



All these products make use of soybeans. When ARS research develops new uses for agricultural commodities, it benefits both consumers and farmers.

For You, the Consumer

A bundant, affordable, safe, vast variety—it's the American way when it comes to shopping. What isn't found on any store shelf is an Agricultural Research Service brand name. But many products that people use every day could justifiably carry the stamp "Courtesy of ARS Research."

Pharmaceuticals, cosmetics, roach and termite controls, leather, shampoos, and processed foods, not to mention a proverbial cornucopia of fruits, vegetables, berries, meats, and nuts, all come to a store near you by way of ARS laboratories. Of course, there are essential stops along the way for technology transfer to the companies that turn out the actual products.

But without the work that ARS invests in research—often long-term, high-risk research—there are whole industries of products that might never have gotten off the ground. Some products make it tastier to balance your diet. Some keep you warm and fashionable. Some improve recreation and athletics, and others keep you safe and healthy.



STEPHEN AUSMUS (K10005-1)

Irradiated ground beef from Omaha Steaks.

Tasty Juice

Sixty years ago, orange juice came either freshly squeezed in season or canned—and tasting like the can. But in 1948, ARS scientists collaborated with Florida Citrus Commission researchers to perfect a method to produce a practical, flavorful frozen concentrate with all its vitamins and minerals. Today, U.S. consumption of orange juice from frozen concentrate, still made using these methods, comes to more than 1.07 billion gallons a year.



SCOTT BAUER (K7237-13)

An abundance of useful products from ARS research benefits consumers and farmers alike.

One product in that last category of safety and health to which consumers now have access as a result of ARS research is irradiated hamburger free of *Escherichia coli* O157:H7, bacteria that can cause serious, even life-threatening illness. Ground beef is especially vulnerable because more than just the surface of the meat may potentially have been exposed to bacterial contamination.

The term “irradiated” refers to treatment with ionizing radiation from gamma rays produced by cobalt and cesium atoms, machine-produced X-rays, or electron beams. Treated meat in no way becomes radioactive.

Omaha Steaks, for example, began offering irradiated hamburger patties and ground beef in November 2000. Today, all the 6.5 million pounds of ground beef they sell each year in their retail and bulk food service operations is irradiated.

Bruce Simon, president of Omaha Steaks, feels strongly that, with irradiation, research has developed a way to provide consumers with an extra measure of food safety for ground beef.

“We know we were among the first beef companies to make use of irradiation. Whenever we can add another safeguard to make sure that there is less possibility that anyone, especially a child, could be exposed to *E. coli*, it’s a step we just have to take,” Simon explains.

Consumers won’t see ARS’ name where it says “Treated by Irradiation” on Omaha Steaks’ hamburger packaging. But much of the research to prove irradiation an effective and safe method to sanitize ground beef came from the laboratory headed by ARS microbiologist Donald W. Thayer.

“When you look at the docket that was submitted to the Food and Drug Administration and the Food Safety and Inspection Service to get approval for irradiation of red meat, many of the papers they cite are from ARS,” Thayer says. Final approval for irradiation treatment of meat came in February 2000.

Products that protect people from illness are not new accomplishments for ARS. In 1954, ARS developed N,N-diethyl-meta-toluamide for the Department of Defense to protect

soldiers from disease-carrying insects. Now best known simply as DEET, it remains the most effective mosquito repellent available. About 230 products containing DEET are currently registered with the U.S. Environmental Protection Agency.

World Health Organization statistics report that mosquitoes spread about 4 million malaria cases, causing about 1 million deaths globally each year. These insects also spread dengue fever-related illnesses, which lead to 24,000 deaths annually.

More recently, the spread in the United States of West Nile virus, also mosquito borne, has focused new attention on DEET. West Nile virus has been reported in 36 states plus Washington D.C., and it is expected to spread to all 50 states.

The Centers for Disease Control and Prevention recommend that people in affected areas always wear an insect repellent containing DEET when they go outside during mosquito season as the best protection against being exposed to West Nile virus.

Some possible concerns about DEET posing a health risk have been raised. EPA has reviewed the data and determined “normal use of DEET does not present a health concern.” Several changes have been made in the label directions to ensure DEET is safely applied, principally to avoid oversaturating skin or clothing and not to spray infants.

Many antibiotics could also bear the ARS stamp. In 1941, British scientists, overwhelmed by World War II, requested U.S. help to find a way to produce penicillin in mass quantities. The problem was given to Andrew J. Moyer and others at the National Center for Agricultural Utilization Research, then called the Northern Regional Research Center (NRRRC), in Peoria, Illinois.

Work began in July 1941. By November, Moyer had succeeded in increasing the yield of penicillin by creating a better growth medium with the addition of corn steep liquor, an inexpensive byproduct of wet corn milling, and milk sugar. The team’s development of deep vat techniques to grow the mold cultures, called deep fermentation, added the missing piece of the production puzzle.

