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It all starts here.
Nature is often recalcitrant. Risks are high, yields are often precarious, and profits usually uncertain.
Yet Americans are blessed with an abundant, inexpensive and *safe* supply of food.
It is a remarkable achievement.
Shouting from the Rooftop and Looking under the Table
Legislating food safety is somewhat like legislating some forms of morality. Compliance ultimately reflects beliefs rather than regulations.

Fortunately, when it concerns food safety, most of the firms that process and distribute food in Utah are believers, says John Poulson.

And he should know.

Poulson supervises the Utah Department of Agriculture staff that inspects every nook and cranny of almost 2,500 firms that process, manufacture or distribute food in the state, as well as almost 750 dairies. (County health inspectors inspect some food services.)

He has high praise for the system, which is a hefty compliment coming from a man who seeks (and occasionally finds) the worst. An overwhelming majority of food establishments in the state voluntarily adhere to high standards, sometimes with prodding by a dozen eagle-eyed inspectors.

It's not all rosy, however. Occasionally, the department must wield legal and financial sanctions to force compliance. And there are several practices not covered by existing regulations that may warrant some oversight by the department.

The chance of a mistake that endangers human health is constantly on Poulson's mind. It happened in the Midwest several years ago when bacteria lingering in cracks of milk processing equipment triggered hundreds of cases of virulent food poisoning, some of them fatal. Poulson and his staff assiduously work to prevent this from occurring in Utah.

The regulations, which fill hundreds of pages of densely packed type, are no better than the commitment of those handling and distributing food. Without that, Poulson says not even the most pervasive system of enforcement would suffice.

"The U.S. food supply is worldwide. Sometimes people have a false sense of confidence that every step of the process is monitored. That's not possible, except at an astronomical price," Poulson says.

Processes that can be monitored are monitored thoroughly, however. Inspectors visit every establishment under their jurisdiction at least once a year, more often if there are problems. Serious problems can precipitate sterner action, although Poulson says they often tread a fine line between offering assistance and what he terms a "heavy regulatory approach," which is invoked about 10 percent of the time violations are detected.
In some “critical food processes”—processes where contamination could easily be life-threatening—there isn’t any leeway. This includes pasteurization, retort processing and canning, and the curing and smoking of meat. For example, pasteurization equipment in dairy plants is monitored at least 4 of 6 months, and equipment is tested quarterly. The controls of pasteurization equipment are sealed after calibration, and the equipment cannot legally be operated unless seals are in place. “Some of the most sophisticated dairy processing equipment in the world is located in the state,” Poulson says.

In addition, dairy products are tested 4 of 6 months, and monitored for bacteria as well as enzymes that indicate proper pasteurization.

All dairy farms are inspected at least twice annually. Most are inspected quarterly. Poulson’s division also inspects retail meat purveyors. (Wholesale distributors and packing plants are inspected by another division of the department and the USDA.) This system means that a large retail grocery may fall under three types of inspection—bakery, grocery (including produce) and meat.

On-site inspections are bolstered by thousands of lab tests, including tests for pesticide and antibiotic residues. “We have vastly improved our testing methods to the point where we can almost detect a grain of salt in the ocean.

“I’d like to shout from the rooftops that we have the cleanest, safest food supply in the world,” he says.

Additiona l Concerns

Human ingenuity creates new marketing opportunities and some gray areas for enforcement, some of which may fall under Poulson’s purview.

“Health” foods. So-called health foods are big business in Utah, and the state ranks as one of the nation’s largest producers of these products. Some estimate that health foods generate $200 million in income annually in Utah County alone.

“Trying to keep up with this area is an overwhelming task. Some health food businesses tread a fine line between medical and food supplements. If a product makes medical claims, then it falls under the category of a drug and must be proven to be safe and effective before it can be sold. Most health foods are marketed as supplements, but those that contain a new food additive must also be proven to be safe. We try to monitor health foods on a complaint-by-complaint basis, but there are all kinds of concoctions promising to cure everything from hemorrhoids to AIDS,” Poulson says.

Nonetheless, the number of products making unproven health claims seems to be increasing, as does the internecine wrangling among firms battling for a share of the market. For example, there were separate petitions to the department for approval of diatomaceous earth as a pesticide and a supplement. Three Utah firms were recently involved in a high-stakes battle over the right to claim the authentic “ancient Chinese formulas” promising the secret to long life and health.

Poulson has similar concerns over the definition of so-called “organic” foods.

The department may have to take a more active role if exaggerated claims continue to proliferate.

Food labeling. Utah is one of the few states to stringently review food labels. In the early 1960s, the federal government passed legislation mandating more accurate food labeling and, subsequently, the inclusion of nutrition information. However, cutbacks at federal regulatory agencies during the 1980s prompted the FDA to announce that it would no longer enforce regulations that did not directly concern health.

Reduced enforcement prompted some manufacturers to emphasize marketing at the expense of accuracy. “There is now absolute chaos in standards for labeling,” Poulson says. He has a suitcase full of examples, including a product made from “imitation cheddar cheese” that is simultaneously labeled as
“natural” and “processed,” a “papaya-flavored” punch containing nothing but, Poulson says, “chemically flavored water” (not a molecule of actual papaya juice in the bottle), cholesterol-free bread that lists butter as an ingredient, and a host of “light” products such as ice milk that have not been altered except for new labels. A favorite ploy of some manufacturers is to reduce the caloric or cholesterol content of a container simply by increasing the number of supposed servings per container.

Poulson says most customers probably are not aware of the latitude allowed in labeling, which could be confusing and dangerous to those on special diets. He notes that U.S. Senator Orrin Hatch is sponsoring a bill that would increase the FDA’s ability to monitor accuracy in labeling.

**Retail curing and vacuum packaging of meat.**

Some large grocery stores in the state are now curing and smoking meats, which is allowed under current regulations. Poulson is concerned that employees of these firms may not be as well trained in the proper processing techniques as employees of officially inspected processing plants, particularly in the use of nitrates, which can be dangerous if not used properly.

Poulson thinks that the vacuum packaging of meat at the retail level “is a time bomb just waiting to explode.” Particularly worrisome is the effort to sell vacuum packaging equipment to households. Vacuum sealing foods prolongs storage if foods are free of bacteria. If not, the anaerobic environment is conducive to the growth of *Clostridium botulinum*, the bacteria that produce one of the deadliest toxins known. Poulson sees several scenarios for disaster—vacuum packaging of fish, which already tend to have a heavy load of bacteria, due to the manner in which they are obtained and processed (only a small percentage of fish is federally inspected), or leftover roast beef that has been handled by several employees as it is moved to and from the display case. Some states, such as Illinois, have outlawed the vacuum packaging of meat by retail stores.

Additional legislation may be necessary to regulate the practice in Utah.

**Making Safety Commonplace**

Every year, Poulson and his staff conduct nearly 3,000 inspections of food establishments and bakeries, nearly 3,000 inspections of dairy plants and farms, and almost 600 inspections of retail meat establishments. The inspections are rigorous. Many kitchens wouldn’t pass muster.

The results seldom make the news.

That’s just fine with Poulson. It means that a safe, wholesome supply of food is an everyday event. Everyday events don’t make the news.

And in this case, no news is good news.

*KG*

John Poulson 974-1258
Poulson is now Director of
Quality Assurance with Smith Food
and Drug Centers, Inc.
Food Fears That Fizzled

You'll die if you eat today's food.
But you'll die much sooner if you don't.

Many Americans have acquired some irrational fears about food, and, unfortunately, it's no laughing matter, says USU food scientist Von T. Mendenhall. The flood of stories about food-related dangers seems to have fostered a certain amount of hysteria about our groceries.

