



Nov 05, 2025

Version 2

🌐 Preparation of Ex-Vivo Samples in Potato Starch Suspension for a Horizontal Bore MRI Scanner V.2

DOI

<https://dx.doi.org/10.17504/protocols.io.q26g7n473lwz/v2>

Brianna Wrightson¹, Elena Carlson¹, Robert Espinoza¹

¹Fred Hutchinson Cancer Center



Brianna France

FRED HUTCHISON CANCER CENTER

Create & collaborate more with a free account

Edit and publish protocols, collaborate in communities, share insights through comments, and track progress with run records.

Create free account

OPEN  ACCESS



DOI: <https://dx.doi.org/10.17504/protocols.io.q26g7n473lwz/v2>

Protocol Citation: Brianna Wrightson, Elena Carlson, Robert Espinoza 2025. Preparation of Ex-Vivo Samples in Potato Starch Suspension for a Horizontal Bore MRI Scanner. **protocols.io**

<https://dx.doi.org/10.17504/protocols.io.q26g7n473lwz/v2> Version created by [Elena Carlson](#)

License: This is an open access protocol distributed under the terms of the **[Creative Commons Attribution License](#)**, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited



Protocol status: Working

We use this protocol and it's working

Created: September 25, 2025

Last Modified: November 05, 2025

Protocol Integer ID: 228204

Keywords: MRI, magnetic resonance imaging, MR, magnetic resonance, PSS, Potato starch suspension, PS, Potato starch, PBS, Phosphate-buffered saline, horizontal bore, horizontal bore MRI, horizontal bore mri scanner potato starch suspension, magnetic resonance scanner, horizontal bore magnetic resonance scanner, potato starch suspension, background signal intensity from water proton, perfusion, contrast enhancement, fluorinert, fomblin, proton free, potato starch for horizontal bore mri imaging, vivo mri imaging, horizontal bore mri imaging, background mr signal intensity, background mr signal intensity from water proton, perfusion of the sample, potato starch, enhanced perfusion, approach with mr

Funders Acknowledgements:

National Institutes of Health

Grant ID: P30 CA015704 (RRID:SCR_022616)

Abstract

Potato starch suspension is a valuable alternative to fluorinert or fomblin for ex vivo MRI imaging. It can be used to suppress background MR signal intensity from water protons and motion artifacts, improving image quality for studying small specimens.^{1,2} Here we describe how to modify previously published protocols to work specifically in horizontal bore magnetic resonance scanners.

This ex-vivo sample preparation method is a low cost & simple approach to reducing background and motion effects, and is more eco-friendly, safe, and economical than commonly employed alternatives (e.g. fomblin or fluorinert).

We further discuss some considerations on how to couple this approach with MR-contrast enhanced perfusion of the samples, before packing them in potato starch for horizontal bore MRI imaging.



Materials

Supplies/ Equipment

- Potato starch (Can purchase from Sigma or from grocery store)
- Cyanoacrylate super glue
- Phosphate-buffered Saline (PBS)
- Disposable Absorbent Pads
- Scoopula (small & medium)
- Wooden popsicle sticks
- Conical tube (scientific) / conical centrifuge tubes
- Scissors and file
- Gadopentetic acid Gd-DTPA

⊗ GADOPENTETIC ACID Merck MilliporeSigma (Sigma-Aldrich) Catalog #ATEH9B9AC609

⊗ Potato starch Merck MilliporeSigma (Sigma-Aldrich) Catalog #S4251-2KG

Protocol materials

⊗ GADOPENTETIC ACID Merck MilliporeSigma (Sigma-Aldrich) Catalog #ATEH9B9AC609

⊗ Potato starch Merck MilliporeSigma (Sigma-Aldrich) Catalog #S4251-2KG

⊗ Neutral Buffer Formalin

Considerations before proceeding

1

Note

It is important to keep in mind that the hydration properties of live tissue (for in vivo imaging) are quite different when compared to fixed tissue for ex vivo imaging. These tissue hydration properties directly affect the contrast inherent in MR images.

Additionally, the relaxometry values (R1 and R2) of MR contrast agents may also change as a result of both whether the tissue is live or not.

For ex vivo samples, you must also consider how fresh the fixed tissue is. (See Ref 3, where they discuss that their contrast agent could not be completely retained over 7 days post fixation of tissue).

There are also considerations regarding different fixatives and how they affect the hydration state of tumors and normal tissue.

Prepare tissue in fixative with MR contrast agent

- 2 Prepare gadolinium MR contrast agent in fixative agent prior to perfusion or sample fixation protocol.

[M] 1-5 millimolar (mM)



GADOPENTETIC ACID Merck MilliporeSigma (Sigma-Aldrich) Catalog #ATEH9B9AC609

in [M] 10 % volume  Neutral Buffer Formalin .

After 24-48 hours in fixative, transfer to [M] 70 % (v/v) ethanol for long term storage.

