

We are what we eat, so why not eat healthy?

NATURE'S SECRETS
MEG LOWMAN



"Indeed, no people on earth worry more about the consequences of their food choices than we Americans do – and no people suffer as many diet-related health problems. We are fast becoming a nation of orthorexics: people with an unhealthy obsession with healthy eating."

MICHAEL POLLAN,
"IN DEFENSE OF FOOD"

Thanks to first lady Michelle Obama's healthy-eating campaign, and to a number of recent medical reports, Americans are looking more closely at their diets. Most countries have evolved a cuisine over many centuries based on their environment and culture. The French stay healthy with a long-standing affection for red wine, cheese, fresh bread and olive oil. Asians remain slim and relatively free of heart attacks with fish and rice. But in the past few decades, Americans have witnessed radical dietary shifts, ranging from obsessions for fast foods, low cholesterol, fiber, omega-3 and flax. What next?

Ironically, many families pay more for what goes into their cars than what goes into their stomachs. And, despite all the information about nutrition, our population increasingly suffers from obesity, diabetes, heart problems and high cholesterol. Even worse, the joy of eating is declining amid all the confusion about how to eat healthy.

This may be the only Nature's Secrets column worth clipping and affixing to your refrigerator (with thanks to advice from food writers Michael Pollan and Alice Waters, and our local farmers markets). Here are 10 rules of healthy eating:

1. Pay more for your foods (for higher-quality food) and eat smaller portions.
 2. Make meals a daily ritual. Eat slowly and always at the table.
 3. Do not buy fuel for your body at the same place you buy it for your car.
 4. Cook with love and eat with appreciation.
 5. Avoid food products with ingredients that are unpronounceable, contain more than five unfamiliar ingredients or include high-fructose corn syrup.
 6. Avoid eating foods that make grandiose health claims.
 7. Eat plants, mostly leaves, and try to consume wild, local varieties of food whenever you can.
 8. You are what you eat eats. (If you eat fish that ate mercury and plastic, then you ingest those things, too.)
 9. Don't eat anything your grandmother would not recognize in her kitchen as food.
 10. Eat more like the French or the Greeks or the Italians or the Japanese (almost any other culture except our Western diet).
- Bon appétit!

Meg Lowman is an N.C. State University professor and forest canopy expert who directs the Nature Research Center, N.C. Museum of Natural Sciences. Online: www.canopymeeg.com.

REACH OUT

We value reader comments and suggestions. Contact John Bordsen, SciTech editor:



Bordsen

jbordsen@charlotteobserver.com;
704-358-5251; SciTech, P.O. Box 30308,
Charlotte, NC 28230-0308
Online: charlotteobserver.com/scitech
On Facebook: Search for "SciTech."

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Silk + spider DNA = super fabric

N.C. biotech firm puts arachnid genes in silkworm eggs to create spinners of new fiber

BY AMBER VEVERKA
Correspondent

Stumble into a sticky spiderweb and your first thought probably isn't "Someone should make cloth out of this."

But David Brigham has made spider-silk fabric, and to hear him describe it, the stuff is close to magical. Spider silk, he says, has the potential to replace human tendons, help re-grow organs and stop bullets.

Brigham is the scientist behind the Charlotte-based company EntoGenetics, which is developing spider silk into a commercial product for medical, industrial and military customers. EntoGenetics last week announced the production of their first woven fabric that appears to be at least partly made of spider silk, and Brigham says he and company president Gary Lesley are talking with potential commercial partners. Lesley and Brigham have a vision of ex-tobacco fields being used one day to farm mulberry leaves to feed silkworms whose fiber is woven in North Carolina textile mills.

Spider silk's great strength is well-known. Pound for pound, spider silk is five times as strong as steel.

But spiders aren't exactly the most farm-friendly of creatures.

"First of all, they are cannibalistic," Brigham says. "If you have five spiders in a cage, pretty soon you'll have one fat spider. And they make tiny quantities of silk. And the other thing is – they bite."

On the other hand, silkworms don't bite people or devour each other and they are prodigious producers of silk. They've been bred for thousands of years to create fiber. And the domestic moths are flightless, so they can't escape to become pests.

So Brigham has inserted part of a silk-making gene from a golden orb weaver spider into silkworms, so that the worms produce strands that appear to be part spider silk. The pale-ivory fabric woven from such silk, he says, is tough but "cloud-like."

Challenge of size

But it was a long process from idea to fabric. First, Brigham, in conjunction with N.C. State University's entomology lab, created a synthetic spider silk gene. "These are horrible genes to work with. They're incredibly repetitive and the DNA makeup is different than anything we've worked with," says Marce Lorenzen, an N.C. State assistant professor of entomology and principal investigator on the silkworm project. "What David has chosen to work with is the most challenging DNA of a spider to put into the most challenging part of a silkworm."

