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FOOD SAFETY & SUSTAINABILITY CENTER

BEEF REPORT

Bios

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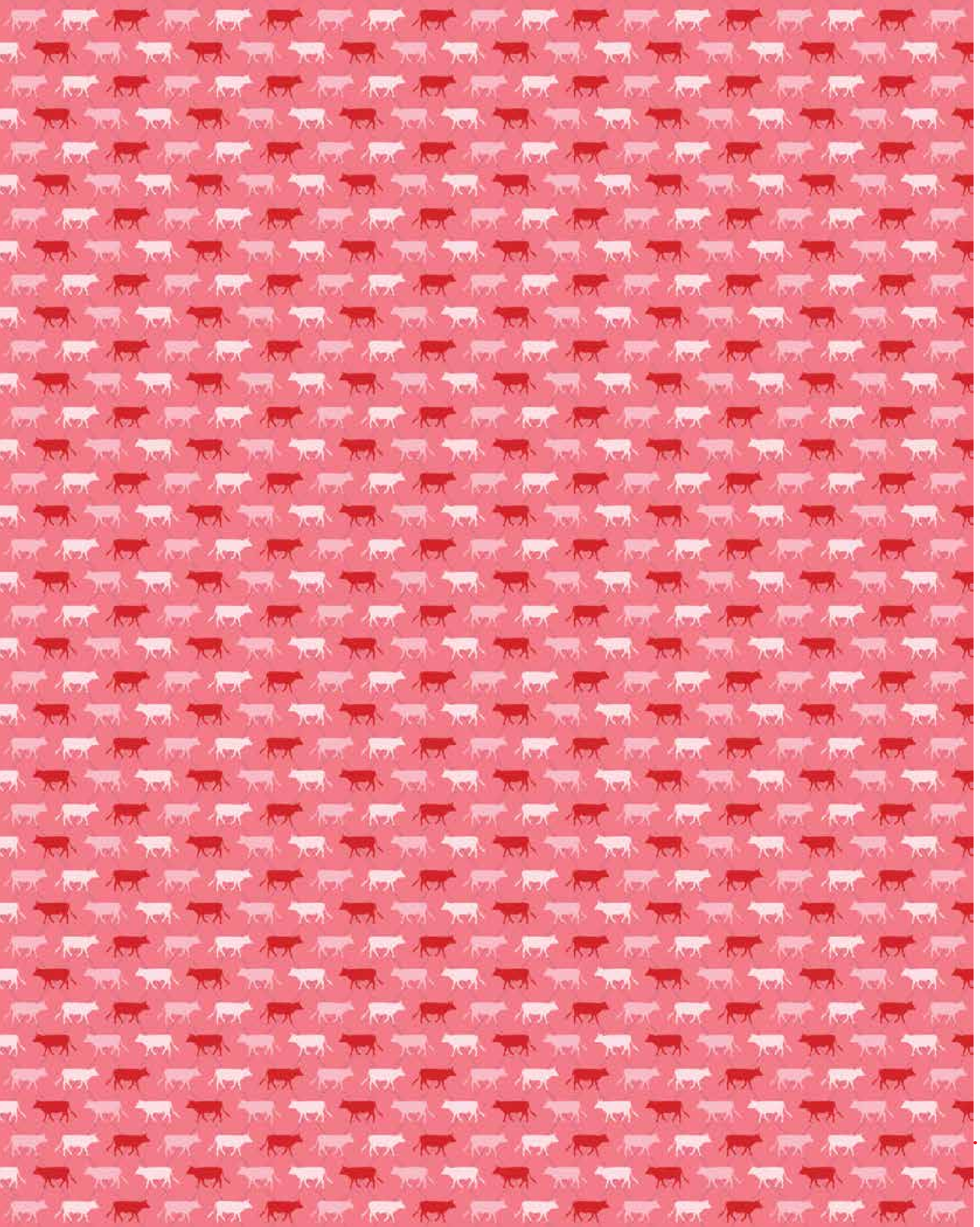
We acknowledge the contributions from former staffer Michael Crupain, MD.

