for the protein on the magnetic nanoparticles has gradually dimmed, which this fading stain shows that biomolecules are absorbed on the surface of magnetic nanoparticles. Therefore, spectrophotometric absorption and electrophoresis of both devices showed acceptable results for this absorption. First in 5 different patterns for DNA-L/C and protein in three separate tests at a dose of 25 µg/ml and at 0-15 min and 0-30 min on a sol-gel plate (Different mixed supernatant solution and biomolecules (DNA-L, C and protein)-MNPS and eventually the last point of the mass of magnetic nanoparticles containing biomolecules). In the first line the ladder is the first point and the second line of staining for two DNAS or proteins separately and without nanoparticles (sample 1) and the third line contains any DNA's or protein mixed in nanoparticles (without catalytic) at zero time (sample 2) The fourth line contains either DNA-L/ C or fixed protein in nanoparticles at 5 minutes (sample 3), fifth line at 10 minutes for DNAS and 15 minutes for protein (sample 4) and line six for 15 minutes For DNAS and 30 minutes for protein (Example 5). Then, sol-gel was placed on the electrophoresis and began to scan and stained. After 2-5 hours, results in the same spots of about 55% of the apparently weaker spots were observed separately from the specimens containing the pure amount of each of the DNAS and proteins separately and the staining smoothed showed that the absorption rate the nanoparticle surface is at least 85% for DNA-C, L and 65% for protein. Biomolecules [(DNA-L, C) or protein] are absorbed on the surface of the magnetic nanoparticles which confirms the stability of the biomolecules (DNAS, protein) in the nanoparticles, which are shown in **(Table 2, Figure 9)** are evidence for this stability.

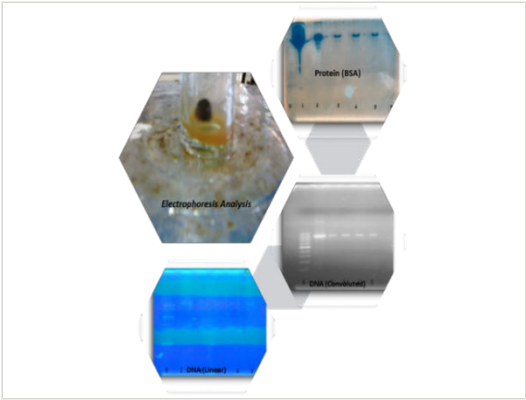


Figure 8 Electrophoresis Analyses was proved of absorption the DNA and protein on surface magnetic nanoparticles.

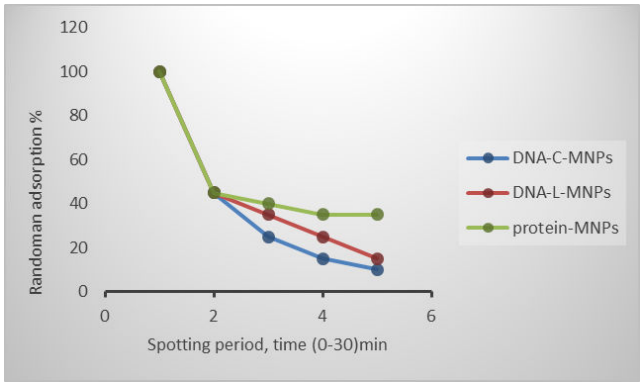
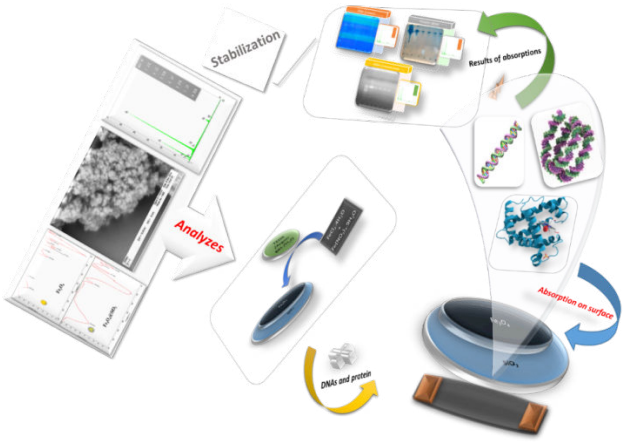


Figure 9 Picture of the absorbance DNA-L, C and protein on the surface of MNPS, that analyzed by Electrophoretic equipment.