Many of us don't trust what we eat. And most of that fear is unwarranted, Mendenhall says. He cites several widely publicized food-related scares during the last few decades that stirred up considerable concern for a while, but then lost their fizzle as more accurate information was available. To wit:

- **The nitrite scare.** In the mid-1970s, there were reports that nitrates used to preserve cured meat products such as bacon and sausage reacted with amines in the digestive system to form carcinogenic nitrosamines. The resulting flap eventually resulted in a lowering of the allowable nitrite in bacon from 156 parts per million (ppm) to 120 ppm, but not before generating considerable fear among consumers and consternation among meat processors. Later, researchers reported that vegetables contribute far greater amounts of nitrates that are converted by micro-organisms in the lower gut to nitrites, which enter the bloodstream and are secreted in saliva.
The bottom line? In the average diet, cured meat products contribute biologically insignificant amounts of nitrosamines.

- **A sweet tooth and nasty behavior.** Several widely reported studies linked criminal behavior and hyperactivity to excessive sugar consumption. The reports even prompted some officials of the federal prison system to withhold sugar from inmates. Concerned parents attempted to purge sugar from their children's diets and lobbied companies to eliminate it from cereals and other products.

A double-blind study a few years later found no evidence that sugar caused any of these antisocial behaviors. Mendenhall notes that sugar, like many grains and starches, is converted into glucose, a source of energy for our bodies. However, things have never been quite as sweet for the sugar industry since then.

- **The anticarcinogenic vegetables.** A few years ago, the American Cancer Society announced that cruciferous (mustard family) vegetables (e.g., cauliflower, broccoli, brussels sprouts, collards, kale, turnips, etc.) contained anticancer substances. It was only half the story. Scientists also discovered that the high levels of natural pesticides produced by these vegetables were carcinogenic.

- **The friendly fish fiasco.** The media were saturated with reports that Eskimos and Indians in the North-west had a much lower risk of developing heart disease because they ate lots of fish, which supposedly contains protective omega-3 fatty acids. Thousands of Americans started consuming more fish and fish oil. Researchers subsequently discovered that the incidence of heart disease among these Indians and Eskimos was lower because most didn't live long enough to show signs of the ailment, which becomes more prevalent as people age. The life expectancy of some Eskimos cited in early studies was 46 years, due in part to the inadequacy of medical treatment. Average life expectancy of Americans is 76 years. The repercussions of this monumental fish story still linger.

- **The Alar scare.** Several consumer groups said 6,000 children would die annually from consuming apples sprayed with Alar, and the apple industry reeled as consumers avoided the fruit in droves. Mendenhall says only 5 percent of the apples produced in the United States are sprayed with the pesticide, and at levels so low as to pose no health threat. The negative claims about apples saturated airwaves and newspapers. The counterclaims have hardly created a ripple.

Mendenhall says Americans' attitudes toward food are not simply shaped by a pursuit of nutrients. Food is often a talisman for the American pursuit of youth and beauty. "We're afraid to die and apprehensive of becoming old, and we want everything to be 100 percent safe, regardless of our own actions," Mendenhall says. "This obsession leads us to being neophobic, a fear of new things, such as chemicals, which we believe could have catastrophic results over which we have no control."

That fear is exacerbated by our ignorance of the chemistry underlying digestion and the role of nutrients, Mendenhall says. Food must provide 52 essential chemicals (nutrients), but there are thousands of other chemicals that perform other functions, such as quality (flavor, color, odor and texture), chemical functions (emulsifiers, acidifiers, and antioxidants), regulators (enzymes and hormones), and protection (pesticides and toxins).
Moreover, even though few Americans face starvation, animals, insects, plants and microorganisms compete with us for the nutrients in food. Approximately one-fourth to one-third of the food produced never reaches consumers because it is eaten, spoiled or damaged by these organisms.

The ability to select food is a cherished right, and not one that Americans are about to sacrifice voluntarily, even if experts say they should. Nonetheless, those trained in public health and other fields who are best able to objectively assess the risks associated with food think that many of the risks that receive the most publicity pose far less threat than, for example, the improper handling of food in the home.

That gulf is apparent in the actual causes of deaths in the United States. While nutrition plays a role in some ailments such as heart disease and cancer, Americans’ risk of dying from nutrition-related ailments is much less than from other causes.

Mendenhall cites a recent attempt to rank substances, based on the ability of substances to cause cancer in rodents. Potent mold toxins may represent the most significant carcinogen in food in developing countries. (They pose much less of a threat in developed countries as a result of modern agricultural production and storage techniques, including the use of synthetic pesticides and fumigants). Moreover, we ingest many times more natural pesticides than man-made pesticide residues.

The researchers also noted that plants commonly produce many more natural toxins when damaged by insects or fungi. They doubt that Nature has equipped humans to cope perfectly with the naturally occurring toxic chemicals.

Public and Expert Perception of Risks from Eating Food

The Experts

1. Microbial safety
2. Over-nutrition
3. Non-microbial safety
   a. Contaminants
   b. Natural toxins
   c. Ag. chemicals
   d. Food additives

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In other words, Americans may markedly overestimate the risks of cancer that result from human action and vastly underestimate the danger posed by "natural" factors, an irony considering the emphasis placed on "natural" ingredients and foods.

O.K. Now what? Probably more of the same, Mendenhall says. Americans will probably continue to be encouraged to identify some foods as villains or culprits and others as beneficial, depending on headlines. Short of enrolling everyone in a basic chemistry course to teach them how food is digested and utilized, Americans will continue to be swayed by inaccurate and misleading information. "Most consumers are simply not prepared to sort out what to eat and what to leave alone," Mendenhall says.

And when all is said and done, Mendenhall has some advice that's, well, rather ho-hum: "Eat a balanced diet, one that includes meat, milk, bread, fruits and vegetables, exercise regularly, maintain an ideal weight, keep an open, active mind, and learn how to relax," he says.

And perhaps eating shouldn't always be such a serious issue.

"I told my 103-year-old great-grandmother that I was going to give up chocolate and red meat, exercise every day, go to bed early every night and get 8 hours of sleep. I asked her whether I would live longer.

"No," she said, 'but it will seem longer.'"
When You and Microbes Share the Same Food:

HOW TO PREVENT FOODBORNE ILLNESSES
Don’t worry about the stomach flu. Do worry about foodborne illness.

People often complain about the ‘stomach flu,’ says USU microbiologist D. Andy Anderson. “In fact, there is no such thing. The influenza virus causes respiratory problems, but doesn’t infect the digestive tract. Most people with ‘stomach flu’ have food intoxication.”

Regardless of what you call it, it hurts. And it’s dangerous. Researchers estimate that from 6.5 to 33 million Americans become ill every year from microorganisms in their food. About 9,000 die. Obviously, the microbes that can flourish in our food are responsible for more than stomachaches.

Many of the culprits are bacteria, invisible to the naked eye, that play an invaluable ecological role by breaking down and recycling organic matter. Most bacteria do not cause human disease and live unnoticed in the soil, on our skin—almost everywhere. However, when they are allowed to multiply in our food, some produce toxic metabolic byproducts. Others may infect the digestive tract.

The severity of infection varies with the number and strain of bacteria, and the general health of the victim. If other health problems have weakened your immune system, bacteria can gain a greater foothold.

Bacteria multiply rapidly, dividing about every 20 minutes under favorable conditions. Thousands are usually required to cause intestinal problems, but it doesn’t take long for them to multiply. For example, just one bacterium lurking in the potato salad or ham (and there are probably many more) can produce more than 500 progeny within 3 hours and more than 4,000 offspring within another hour.

Refrigeration and cold temperatures slow the metabolism of bacteria and retard their growth.