- 3 It is recommended to perfuse the tissue with fixative mixed with the MR contrast agent for better perfusion and improved image contrast. There are many procedures outlining how to do this, we recommend starting with the below.

typically you need access to a chemical fume hood for this step. Check with your institutional safety team as to their recommendations.



Protocol

NAME

Intra-cardiac mouse perfusion

CREATED BY

Lauren C. Faget

Preview

4 Non-perfusion

If perfusion is not necessary, simply remove the tissue from the euthanized subject carefully. Place directly in the [M] 1-5 millimolar (mM)



GADOPENTETIC ACID Merck MilliporeSigma (Sigma-Aldrich) Catalog #ATEH9B9AC609

in [M] 10 % volume [M] Neutral Buffer Formalin or other fixative agent of choice.

After 24-48 hours in fixative, transfer to [M] 70 % (v/v) ethanol for long term storage.

Glue sample to popsicle stick

5

Note

Once the sample has been packed in potato starch in a conical tube, it will be difficult to adjust its orientation for imaging in the scanner without fully removing the entire contents of the tube and repreparing the sample. Thus it is important to have the sample glued to something like a popsicle stick, and aligned with the length of the conical tube, so that you can place it in the bore in a straight and regular orientation.

Measure the size of your conical tube. Use an exacto knife or something similar to cut the stick to the right shape so that it fits snugly in the conical tube with the cap on, and is aligned along the center axis of the tube.

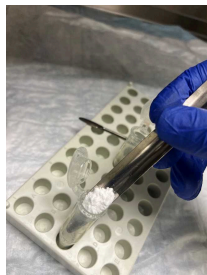
Glue sample to popsicle stick

- 6 Remove sample from ethanol. Dry with a kimwipe.
- 7 Use cyanoacrylate super glue to adhere the tissue to the dry popsicle stick. If possible, glue along a section of tissue that, if damaged later when removing the sample off the popsicle stick, is not as critical to your experiment (e.g. if imaging a brain, leave skull cap on and glue to the skull cap rather than directly to the brain tissue itself.)

Have your fragment/partial popsicle stick and apply cyanoacrylate super glue to it. Have your ex-vivo sample place it on top of the glue (Figure 3 and 4). Gently press down on the tissue sample to aid its binding. You may also want to add some more glue to the sides to achieve superior binding. You may gently push on the tissue after 1-2 minutes to get an idea of how well it has bound so far.

Place Sample in Potato Starch

- 8 Scoop potato starch (PS) into a conical tube, only to cover roughly 20-25% of the bottom (Figure 1).



1

- 9 Then add PBS to roughly match the volume occupied by the PS (Figure 2). Swirl and poke the PS at the bottom of the tube in order to have all the PS be hydrated/wet.



2

- 10 Transfer your tissue/popsicle stick into the PSS containing conical tube (Figure 5).



5

- 11 Start slowly and incrementally packing the rest of the tube with PS & PBS (Figure 6). You don't want the ratio to be towards the water. The goal is to have the PS just barely hydrated enough, with the consistency of damp sand. Slowly keep adding either PS or PBS to keep the balance and pad/push down on it to get rid of air bubbles (Figure 7).



6



7

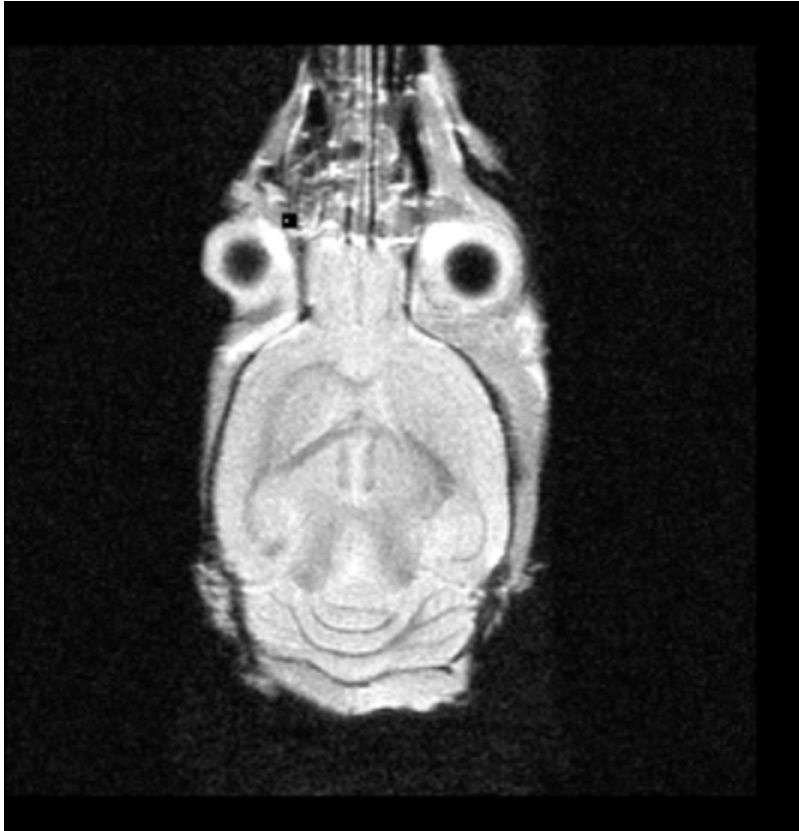
- 12 Once you successfully packed the conical tube with barely hydrated PSS then you tightly close the cap to prevent evaporation (Figure 8).



