Heme-sensing Microbes for in vivo Gastrointestinal (GI) Disease Monitoring
Technology #17764

Applications

Microbes engineered to detect and respond to blood are suited for in vivo monitoring of gastrointestinal (GI) bleeding, which can occur as a result of trauma, colon cancer, inflammation, etc., GI disease progression and flare-ups are challenging to detect using existing methods and would benefit from early intervention and routine monitoring.

Problem Addressed

Existing methods to detect blood in the GI tract (e.g., endoscopy, ex vivo stool sampling) are often inconvenient, invasive, and lacking in sensitivity. A sensor that functions in vivo with minimal interference and high sensitivity would provide a needed alternative to existing disease monitoring options. Bacteria that can sense and respond to environmental stimuli are a promising means to monitor human health, but often fail to sense biomedically relevant stimuli. The generation of microbes that can detect heme (a component of hemoglobin—the red pigment in blood) and respond in the form of a bioluminescent readout provides a novel method to monitor intestinal bleeding in a quantitative and minimally invasive manner.

Technology

Here we describe a genetically engineered microbe that is functionalized with a heme-response circuit. The system is comprised of two proteins: 1) heme transporter ChuA, and 2) heme-responsive transcription factor HrtR. ChuA imports extracellular heme into the cell. Once in the cytoplasm, heme binds the transcriptional repressor HrtR, releasing it from its cognate HrtO operator sites. Once released, HrtR permits the transcription of heme exporter HrtAB. A bioluminescence reporter system can be cloned downstream of the HrtAB promoter, resulting in heme-responsive luminescence that serves as a quantifiable readout of exposure. This functionalized microbial strain is the first example of an autonomous heme-responsive biosensor capable of sensing and responding to GI bleeding.

Advantages

- in vivo detection
- High sensitivity
- Low-cost
- Minimally invasive

Categories For This Invention:

Medical Devices
Life Sciences
Intellectual Property:
Genetically engineered sensors for in vivo detection of bleeding
US Patent Pending
2017-0058282
Genetically engineered sensors for in vivo detection of bleeding
PCT
2017-008018

Inventors:
Timothy Lu
Mark Mimee

External Links:
Synthetic Biology Group
http://www.rle.mit.edu/sbg/

Image Gallery: