Is Your Food Contaminated?
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Given the billions of food items that are packaged, purchased and consumed every day in the U.S., let alone the world, it is remarkable how few of them are contaminated. Yet since the terrorist attacks of September 11, 2001, “food defense” experts have grown increasingly worried that extremists might try to poison the food supply, either to kill people or to cripple the economy by undermining public confidence. At the same time, production of edible products is becoming ever more centralized, speeding the spread of natural contaminants, or those introduced purposely, from farms or processing plants to dinner tables everywhere. Mounting imports pose yet another rising risk, as recent restrictions on Chinese seafood containing drugs and pesticides attest.

Can the tainting of what we eat be prevented? And if toxins or pathogens do slip into the supply chain, can they be quickly detected to limit their harm to consumers? Tighter production procedures can go a long way toward protecting the public, and if they fail, smarter monitoring technologies can at least limit injury.

**Tighten Security**
Preventing a terrorist or a disgruntled employee from contaminating milk, juice, produce, meat or any type of comestible is a daunting problem. The food supply chain comprises a maze of steps, and virtually every one of them presents an opportunity for tampering. Blanket solutions are unlikely because “the chain differs from commodity to commodity,” says David Hennessy, an economics professor at Iowa State University’s Center for Agricultural and Rural Development. “Protecting dairy products is different from protecting apple juice, which is different from protecting beef.”

Even within a given supply chain there are few technology-based quick fixes. Preventing contamination largely comes down to tightening physical plant security and processing procedures at every turn. Each farmer, rancher, processor, packager, shipper, wholesaler and retailer “has to identify every possible vulnerability in the facility and in their procedures and close up every hole,” says Frank Busta, director of the National Center for Food Protection and Defense at the University of Minnesota. The effort begins with standard facility access controls, which Busta often refers to as “gates, guns and guards,” but extends to thoroughly screening employees and carefully sampling products at all junctures across the facility at all times.

That advice seems sound, of course, but the challenge for operators is how best to button down procedures. Several systems for safeguarding food production have been rolled out in recent years. Though these are not required by any regulatory agency, Busta strongly recommends that producers implement them. In the U.S., that impetus has been made stronger by legislation such as the 2002 Bioterrorism Act and a 2004 presidential
directive, both of which require closer scrutiny of ingredient suppliers and tighter control of manufacturing procedures.

The primary safeguard systems Busta recommends borrow from military practices. The newest tool, which the FDA and the U.S. Department of Agriculture are now promoting, carries the awkward name of CARVER+Shock. It is being adapted from Defense Department procedures for identifying a military service’s greatest vulnerabilities. “CARVER+Shock is essentially a complete security audit,” says Keith Schneider, associate professor at the University of Florida’s department of food science and human nutrition. The approach analyzes every node in the system for factors that range from the likely success of different kinds of attacks to the magnitude of public health, economic and psychological effects (together, the “shock” value) that a given type of infiltration could cause.

**Track Contaminants**

No matter how tightly procedures are controlled, determined perpetrators could still find ways to introduce pathogens or poisons. And natural pathogens such as salmonella are always a concern. Detecting these agents, tracing them back to the spot of introduction, and tracking which grocery stores and restaurants ended up with tainted products are therefore paramount. Putting such systems in place “is just as important as prevention,” Schneider says.

Here new technology does play a major role, with various sensors applied at different points along the chain. “You can’t expect one technology to counter all the possible taintings for a given food,” notes Ken Lee, chairman of Ohio State University’s department of food science and technology.

A variety of hardware is being developed, although little has been deployed commercially thus far. Radio-frequency identification (RFID) tags are furthest along, in part because the Defense Department and Wal-Mart have required their main suppliers to attach the tokens to pallets or cases of foodstuffs. The Metro AG supermarket chain in Germany has done the same. The ultimate intent is for automated readers to scan the tags at each step along the supply chain—from farm, orchard, ranch or processor, through packaging, shipping and wholesale—and to report each item’s location to a central registry. That way if a problem surfaces, investigators can quickly determine where the batch originated and which stores or facilities might have received goods from that batch and when. Retailers can also read the tags on their items to see if they have received a product later identified as suspicious.

As RFID tags get smaller and cheaper, they will be placed directly on individual items—on every bag of spinach, jar of peanut butter, container of shrimp and sack of dog food. “That way if a recall is issued, the items can be found as they run past a scanner at the checkout counter,” says Jean-Pierre Émond, professor of agricultural and biological engineering at the University of Florida.
Universities and companies are developing all kinds of other tags, some that are very inexpensive and others that cost more but supply extensive information. Some tokens, for example, can sense if food has been exposed to warm temperatures and thus might be more likely to harbor Escherichia coli or salmonella. Other tags could track how long items spent in transit from node to node in the supply chain, which could indicate unusually long delays that might raise suspicion about tampering. So-called active packaging could detect contamination directly and warn consumers not to eat the product they are holding.

The big impediment for any marker, of course, is the price. “Right now it costs 25 cents to put an RFID tag on a case of lettuce,” Emond notes. “But for some growers, that equals the profit they’re going to make on that case.”

To be embraced widely, therefore, he says tags will have to provide additional value to suppliers or buyers. His university has been conducting an ongoing project with Publix Super Markets and produce suppliers in Florida and California to assess the possibilities. In initial trials, tags tracked crates and pallets that were shipped from the growers to several of Publix’s distribution centers. Information gleaned from scanning tags at various points was available to all the companies via a secure Internet site hosted by VeriSign, the data security firm. The compilation allowed the participants to more quickly resolve order discrepancies, to log how long food sat idle, and to reveal ways to raise shipping efficiency. The group plans to extend the test to retail stores.

**Control Suppliers**
Costs will not drop until new technologies are widely deployed, but food defense analysts say adoption is unlikely to occur until clear, streamlined regulations are enacted. That prospect, in turn, will remain remote until the highest levels of government are reformed. “There are more than a dozen different federal agencies that oversee some aspect of food safety,” Lee points out, noting that simple coordination among them is difficult enough, and efficient approval of sensible requirements is even harder to come by. The FDA regulates pizza with cheese on it, but the USDA regulates pizza if it has meat on it, quips Jacqueline Fletcher, professor of entomology and plant pathology at Oklahoma State University. “The requirements for organic farmers are different from those for nonorganic farmers.”

Spurred by recent recalls, members of Congress have called for streamlining the regulation system. Illinois Senator Richard Durbin and Connecticut Representative Rosa DeLauro are advocating a single food-safety agency, but turf wars have hampered any progress toward that goal.

Concerned that more effective government is a long shot, experts say the responsibility for improved vigilance falls largely on food suppliers. “The strongest tool for stopping intentional contamination is supply-chain verification,” says Shaun Kennedy, deputy director of the National Center for Food Protection and Defense. That means a brand-name provider such as Dole or a grocery store conglomerate such as Safeway must insist that every company involved in its supply chain implement the latest security procedures
and detection, track and trace technologies or be dropped if it does not. The brand company should also validate compliance through inspections and other measures. The impetus falls on the brand-name provider because it has the most to lose. If a natural or man-made toxin is found in, say, a bag of Dole spinach or a container of Safeway milk, consumers will shun that particular label. “If a brand-name company wants to protect its products,” Kennedy says, “it should validate every participant in the chain, all the way back to the farm.”

Making Imports Safer
Alarming warnings about Chinese products in recent months have shown how dangerous imported edibles can be. In March some 100 brands of pet food were recalled after they were found to contain melamine, a toxic chemical used as a cheap replacement for wheat gluten. Then in June the U.S. Food and Drug Administration issued alerts about five types of seafood that contained antibiotic residues, pesticides and salmonella.

After the seafood scare, Senator Charles Schumer of New York declared that the federal government should establish an import czar. He blamed poor control of imports on a lack of inspection and poor regulation, telling the Washington Post that “neither the Chinese or American government is doing their job.”

Regardless of how safe domestic production is, “imports are our Achilles’ heel,” says Ken Lee, chairman of Ohio State University’s department of food science and technology. “There is no global food regulator. If the Chinese want to put an adulterant into food, they can do it until they get caught. I’ll wager it will happen again, because it’s driven by the profit motive.”

Realistically, no technology can ensure that imports are safe. The food in every shipping container entering a U.S. port or border crossing could be pulled and irradiated, and some comestibles such as spices are already processed this way. But industry says the step would add significant cost for producers and shipping delays for middlemen. And the public continues to be wary of the technology. Furthermore, although irradiation would kill pathogens, it would have no effect on poisons or adulterants.

Inspecting all incoming food would also require vast increases in FDA and U.S. Department of Agriculture budgets; the agencies currently inspect a meager 1 percent of imports. As a partial alternative, in June the FDA said it intended to conduct more inspections of products from countries it deems to have poorer food-safety controls, such as China, offset by fewer inspections of products from countries with stronger standards, such as Britain and Canada. The agency also said it might require importers and U.S. manufacturers that use imported ingredients to provide more detailed information about production processes at foreign suppliers.

The best recourse, Lee says, is for companies to insist that suppliers impose strict standards and that the companies send inspectors overseas to verify compliance. Other experts agree, adding that government edicts are not as effective. “Too often import requirements are used as trade barriers, and they just escalate,” says David Hennessy, an
economics professor at Iowa State University. “The food companies themselves have a lot to lose, however. When they source a product in a country, they ought to impose tough procedures there.”