PHOTOGRAPH BY EVAN KAFKA

COVER PHOTOGRAPH COURTESY OF WHITE OAK PASTURES, BLUFFTON, GEORGIA



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Introduction

Beef is a staple of the American diet, and in 2014 consumption was more than 50 pounds per capita. Although steaks top the list for popularity, ground beef, especially in the form of hamburgers, is also a favorite. In order to meet the high demand for beef, more than 2 million head of cattle are slaughtered per month in the U.S., and additional beef is imported.[1]

In addition to being a popular food, beef—and particularly ground beef—is also a notable vehicle for foodborne illness. Bacteria in meat can cause sickness ranging from simple cases of food poisoning to more severe illnesses that can result in organ failure or even death. In addition, bacteria, like those found on beef, can be associated with infections in other parts of the body. Handling and cooking beef properly can help reduce the risk of illness, but more fully preventing foodborne disease requires addressing how animals are raised and processed. The basis for those practices is documented in this report for conventional beef, for beef that comes with production claims that in reality add little value compared with conventional beef, and for beef that is more sustainably produced.

In conventional beef production, cattle spend the first portion of their lives out on range or pasture, usually foraging grasses, then finish their lives in confined feedlots where they are fed increasing quantities of concentrated grain to accelerate their weight gain and get them to market sooner. Grains aren't the only item used to increase growth; cattle can also be fed other things such as candy and animal waste, and they can be given drugs like antibiotics, beta-agonists, and hormones.[2] In addition, antibiotics may be used to prevent or treat diseases that result from the conditions in which the animals are raised. The daily use of antibiotics and other drugs in healthy animals is unsustainable and props up a system where hygiene and space requirements are secondary—if they exist at all.

Fortunately, there are more sustainable ways to raise cattle for beef, and many options exist for consumers looking to support these sustainable systems. Cattle raised on pasture with grass-based diets live healthier and better lives, which result in better outcomes for the planet and healthier meat for consumers. All organic, many grass-fed, and some other animal-welfare systems don't rely on regular doses of drugs such as antibiotics. Unlike their confined feedlot counterparts, those alternative systems don't contribute significantly to the development of antibiotic resistance and show that there are economically feasible ways to produce beef without exacerbating that major, global public health problem. For example, Consumer Reports' tests show lower overall bacterial prevalence and resistance in more sustainably produced beef compared with conventionally produced beef.

Sustainable beef production is not only viable but also something consumers are demanding. In 2014, Consumer Reports National Research Center conducted a nationally representative telephone survey that found that consumers are interested in buying food produced using methods that are environmentally conscious and socially responsible.[3] Eighty-nine percent of U.S. adults surveyed think that it is important to protect the environment from chemicals such as pesticides when purchasing food, 78 percent feel that meat production methods should reduce antibiotic use, and 80 percent think that purchasing meat from animals that had good living conditions is important.

This report presents the results of Consumer Reports' testing of conventional and more sustainably produced ground beef samples purchased at retail for bacteria and antibiotic resistance, along with a discussion of conventional and alternative practices for producing cattle for ground beef, and a detailed rating and review of which production label claims on ground beef are meaningful and which aren't. The discussion of our testing results along with our label certification reviews will serve as a guide for readers to make better and more sustainable choices.

Ground Beef Market Overview

Popularity of Beef

Americans are the No. 1 consumers of meat in the world, and beef is the second most popular fresh meat they eat.[4,5,6] Despite price increases and the fact that beef is higher in saturated fats than other types of meat, the most recent data suggest that average consumption of beef in the U.S. is still more than 50 pounds per person per year.[7] Ground beef accounts for around 42 percent of beef sold to U.S. consumers and more than 60 percent of the beef they consume outside the home.[8,9,10] The vast majority of that beef is produced by an unsustainable system (discussed in detail below).

Beef production in the U.S. is an $88 billion industry. Just 10 percent of domestically produced beef is exported, and the rest—an equivalent of more than 25.5 billion pounds—is sold here.[11]

A Consolidated Industry

In recent years, consolidation of the U.S. beef industry has left control of 75 percent of the market share in the hands of just four producers: Tyson Foods, JBS USA Beef, Cargill Meat Solutions, and National Beef.[24,25] The majority of the ground beef produced by these companies is made from cattle that were raised using conventional methods (i.e., confined systems) of raising and feeding cattle.[26] The U.S. beef industry has greater total production compared with other countries—although the number of cattle is actually higher in India, China, and Brazil—and the greater productivity from U.S. cattle is attributed to higher cattle weights.[27] Unfortunately, those conventional methods of mass-producing beef are unsustainable and impose an unnatural diet and inhumane living conditions on cattle prior to slaughter.

Alternative Models of Beef Production

There are now quite a few viable sustainable beef production systems that are based on organic farming practices and grass-based diets, as well as some that place an emphasis on animal welfare.

Ground beef produced from cattle raised using more sustainable methods has become increasingly available at retail outlets in many areas of the country, and according to a 2012 survey of U.S. adults conducted by Consumer Reports, consumers are willing to pay more for meat that is labeled with sustainability claims such as "no antibiotics."[28] A 2014 survey by the Consumer Reports National Research Center also showed that when shopping for food, consumers feel that it is important that their purchases support local farmers, protect the environment, support companies that treat workers well, provide better living conditions for animals, and reduce the use of antibiotics.[29]

An example of a more sustainable product is grass-fed beef (discussed in detail below). Based on recent USDA reports, the price of grass-fed ground beef can be between $4 and $5 more per pound than the average price of retail ground beef.[30,31] It has been estimated that sales of domestic and imported grass-fed beef may have passed $1 billion annually.[32] In addition to offering options for buying grass-fed ground beef, Whole Foods Market has committed to selling only beef raised without antibiotics.[33]

Like conventional beef sold in the U.S., some of the organic beef sold is also imported for processing or sale and can hail from Canada, Australia, and South American countries.[34] Grass-fed beef found in restaurants and stores can be sourced from a variety of countries, but it is most often from the U.S., Australia, New Zealand, and South America.[35]

Although some production label claims are highly meaningful and verified, many others may imply sustainability, animal-welfare standards, or natural claims that are not meaningful. A full review of more sustainable options—and which ones claim to be but aren't—is provided in this report on pages 18-31.

Country of Origin Labeling (COOL)

Consumers buying beef in a supermarket can figure out where it comes from by reading the Country of Origin Label (COOL). COOL laws and regulations first went into effect for ground beef and other meats in 2009, after a long process of development by Congress and the Department of Agriculture (USDA), and were revised in 2013. The regulations currently require retailers to specify the countries where the cattle was born, raised, and slaughtered. According to the regulations, beef can be labeled as a product of the U.S. only if the animals were born, raised, and slaughtered in the U.S.[12]

Interestingly, a large proportion of beef cattle is foreign-born, for instance in Canada and Mexico,[13,14] and imported to the U.S. prior to slaughter and processing. Since COOL went into effect, those countries and trade groups representing large international beef corporations have opposed it. The groups state that labeling requires cattle and meat to be segregated, and puts an undue burden on producers and processors with cattle born or raised elsewhere.[15]

Meat producers challenged the COOL regulations in U.S. courts but lost their case.[16] Canada, Mexico, and others also brought the issue before the World Trade Organization (WTO), complaining that the regulations were an unfair trade barrier under WTO rules because they placed an unfair burden on processors and discriminated against imported beef and pork.[17] A 2011 three-person dispute-resolution panel as well as a 2012 three-person appellate body decided against the U.S.[18] The decision agreed that the regulations put a disproportionate burden on upstream processors, because they are required to track and transmit a significant amount of information (locations of slaughter) that was not required to be on the label.[19] (Note: The original COOL regulations of 2009 required only a list of countries the animals were in, not that the label specify which country was the location of where the animal was born, raised, or slaughtered.[20]) As a result of the WTO decision, in 2013, the USDA revised the COOL regulations to their current, more detailed form, requiring labels to include where animals are born, raised, and slaughtered.[21] That decision was considered by Consumers Union, the policy and action arm of Consumer Reports, to be an improvement over an already good regulation because it further increased transparency for consumers. But Canada and Mexico have again brought a WTO challenge against this version of the regulations, and the WTO ruled against the U.S. again.[22] The U.S. appealed the decision and the appellate body issued their final decision on May 18, 2015, ruling against the U.S.[23] In June 2015, Canada and Mexico moved forward with requesting permission from the WTO to impose retaliatory trade sanctions while the U.S. House of Representatives voted to repeal the COOL meat provisions within the 2008 Farm Bill. The Senate has yet to act. Consumer Reports is disappointed that critical and widely-support consumer transparency standards face obliteration because of these events and urge Congress and the Administration to continue its efforts preserve at least some of these important standards.