8

Verifying Efficient Preparation with the MRI images

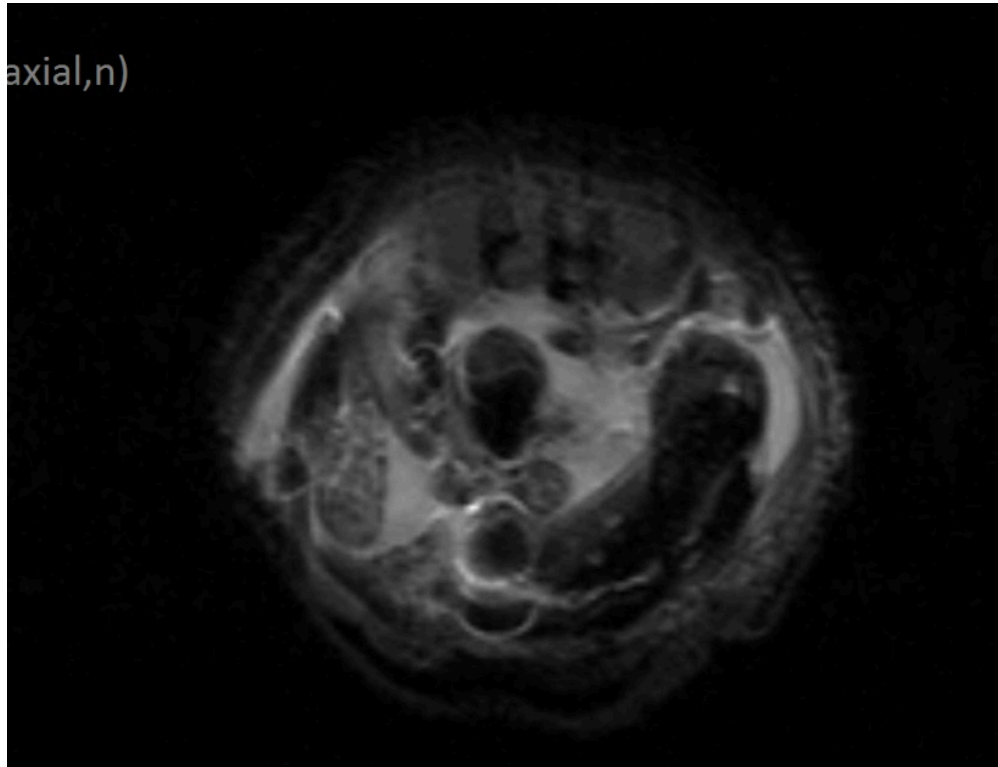
- 13 This is what an example brain sample should look like in the resulting MRI image



A nicely prepared, T1w sample. No contrast agent was added to this sample.

- 14 This is what it looks like when there are bubbles that allow motion and then cause some artifacts

If you see this you can remove the sample from the tube and repack. Make sure to tap as you add the PSS to compress it as you add the PSS.



Axial cross section of a fixed mouse abdomen. Image is blurry because sample was not packed down enough, and vibration and movement of the sample occurred as the pulse sequence ran.



Protocol references

Resources

1. Tomokazu Tsurugizawa, Takuma Kumamoto, Yoshichika Yoshioka, Utilization of potato starch suspension for MR-microimaging in ex vivo mouse embryos, iScience, Volume 25, Issue 12, 2022, 105694, ISSN 2589-0042, <https://doi.org/10.1016/j.isci.2022.105694>.
(<https://www.sciencedirect.com/science/article/pii/S2589004222019678>)
2. Tomokazu Tsurugizawa, Takuma Kumamoto, Yoshichika Yoshioka, Micro-magnetic resonance imaging of ex vivo mouse embryos with potato starch suspension, STAR Protocols, Volume 4, Issue 3, 2023, 102483, ISSN 2666-1667, <https://doi.org/10.1016/j.xpro.2023.102483>.
(<https://www.sciencedirect.com/science/article/pii/S2666166723004501>)
3. Sato, C., et al. (2018). "Isotropic 25-Micron 3D Neuroimaging Using ex vivo Microstructural Manganese-Enhanced MRI (MEMRI)." Frontiers in Neural Circuits 12.

Acknowledgements

Thank you to Dr. Erik Shapiro and Dr. Donghoon Lee for helpful advice regarding concentration of Gd agents for perfusion to then do ex vivo MRI imaging.