Table 2 Amounts of absorption and releasing data by electrophoresis and spectrophotometer analysis.

Pattern 50 (µl/ml)	Ads. (µg/ml) Time: 0 min	Ads. (µg/ml) Time:5 min	Ads. Time:10 min	Ads. Time:15 min	Ads. Time:30 min
DNA-L	0.505	-	-	-	-
DNA-C	0.496	-	-	-	-
Protein	0.489	-	-	-	-
DNA-L-MNPS	1.110	0.56/55%	0.33/70%	0.23/85%	0.129/85%
DNA-C-MNPS	1.210	0.62/55%	0.29/75%	0.147/95%	0.07/95%
Protein-MNPS	1.09	0.59/55%	0.25/60%	0.23/65%	0.21/65%

We studied a separate mixture of DNAS-MNPS and protein-MNPS, which biomolecules (DNAS, protein) were dissolved together with magnetic nanoparticles in distilled water. The results of the adsorption were analyzed in the electrophoresis and the results showed that the concentration of biomolecules in the solution decreased with time of 0-30 minutes. Using spectrophotometric analysis, it was proved that this reduction process means absorption to the surface of magnetic nanoparticles. Finally it can be proven that a bond between the biomolecules and the surface of the nanoparticles is carried out, which is an electrostatic bonding that was measured by the EDX analysis. The overall conclusion is that biomolecules are stabilized on the surface of the magnetic nanoparticles with the highest possible percentages. The process is fully illustrated in **Scheme 3**.



Scheme 3 A full of the reaction circulation from synthesis nanoparticles until absorption of biological biomolecules DNA and protein on magnetic nanoparticles.

Conclusion

In this project, the maximum capacity of magnetic nanoparticles (MNPS) with silica coating was used to stabilize

and liberate biomolecules (DNAS and proteins). To do this, the MNPS were originally synthesized using a chemical co-precipitation method and their structure was identified with tools such as SEM and FT-IR. After confirming the core/shell structure of the nanoparticles, the silica coating is used for two reasons: one to prevent further oxidation by air and another to increase the performance level of these nanoparticles. In order to do this, the amount of 20 mg of MNPS in 1 ml of solution of each biomolecule (DNA-L/C or protein with an optimal concentration of 25 $\mu g/ml^{-1}$) at 25°C (room temperature) in a water solvent in the specimens were then isolated for 15 minutes for DNA-L/C and 30 minutes for the protein after the reaction (these times are optimal) and tested in the spectrophotometer and UV-Vis apparatus to measure their absorbance. The results showed that the absorption rate for DNA's was higher than 85% and for a protein higher than 65%, which indicates a high percentage of absorption of biomolecules (DNAS and protein) on the surface of magnetic nanoparticles, addition of any biomolecules (DNAS, protein) from the surface of the nanoparticles in the presence of external magnetic field and buffers (TrisaminomethaneHCl buffer for DNA-L/C and PBS buffer for protein) was shown to be more than 90%. After the experiments, magnetic nanoparticles were extracted by external magnetic field. The overall results showed that biomolecules (DNA-L/C or protein) were almost completely stabilized on the surface of magnetic nanoparticles. With the endured studies, this project can be a way of stabilizing biological molecules by MNPS- (DNA-L, C, or protein) systems, so I hope that in the future, this method will be used to transport targeted proteins and DNAS and repair damaged cells to be used.

Declarations

Author's contributions

The Supporting Information contains UV-Vis spectrophotometry absorption, Absorption time, Concentration absorption, EDX analysis, Electrophoresis analysis, table of amounts adsorbed and released and an SEM image of the magnetic nanoparticles and FT-IR analysis of agents group the silica layer and pictures of the influence of magnetic nanoparticles on bacterial growth and recovery graph nanoparticles.

Acknowledgements

The authors gratefully acknowledge support from The College at Brockport, SUNY through the scholarly incentive and Provost post-tenure grant programs.

The Author(s) declare(s) that there is no conflict of interest.

Availability of Data and Materials

All data's and values are fully measurable and availability.

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