What Is Ground Beef?

The Making of Ground Beef

Meat from cattle is harvested at processing facilities. After slaughter, portions of their muscles are removed and prepared as specific cuts of meat and fat trimmings. For ground beef, meat and fat trimmings from beef cattle may be mixed with meat from other cows, including dairy cows and bulls that have been culled from milk production or are no longer good breeders.[36,37] The end product, ground beef, can come from many different cows,[38] although we were not able to identify any reliable publications stating how many cows on average contribute to each pound produced. Ground beef cuts are subjected to two or more grinding steps, which can occur either at a processing plant under USDA inspection or at retail stores. After the initial grind, the fat content of the batch of coarse ground beef is measured so that the processor can determine how much beef from a fatter component, such as trimmings, needs to be added to achieve the desired fat content.[39]

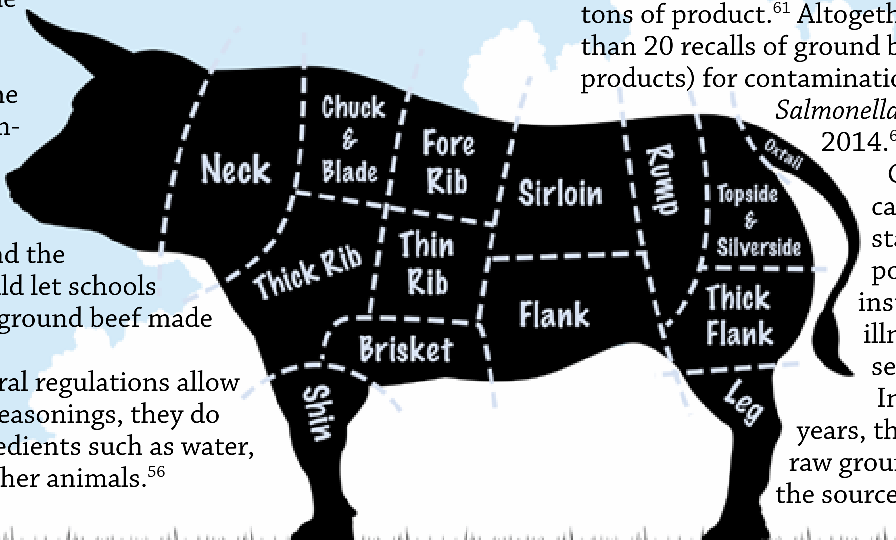
Ingredients

According to the Food Standards and Policy Labeling Book published by FSIS, ground beef may be produced using any part of the boneless carcass, which includes skeletal trimmings left over after primal beef cuts are removed from the carcass.[40,41] Some ground beef is labeled with which primal cut of beef it has been made from, for instance, sirloin, ground round, or chuck, and any trimmings used must come primarily from that cut of beef as well.[42,43] If the cut is not specified, or if the product is labeled as "ground beef," it may also contain ground beef components including esophagus, diaphragm, or cheek meat but not organ meats such as heart or tongue.[44] No more than 25 percent cheek meat can legally be used in making ground beef, and if more than 2 percent is used, it must be indicated on the product label.[45,46]

A maximum of 30 percent fat content is allowed in either hamburger or ground beef, but there is a difference between products labeled as "ground beef" and those labeled "hamburger": According to the USDA, pure beef fat without meat may be added to product labeled as "hamburger," but pure beef fat may not be added to "ground beef."[47]

Another raw ground beef component, lean finely textured beef (LFTB), which may be known to some consumers as "pink slime," is composed of lean bits of meat from trimmings that have been separated from the fat. LFTB is produced using ammonium gas as a sanitizing agent to reduce bacterial contamination. But although LFTB may be composed of up to 15 percent of ground beef, the USDA does not require declaration of the chemical as an ingredient on the label because it is considered a processing aid, not an ingredient.[48] Cargill produces a similar product called finely textured beef or FTB, which is produced using citric acid.[49] Canada does not allow sale of ground beef made with LFTB because anhydrous ammonia is not allowed as an anti-microbial agent, but FTB produced with citric acid may be allowed.[50] Ammonium gas is also not permitted as a processing agent in USDA-certified organic food, so packages of beef labeled organic and sold in the U.S. would also not contain LFTB.[51] The media coverage of the use of LFTB in ground beef, particularly its use in schools, led at least one company to seek to voluntarily label LFTB as an ingredient, some stores not to sell store-ground beef made with LFTB, and the USDA to rule that it would let schools decide whether to serve ground beef made with LFTB.[52,53,54,55]

