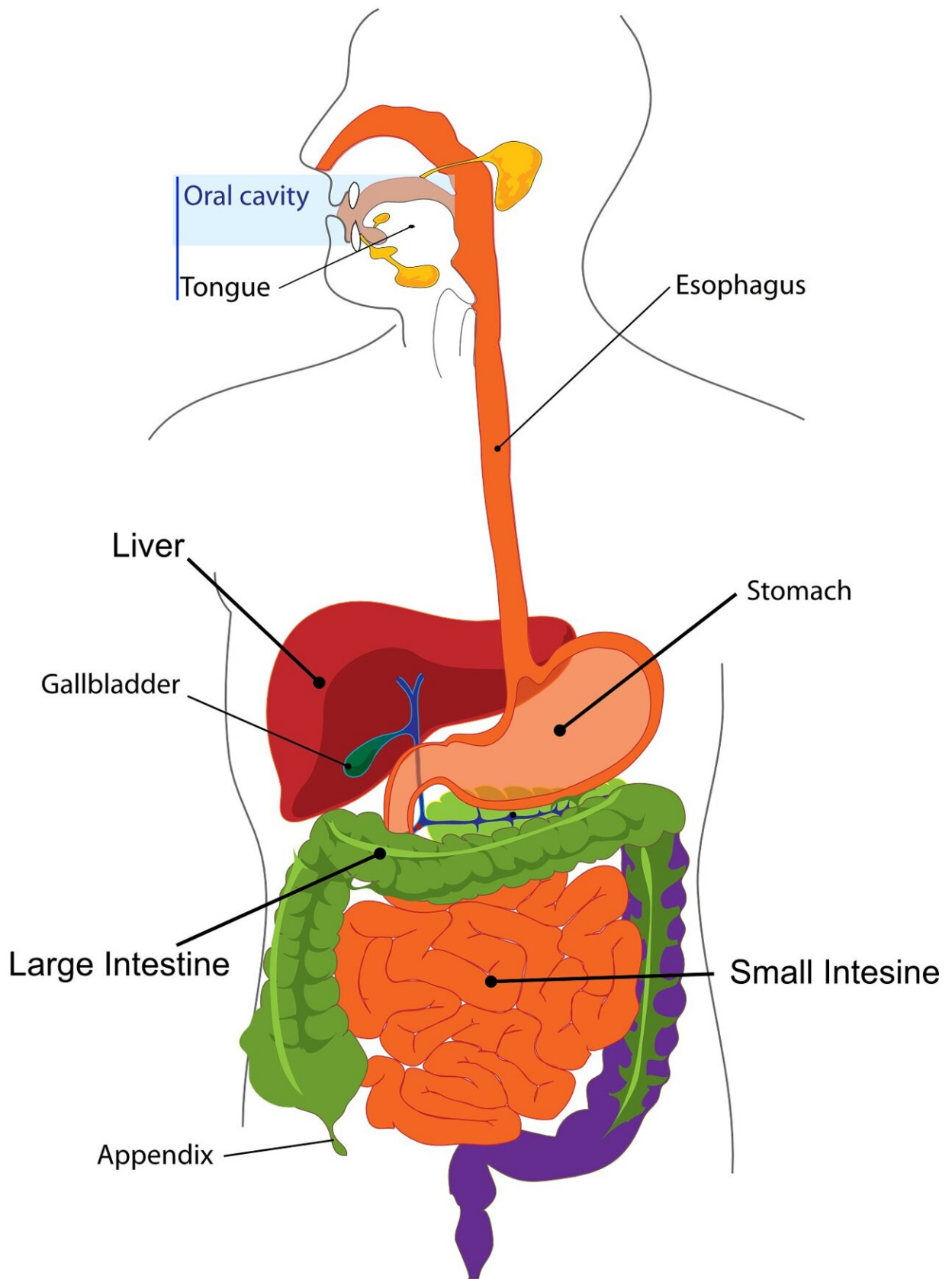


Researchers develop the first-ever ingestible electroceutical device to control appetite by hormone modulation

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A team of researchers at NYU Abu Dhabi (NYUAD), led by Khalil Ramadi, assistant professor of bioengineering at NYU Tandon and the Director of the Laboratory for Advanced Neuroengineering and Translational Medicine at NYU Abu Dhabi, has developed a first-of-its-kind ingestible electroceutical device for the neuromodulation of the gut-brain axis, the signaling pathway between the gastrointestinal tract and central nervous system.

The ingestible capsule is a noninvasive and precise method that could be used to modulate hunger levels and treat metabolic and neurologic diseases. This was developed in collaboration with Professor Giovanni Traverso of MIT, who is a joint senior author of the study and James McRae, a graduate student at MIT, who is first co-author of the paper published in the journal *Science Robotics*.

The FLASH system uses electrodes on its surface to deliver [electrical stimulation](#) to stomach mucosal tissue. The gut-brain axis regulates several physiological functions, including feeding and emotional behavior. The existing pharmaceutical and surgical methods to modulate the axis, including implanting electrodes through surgery, are imprecise, invasive, and have been associated with significant recovery periods and associated risks.

Inspired by the water wicking skin of *Moloch horridus*, the Australian thorny devil lizard, FLASH features a fluid-wicking capsule coating with grooved patterns and a hydrophilic (water compatible) surface, enabling them to bypass the gastric fluid in the stomach and achieve direct

electrode-tissue contact.

Gastric electrical [stimulation](#) (GES) directly induces the release of the hormone ghrelin, which stimulates hunger, from the gastric mucosa through endoscopic stimulation. Oral ingestion of the FLASH [capsule](#) was shown to modulate levels of the ghrelin hormone significantly and repeatedly.

In the paper, titled "Bioinspired, fluid-wicking, ingestible electroceutical capsules for hunger-regulating hormone modulation," published today (April 26), the researchers report the process of developing the FLASH capsules, which are swallowed. The capsules are powered by ingestible batteries, which were shown to deliver stimulation for 20 minutes. The capsules can then be excreted within two weeks of ingestion in large animals.

Current hormone medications have poor bioavailability when taken orally. This is why medications such as insulin need to be injected. FLASH can be taken orally to specifically target gastric neurohormonal circuits and modulate hormone levels in the blood. It is anticipated that this device could be used for a range of applications to treat metabolic, feeding, gastrointestinal and neuropsychiatric disorders non-invasively, and with minimal off-target effects.

"Electroceuticals, or electrical stimulation therapies, have emerged as the next frontier of neuromodulation," said Ramadi. "FLASH is one of the first ingestible electroceutical that can regulate precise neurohormonal circuits, while avoiding the discomfort patients can experience with invasive treatments. Future ingestible electroceutical systems could be designed and customized for specific applications beyond acute, short-term gastric stimulation."

More information: Khalil Ramadi et al, Bioinspired, ingestible

electroceutical capsules for hunger-regulating hormone modulation, *Science Robotics* (2023). DOI: [10.1126/scirobotics.ade9676](https://doi.org/10.1126/scirobotics.ade9676).
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