Eight days after the bombing of Pearl Harbor, NRRRC representatives met with U.S. drug companies, which agreed to attempt large-scale production of penicillin using the new methods. The combined work of many researchers, including ARS scientists, resulted in making penicillin available in mass

quantities by June 6, 1944, just in time to treat Allied soldiers wounded on D-Day. Infection has always been one of the largest causes of death in war, more so than direct battle injuries.

Mass-produced penicillin saved many lives during World War II and continues to do so. And the improved growth media and deep-fermentation methods and their outgrowths have since been used in development of many other important antibiotics. In 1987, Moyer became the first federal government scientist inducted into the National Inventors Hall of Fame.

Filling the Cornucopia

Any time they shop for produce, people are very likely to be buying a result of ARS research. The agency’s successes in breeding new fruit, vegetable, nut, and berry varieties have had an incredible impact on what consumers eat. New flavors, extended harvest seasons, increased growing range, and better shelf life are just a few of the improvements ARS researchers have made.

Almost all the blueberries and cranberries in commercial production were either developed by ARS or bred from ARS varieties. ARS also brought consumers super-sweet strawberry varieties with longer shelf life. Southern-grown fresh peaches would probably not be readily available to consumers in eastern U.S. markets if ARS had not developed improved peach varieties as well as the Guardian rootstock.

Citrus—fresh and processed—also has ARS’ fingerprints all over it. More than 80 percent of the citrus grown in the United States are rootstock or fruit varieties developed by ARS. When you buy a sweet red grapefruit, chances are pretty good that it will be a Flame grapefruit from ARS. Most of the early-season tangerines—about a \$100 million annual retail product—are ARS varieties Sunburst and Fallglo.

Red seedless grapes were all but unknown to the U.S. consumer before ARS released the Flame variety in 1973. Release of another ARS variety, Crimson, in 1989 further increased this table grape’s popularity. The two varieties alone, now grown extensively by both domestic and foreign producers, make up a major portion of today’s consumer market.

Sweetpotato varieties released by ARS are the standard, keeping the price of this crop affordable, the quality high, and

SCOTT BAUER (K7243-7)



Insect repellents made from DEET, an ARS-developed compound.

SCOTT BAUER (K7229-21)



Strawberries, blackberries, and blueberries have all been improved by ARS research.

the supply steady. The same can be said for cantaloupe, watermelon, broccoli, nectarines, plums, lettuce, peppers, onions, carrots...the list of fruits and vegetables that ARS research has improved is almost endless.

In addition to whole foods like apples and oranges, ARS has also developed many ingredients that people buy every day as part of processed foods. On a wide variety of food ingredient lists appear some form of the words “hydrolyzed oat flour” or “hydrolyzed oat bran.” A lot of that is actually ARS’ patented Oatrim, a calorie- and cholesterol-lowering replacer for shortening made from enzyme-treated oats and barley.

Oatrim has been licensed to several companies, including Quaker Oats, Inc., which uses Oatrim in foods like some Healthy Choice dinners. Oatrim production was estimated to be in excess of 20 million pounds in 1999, resulting in more than \$1 billion in retail sales.

Nutrim, another ARS development similar to Oatrim, has recently led to a new, niche-market consumer product: gourmet

Lactose-Free Milk

One-quarter of all adults cannot digest dairy products. But ARS used a bacterium to produce an enzyme that breaks down the milk sugar responsible for the problem. Today, consumers have access to lactose-free products like milk, cheese, and ice cream as well as Lactaid tablets, which let lactose-sensitive people have dairy products. Lactose-free milk is now 1 percent of all fluid milk sales, about 40 million gallons a year.

vegan chocolate truffles. Mrs. Mudd’s, Inc., of Oceanside, California, worked out a way to make tasty chocolate truffles with a great mouth feel without any dairy ingredients. When mixed with water, Nutrim flows like heavy dairy cream or coconut cream.

“It took 2 years to work out the right formula,” says company president Jan Mudd. “But our dark chocolate truffles are certified organic and completely vegan, so they are the perfect choice for people who are watching their cholesterol or those who do not eat dairy products.”

Xanthan gum, discovered by ARS in the 1960s, is another food ingredient that appears in a whole host of consumer products. This natural product comes from fermenting corn sugar with the microorganism *Xanthomonas campestris*. Even a partial list of functions provides insight into why it is a ubiquitous ingredient: it thickens liquids, provides good cling, provides easy pourability and pumpability; controls crystallization, increases baking volume, provides temperature stability, and suspends active ingredients.

PEGGY GREB (K10141-1)



Gourmet vegan chocolates made with Nutrim, an ARS-developed product that can substitute for dairy products in baking.



Tifsport, a tough turfgrass developed by ARS, is used for sports fields by some high schools, universities, recreation departments, golf courses, and professional sports teams. Here, the Tennessee Titans play the Washington Redskins on Tifsport in their Nashville stadium.