Finally, although federal regulations allow ground beef to contain seasonings, they do not allow any other ingredients such as water, binders, or meat from other animals.[56]



Ground Beef Is a Significant Source of Foodborne Illness

In addition to being a popular food item, ground beef, especially in the form of undercooked hamburgers, is a frequent cause of foodborne illness. An analysis published in 2015 by the Interagency Food Safety Analytics Collaboration (IFSAC)—in which the USDA, the Food and Drug Administration (FDA), and the Centers for Disease Control and Prevention (CDC) team up to study foodborne disease—attributed 46 percent of *E. coli* O157 illnesses and 9 percent of *Salmonella* foodborne illnesses to beef.[57] Beef has also been identified in a previous CDC study as a common cause of foodborne illness caused by *Clostridium perfringens* and *Staphylococcus aureus* (Table 1).[58]

Table 1. Estimated percentage of foodborne illness by pathogen attributable to beef.[59,60]

Pathogen	Percent Range	Outbreak Years, Source
Escherichia coli O157	36-55%	1998-2012, IFSAC
Clostridium perfringens	16-41%	1998-2008, CDC
Staphylococcus aureus	4-19%	1998-2008, CDC
Salmonella enterica	6-13%	1998-2012, IFSAC
Shigella spp.	2.1-7.4%	1998-2008, CDC
Listeria monocytogenes	0-1%	1998-2012, IFSAC
Campylobacter	<1-1%	1998-2012, IFSAC

In 2013, there were six USDA Food Safety and Inspection Service (FSIS) Class I recalls (which occur in response to a health hazard situation in which there is a reasonable probability that eating the food will cause health problems or death) for contamination of ground beef (or ground beef products) with either *Salmonella* or *E. coli* O157:H7, involving more than 38 tons of product.[61] Altogether, there were more than 20 recalls of ground beef (or ground beef products) for contamination with *E. coli* and *Salmonella* from 2011 through 2014.[62,63,64,65]

Ground beef has caused many multistate outbreaks of food poisoning, and in some instances, the cases of illness are extremely serious or even deadly. In the past seven years, the CDC identified raw ground beef products as the source of at least seven multistate outbreaks, including a 2012 outbreak with 46 reported cases in nine states and 12 hospitalizations.[66,67] The outbreaks were all caused by *Salmonella* and toxic types of *Escherichia coli* (*E. coli*), two of the most common bacterial causes of foodborne illness. In each of the outbreaks, the distributors responsible for the identified source product issued voluntary recalls, in some instances exceeding 1,000 tons of ground beef.[68, 69]One of those large-scale recalls occurred just last year. On May 14, 2014, the Michigan Health Department issued a press release announcing that ground beef was the likely source of five cases of confirmed illness caused by *E. coli* O157:H7 in that state.[70] What ensued was a single recall of 1.8 million pounds of ground beef products after 12 people in four states, including the initial cases reported in Michigan, were confirmed infected. Although there were no deaths, there was a high rate of hospitalization, 58 percent.[71]

Foodborne pathogens caused by beef put consumers at serious risk of illness, hospitalization, and even death. A 2011 report based on

CDC outbreak data from 1998 to 2008 estimated that consumption of *E. coli* O157:H7 and *Salmonella* in contaminated beef resulted in more than 99,000 illnesses, 2,368 hospitalizations, and 35 deaths, for an estimated cost of $356 million.[72]

But data on recalls and outbreaks related to beef are a limited indicator of the potential magnitude of the problem of contaminated beef because they may only capture a small percentage of cases that are likely to occur. A recent report from the Center for Science in the Public Interest, based on outbreak data from 1998 to 2010, ranked ground beef in the highest risk category for causing severe illness requiring hospitalization.[73]

