Case name

Concepts and Methods for Magnifying Whole Intact Tissues While Preserving Their Structural and Molecular Information

Owner

MIT

Website

http://tlo.mit.edu/technologies/concepts-and-methods-magnifying-whole-intact-tissues-while-preserving-their-structural

description

Applications This technology is a technique that facilitates 3D imaging of whole organs/tissues with multiplexed protein labeling and has many applications as an imaging tool. Problem Addressed Understanding molecular structure and function of organs has great potential to inform disease treatments and tissue engineering research. An organ's function is a result of both the constituent cell identities and their three-dimensional interactions. It was previously impossible to study long range 3D tissue structure, but the recent development of chemical organ clearing techniques has now made it possible to image an organ in it's entirety. However, the current organ clearing and imaging techniques still have many issues, including long clearing timescales, specialized equipment or solutions, and loss of antigen integrity. These inventors have developed a novel method for clearing and expanding organs that allows visualization of whole organs with multiplexed protein imaging. Technology This technology uses tissue-hydrogel complexes to facilitate processing and imaging of whole organs. First, the organ is perfused with a very high concentration of acrylamide hydrogel, with or without fixative. The high concentration of hydrogel results in formation of methylene bridges between the hydrogel and protein and reduces protein-protein crosslinking. After a denaturation step, the tissue is put in an expansion solution that expands and clears the tissue through osmotic flux into the hydrogel. The tissue-hydrogel complex expands up to 4 fold linearly in all directions while maintaining the three-dimensional structure of the organ, since the proteins are linked to the hydrogel. This technique, called magnified analysis of proteome (MAP), results in cleared organs that can be imaged on diffraction-limited microscopes. MAP is generalizable between organ systems and the inventors tested clearing and imaging of many tissues, including brain, heart, lung, kidney, spinal cord, and liver. Importantly, MAP maintains the molecular integrity of antigens, and most off the shelf commercial antibodies tested were compatible with MAP expansion and clearing. Antigens in the tissue are also stable through multiple rounds of stripping and re-probing, which allows multiplexed protein expression profiling. Additionally, the inventors describe a modified version of this protocol that facilitates MAP imaging of previously preserved tissues, allowing imaging of stored organs or tissue samples, such as post-mortem tissue or stored biopsies. Advantages 3D visualization of whole organs with multiplexed proteomic imaging Compatible with whole organs or with cultured cells/organoids of many tissue types Antigens are preserved through multiple rounds of stripping and re-probing for multiplexed imaging Reversible expansion of organ/tissue that maintains long range 3D structure Facilitates super-resolution microscopy with diffraction-limited light/fluorescence microscopes Compatible with either fresh or previously stored tissues/organs

Date

2018-10-29 00:00:00

Case Ref.

MIT_788

Industry

Life Sciences

Application number
PCT

Applicants
Massechusetts Institute of Technology

Inventors
Kwanghun Chung, Justin Swaney, Taeyun Ku, Jeong Yoon Park

Limitations:

Meta information:

Meta title
Concepts and Methods for Magnifying Whole Intact Tissues While Preserving Their Structural and Molecular Information

Support:

Access to additional documentation
Please inquire

Support from inventors
Please inquire

Bibliographic details:

Publication number

Priority number