Taters for tots provide an edible vaccine

Consider the versatile potato. Even most children consume it in at least some form—baked, mashed, French fried, the list goes on. Now, molecular biologists predict that through genetic engineering they can turn spuds into the darling of the medical world: low-cost, nutritious vaccines.

William H.R. Langridge and his coworkers at Loma Linda (Calif.) University School of Medicine say they have inserted into potatoes a gene that enables the tuber to make a nontoxic component of the cholera toxin. The research could lead to protection against a scourge that afflicts 5 million people annually, they assert.

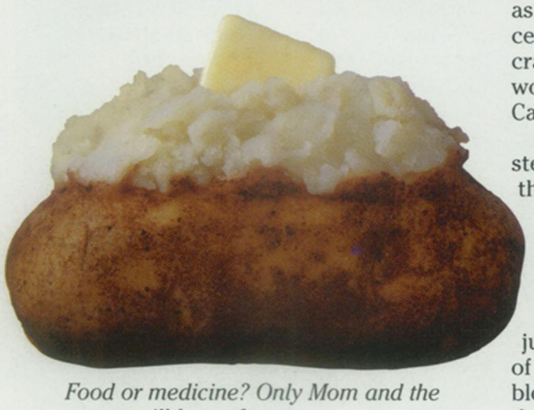
Moreover, because the toxins produced by the bacterium that causes cholera and by the more common *Escherichia coli* are nearly identical, Langridge says, vaccines against one germ may head off or ameliorate disease caused by the other.

Cholera locks open crucial pores in cells lining the gut. "So water pours from the blood into the intestines and then out of the system," Langridge notes. People with this diarrhea can quickly become dehydrated and die.

Langridge's team added the cholera toxin's B-protein to potatoes. This portion of the toxin not only binds to cells in the gut, it also triggers the production of antibodies against cholera.

Mice ate the altered potato raw once a week for 4 weeks and downed a booster meal some 40 days later. The scientists then removed pieces of intestine from the animals and added cholera toxin to the tissues. In the March NATURE BIOTECHNOLOGY, Langridge's team reports that tissue from the treated mice leaked about half as much as tissue from mice that ate only regular potato.

Because people seldom eat potatoes raw, the scientists cooked the medicinal spuds and found that at least half of the vaccine survived in biologically active form—a donut-shaped ring of five linked B-protein molecules. Taking into account the fact that to develop immunity, people need far less of the vaccine than mice do, Langridge calculates that one cooked potato a week for a month should provide enough active B-protein to immunize against the cholera toxin. However, because immunity falls over time, periodic booster spuds would be required.



Food or medicine? Only Mom and the grocer will know for sure.

Langridge plans to refine the potato further, adding genes to make its vaccine target not just the toxin but also the bacterium that produces it. Such potatoes would constitute a medicine, he emphasizes, and should not be eaten too often. Overexposure to their vaccine could suppress a person's production of disease-fighting antibodies.

Charles J. Arntzen of Cornell University's Boyce Thompson Institute for Plant Research was one of the first scientists to engineer a potential vaccine into potatoes, but the *E. coli* protein he uses breaks down at high temperatures. He says he is especially interested in the results from cooked potatoes in the Loma Linda project.

Concern that heating would inactivate vaccines had led to an expectation that any useful ones would eventually need to go into foods eaten raw, such as bananas, observes Carol Tacket at the University of Maryland's Center for Vaccine Development in Baltimore. "But now that we know you can cook them, maybe potatoes will become the ultimate vehicle." —*J. Raloff*

Craft eyes new evidence of a slushy Europa

The promise of a watery world lurking beneath the surface of a faraway moon just got more real. The sharpest images ever taken of Jupiter's icy satellite Europa offer fresh evidence that it possesses either a vast liquid ocean or a partially frozen sea as slushy as a snow cone.

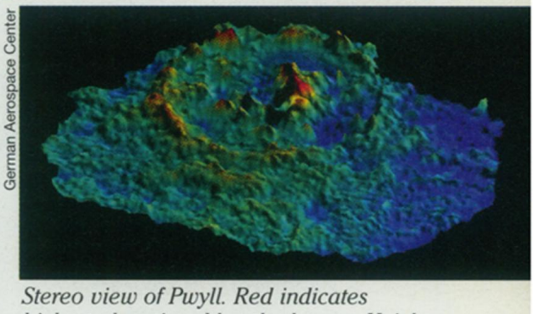
Unveiled this week, the pictures were recorded by the Galileo spacecraft on Dec. 16, 1997, when it came within 900 kilometers of the moon—its closest pass. These images show details as small as 6 meters across. Several features are best explained by water or slush a few kilometers below the surface, scientists asserted at a briefing at Brown University in Providence, R.I.

Water remains frozen on Europa's chilly surface, but the gravitational tug of Jupiter and other moons causes flexing that may generate enough heat to melt subsurface water (SN: 8/9/97, p. 90).

One area examined by Galileo contains the crater Pwyll. Several properties of this 26-km-wide crater, including its girth and the presence of debris ejected during its excavation, suggest that Pwyll formed as recently as 10 million years ago. A crater this young, if it forms in rock or solid ice, typically retains its original size and depth. Yet stereo pictures constructed from Galileo images reveal that Pwyll's bottom is at the same level as its surroundings and that the crater's central peak rises far above the rim. A crater of similar size on Earth's moon would have a hole as deep as the Grand Canyon, says James Head of Brown.

He argues that Pwyll's shallowness stems from the presence of fluid beneath the surface. This material, displaced by the impact that created Pwyll, quickly flowed back, lifting the entire structure, Head and his colleagues propose.

Galileo also took a close look at a jumbled collection of fractured chunks of ice, each the size of several city blocks. Previous images indicated that the chunks are either gliding on warm



German Aerospace Center

Stereo view of Pwyll. Red indicates highest elevation, blue the lowest. Height is exaggerated by a factor of 4.

ice or floating like icebergs in an ocean. The new images reveal that the material between the chunks has a rough, ropy texture. Such a texture is most likely formed by slush that froze in place when it rose to the moon's frigid surface, says Robert T. Pappalardo of Brown.

In addition, Galileo homed in on a region containing wedges of dark material thought to be new crust. The images show more clearly than ever that the wedges are scarred by linear ridges and parallel grooves. Such markings resemble those seen in new crust on Earth's seafloor, where lava has pushed up, cracking and separating the old surface. Instead of lava, the molten material on Europa could be water or slushy ice, says Louise Prockter of Brown.

The new pictures provide "a compelling case for liquid in recent times" beneath parts of the surface, says William B. McKinnon of Washington University in St. Louis. More images, though not quite as detailed, are expected as Galileo flies past Europa another six times over the next 22 months.

McKinnon notes, however, that the "concrete proof that people want" awaits a new mission, set for launch in 2003. That craft, orbiting Europa rather than repeatedly flying past it, will generate radar maps to deduce more directly the presence of an ocean. —*R. Cowen*