From a processing perspective, there are a few reasons that ground beef may pose greater risk of foodborne illness than other forms of beef. One reason is that the grinding process allows bacteria that may have been present on the surface of the meat to be mixed throughout a larger portion of meat.[74] Another reason is that because beef trimmings used to make ground beef may originate from multiple carcasses, that could increase the chance of including contaminated meat in the batch. Additionally, consumers sometimes eat burgers made from ground beef at rare or medium-rare doneness,[75] which means that they are not cooked to temperatures that would kill bacteria (160° F).[76]

Questions about ground meat or hamburger safety continue to be in the top five food topics for calls from consumers to the USDA Meat and Poultry Hotline.[77]

Requirements, Limitations, and Needs for Controlling Bacteria

All meat transported and sold in interstate commerce is required by the USDA to be produced with government inspectors present at the processing plant. Packages of ground beef will usually display the USDA inspection seal and processing plant number, though may not if it's ground or packaged in the store.[78,79] Additionally, although product dating, such as a sell-by date, is not required, a safe-food-handling label that provides instructions for safely handling, storing, and cooking meat is required for all raw meats regardless of packaging type.[80,81]

The USDA introduced Hazard Analysis & Critical Control Points (HACCP) as part of a new meat-inspection process in 1996, and it was phased in starting in 1998.[82,83] HACCP is a management system that addresses certain food safety hazards, including chemical, biological, and physical hazards throughout the production process.[84] It also includes performance standards for some bacteria such as *Salmonella*, and it's supposed to address adulterants such as Shiga toxin-producing *E. coli* as well.[85] Under the HACCP program, processors are asked to determine critical control points at which food safety hazards might be posed and establish monitoring procedures and corrective actions.[86] As a result, many monitoring activities related to food safety (i.e., suspected bacterial contamination) may be performed by employees of the meat producers.[87] USDA inspectors are still required to be present for meat to get the USDA seal of inspection.[88] The Government Accountability Office (GAO), an independent, nonpartisan agency that works for Congress, has criticized the HACCP's shortcomings.[89]

In addition to standard inspection activities, the USDA's FSIS also conducts sampling at processing facilities throughout the year for toxigenic *E. coli*.[90] But only meat-processing plants are inspected at this time, and farms are not routinely tested or inspected.[91]

One of the most important and concerning limitations of USDA authority in protecting the food supply from contaminated meat is the department's lack of authority to issue a mandatory recall of meat, even in the event of a documented outbreak source, so the USDA may feel it is unable to take action to keep consumers safe from contaminated products.[92,93,94] That weak regulatory oversight continues to put the public at risk.

The Danger of Superbugs

Foodborne illness caused by drug-resistant bacteria, such as the antibiotic-resistant strains of *Salmonella* that have caused beef-related outbreaks in recent years, are also a major cause for concern.[95,96] Infections caused by drug-resistant bacteria can be more difficult to treat and are a major public health problem. In fact, the CDC estimates that each year more than 23,000 people die as a result of an infection caused by antibiotic-resistant bacteria.[97] Despite the importance and prevalence of that problem, the government does not have requirements related to antibiotic-resistant bacteria in any meat product.

Two of the most important bacteria responsible for outbreaks attributed to ground beef are toxin-producing *E. coli* and *Salmonella*, which are discussed below.

SHIGA TOXIN-PRODUCING *E. COLI*

Although most cases of foodborne illness are simple cases of vomiting and diarrhea that resolve after a day or so, some bacteria found in ground beef, such as Shiga toxin-Producing *E. coli* (STEC) can be very dangerous. STEC produces Shiga toxin and can cause severe illness that can last five to seven days and even be so severe that infections require hospital treatment.[98] Additionally, some people can be left with a life-threatening condition called hemolytic uremic syndrome, which damages the kidneys.[99] STECs are also concerning because they can cause those serious infections at relatively low infectious doses.[100] The STECs can live in the cattle's gut and are often found on hides, but they cause disease only in humans, not in the cattle.[101] Recent data published by the CDC show that incidence of illness caused by *E. coli* O157:H7 in the U.S. decreased in 2014 to 0.92 cases per 100,000 people, compared with the incidences measured in 2006 to 2008 or 2011 to 2013; the incidence of infections caused by non-O157:H7 STECs and other pathogens did not decrease and remained higher than target rates defined in the government's Healthy People 2020 goals.[102,103]

