Microbiology

How to stomach a stomach infection

Science **305,** 1003–1006 (2004)

Researchers might have discovered why most people infected with the stomach bug *Helicobacter pylori* never become ill. Masatomo Kawakubo *et al.* have found a naturally occurring antibiotic that might offer protection against the bacterium.

H. pylori infects around half of the world's population. It exists in the stomach lining and can cause ulcers, gastritis and malignant lymphoma. But most infected individuals stay symptom-free, suggesting that the body possesses some form of natural defence. The bacteria are rarely found in the deep layers of the stomach lining, where cells secrete mucus loaded with proteins called *O*-glycan glycoproteins, containing unique α1,4-*N*-acetylglucosamine residues. So Kawakubo *et al.* decided to test these molecules for microbicidal activity.

The authors found that *O*-glycans suppress the growth and mobility of *H. pylori* by interfering with its ability to form a key cell-wall component. They also work on a variety of *H. pylori* strains. Because the antibiotic is naturally produced, the authors hope that their discovery will boost the development of safer drugs to prevent and treat *H. pylori* infections. **Helen Pilcher**

Chemistry

Azaspiracid all joined up

Angew. Chem. Int. Edn **43**, doi:10.1002/anie.200460695 & 200460696 (2004)

Azaspiracid-1 is a complex neurotoxin, originally isolated from the mussel *Mytilis edulis* (pictured), that can cause acute poisoning in humans. But its mode of action is poorly understood — not least because of uncertainties about its chemical structure, which has been one of the hottest challenges in synthetic chemistry. The structure is fiendishly complex, with nine interlinked rings, made of carbon, oxygen and nitrogen atoms, arranged in highly specific orientations that have been difficult to reproduce in the laboratory.

Now, however, K. C. Nicolaou *et al.* report a total chemical synthesis of azaspiracid-1. By comparing the synthetic molecule with the natural product, they are able to confirm the structure and so rule out an earlier proposal of a slightly different arrangement. The key step in the synthesis, say the authors, came when a flaw in the original proposal was tracked down to a portion of the molecule with a similar structure to lissoketal, a much simpler marine natural product whose

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structure was already well understood.

The ability to prepare azaspiracid-1 in sufficient quantities allows further investigation of what makes the molecule so toxic. The authors also hope that it will open the route for the development of a test to detect it in seafood and water. **Mark Peplow**

Neurobiology

Night visionaries

Curr. Biol. **14,** 1309–1318 (2004)

Working at night can be advantageous for a bee — many plants flower nocturnally, and there are fewer predators around. But bees are famously visual creatures, navigating with the aid of familiar landmarks. So how do nocturnal species such as the South American sweat bee *Megalopta genalis* find their way around in the dark?

The answer, report Eric J. Warrant and colleagues, is that they have acquired a suite of sophisticated modifications to the standard equipment. Like daytime bees, *M. genalis* has 'apposition' eyes made up of separate lenses that each focus onto an area of light-sensitive cells called a rhabdom. But the total rhabdom area is much larger than that of daytime bees, helping to provide 30 times more light-detecting power.

Even this is not enough for the bees to find their way home after dark, however — they typically live in 6-millimetre-wide holes in the rainforest undergrowth. It turns out that the bees' optical nerves are also interconnected to facilitate 'spatial summation', combining the signals from the few photons they detect to build a cumulative low-resolution picture. The authors argue that the bees probably use temporal summation too. The resulting picture is probably both blurry and jerky — but when you're in the forest at night, it's better than nothing. **Michael Hopkin**

Energy generation

Power from heat and noise

Appl. Phys. Lett. **85,** 1085–1087 (2004)

Onboard power for spacecraft must be lightweight and efficient. Currently, it is typically provided either by fuel cells or by thermoelectric devices, which convert a temperature gradient (produced by a radioactive source) directly into electrical power. But S. Backhaus *et al.* think they can do better.

They have made a thermoacoustic generator that converts heat to electricity with around 18% efficiency, more than twice as good as thermoelectrics. The device uses the same principle as a Stirling heat engine: expansion of a hot gas creates the engine's power stroke. In the present case, motion of the piston is driven by expansion of helium inside a tube that is hot at one end and cool at the other. This motion is converted to electricity using linear alternators — coils of copper wire attached to the piston that move through a magnetic field.

The pressure oscillation of the gas basically corresponds to an acoustic travelling wave inside the engine, which is amplified by the temperature gradient (provided here by electrical heating, although it could come from radioactive decay for space applications). This amplification allows the motion to arise purely out of thermal noise, just like acoustic feedback in a public-address system. **Philip Ball**

Genetics

Advantage, testis

Proc. Natl Acad. Sci. USA **101,** 11695–11700 (2004)

In males with the 'juvenile spermatogonial depletion' mutation, sperm are produced but don't develop, rendering adults infertile. Jan Rohozinski and Colin E. Bishop offer insight into the basis of this disorder, as well as a proposal for the evolution of male germline function.

In male mice with this mutation, the authors identified an error in the *Utp14b* gene. This gene encodes a protein required for the production of 18S ribosomal RNA, which in turn is needed for general protein synthesis. The authors found that *Utp14b* is expressed primarily in male germline cells, explaining why the mutation is so detrimental to sperm production.

The authors also identified a related gene, *Utp14a*, on the X chromosome; this gene is expressed in non-germline cells and in a later stage of sperm production. Curiously, the sequence of *Utp14b* indicates that it was derived from spliced *Utp14a* messenger RNA that jumped back into the genome.

So why are there two copies of *Utp14*? Rohozinski and Bishop propose that *Utp14b* acquired testis-specific expression, and that this property proved evolutionarily advantageous, as the highly proliferative germ line would require high levels of protein synthesis. In support of this view, humans have a similar 'retrogene' that seems to have arisen independently of the mouse version — suggesting that it, too, was selected by evolutionary pressure. **Angela K. Eggleston**