Although refrigeration reduces the risk of severe infections, it’s no guarantee against food poisoning, particularly when food has been handled improperly. Consider, for example, food that has not been thoroughly cooked (which encourages bacterial growth) that is then allowed to sit out for some time. Even if refrigerated later, the food could cause food poisoning when served. Anderson says many outbreaks of foodborne disease in the summer are associated with picnics where food stays unrefrigerated for long periods.

If you suspect that food may not be safe and has turned into a science project, Anderson has some unequivocal advice:

“If in doubt, throw it out.”

He has some additional information about some of the most common food-bacteria problems:

**Staphylococcal Food Poisoning**

This disease is caused when the round bacteria *Staphylococcus aureus*, which are found on skin and other parts of our bodies, contaminate food. About 30
percent of people harbor the organisms in their nasal passages. These bacteria produce an enterotoxin (a toxin that attacks the intestinal tract) that is not easily destroyed by heat.

Warm foods that are often implicated in cases of staph poisoning are ham, potato salad and other picnic foods, custards and cream pies. People who ingest the toxin usually become nauseous, experience diarrhea and vomit within 1 to 6 hours, actions which help flush the toxin from the digestive tract. Symptoms usually disappear in 24 hours. Treatment involves fluid replacement and bed rest.

The disease is best prevented by proper refrigeration of foods. Help leftover food cool quickly by dividing large amounts into smaller portions before refrigeration.

**Botulism**

Botulism is caused by a neurotoxin produced by a rod-shaped bacterium, *Clostridium botulinum*. The bacterium grows best in the absence of oxygen, and is usually found in the soil and in sediments of lakes and streams. It forms hard capsules or spores that enable it to survive unfavorable conditions.

The botulism toxin causes muscle paralysis. Victims become limp, immobile, unable to control their eye movements, and may die from respiratory failure (due to paralysis of the diaphragm) or heart failure. Treatment by injecting antitoxins is only partially successful.

Infants are particularly susceptible to botulism because their gastrointestinal fauna is not well established and their digestive tracts are less acidic than adults’; these factors let botulism spores survive and produce toxin. Because honey can contain *C. botulinum* spores, pediatricians don’t recommend giving honey to babies.

Most Americans probably think food poisoning is about as threatening as an upset stomach.

Not Paul Rasmussen. Not after a recent bout with food poisoning leveled him for more than a week. It was, he says, the sickest he has ever been.

Rasmussen, director of the Utah Agricultural Experiment Station, became ill in March at a meeting with several directors of Experiment Stations in Guam.

Upon arrival in Guam, he was assured that the food and water could be consumed safely, although he was told that chlorination of drinking water tended to be somewhat erratic. He ate without concern and slaked his thirst freely as temperatures and humidity increased. He drank iced lemonade instead of paying $4 for a canned drink.

The morning of his departure for home, he woke up feeling queasy. By 10 a.m. he knew he was ill. By 11 a.m. he was excessively thirsty, dizzy, lethargic and experiencing considerable gastrointestinal distress.

By the time he boarded his plane several hours later, he was almost too weak to stand. The plane was full. And Rasmussen was very, very ill.

Less than an hour into the flight, he was vomiting and experiencing severe diarrhea. He remained in the bathroom throughout the flight, anchored to his “unusual seat” even when air turbulence tossed the plane around for 45 minutes. "The flight from Guam to Honolulu was the worst 6 hours I have ever spent in my life, much less confined in a Boeing 747,” he says.

There was worse to come—a seemingly endless trek through the airport in Honolulu and the 4 1/2-hour flight to San Francisco on a packed flight, followed by a 1-hour layover for the next plane to Salt Lake City, all the while battling diarrhea, a splitting headache and an unquenchable thirst.

When he arrived in Salt Lake City, his wife knew that the gaunt, malodorous person she met in the airport was ill. Rasmussen went to the emergency room shortly after arriving in Logan, where he received intravenous liquids for 4 hours, medication to correct a potassium deficiency, and antibiotics. “I had never been so sick in my entire life,”
he says. “Upon leaving the hospital, the nurse said that if I felt 100 times worse the next day to be sure and call her. I told her that if I felt 100 times worse, no one would be calling the hospital because I would be dead.”

For the next 4 days, Rasmussen experienced something similar to a bad case of the flu, not a pleasant feeling but far better than the way he had been feeling.

The diagnosis—a double whammy of salmonellosis, an inflammation of the intestine caused by several strains of Salmonella bacteria, and shigellosis (bacillary dysentery) caused by several strains of Shigella bacteria, in this case, a relatively rare strain called Plesiomonas shigeloides.

About 65,000 cases of salmonellosis were reported in the United States in 1986, although public health officials say most cases aren’t reported. They estimate the actual number at more than 2 million cases annually.

About 15,000-20,000 cases of Shigella are reported annually in the United States. In developing nations, it is a major cause of infant mortality. Shigella are very infectious. Ingesting as few as 100 of the organisms can make a person ill.

There are millions of cases of food poisoning in developing countries where the lack of treatment often means that the resulting dehydration, and fluid and electrolyte imbalances are fatal.

Five days after his return home, Rasmussen felt weak but gradually returned to work for a few hours a day. A test 12 days after he returned home indicated that P. shigeloides was still present, so antibiotic treatment was continued for 10 more days.

The experience has renewed Rasmussen’s appreciation for the safety of the American food supply, something that most of us take for granted.

And it confirms what doctors and public health officials have been saying for decades: It’s far better to avoid food poisoning than to suffer its consequences.

It you don’t believe it, ask Paul.

Botulism bacteria can survive and grow in improperly canned foods, so careful canning and cooking are essential. Heating and boiling will break down and destroy any toxin that is present.

Some cases of botulism have been attributed to commercial pot pies that were baked, thus killing competing bacteria and driving off most of the oxygen, thereby letting the heat-resistant, anaerobic C. botulinum that were present multiply under the piecrust and produce toxin. The pies were kept for more than a day at warm temperatures, and were eaten without reheating, which would have destroyed the toxin.

Salmonellosis

Salmonella gastroenteritis is caused when people are infected with the rod-shaped bacterium, Salmonella, which is found in the intestinal tracts of humans and many animals.

Salmonella bacteria may be contracted from poultry and raw eggs, untreated cow’s milk, meat and meat products, and from food and water contaminated by human feces.

The bacteria infect the intestinal tract, multiply and invade the intestinal lining. The disease manifests itself from 1 to 14 days later with nausea, abdominal pain and cramps, diarrhea and fever. Victims usually recover in a few days following fluid replacement and bed rest.

Typhoid, a much more serious disease, results when the bacteria invade the circulatory system and spread throughout the body. Victims must be hospitalized and treated with antibiotics. Many die. Some who recover may carry and spread the bacteria, as did “Typhoid Mary,” a cook who infected numerous New York families around the turn of the century.
The bacteria are destroyed by heat. *Salmonella* gastroenteritis is best prevented by completely cooking high-risk foods and by proper refrigeration of foods. Cutting boards exposed to raw meat should be thoroughly washed with hot soapy water.

**Waterborne Illnesses**

Waterborne illnesses are uncommon in the United States and other developed countries where water supplies are monitored and treated. They are common in countries where sanitation is poor and sewage disposal is inadequate.

Anderson says a few precautions can help tourists avoid "traveler's diarrhea," a common, mild and self-limiting gastrointestinal ailment that affects about 40 percent of those traveling between countries.

Tourists, he says, should boil their drinking water, or drink from a hot water faucet, and think about what they are ingesting.

"Surprising things get you," Anderson says, "ice cubes, for instance."

Victims should avoid drugs that reduce intestinal movement. "The best therapy is to flush the system of the offending toxins or bacteria, and replace lost fluids," Anderson says.

The most common waterborne illness in the United States is caused by the protozoan parasite *Giardia lamblia*. About 7 percent of humans are healthy carriers who shed the protozoan cysts in their feces. Infected animals such as beavers and rabbits can contaminate streams.

