Gut counts calories even when we do not

With holiday feasting in full swing, the digestive tract is working overtime, not just processing all the turkey, green beans, and apple pie, but also keeping tabs on the nutrients ingested.

For the first time, scientists can glimpse the extensive array of sensors that do this tracking, says Terry L. Powley of Purdue University in West Lafayette, Ind. And contrary to what scientists thought, the body closely monitors every morsel, from the tongue's first taste of it to its passage through the intestines.

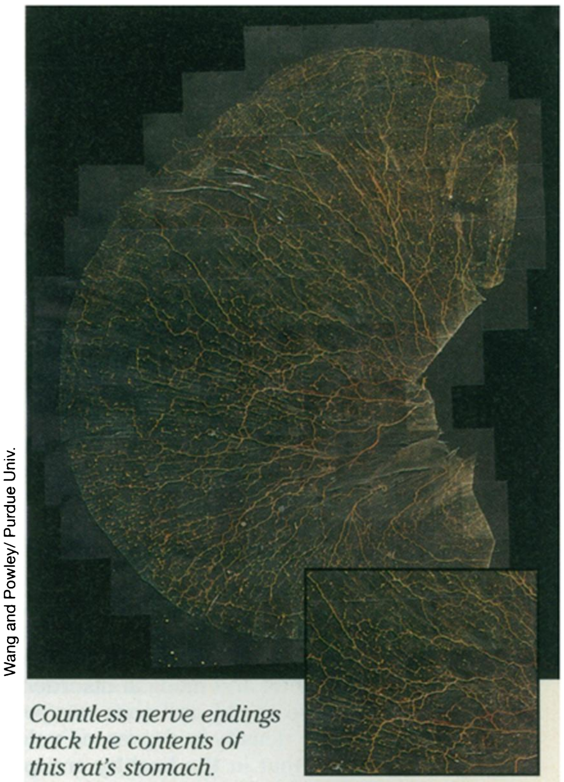
Researchers have long known that the vagus nerve connects the digestive system to the brain, Powley explains. But because of the limitations of their research techniques, they viewed the connections as sparse and simple.

He and Purdue graduate student Feng Bin Wang now know better. Just a few nerves, called afferent fibers, extend from the central nervous system to the stomach, Powley agrees. But from there they send out a dense array of branches that reach down to the intestines and up toward the throat. He and Wang reported their findings this week in Miami at the annual meeting of the Society for Neuroscience.

Even before dessert, the body has begun to assess the caloric and nutrient intake from the meal's earlier courses, adds Timothy H. Moran of Johns Hopkins University School of Medicine in Baltimore. The tongue recognizes familiar flavors and clues the brain in on fat or carbohydrate consumption. Also, some foods may sneak past the stomach and activate the nerve endings at the top of the small intestine, he explains.

These endings react to the volume, osmotic pressure, acidity, and quality of the food in the gastrointestinal tract. The sensors assess the meal and signal the brain to slow consumption, end the meal, or wait awhile before starting the next one, they suggest.

"The sensory characteristics of the gut have been tremendously underestimated," comments Gerard P. Smith at New York Hospital-Cornell Medical Center in New York City. "It's like a vast sensory sheet." Smith says that the gut knows, and gets the brain to respond differently to, particular fats such as oleic or linoleic acids.



Wang and Powley/ Purdue Univ.

Countless nerve endings track the contents of this rat's stomach. Close-up (inset) reveals thin parallel fibers that may measure food volume.

Just as the retina sends the brain visual information, this "sheet" relays food data. Therefore, controlling diet is as much a neurobiological issue as a nutritional one, these researchers assert. They hope this new view will lead to a better understanding of, and perhaps treatments for, eating disorders.

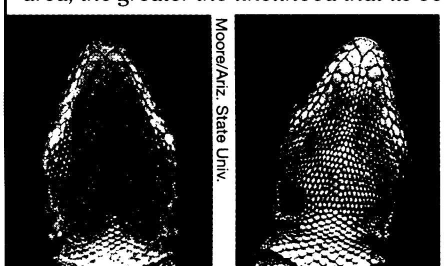
Surprisingly, rather than relay all this information directly to the brain, the fibers can process the data they collect, Powley says. The brain then receives an integrated message. This processing also results in local adjustments to the digestive tract that ensure maximum nutrient absorption, he adds.

Various chemicals, including hormones and protein fragments, or peptides, take part in gut-brain communication and in the regulation of food intake, says Sarah F. Leibowitz from Rockefeller University in New York. She and her colleagues described how insulin puts the brakes on the production of a peptide called galanin, which stimulates fat intake (SN: 11/13/93, p.310). Galanin also helps control the release of insulin and stimulates brain messengers that reinforce eating. Stress or overeating, especially consuming high-fat foods, can diminish insulin's effects, she adds.

As proteins and fats enter the gut, the intestine releases a different peptide, cholecystokinin, Smith says. This stimulates the gut's nerve endings, which tell the brain to reduce food intake, he reported at the meeting. — *E. Pennisi*

Do orange lizards wish they were blue?

Male tree lizards, Urosaurus ornatus, *come in two colors. Some have an orange flap of skin, called a throat fan, under their chin (left); others display an orange throat fan with a blue or green spot (right). "The blue is a status signal," says graduate student Rosemary Knapp of Arizona State University in Tempe. The bigger the blue area, the greater the likelihood that its bearer will win a dispute with another male.*



Moore/Ariz. State Univ.

Even tethered, a blue bigwig stakes out a territory and will defend females within it against other courting males (lower right). Orange males either roam, seemingly aimlessly, or stick near one territory and act as if it's theirs whenever the blue male goes elsewhere.

Michael C. Moore, Knapp's adviser, and his team first found that status was in part genetically determined but could be manipulated by giving hormones to young lizards right after they hatch. Surprisingly, concentrations of testosterone (which helps make an animal aggressive) and corticosterone (which imparts submissive behavior) in the lizards' blood appear about equal in both high- and low-status individuals, Knapp says.

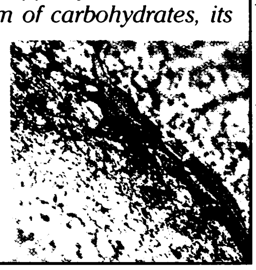
After a fight, the amount of corticosterone increases in orange males but stays the same in blues, even when those animals lose, Knapp reported this week in Miami at the annual meeting of the Society for Neuroscience.

She measured concentrations of the hormones in the blood of 40 lizards, then marked and released nine orange males in the desert. A month later, whenever she found a marked male, she tied a blue male nearby. After the orange male fought off the blue one, she tracked the amount of corticosterone in the marked male for a week.

The hormone didn't increase until 1 day after the fight, and it returned to normal within 7 days. "This really delayed effect is unprecedented," Knapp says.

She thinks that because corticosterone aids the metabolism of carbohydrates, its rise helps the orange male overcome exhaustion from fighting. During that recovery time, the male seems to wander more and be more submissive, perhaps to avoid getting into another fight.

"[The hormone] really does seem to influence a whole suite of behaviors," she adds. Therefore, she and Moore expect that the more an orange male fights, the more nomadic he will be. — E. Pennisi



Christopher W. Thompson/ Ariz. State Univ.