Silkworm eggs are about the size of large poppy seeds, and Brigham had to use a needle that, at its tip, is the width of a human blood cell. Maneuvering it under a microscope, he slid the almost-invisible needle into each silkworm egg and deposited the new spider DNA. He did this hundreds of times. Yes, says Brigham, "it's extremely tedious."



A golden orb weaver spider. Spider silk is five times as strong as steel, pound for pound, so scientist David Brigham injected part of a silk gene from golden orb weaver spiders into silkworm eggs.



Inside a bin of EntoGenetics silkworms. Silkworms have been bred for thousands of years to create fiber.

He's working on a different method of gene insertion, which he won't yet discuss, that he says will simplify the process.

After all the work, many of the resulting silkworms didn't carry the new gene. And after those that did were bred together, just 25 percent of their offspring carried the necessary two copies of the spider gene in order to create a breeding population.

Finally, at EntoGenetics' Polkton lab, enough spider-silk-spiked silkworms were alive and breeding to create the fuzzy cocoons Brigham needed to yield fiber. The N.C. State lab is testing the silkworms' DNA to find out where in the worms' chromosomes the spider genes are located. But Brigham says the fiber that EntoGenetics' silkworms made already is tougher than regular silk.

It could be used for thinner, stronger medical sutures and textile applications, he says.

But his main goal is to beat Kevlar. "We're looking to be three to five times tougher – that's how much energy the fiber absorbs – than Kevlar or Spectra," Brigham says. Kevlar and Spectra are synthetics that currently are the gold standard for ballistic fabrics. Brigham says pure spider silk can outperform both in terms of energy absorption, while also being lighter and more flexible.

The next step is inserting the complete strand of spider DNA into a silkworm – no easy task. "That is an immensely large gene," Brigham says. "Imagine cooked spaghetti. If you have a one-inch piece of cooked spaghetti, you can push it around with your fork and make it do what

you want. Very large pieces of DNA don't work well, like full-length spaghetti."

Brigham says spider silk's potential is "breath-taking."

"Somebody breaks an Achilles tendon on the basketball court and they're out for six months. You could replace that tendon with a spider-silk one and you could be walking as soon as staples are out," he says. "You can use it for culturing organs. You can weave the silk into complex shapes, then you can put stem cells in there and they can grow into... whatever this thing I've woven is."

Next: Marketing

Gary Lesley, EntoGenetics' newly hired president, says the company will need about \$5 million in cap-

ital over the next three to five years.

"The funding strategy is to ideally find a strategic partner that's already in the industry that would not only be a ready-made customer but a portal that is already connected with many, if not all, the potential market niches," Lesley said. "There are a small number of entities like that not far from Charlotte. We're in conversation with a small number of potential partners (and) later this spring we expect to announce the first major partner."

EntoGenetics got some startup funding from N.C. IDEA, a not-for-profit that gives seed money to new technology companies, and from Duke University and the N.C. Rural Development Center. More money came from the N.C. Biotechnology Center, Brigham's friends and family and, as he put it, "a second mortgage on a house, cashing in a retirement fund and credit-card max-ing."

EntoGenetics isn't alone in the field. A Lansing, Mich.-based company, Kraig Biocraft Laboratories, also is pursuing spider-silk creation through genetically modified silkworms. Kraig Biocraft, which is publicly traded, also has yet to commercialize its product.

As for Brigham, he envisions turning former tobacco fields into mulberry tree plantations, with leaves being grown to feed to silkworms housed in abandoned textile plants whose fiber can be spun and woven in the state.

"That's the goal – to not only eventually making it here, but reeling it and turning it into fabric here," he says. "We may be able to pull off most of it, but I'm hoping for all of it."

Science Briefs

» Your personal close-up photo of the moon

The public is invited to a presentation of NASA's GRAIL mission April 13 at the Pisgah Astronomical Research Institute, near Rosman, in the Pisgah National Forest. Dr. Michael Castelaz, PARI Science director, will explain the Gravity Recovery and Interior Laboratory mission and how NASA is offering the public a rare opportunity to photograph the moon using cameras aboard lunar satellites.

NASA's GRAIL mission began with the launching of two satellites last September. The satellites are now orbiting the moon and are equipped with cameras that can be used by middle-schoolers and others who are granted access to photograph craters, mountains and other features of the lunar surface.

At the April 13 presentation, you'll be given a one-per-family one-time password enabling you – at a PARI computer or later, from your own home computer – to capture your personal image from the moon.

"Imagine yourself orbiting the moon getting as close as 10 miles from the lunar surface, spotting an interesting looking crater, and then snapping a photo," said Castelaz.

Cost: \$20; \$10 for 14 and younger. Details/reservations: 828-862-5554; www.pari.edu. — STAFF REPORTS

» Ballet fans know how to feel the moves

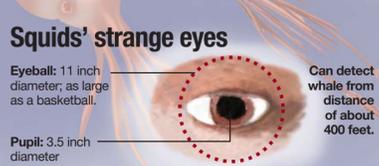
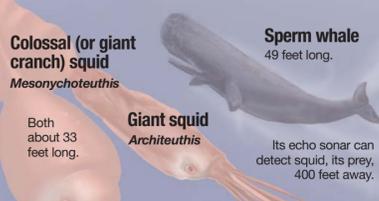
Ballet lovers may "truly feel that they are dancing" when they watch a performance, researchers have found after measuring the brain activity of experienced spectators.

In findings published in the current issue of the journal PLoS One, the scientists report that the spectators showed muscle-specific responses in their brains as if they were expert dancers – even though "they were clearly not capable of doing the actual movements," in the words of one author, Corinne Jola, a cognitive neuroscientist at the University of Surrey in England.

The researchers focused their work on a muscle called the extensor carpi radialis, which connects the upper arm to the hand. It is one that ballet dancers pre-

Giant eyes watch for killer

Researchers say they now understand why huge eyes – the animal kingdom's largest – are useful to the giant squids.



Squids' strange eyes



90 million years ago, another ocean predator had large eyes it could use to evade a larger predator; both were dinosaurs.

Source: Dan Nilsson of Lund University (Sweden), Current Biology; squid drawing by Citron Graphic; Helen Lee McCormick. © 2012 MCT

sumably rely on, Jola said.

They used a method called transcranial magnetic stimulation to measure brain activity in the dance spectators.

— NEW YORK TIMES

» Noise pollution is changing forests

A few years ago, researchers discovered that in areas polluted by human-made noise, a species of hummingbird seemed to increase in population, while a jay species seemed to decrease. The same researchers now report that noisy areas have more flowers, but fewer trees. It's a domino effect, said Clinton Francis, an evolutionary ecologist at the National Evolutionary Synthesis Center (NESCent) in Durham.

Pinyon pine trees rely on scrub jays to disperse their seeds, he

said. And black-chinned hummingbirds, which pollinate flowers, seek out noisy areas to avoid the jays, which eat their eggs and even their nestlings.

The scientists set up motion-activated cameras at various sites in northwestern New Mexico. Some sites were quiet; others were near natural gas wells, equipped with noisy compressors.

Francis' team found that in noisy areas, many mice seek out pinyon seeds, while scrub jays avoid them altogether. Francis says he worries about the loss of pinyon pines, which play a crucial role in the ecosystem of the Southwest.

NESCent is a nonprofit science center jointly operated by Duke University, UNC Chapel Hill and N.C. State. — NEW YORK TIMES

In the News

Many carnivores lack a sweet tooth

The affected mammals don't have a working copy of a key receptor gene

BY AMINA KHAN
Los Angeles Times

For all their sharp teeth, many meat-eating mammals lack a sweet tooth, a genetic analysis of a dozen species has shown.

The study, published last month in the journal Proceedings of the National Academy of Sciences, shows that carnivorous mammals whose diets don't feature much in the way of sugar may lose the ability to taste it at all.

Study co-author Gary Beauchamp, director of the Monell Chemical Senses Center in Philadelphia, wasn't sure what he was expecting to find when he and his colleagues began looking at DNA samples of a dozen different species to study their taste receptor genes. But he knew that cats are indifferent to sweet carbohydrates and lack a working copy of a key taste receptor gene called Tas1r2. "At the time, the feeling was that the cat was a very unusual anomaly



The spotted hyena is among several species of carnivorous mammals that can't taste sweets.

among mammals in that it didn't respond to sweets," Beauchamp said. "But we wondered if the cat represented something that had happened many times."

Using DNA samples mostly pro-

vided by the San Diego Zoo, the team from Monell and Switzerland's University of Zurich examined taste receptor genes in a dozen different mammals and found that seven species – including sea lions, Asian otters and spotted hyenas – lack a properly functioning Tas1r2 receptor. All seven were meat- or fish-eaters.

The precise mutation in the Tas1r2 gene varied from species to species – indicating that the loss of a sweet tooth wasn't something that occurred just once in the mammalian family tree but happened independently at different points in time.