After 1 to 4 weeks victims of giardiasis will become weak, lose weight, and experience abdominal cramps and diarrhea. Diagnosis is based on a fecal examination. Treatment with metronidazole (Flagyl) kills the parasites.

Hikers and campers should boil or filter drinking water. Chlorine and iodine treatments are not reliable precautions.

In 1983, there was an outbreak of giardiasis in Tooele, apparently when mudslides contaminated the city water system. Approximately 1,400 cases of gastroenteritis were reported, and 54 victims tested positive for *Giardia*. That same year, 265 additional cases were reported from other areas of the state, most caused by drinking untreated surface water.

About 100,000 cases of cholera are reported annually around the world but fewer than 10 of those are in the United States. Cholera is caused by a curved rod-shaped bacterium, *Vibrio cholerae*, usually spread by water contaminated with feces. These bacteria multiply in the intestine and produce a toxin that drastically alters the function of the cells lining the intestinal tract. Damaged cells release fluids and salts. The fluid loss, up to 20 liters a day, causes shock, dehydration and circulatory collapse, which can kill quickly. Treatment involves the intravenous and oral replacement of fluids and salts.

The Utah Department of Health and the U.S. Public Health Service monitor outbreaks of disease, including those caused by foodborne or waterborne agents. Anderson says not all outbreaks are reported, however. "Large outbreaks, those associated with a restaurant or those that result in a serious illness or hospitalization are much more likely to be reported than are mild illnesses after a family cookout."

*JC*  
*D. Andy Anderson 750-1913*
USU Research Launches Milk to New Heights

Milk should reach astronomically high levels in the next decade. USU food scientist Paul Savello is processing milk for use in the space station Freedom, which is expected to be constructed sometime during the 1990s. Milk has not been included on the menu during previous space voyages due to a lack of refrigerator space and the difficulty of consumption in zero gravity.

Both of these problems appear to have been solved. Lockheed Engineering has developed a laminated, flexible pouch for use in zero gravity. Savello processes milk at ultra-high temperatures (UHT) before injecting it into the pouches, which have been sterilized by irradiation. The milk can be safely stored without refrigeration for several months.

“Milk is the number one priority on the space station for new and modified food items,” Savello says. Although UHT-processed milk is commercially available in boxlike brik-paks, in these containers milk floats in zero gravity and is difficult to extract with a straw. The flexible pouches can be rolled up like a tube of toothpaste, thus forcing milk through a special adapter at the top used to fill and remove milk.

Savello will test 2 percent and whole milk, strawberry-flavored milk, and chocolate-flavored milk with sugar or aspartame. He also hopes to test other UHT-processed dairy products that he feels may be just the ticket in space, including yogurt “which is sticky and won’t fly off the spoon.”

KG  Paul Savello 750-2106

Putting TILLERING in a Different Light

Wheat often sends out several shoots (tillers) that develop and mature at different times. That could be a real disadvantage because it delays harvest. Yields would also decrease because tillers also produce smaller and lighter heads of grain.

Controlling the quality of light may help solve the problem, according to USU researchers studying ways to maximize wheat production in the controlled environments like those that will be required in space. Tillering was reduced by either filtering out light in the red portion of the spectrum, thus bathing plants in blue light (wavelengths of 400-500 nanometers) and far-red light (750-800 nm), or by enriching far-red light with incandescent lights. All plants were grown under metal halide lamps that provide high-intensity light.

However, a reduction in tillering was also associated with longer leaves, an indication that plants may be diverting resources to less productive uses, says graduate student Charles Barnes.

These preliminary studies involved just a few plants. Additional research with plants grown in dense canopies should give a better idea of the type of light that will best reduce tillering. Generally, however, plants spond to dense canopies much as they respond to far-red light, which they perceive as shading by other plants.

KG  Charles Barnes 750-2265
TEST-TUBE CALVES Aid Genetic Improvement

The search for the genes that could improve disease resistance, feed efficiency, carcass quality and innumerable other traits in cattle is hampered by the inability to regularly fertilize bovine eggs and produce viable embryos in test tubes (*in vitro*).

USU researchers are studying bovine fertilization and embryo development using eggs (oocytes) harvested from slaughtered cows. The production of "test-tube" calves will help scientists use microsurgical techniques to add or alter genetic material in embryos to produce transgenic livestock.

Much of what has been learned about *in vitro* fertilization and embryo development is based on research involving humans and experimental animals such as mice. *In vitro* research with mice costs a fraction of that involving cattle, but the results often don't apply to cattle, says animal scientist Tom Bunch.

Collecting bovine eggs makes bovine *in vitro* research economically feasible. "It used to cost several thousand dollars to acquire cattle embryos for transgenic studies. We can now obtain these embryos at a fraction of that cost, and can obtain many more eggs than was possible with superovulation and embryo recovery," Bunch says.

Bunch and USU dairy scientist David Marcinkowski collect about 100 ovaries at a time from a nearby meat-packing plant. Follicles that are about 1/4 inch in diameter are punctured to remove the small egg, which is then allowed to mature before it is fertilized. They can harvest nearly 1,000 oocytes in 6-8 hours.

Bovine eggs and embryos have proven to be much more difficult to mature *in vitro* than eggs or embryos of other species such as mice and humans. Bovine semen is also more difficult to capacitate (treat so it can fertilize eggs) but much is known about its requirements, thanks to extensive research prompted by the popularity of artificial insemination in the dairy industry.

When eggs are released naturally from the ovary, they are surrounded by tens of thousands of granulosa cells that are necessary for normal maturation and development. Eggs prematurely removed from the follicle must be cultured with granulosa cells.

"Bovine embryos are also extremely sensitive to the culture system. Unless they are co-cultured with another cell type, early embryos, even if fertilized, will not develop," Bunch says.

The cells surrounding the oocyte loosen and expand and eventually pull away from the egg. Normal development of the egg is gauged by monitoring stages in this process. If eggs fail to go through the normal stages of development—nuclear maturation, cumulus expansion and cytoplasmic maturation—eggs will either not be fertilized or will fail to support life beyond a few stages of embryo development.

About 25 mature oocytes are placed in a small drop of medium. Bull semen is thawed and added. If fertilization is successful, two-celled embryos are visible in about 24 hours.

About half the bovine eggs develop normally, of which 70 percent are fertilized (an effective fertility rate of about 35 percent). Normal fertility rates are between 90 and 95 percent.

So far, 10-20 percent of the fertilized oocytes in the best culture system will eventually develop to term when transferred to recipient cows. This is far
less than in normal reproduction but is a marked improvement over levels that were possible just a few years ago.

The medium used for embryos contains buffers to control the pH, antibiotics and fetal calf serum.

"Without adding the serum, the embryo won't develop at all. Serum is a highly complex mixture that contains everything an animal releases into the blood. It includes thousands of proteins, including some produced in undetectable amounts.

"Embryo development is a cascade of events in which factors are produced that signal other genes to produce substances. It is a complex feedback system. And development during the early stages seems to be most critical. The development of a single cell to a newborn animal is a mind-boggling process.

"It's amazing that any embryos develop in vitro," Bunch says.

Bunch notes that procedures for in vitro fertilization in cattle were developed only during the past few years, a marked contrast to progress made in human reproduction. The first "test-tube" baby was born more than 10 years ago.

The USU researchers are cooperating with animal scientist Robert Godke at Louisiana State University.

Iron-Fortified Cheese Developed at USU to be Marketed

A USU food scientist who developed iron-fortified cheddar cheese says the product should be widely available in 2 or 3 years.

Food scientist Arthur W. Mahoney, who has been studying the process for 3 years, says cheese is the perfect food for iron fortification because it is easy to prepare, flavorful and popular.