Since 1994, the USDA has considered *E. coli* O157:H7 in ground beef to be an adulterant, and in 2012, it added six of the most common non-O157:H7 *E. coli* STECs (the "Big 6") to the list of adulterants.[104] That means that if those bacteria are found during processing in ground beef or in intact beef destined to become ground beef, the product cannot be sold unless it is to be further processed (cooked). Controls for those toxic STEC *E. coli* are included as part of Hazard Analysis & Critical Control Points (HACCP) at processing plants, and if any are detected, the product is considered adulterated and must be discarded, and the plant must report the result to FSIS.[105] FSIS does not actually require plants to do regular testing for *E. coli* O157:H7 or other pathogens that may cause severe food poisoning, but only for generic *E. coli*. Generic *E. coli* is considered by FSIS to be a measure of fecal contamination and a measure of the effectiveness of sanitation in plants, yet there is no performance standard for generic *E. coli*.[106] Consumer Reports believes there should be performance standards for filth indicator organisms such as generic *E. coli*, as well as required tests for STECs. FSIS conducts its own testing for *E. coli* O157:H7 and other STECs in beef at processing plants, but there are important limitations, including the frequency and prior notice of inspection to establishments regarding sampling,[107] which could allow plants to temporarily alter procedures.

Interestingly, there are a number of factors related to the way cattle are raised that may affect their levels of generic *E. coli* and *E. coli* O157:H7 within and shed from their intestines. For example, cattle eating grain-based diets appear to shed higher levels of generic *E. coli* than forage-fed animals. Studies of O157:H7-specific shedding are suggestive of the same, although there are mixed results. Stress and feedlot confinement also foster poor hygiene practices that can increase contamination.[108]

SALMONELLA

Although the reported prevalence of *Salmonella* is low, the morbidity and mortality caused by foodborne illness from *Salmonella* is significant, and drug-resistance is particularly concerning because outbreak strains found in beef have been resistant to several important clinical antibiotics, including first-line agents prescribed to treat *Salmonella* and other infections.[109,110] Among the recent, large multistate outbreaks that have been caused by *Salmonella*-contaminated ground beef, the strain responsible for the 2011 outbreak was notable for its resistance to multiple antibiotics, including amoxicillin/clavulanic acid, ampicillin, ceftriaxone, cefoxitin, kanamycin, streptomycin, sulfisoxazole, and tetracycline.[111] Ceftriaxone is an example of a recommended antibiotic prescribed for *Salmonella* infections in humans, and strains resistant to those agents would be more difficult to treat, even in the hospital.[112]

FSIS has a performance standard of 7.5 percent for *Salmonella* in ground beef.[113] Plants that do not meet performance standards can be subjected to increased testing and scrutiny from FSIS and can have their names published on the USDA website.[114] As of 2014, FSIS tests for *Salmonella* in the same samples collected for STEC testing; this is an improvement over collection of separate samples to do *Salmonella* testing because the size of the sample is now larger (325 grams), which increases the chance of detection of contaminated meat.[115] But although the USDA has said that it plans to revise the *Salmonella* performance standard, it has yet to do so.[116] Considering that the prevalence of *Salmonella* identified by the FDA National Antimicrobial Resistance Monitoring System (NARMS) is less than 1 percent,[117] a performance standard of 7.5 percent does not reflect what is truly possible and does not seem to be preventing outbreaks of *Salmonella* related to ground beef. A lower performance standard would add a greater level of scrutiny and safety control for processing plants.

OTHER BACTERIA OF SAFETY CONCERN

Overall, the potential risk of foodborne illness to consumers of ground beef is unclear because other bacteria that are important causes of foodborne illness attributed to beef, such as *S. aureus* and *C. perfringens*, are not included in inspection programs.[118] There is not reliable data available for prevalence or antibiotic resistance for those bacteria.