Sweet wasn't the only taste to disappear. Sea lions also appeared to lack functioning genes for detecting the savory tastes known to humans as umami. So did dolphins, which also lack working genes to detect different types of bitter substances. That was surprising to Beauchamp, he said, since bitterness is a useful warning of the presence of poison.

Another, the findings "illustrate the fact that the sensory world of animals is highly attuned to their dietary patterns," Beauchamp said. The loss of major taste receptors in

sea lions and dolphins makes sense given that these species often gulp their food without chewing, he added.

A similar pattern appears to hold for vegetarian mammals. Beauchamp pointed to research showing that bamboo-eating pandas have a well-developed palate for sweets, but they lack working umami receptors to detect savory, "meaty" foods.

Thomas Finger, a neurobiologist at the University of Colorado's Rocky Mountain Taste and Smell Center in Aurora, who was not involved in the research, said the study was "pretty impressive." Now he wonders whether the lack of working sweet genes is a sign that there's an evolutionary cost to maintaining an essentially useless taste receptor.

As for those cat owners who insist their feline loves chocolate or goes crazy for ice cream, Finger shrugged at humans' tendency to anthropomorphize their pets' tastes. "Ice cream has a strong umami taste to it, so that's why your cat likes ice cream," he said. "It's the milk protein. We're very sensitive to sweets, but the cat doesn't get it."

Science Q & A

What's making my HDTV slip out of sync?

New York Times

Q: I watch television through a small antenna attached to my HDTV. Sometimes the sound and picture get increasingly out of sync as a show goes on. The sound usually precedes the picture. Why does that happen?

Although the pictures and sound in digital television are transmitted together (the technical term is "multiplexed"), they are "separate streams of data and are processed by separate hardware and/or software paths at television stations and in TV receivers," said V. Michael Bove Jr. of the Media Lab at the Massachusetts Institute of Technology.

When the two streams do not match, "it might be the television station's or network's fault, or it might be your TV set's fault," Bove said.

"The audio is supposed to stay synchronized to within a frame or two of video," he said, "but sometimes things are misconfigured somewhere at the origination end."

Television receivers can also have hardware or software problems that cause loss of synchronization.

"The easiest way to determine where the problem lies is to watch the same program on another set at the same time and compare the audio lip-sync," Bove said.

Q: If I find myself in a free-falling elevator, is there any position that might increase my chance of survival? (Climbing on top of other people is not an acceptable answer.)

The best option would be to lie on your back on the floor as flat as possible, said Eliot H. Frank, a research engineer at the Center for Biomedical Engineering at the Massachusetts Institute of Technology.

"This will distribute the force of impact over the greatest area of your body so that no particular part of your body is subjected to the weight of any other part of your body," he said. "The impact of the elevator at the bottom of the shaft would subject you to extreme gravitational acceleration, or G-forces," Frank explained. "The number of G's you experience multiplies your normal weight, so if you experience 10 G's, you would experience 10 times the weight of your body."

"You might think that bracing yourself or bending your legs would help, but at high G-forces, your legs would simply not be able to support the weight of your body," he said.

The folk wisdom of jumping up at the moment of impact is convincingly debunked in a "MythBusters" video on the Discovery Channel website. It would not work unless you could know the precise moment of impact and leap at the same speed the elevator is plunging,



Wind power: A breath of fresh air for energy

As demand for power increases and we look for cleaner, greener ways to produce electricity, finding and developing new, renewable sources becomes more important than ever. That's why Duke Energy has invested more than \$2.5 billion since 2007 to build wind farms that produce "green" energy.

Wind power is the single fastest-growing energy source in the world. It's one of the most readily available, cost-efficient sources for producing electricity. Experts estimate that by 2030, nearly 20 percent of our nation's energy could be supplied by wind.

Duke Energy owns and operates 10 U.S. wind farms and is constructing an additional five sites this year. By 2013, the company's wind farms will be capable



of supplying more than a half-million American homes with clean, renewable energy.

In addition to being one of our most abundant resources, wind is also one of the cleanest. Wind turbines produce zero emissions and the fuel they use to create electricity is inexhaustible and free. And while wind farms can take up a lot of land, most of

it can still be used for other purposes, like farming, ranching and recreation.

Wind power isn't the answer by itself. One drawback is that you only get electricity from wind turbines when the wind is blowing. Storing wind power in large-scale batteries is one way to overcome this challenge. Later this year, Duke Energy will begin testing this potentially game-changing technology at one of its five Texas wind farms.

To learn more about wind power and what else Duke Energy is doing to help meet the demand for affordable, reliable and increasingly clean electricity, please visit duke-energy.com/renewables.