Salad dressings, instant soups, chocolate sauces, ice cream, cake mixes, yogurt, and squeezable chewing gum are just a few of the food products that make use of xanthan gum. It is also in products like toothpastes, cosmetics, rust removers, water-based paints, and antidiarrheal medicines.

Green Side Up

ARS is not an acronym you think of in connection with the NFL, PGA, or even your neighborhood soccer field. But ARS' bermuda grass varieties are taking over recreation fields and golf courses, especially in the southern part of the country. Tifsport, developed and released in 1997 by ARS plant geneticist Wayne Hanna in Tifton, Georgia, has a whole team roster of beneficial traits.

"We managed to breed in all the important traits—excellent cold tolerance, uniform dark green color, aggressive establishment, improved pest tolerance, earlier spring green-up, and an ability to tolerate frequent lower mowing," Hanna explains. "But most importantly, Tifsport can stand up to the stress and demands of big-time sports, to the wear and tear of football and soccer cleats, to the punishment of baseball spikes, and to constant heavy foot traffic."

Professional sports teams, universities, high schools, and local recreation departments across the South have installed Tifsport on athletic fields. Texas A&M recently planted about 97,000 square feet of Tifsport turf to give the Aggie soccer team a new playing field.

The NFL Tennessee Titans football team installed Tifsport when Adelphia Coliseum was built. A league-wide player

Neem Me Up

ARS researchers developed an environmentally friendly alternative to synthetic pesticides from the oil of neem tree seeds that controls about 20 different plant pests and diseases. For home gardeners, it is sold under the Green Light Company name. "It appealed to the organic garden market from the first; now it is being well accepted by all types of home gardeners," says Bing McClellan, Green Light director of marketing.

SCOTT BAUER (K7222-13)



Lactose-free milk and milk products, for people who cannot digest dairy products.

survey in 2001 rated the coliseum as the fourth best playing surface in the National Football League.

“Tifsport has great leaf texture and good dark green color. But the best thing is that the grass stands up well to use; it shears rather than divots so it lasts longer,” explains Terry Porch, sports field manager for the Titans.

Southern golfers not only play on fairways planted with Tifsport; many also putt on Tifeagle, a triploid bermuda grass variety Hanna released in 1999. At last count, there are Tifeagle greens in 14 states and 7 countries. Tifeagle can be mowed to one tenth of an inch daily to provide a smooth, fast putting surface. The previous standard for southern golf greens, Tifdwarf, also an ARS development, can only be mowed to three sixteenths of an inch.

KEITH WELLER (K3560-3)



The beautiful blooms of crape myrtle are now common in many U.S. gardens because of improved cold tolerance and disease resistance provided by ARS.

ARS has been responsible for the bermuda grass standards for southern sports fields, golf courses, commercial landscaping, and home lawns since grass breeder Glenn Burton started the program in 1952. “Golfers were playing on sand or at best rough common bermuda grasses before ARS developed the improved triploid hybrid ones,” Hanna says.

Gardeners also benefit from ARS research. Breeding successes like camellias with better cold tolerance, American elms resistant to Dutch elm disease, and later flowering magnolias have given landscapers and gardeners important new choices.

One ARS advance consumers buy in droves every year are crape myrtles developed to resist powdery mildew in the South and colder temperature in the North, making the shrubs one of the country’s most popular. “Within its current hardiness zone range—which is now pretty much Baltimore south because of ARS introductions—there is hardly a major landscape project today that doesn’t include one or more crape myrtles. ARS changed the crape myrtle world,” says Marc Byers of Byers Wholesale Nurseries of Huntsville, Alabama.

Byers sells tens of thousands of crape myrtles each year and a significant percentage are ARS-developed varieties. Natchez, released by ARS in 1978, continues to be the standard by which all other white crape myrtles are judged. Twenty-four years is a long time for any one woody plant variety to remain the standard for landscapers, Byers points out.

Permanent Research

You may even be wearing ARS research as you read this article. In 1958, wash-and-wear cotton clothes hit the consumer market. Since the 1950s, ARS scientists have played key roles in the research to develop durable press treatments, usually called permanent press, that give cotton and cotton blends wrinkle resistance. And durable press plays a key role in the continued popularity of cotton and cotton-blend fabrics.

“Trousers represent the largest single apparel market for cotton today, and I estimate that when we exclude jeans, more than half of all mens’, boys’, and ladies’ trousers are made from durable press-treated fabrics,” says Andrew Jordan, director, technical services for the National Cotton Council. “ARS’ work was fundamental to putting together the technology.”

Other ARS research on cotton has reached the consumer in the form of fiber-reactive dyestuff groups that allow cotton to be dyed more bright colors and better flame-retardant treatments, including new-on-the-market, fire-resistant cotton carpet.—**J. Kim Kaplan, ARS.**

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