Fresh milk exposed to metallic iron or copper rapidly develops an off-flavor, which Mahoney avoided by fortifying cheese with iron tightly bound in the Fe3+ state, thus preventing conversion to the Fe2+ state. In the human body iron in the Fe3+ state is tightly bound to protein.

"Iron fortification works with Fe-casein, Fe-whey protein or the salt, FeCl3," Mahoney says. "We get good results with all three."

Taste panels have favorably evaluated iron-fortified natural and processed cheddar. The researchers received verbal clearance with the Utah Department of Agriculture to market the iron-fortified cheese in the state within a year. The researchers will then assess consumer reaction and conduct a market analysis.

Mahoney expects to fortify mozzarella and other popular cheeses.

"Young children need iron," he says. "Five to 7%—about one in 20—menstruating women are deficient in iron. The figure is one in four for low-income pregnant women. And about one in 20 elderly men is iron deficient. After menopause, women are protected for about 15 years, then after age 70, they become iron deficient.

"For the elderly, iron deficiency is caused by a combination of physical and social factors and eating habits."

The research has been supported by the Utah Agricultural Experiment Station and the Western Dairy Foods Research Center at USU.

JC

Arthur Mahoney 750-2125
Identifying Water-Efficient GRASSES

Researchers are using carbon isotope ratios to identify individual crested wheatgrasses and Russian wildrye that make more efficient use of water. Results will help them select breeding lines for grasses that thrive on arid and semiarid rangelands.

Plants have a variety of structural and physiological adaptations to help them survive when water is limited. Fuzzy leaves reflect sunlight and deflect desiccating winds. Small leaves lose less water than large leaves. Closing the stomatal openings—the little pores on the underside of leaves that let in carbon dioxide—also prevents water loss. There’s a tradeoff, however: closing the stomates also limits the intake of carbon dioxide, the raw material for the production of biomass.

Plant physiologist Douglas Johnson, research associate John Read and plant breeder Kay Asay with the USDA Forage and Range Research Laboratory have used carbon isotope ratios to indirectly measure water use efficiency (WUE) in individual plants.

About 99 percent of atmospheric carbon dioxide contains the normal carbon isotope $^{12}$C, Asay says. The remaining 1 percent of carbon dioxide is made up of the heavier carbon isotope, $^{13}$C. During photosynthesis, the stomates of plants admit carbon dioxide in the atmospheric ratio, but then the plant cells preferentially “fix” the more common $^{12}$C form of carbon dioxide into sugars.

Read explains the process: Closing stomates to restrict water loss also reduces the outside supply of carbon dioxide. Plants use the carbon dioxide already in leaves to make sugars, discriminating in favor of the $^{12}$C carbon dioxide. This changes the isotopic ratio of carbon dioxide inside the leaf and the $^{13}$C carbon dioxide becomes more prevalent. As the concentration of $^{13}$C increases, a plant incorporates more $^{13}$C into its tissues.

Measuring the ratio of carbon isotopes in the dried plants indirectly measures the degree of stomatal closure and thus water loss over time. The carbon isotope ratios are determined by mass spectrometry at a laboratory in South Dakota.

“The more discriminating plants are less water-efficient,” Read says. “The less discriminating plants are more water-efficient.”

“But WUE is only one characteristic,” Asay says. “It becomes just another factor in an index for selecting plants that make efficient use of water.” The researchers also select for seedling establishment, forage yield and quality, insect and disease resistance, and resistance to extreme drought.

“A plant, just like a human, is a complex of adaptations,” Asay says. “We’re trying to put the best ones together for our purposes. The plants with this characteristic may not necessarily be the most resistant to extreme drought, but they are producing the most biomass per unit of water, and that’s a desirable trait.”

JC

Kay Asay 750-3069
Doug Johnson 750-3067
John Read 750-3066
"NATURAL"
Isn't Necessarily Nontoxic
any people equate “natural” food with “good” food. They’re often wrong. “Nature isn’t benevolent,” says USU toxicologist Roger Coulombe, who has studied the effects of several toxic compounds, many of them natural. “People often tend to be more concerned with ‘man-made’ or ‘synthetic’ chemicals in food than with compounds that are naturally present in foods,” he says.

Consider the toxic potpourri that a staunch aficionado of “natural foods” might ingest during the course of a day: polycyclic aromatic hydrocarbons (burnt toast), furcocoumarins (celery), pyrrolizidine alkaloids (herbal tea), hydrazines (mushrooms), and aflatoxins (peanuts and corn products).

Many scientists believe the majority of cancers are due to avoidable factors—many of them natural—in our diets and lifestyles. And an impressive body of research indicates that “the risk to human health posed by natural compounds may be greater than that posed by acceptable levels of residues of man-made contaminants in foods, such as pesticides,” Coulombe says.

“This doesn’t mean we should be less diligent in monitoring pesticide residues in foods. Hundreds of previously-approved pesticides have been banned because toxicologists have determined that they posed an unacceptably high risk to human health,” Coulombe says.

At this time, it is impossible to completely avoid foods that have been found to contain toxic or carcinogenic agents. The best strategy is to eat a balanced diet and avoid excessive consumption of any one type of food. Even though Americans have heard this advice for decades, it usually commands much less attention than reports concerning the “poisoning” of our food supply.

“It’s also important to remember that our diet contains many ‘anticarcinogens’ that confer protection against the effects of natural and ‘synthetic’ carcinogens. More research is needed to assess both the risks and benefits of agents in the human diet, but the results of this work will be a safer diet,” Coulombe says.

To put the threat posed by “synthetic” chemicals in perspective, Coulombe describes the following types of natural toxicants that are found in foods:

**Mold toxins** (mycotoxins) are produced by molds that can infect growing or stored agricultural products. Levels tend to increase during drought.

Ergot alkaloids grow in overwintered grain such as rye and wheat. History is replete with accounts of ergot poisoning. Some victims of ergot poisoning suffered hallucinations, high fevers and gangrene of the limbs, and eventually died. Others endured such intense itching of the skin that they went insane. Some historians have linked ergot poisoning to the hysteria of the French Revolution, the dancing of the “tarantelle,” and the witchcraft trials in Colonial America.

Other examples of mold toxins include toxins produced by *Fusarium* mold species, more common in grains grown in the Upper Midwest, that cause acute hemorrhaging in humans and livestock, and aflatoxins, produced by *Aspergillus flavus* and *A. parasiticus*. Aflatoxin B₁, found in peanuts, corn, cottonseed and other products, is one of the most potent carcinogens known. The current acceptable level is 20 parts per billion (ppb), although a diet containing as low as 4 ppb causes liver tumors in experimental animals. Dairy cows that consume feed contaminated with AFB₁ convert the aflatoxin into a less toxic and less carcinogenic form, AFM₁, which appears in milk.

**Plant toxins.** Edible mushrooms contain hydrazines, which are carcinogenic. One form of hydrazine, N-methyl-N-formylhydrazine, is found in many mushrooms at a concentration of 50 mg per 100 grams. A low dietary level of this compound (20 μg) daily causes lung cancer in mice.
Celery, parsnips, parsley, citrus oil and figs contain furocoumarins and psoralens, compounds that become carcinogenic following exposure to sunlight. Levels can increase 100-fold when plants are stressed. These compounds often cause rashes on the hands and arms of those who harvest or process celery.

Pyrrolizidine alkaloids are found in “natural” herbal teas, traditional folk medicines and sometimes in honey. In hundreds of plant species, these compounds may comprise as much as 5 percent of plant weight.

Solanine and chaconine are powerful inhibitors of acetylcholinesterase enzymes, the same mechanism by which organophosphate insecticides and nerve gases act. In potatoes that are diseased, bruised or exposed to light, levels may be as high as 15 mg per gram. These compounds help potatoes resist insect infestation and disease. Potato cultivars bred for insect- and disease-resistance unfortunately also contain levels of these compounds that are toxic to humans.

