

# Biopolymer-based iron oxide particles for MRI

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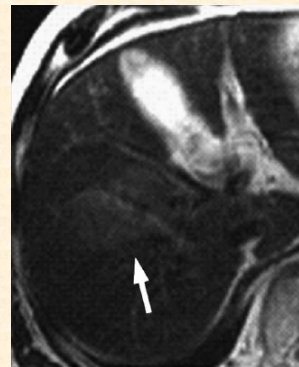
Magnetic resonance imaging (MRI) is a non-invasive method used to render images of the inside of an object. It is primarily used in medical imaging to demonstrate pathological or other physiological alterations of living tissues. MRI is currently the most efficient imaging procedure used in medicine.

In order to improve the efficiency of this procedure, different contrast agents are administered in 40–50% of all MR examinations. Contrast agents are diagnostic pharmaceutical compounds containing paramagnetic ions or superparamagnetic nanoparticles that affect the MR-signal properties of surrounding tissues. They are administered to enhance tissue contrast, to characterize lesions and to evaluate perfusion and flow-related abnormalities. Gadolinium chelates are the most widely used extracellular, non-specific contrast agents. Organ specific contrast agents include superparamagnetic iron oxides particles stabilized with appropriate biopolymers or biocompatible synthetic polymers.

## Commercially available biopolymer based iron oxide MRI contrast agents for IV application

Generic name	Brand name	Stabilizing polymer
Ferumoxide	Endorem, Feridex	dextran
Ferumoxtran	Sinerem, Combidex	dextran
Ferucarbotranum	Resovist	carboxydextran

## Example of MRI of liver tumor after application of dextran-coated superparamagnetic iron oxide<sup>1</sup>



before



after

## Experimental biopolymer-based iron oxides MRI contrast agents:

Protein	Type of agent	Admin.	Application	Polysaccharide	Type of agent	Admin.	Application
Albumin, bovine serum	90 nm size	IV	Subcutaneous abscesses	Alginate	Beads cont. cells and FF	IV	Implanting recombinant cells + MRI
Albumin, human serum	15-25 nm magnetite particles in 1-5 µm albumin particles	IV	Reticuloendothelial system (liver, spleen)	Arabinogalactan	USPIO, SPIO	IV	Hepatocytes, liver tumors
Albumin, human serum	25-30 nm magnetite particles in 0.3-1.5 µm albumin particles	oral	Gastrointestinal tract	Carboxymethyl dextran	Ferucarbotranum (Resovist)	IV	Organ specific MRI contrast agent
Fc fragment of IgG	90 nm size	IV	Subcutaneous abscesses	Chitosan	SPIO in 100 µm chitosan particles	IV	MRI-detectable embolotherapy
Magnetoferritin	Equine magnetoferritin	IV	Liver and spleen	Chitosan	65 nm	IV	Organ specific MRI contrast agent
				Chondroitin sulfate	8 nm iron oxide core	IV	Blood-pool agents
				Dextran	Ferumoxide (Endorem, Feridex)	IV	Organ specific MRI contrast agent
				Dextran	Ferumoxtran (Sinerem, Combidex)	IV	Organ specific MRI contrast agent
				Starch	6 nm iron oxide core	IV	Brain parenchyma

## Oral superparamagnetic MRI contrast agents

➤ current commercially available oral MRI contrast agents are based on silicon coated superparamagnetic particles (GastroMARK, Lumirem) or sulphonated styrene-divinylbenzene latex particles (Ø 3.5 µm) with bound superparamagnetic nanoparticles (Abdoscan).

## Possible new oral superparamagnetic MRI contrast agents

- oral contrast agents stabilized with biocompatible biopolymers
- chitosan, alginate and agarose currently tested as biocompatible polymers
- water-based magnetic fluids and maghemite nanoparticles used
- different procedures used to prepare nano- and microparticles for in vitro experiments

## Reference:

1. Tanimoto, A., Kuribayashi, S.: Application of superparamagnetic iron oxide to imaging of hepatocellular carcinoma. Eur. J. Radiol. 58 (2006) 200-216.