PREPARING ^{99m}Tc LABELED MAGNETITE NANOPARTICLES AS DRUG CARRIERS

E. İ. Medine, P. Ünak
Ege University, Institute of Nuclear Sciences, Department of Nuclear Applications, 35100 Bornova Izmir Turkey e-mail perihan.unak@ege.edu.tr

ABSTRACT

Dextran coated ^{99m}Tc labeled magnetite nanoparticles were prepared in this study. Magnetite was synthesized by a coprecipitation reaction that occurs upon mixing 0.37 g $FeCl_3$, 1.51 g $FeCl_2 4H_2O$ with dextran T-40 (50w%, 10 ml, MW 40000). NH_4OH solution (7.5% w/v) was added up to pH 10. A black magnetite precipitate was formed. Prepared magnetite nanoparticles were labeled using with 74 MBq $^{99m}TcO_4^-$ after adding 100 µl (1 mg/ml) freshly prepared $SnCl_2$ solution. Precipitated magnetic carrier particles were centrifuged and washed with pure water until the rinses became neutral. Labeling yield was over 96% and radiochemical purity was approximately 98%. The average size of particles was 150.2±6.1 nm.

1. INTRODUCTION

Ferrofluids are colloidal suspensions of magnetic particles in a liquid medium. The interest in ferrofluids arises from the fact that these liquids can be controlled directly by the application of a magnetic field. Magnetite (Fe_3O_4) is the best known material as magnetic carrier. Different targets may be obtained with varying the particles size. For example; large iron oxide particles were used for bowel contrast [AMI-121 (i.e. Lumirem and Gastromark) and OMP (i.e Abdoscan), mean diameter no less than 300 nm] and liver/spleen imaging [AMI-25 [i.e. Endorem and Feridex IV, diameter 80-150 nm); SHU 555A (i.e. Resovist, mean diameter 60 nm)]. Smaller iron oxide particles also may be applied for lymph node imaging [AMI-227 (i.e. Sinerem and Combidex, diameter 20-40 nm)], bone marrow imaging (AMI-227), perfusion imaging [NC100150 (i.e. Clariscan, mean diameter 20 nm)] and MR angiography (NC100150). Even smaller monocrystalline iron oxide nanoparticles may be used for receptor imaging and magnetically labeled cell probe imaging [1]. MR system was used for imaging with magnetic particles, however several radionuclide labeled magnetic particles such as ^{188}Re,[2] ^{111}In,[3] ^{90}Y,[3] and $^{125/131}$I[3, 4] were reported especially for therapeutic aim.

Here, we studied dextran coated magnetite nanoparticles to label with ^{99m}Tc to use as an imaging agent oriented by magnetic field.

2. EXPERIMENTAL

$Na^{99m}TcO_4$ was supplied from Department of Nuclear Medicine of Ege University. Dextran-40 was purchased from Eczacıbaşı/Baxter. Water was purified by filtration through a Waters-Millipore purification system. All other chemicals were supplied from Merck Chemical Co and Aldrich Chemical Co.

Preparing dextran coated magnetite nanoparticles: Magnetite was synthesized by a coprecipitation reaction that occurs upon mixing 0.37 g $FeCl_3$, 1.51 g $FeCl_2.4H_2O$ with dextran T-40 (50w%, 10 ml, MW 40000). NH_4OH solution (7.5% w/v) was added up to pH 10 stirring with Metrohm 686 Titroprocessor and 665 Dosimat. Temperature was controlled using Nuve BM 302 water bath. A black magnetite precipitate was formed. Precipitated magnetic carrier particles were centrifuged and washed with pure water until the rinses became neutral. The parameters investigated were temperature, pH, Fe^{+2}/Fe^{+3} ratio, base concentration and base variety.

Transmission electron microscopy (TEM) was used to verify the expected nanoscale size of the particles.
^{99m}Tc Labeling of dextran coated magnetite nanoparticles: Prepared magnetite nanoparticles were labeled using with 74 MBq $^{99m}TcO_4^-$ after adding 100 µl (1mg/ml) freshly prepared $SnCl_2$ solution. Thin Layer chromatography was used to analyze the chelation efficiency.

3. RESULTS AND DISCUSSION

Labeling yield was over 96% and radiochemical purity was approximately 98%. Transmission electron microscopy data have been used to support the analysis carried out with the susceptibility data. The average

size of particles was 150.2±6.1 nm at the conditions of 2 Fe^{+2}/Fe^{+3} ratio, 7.5% w/v NH_4OH concentration, pH=10 and 65 °C.

TEM analyses showed that particles are nearly monodisperse. Using this procedure by varying the stabilizer/iron ratio, or increasing reaction temperature, the magnetite nanoparticles various sized particles can be made. Fig.1 shows a TEM image of 150.2±6.1 nm.

4. CONCLUSION

In conclusion, the labeling yield was high and stability was adequate ^{99m}Tc labeled dextran coated nanoparticles may be useful as a new class of scintigraphic agents. Results of this study are sufficiently encouraging to bring about further evaluation of this and related compounds.

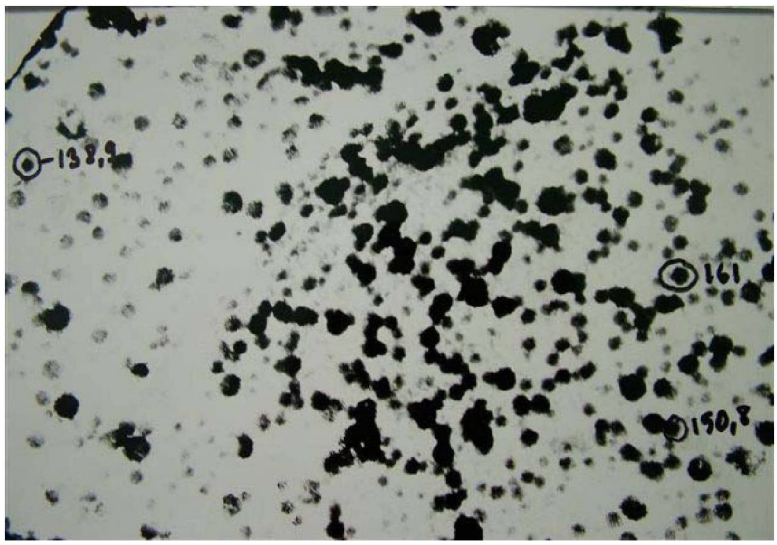


Figure 1: TEM image of the dextran coated magnetic nanoparticles

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6. REFERENCES

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