Garbanzo lima and other types of beans contain vicine and convicine, oxidative compounds that usually cause no ill effects except when consumed by people with a genetic deficiency in levels of the enzyme glucose-6-phosphate dehydrogenase, a condition also associated with increased resistance to malaria. This genetic trait is most common in people of Mediterranean origin, who can become severely anemic when they ingest food or drugs that cause oxidative damage to the body.

**Formed or induced toxicants.** Nitrosamines are formed in the digestive tract when nitrite-rich foods such as cured meats, spinach, beets, carrots and lettuce are consumed. They can cause cancer in the esophagus, liver and stomach. Products such as beer and bacon may contain preformed nitrosamines.

Burnt material in cooked and heat-processed foods (bread crust, coffee, broiled or smoked meat and fish) and food additives (caramel coloring and flavoring agents) may contain large amounts of carcinogenic compounds such as polycyclic aromatic hydrocarbons, aromatic amines and derivatives of tryptophan and quinoline. In many diets, a person could ingest more carcinogens in burnt material in a day than by smoking two packs of cigarettes.

*KG*  
*Roger Coulombe 750-1598*
Facts. Risks.

We supposedly use the former to assess the latter. The relationship seems to get a bit muddled when it concerns food safety.

Why? Publicity appears to explain some of it. One researcher recently found that any news about the safety of a food—good or bad—seems to increase consumer awareness of the supposed problem and causes sales of the commodity in question to plummet.

The storm of publicity surrounding Alar and other pesticides may explain why many Americans consistently overrate the risks posed by pesticides and underrate the dangers posed by other threats, such as microbial contamination.

“‘There’s no doubt that pesticides are potent poisons, but we must remember the toxicological axiom that it’s not what but how much you are exposed to that makes the difference,’” says Howard Deer, USU toxicologist and Extension pesticide specialist. Excessive amounts of almost any substance can be dangerous, even of water (there are cases of water intoxication), while small amounts of harmful substances can be beneficial (some singers have relied on small amounts of strychnine to constrict neck muscles in order to increase their vocal range).

And pesticides include such useful common household items as disinfectants, chlorine bleach and

Clarifying the Risks of
PESTICIDE
RESIDUES
toilet bowl sanitizers, any of which could be lethal if ingested. “However, people tend to separate agricultural chemicals from these other pesticides,” Deer says.

There also seems to be the fear that even a single errant molecule of a pesticide will trigger an ailment such as cancer. “Few experts ascribe to the ‘one-hit’ theory. Most think that cancer is a dose-response disease. In other words, a person is unlikely to get lung cancer from smoking a single cigarette but may after smoking for several years.”

Here are some other statistics to consider:
• It’s estimated that from 6.5 to 33 million Americans—3 to 14 percent of the population—become ill each year from microorganisms in their food. About 9,000 of these illnesses result in death (4 in 100,000 people).

The worst-case estimate by the Environmental Protection Agency is that pesticides in food might cause about 6,000 cases of cancer annually (2 in 100,000 people). Some researchers think the EPA vastly overstates the risk because legal limits assume that every pesticide is used on every crop to the maximum legal level, which does not actually occur. As a result, the EPA risk assumptions may overstate actual risk by 2,600 times on tomatoes, nearly 21,000 times on apples, and nearly 300 times on lettuce.

• Pesticides must now undergo tough scrutiny before they can be approved for use. Ironically, this often means that older, potentially riskier pesticides that were already approved for use continue to be used because newer, safer ones cannot receive approval. This paradox is a result of the Delaney Clause in Section 409 of the Federal Food Drug, and Cosmetic Act that prohibits any pesticide residue in processed foods if the pesticide is shown to cause cancer in human or laboratory animals.

In the past, the clause was seldom applied because few data were available on the link between low levels of pesticide residues and tumors or on how
much pesticide residues concentrated during food processing. Today, it’s possible to estimate even very small cancer risks and to detect very low pesticide residues.

• According to a 1987 report by the National Academy of Sciences (NAS), allowing negligible risk (1 in 1,000,000) would eliminate 98 percent of the oncogenic risk and have much less effect on the availability of pesticides and, therefore, on the quantity, quality and price of food.

One of four people will develop cancer during their lifetimes. The NAS committee also estimated that use of all pesticides may increase the incidence of cancer in the United States from 25 per 100 to 25.1 per 100.

• For a pesticide to be registered for use on a commodity, the EPA must assess the risks and benefits of using that pesticide. Risk is based on an Acceptable Daily Intake (ADI) for the pesticide. The ADI is at least 100 times lower than the amount that has no observable effect in laboratory animals exposed to the pesticide. The ADI represents how much residue of a particular pesticide that a person could ingest every day over a 70-year lifetime without harmful effects on health.

• Foodborne disease is costly. It’s estimated that salmonellosis and campylobacteriosis, both intestinal diseases, each cost about $1 billion annually in medical costs and time lost from work. Congenital toxoplasmosis from raw or undercooked pork can lead to mental retardation in fetuses, leading to costs estimated at $215-$323 million annually.

There are many other foodborne diseases. The final tally? Billions of dollars annually.

• In 1988, the FDA analyzed 18,114 samples of imported and domestic food. No violative residues were found in 96 percent of all of the fruits, vegetables, grains and dairy products sampled, and no residues were found in more than 61 percent of the samples. Less than 1 percent of the samples contained residues that exceeded tolerances. And 84 percent of the violative samples occurred because there was no tolerance for that specific pesticide/commodity combination.

• According to Dr. Bruce Ames, a leading cancer researcher, we ingest 1,500 times as many natural carcinogens as synthetic carcinogens. Ames also says the cancer potential of Alar is about the same as chlorinated tap water that contains trace amounts of chloroform, a carcinogen.

The bottom line? There are risks associated with pesticides. Many experts think they pose a small—perhaps very small—risk.

“The best available information indicates that food-borne illnesses, environmental contaminants such as lead, mercury and arsenic, and natural toxins in foods pose a far greater risk to human health than pesticides. It’s also ironic that we allocate so much attention to pesticide residues when alcohol abuse, heart disease and cigarettes inflict a far greater toll,” Deer says.

That may not be a very exciting message. However, it appears to be the truth.

KG

Howard Deer 750-1602
Your kitchen would occasionally be crowded with inspectors if it was a commercial establishment. It also would probably be a lot safer.

The USDA inspector would hover nearby when you prepared meat. And there would be periodic visits by inspectors with the U.S. Food and Drug Administration (FDA), the Utah Department of Agriculture or the Utah Department of Public Health to make sure you followed procedures designed to maximize food safety and minimize microbial contamination and growth.

Among other things, you would have to wear a hairnet or a "beardnet." You couldn't handle raw and cooked products in the same areas. And you couldn't wash your hands in the kitchen sink where you also wash food and utensils.

It might help to start thinking like a food company, says Charlotte Brennand of the USU Department of Nutrition and Food Sciences. One helpful FDA procedure that food preparers might adopt is HACCP, which stands for Hazard Analysis and Critical Control Points.

It's not as formidable a procedure as it might seem. It will help you out-smart the microbes that
Home Canning: Do it Safely

A food scientist Charlotte Brennand’s desk sits a jar of unappetizing, brownish home-canned beets with a hand-written label: “Warning: This product may be hazardous to your health.”

It may be.

“All canned vegetables—corn, beets, green beans—can be a potential medium for the growth of botulism bacteria, which grow in the absence of oxygen at a pH above 4.6,” she says.

“Fruits and pickles are very acidic and their pH is below 4.6, but tomatoes may be very close to the pH danger zone. The USDA is now recommending that home canners add citric acid or lemon juice to tomatoes to make them more acidic.

“Industrial cannery workers must complete a training course before they can be responsible for canning procedures. The penalty for non-compliance may be prison. At home, we just trust that you’ll follow the USDA recommendations,” Brennand says.

She recommends the USDA’s several-volume Complete Guide to Home Canning, which is available from USU Extension agents.

“County agents will also test your pressure canner,” she said. “Make sure you make the appropriate altitude adjustments.”

Brennand warns against altering established canning recipes.

“Putting extra celery or onions in their canned tomatoes can alter the pH and encourage growth of the botulism bacteria. Extra cornstarch, which alters viscosity, can also alter heat curves so that the product isn’t sterilized properly.”

Minimize the time between holding and processing. She also recommends caution when using vacuum packers.

“Vacuum packers, which remove oxygen, are a good way to keep foods such as nuts or whole wheat flour from becoming rancid, but pulling a vacuum on partially cooked green beans, for instance, creates ideal conditions for the growth of botulism bacteria.”

Preserving fresh basil leaves by layering in olive oil can also create conditions for botulism bacteria.

“Soil contains Clostridium botulinum. The olive oil would exclude oxygen. If the food is kept in the refrigerator or freezer, however, it would be safe.”

“Never taste a suspect can of vegetables, she said. Avoid the temptation to stick in a finger and touch it to the tongue.”

“The botulism toxin is potent,” Brennand says. “A very small amount can be lethal.”

Brennand echoes a microbiologist Andy Anderson’s advice:

“If in doubt, throw it out.”

Charlotte Brennand 750-2116
threaten to inhabit your food—and that can make you extremely ill.

"The first step is to identify every step in the process where physical, chemical or microbial contamination might occur that will make the food unsafe for human consumption. Then we identify critical points where proper controls should be in place," Brennand says.

Food scientists assume that certain microbes are present, and handle, prepare and store food to prevent these microbes from multiplying. Microbes grow and multiply best at room temperature—below 40° F and above 140° F they are killed or growth is retarded.

"We assume that poultry will have Salmonella and Campylobacter, that vegetables have spores of Clostridium botulinum, which grow naturally in the soil, and that the cooks and cooks’ assistants have Staphylococcus aureus on their skin.

"We assume that pork and bear meat have trichina worms, that raw milk carries streptococci, Listeria, and the organism that causes brucellosis, called undulant fever in humans. We assume that raw oysters carry the organisms that cause infectious hepatitis, and that water from streams and lakes contains Giardia.

"In addition, Clostridium perfringens, Shigella and Escherichia coli may all be present, and they can cause problems."

In most cases it requires about a million organisms to cause food poisoning. The objective of HACCP is to handle food so these organisms—if they are present—will not multiply to unsafe levels.

As an example, here are the steps and procedures

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**Tips for Handling Meat and Poultry**

- To avoid contamination, don’t let juices from poultry (or any raw meat) come in contact with any other food, raw or cooked.
- Don’t re-use marinades.
- Never put cooked poultry or meat back on the platter that held raw poultry or meat.
- Wash hands, counters, equipment and utensils with soap and water. Acrylic cutting boards are easier to keep clean than wooden boards.
- The USDA advises against buying fresh, pre-stuffed whole poultry. Purchase cooked stuffed poultry only if it will be served within 2 hours after purchase. If you must stuff meat, do it immediately before cooking. Remove the stuffing from a turkey before cooling or freezing.
- Use a meat thermometer to judge safe internal temperatures. For meat and poultry less than 2 inches thick, look for clear juices and lack of pink in the center as signs of "doneness."
- When using slow cookers, start with fresh chunks of meat rather than frozen or large cuts. Check internal temperatures in three spots.
- Hold hot food above 140° F.

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Charlotte Brennand 750-2116
that Brennand uses to prepare meatloaf, and her comments:

**Purchase ingredients:** Because ground meat is chopped up (which increases its surface area) and mixed, it will naturally contain more microbes than steak or roast. Pork, often used in meatloaf, may contain trichina worms.

Dried spices may be a source of microbes. Spices are usually imported from third-world countries, and they are not sterilized because they would lose flavor. Raw eggs may carry bacteria, especially *Salmonella.* The canned tomato sauce and salt will have the lowest microbial levels. The consumer’s major concern at this point is that the meat is fresh and USDA-inspected, and that the eggs have been refrigerated.

**Transport ingredients home:** Shoppers should refrigerate perishables as soon as possible after purchase, so it’s best to go straight home after grocery shopping. If it’s more than a 2-hour drive home, put the meat, eggs, milk and other perishables in an ice chest to retard growth of bacteria.

**Store ingredients properly:** The time required for meat to spoil is directly related to its microbial load, which depends on sanitation in the butcher shop and the temperature of the refrigerator where meat is stored. Do not keep nonrefrigerated foodstuffs near chemical hazards. Potatoes and onions, for instance, should not be kept under the kitchen sink near cleaning supplies. Dripping kitchen drainage pipes may introduce microbes into food. (These types of storage would be prohibited in a food company.)

**Mix ingredients:** Mixing ingredients is another potential source of microbial contamination. Wash hands for 20 seconds before handling food. An unwashed can opener blade may contaminate canned ingredients. Perhaps the most dangerous source of microbes is a wood cutting board. Wash the cutting board with hot soapy water after each use.

**Bake:** Cooking decreases the number of microbes but does not sterilize meatloaf. Cooking hamburger to at least 160°F destroys most pathogens. Pork needs to reach an internal temperature of 170°F to kill trichina worms. Once cooking starts, cook a product until done. Microbial growth is encouraged if cooking is interrupted.
Because food is not heated as long, microwave cooking is not as lethal to microbes as slower cooking methods. Microwaves cook food from the inside out, which means that microbes may survive on the surface of food. Microwaving in a baking bag or covered casserole will solve the problem by steaming the surface.

Proper cooking can markedly reduce the risk of food poisoning. A 1976 study compared several hundred raw and commercially prepared ready-to-eat foods: 54 percent of the raw foods contained the pathogens *Clostridium perfringens*, *Staphylococcus aureus* and *Salmonella*, whereas only 6 percent of the ready-to-eat foods were contaminated.

**Oven to Plate:**
If the football game runs into overtime, guests arrive late, or the turkey is done before the pies, food serving time can be prolonged. Once the temperature drops below 140°F, microbial growth is once again a consideration. Observe the 2-hour rule: don't hold food for more than 2 hours if its temperature is between 40°F and 140°F.

Also remember to keep food from a delicatessen either hot or cold, depending on the type of food. Heat-resistant microorganisms and reintroduced microbes are of main concern at this stage. During hot weather (90°F or warmer), don't hold food for more than 1 hour.

**Serving:** Serve food with serving utensils, not with personal forks or with fingers. At this stage, if food has been handled properly, only the more virulent microorganisms should pose a health risk.

**Handling Leftovers:** Chill leftover food rapidly. Refrigerate or freeze cooked leftovers in small, covered, shallow containers within 2 hours of cooking. Leave airspace around the containers to help assure rapid cooling. Dishes can be cooled in cold water if you are reluctant to put a warm dish in the refrigerator. Heat-resistant, spore-forming bacteria can grow in leftovers, especially because initial heating has destroyed competing bacteria.

**Reheating Leftovers:**
Reheating to original cooking temperatures (a rolling boil for wet foods, 165°F for others) will reduce microbial growth. Consume leftovers quickly and discard those that are fuzzy, discolored or putrid. Don't taste cold leftovers to determine safety. And don't dispose of unsafe leftovers where animals can eat them. They can get sick, too.

*JC*  
*Charlotte Brennand 750-2116*

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FOOD SUBSTITUTES
Pose Nutritional Concerns


No matter what they’re called, Americans will select from a wider variety of food substitutes in the future, including “fake fats.” Many will consume food substitutes in an effort to shed pounds. They need to be sure that they also don’t shed some essential nutrients in the process, warns Bonita Wyse, nutritionist and dean of the USU College of Family Life.

Wyse endorses the NRC recommendations (see sidebar), which were the result of an exhaustive review of the findings concerning diet and chronic disease, and says they provide useful guidance for nutrition education and agricultural production. But the increased popularity of artificial fats and sweeteners, as well as the tendency to seek nutrients from supplements rather than foods, have fostered new concerns, Wyse says. “Now we need to balance the guidelines with some concerns about food safety.”

For instance, the desire to lose weight combined with our penchant for sweets spurred the search for low-calorie sugar substitutes. Saccharin, the first artificial sweetener, was prescribed in weight-reduction diets long before it came into common use. Cyclamate was removed from the market in the United States because of concerns about its possible carcinogenic potential. Now aspartame (NutraSweet™), a protein compound with little aftertaste, is the most widely used artificial sweetener.

Concerns about the safety of aspartame seem to have subsided; however, Wyse says she is still not convinced that young children should consume aspartame.

Likewise, the recommendation that Americans reduce their consumption of fats to 30 percent or less has stimulated the development of “fake fats,” substances that taste like and have the satisfying “mouth feel” of fats but contain relatively few calories.

Olestra, discovered by Procter and Gamble scientists in 1968, looks, cooks and tastes like fat, but differs from ordinary fats or oils in that our bodies cannot break down, absorb or convert its bulkier molecules into calories.

Research seems to indicate that olestra is safe. (The product is being reviewed by the FDA.) However, Wyse says that consumption of large amounts of indigestible and nonabsorbable substitute foods may cause indigestion and interfere with the absorption of nutrients.

Wyse has fewer concerns with Simplex™, a natural fat substitute made from egg whites or milk protein. This product cannot be cooked, baked or fried, however.

It’s best to obtain nutrients from food rather than dietary supplements. For example, excessive intake of either calcium, zinc and iron can interfere with
absorption of the other minerals because all compete for the same absorption and bonding sites.

Wyse also recommends moderation in the consumption of mineral micronutrients. Fluoride is important in bone and teeth development. However, animal studies have associated the development of bone tumors with the consumption of large quantities of fluoride. Only 2 percent of Utah’s water is fluoridated, Wyse says, but she does not recommend fluoridated toothpaste until children have learned to spit out toothpaste after brushing their teeth to avoid ingesting fluoride.

It also pays to be leery of some claims made on food labels. For example, a food labeled as “90 percent fat-free” may actually provide all of its calories as saturated fatty acids. There are several proposals to revamp the food-labeling regulations.

Wyse also cautions against completely eliminating red meat from diets, even those that include fish and poultry. When dietitian Eileen DeLeeuw created a week’s menus based on NRC diet recommendations, it was necessary to include lean beef to supply adequate protein and enough zinc and iron to meet the RDAs for these minerals.

“Fish and poultry are high in protein,” Wyse says, “but they’re low in zinc and iron”


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National Research Council
Dietary and Health Recommendations

1. Reduce total fat intake to 30 percent or less of total calories. Reduce saturated fat intake to less than 10 percent of total calories and the intake of cholesterol to less than 300 milligrams daily.

2. Every day eat five or more one-half-cup servings of a combination of vegetables and fruits, especially green and yellow vegetables and citrus fruits. Increase intake of starches and other complex carbohydrates by eating six or more daily servings of a combination of breads, cereals and legumes. Carbohydrates should total more than 55 percent of total calories.

3. Maintain protein intake at moderate levels—that is, approximately the current Recommended Dietary Allowance (RDA) for protein but not exceeding twice that amount, or 1.6 grams per kilogram body weight for adults.

4. Balance food intake and physical activity to maintain appropriate body weight.

5. Alcoholic beverages are not recommended. If you do drink, limit intake to less than one ounce of pure alcohol daily, the equivalent of two cans of beer, two small glasses of wine, or two average cocktails. Pregnant women should avoid alcohol altogether.

6. Limit total daily intake of salt to 6 grams or less. Limit the use of salt in cooking and avoid adding it to food at the table. Salty, salt-preserved and salt-pickled foods should be consumed sparingly.

7. Maintain adequate calcium intake.

8. Avoid taking dietary supplements in excess of the RDA for one day.

9. Maintain an optimal intake of fluoride, particularly during the years of primary and secondary tooth formation and growth.
Tests Guarantee
MILK’S SAFETY

Is our milk tainted by drugs?

Don’t believe it, says nutritionist Rodney Brown, head of the USU Department of Nutrition and Food Science. Claims that milk is laced with antibiotics and tainted with other types of veterinary drugs are simply not true.

“The current legal acceptable level for antibiotics in dairy products is limited only by the ability to detect them, and the detection levels are improving all the time,” Brown says.

Veterinary drugs are often used to treat mastitis, an inflammation of the mammary gland. Milk from treated udders must be withheld from market for a specified time until it no longer contains any traces of the drug.

Occasionally, milk containing residues of antibiotics and other veterinary drugs might slip through the elaborate surveillance and detection network, but it’s not a widespread problem and doesn’t approach the level that some critics claim. Last year, a Wall Street Journal article claimed 38 percent of all milk samples contained residues of veterinary drugs. Their findings were based on general screening tests that detect classes of drugs, not the levels of specific drugs.
The FDA, using more accurate tests, subsequently found that less than 1 percent of randomly selected milk samples contained detectable levels of any type of veterinary drug.

Milk is subjected to a battery of tests conducted by milk processors, the state, and agencies of the federal government. It's estimated that the dairy industry spends about $100 million annually to test milk and milk products. This includes approximately 1,200,000 regulatory tests of milk for antibiotics and at least 100,000 regulatory tests of finished dairy products.

Woe to the farmer caught shipping milk with illegal residues. "Dairies use drastic measures to keep residues out of milk. It's not unusual for a dairy farmer whose milk is found to contain antibiotics to be required to pay for the entire tankload of milk that had to be discarded, as well as disposal costs," Brown says.

Milk containing antibiotics can ruin dairy manufacturing processes. There is also a danger of allergic reactions and that pathogens will develop resistance to antibiotics, thus reducing the effectiveness of antibiotics in human medicine.

KG Rodney Brown 750-2102

**No Compromises when Safety is Involved**

What do processors have invested in food safety?

Everything.

And who's involved?

Everybody.

That's a synopsis of the comments of Dolores Wheeler, president and chief executive officer of Gossner Foods, Inc., one of Utah's leading processors of milk and manufacturers of dairy products. Safety is a high-stakes proposition for the firm. Any lapse in safety could trigger lawsuits and jeopardize business relationships that have taken decades to develop.

"We have built our reputation on quality and have cultivated our customers on that basis," she says.

Quality and safety don't come easily—or inexpensively. At Gossner's, the investment in food safety includes a large laboratory for quality testing ("One of the finest in the United States," she says). They have invested heavily in automatic cleaning equipment. In addition to testing milk and milk products for quality, bacteria levels, and antibiotics, swabs from plants are sent to private laboratories to test for *Salmonella* and *Listeria* bacteria.

The firm employs two full-time fieldmen who inspect dairy farms. Quality assurance personnel monitor every step of the process. Milk is tested on the farm, when it arrives, during processing, and before shipment. She says all employees are alert to potential problems. Plants are also scrutinized by USDA, FDA and state inspectors.

"I appreciate the fact that we are inspected. It creates a level playing field so everyone has to meet the same standards.

"The dairy industry is very, very competitive. Every firm is trying to find a market niche. And the only way to survive is to produce high-quality products," she says.

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