Beef Production Systems

As discussed below, conventional beef production requires a large amount of natural resources and has a substantial impact on the environment. An important step toward making more sustainable beef choices is to eat less beef. The 2015 scientific report of the Dietary Guidelines Advisory Committee identifies diets low in red and processed meat (as well as low in refined grains and sugar-sweetened drinks and foods) as healthier. It also associates diets higher in plant-based foods and lower in calories and animal-based foods with less environmental impact.[119]

Americans in general eat more meat than they should. The 2010 USDA Dietary Guidelines, which are scheduled to be updated in 2015, recommend 5 to 6 ounces of "protein foods," which includes seafood, poultry, eggs, beans and peas, soy products, nuts, and seeds in addition to meats.[120] According to USDA recommendations, people should eat no more than 1.8 ounces of meat per day on average.[121] Although sustainably raised meat can be more expensive, it is a good value, especially if you are reducing your overall beef consumption. When consumers eat beef they should choose the most sustainable options.

Animals are an integral part of sustainable farming, including for crops, because their manure provides an important natural source of soil fertility. A sustainable food system relies on natural inputs and processes, and ideal sustainable farms are as much as possible self-reliant and self-sustaining systems. The environmental costs are high when feed is grown in distant places and has to be transported to a feedlot, where animals are confined and fed drugs daily that pass into the manure, and where concentrated manure can create a pollution problem rather than being returned to the soil to fertilize it and grow crops. This feedlot system breaks the cycle of fertility and creates pollutants.

Beef producers can make significant choices that change the system of beef production and reduce pollution, resource use, and animal suffering.

Conventional Beef Production

In 2014, about 30 million head of cattle were slaughtered in the U.S.,[122] and about 97 percent of meat in the U.S. came from a conventional production system.[123] As in other animal production systems, conventional beef cattle production has trended toward fewer and larger operations.[124] Beef cattle typically spend the first part of their lives in grass-based "cow-calf operations," then are moved to crowded feedlots for finishing, where they are fattened quickly on grain-based diets.[125]

Feedlots are crowded pens without vegetation—very different from the open range where the animals spend the first part of their lives. Cattle spend somewhere between 90 and 300 days in feedlots until they reach slaughter weight. Animals in a feedlot are fed a diet that contains 70 to 90 percent grain and protein concentrates, and they can gain up to about 4 pounds per day. Feedlots can vary in size, with the largest operations (with more than 1,000 animals) making up a small percentage (less than 5 percent) of the total beef farms in the U.S. but raising the overwhelming majority of beef (80 to 90 percent). In addition, a large percentage of feedlots are significantly larger than 1,000 head: Those with 32,000 head or more represent 40 percent of the market.[126]

The diets and drugs relied upon by feedlots to speed growth as well as the outputs from those systems raise serious environmental, public health, and animal-welfare concerns, which are discussed on page 14.

Feed and Drugs

Under the Federal Food, Drug, and Cosmetics Act, any ingredient in cattle feed must either be approved by the FDA or be considered Generally Recognized as Safe (GRAS). But the FDA allows certain ingredients in cattle feed that are neither approved nor listed as GRAS if the ingredient is listed in the Association of American Feed Control Officials (AAFCO) Official Publication and provided "there are no apparent safety concerns."[127] The AAFCO is a voluntary membership association of local, state, and federal agencies charged by law to regulate the sale and distribution of animal feeds.[128]

GRAIN-BASED FEED

Cows are ruminants, whose natural diet consists of grazing on pasture. Their gastrointestinal systems are designed to digest high-fiber and low-starch plants rather than the high-starch, low-fiber grain-based diet they receive in feedlots to promote rapid "fattening."[129] A diet with a high concentration of grain can have negative effects on the health of cattle. For example, grain-based diets can lead to gastrointestinal diseases such as acidosis,[130] which can promote infections.[131] It may also lead to greater shedding of *E. coli* from the animal, which may affect contamination rates.[132]

A diet rich in grains can also have a negative effect on the environment. Turning grain into meat is an inefficient process: It takes 7 kilograms of grain to produce 1 kilogram of beef. As a result, the conventional beef industry consumes vast amounts of corn and soybeans.[133] Those crops require significant amounts of water: It takes about 1,000 tons of water to grow 1 ton of feed.[134] In addition, nonorganic farms use synthetic pesticides, synthetic fertilizers, and genetically engineered seed to grow the feed crops, which raises a variety of sustainability concerns:

- *Synthetic fertilizers.* The starting material to produce synthetic fertilizers is natural gas or other petrochemical and nonrenewable sources,[135] and its use is a major contributor to greenhouse gas emissions.[136] Synthetic fertilizers also reduce soil organic matter and contaminate waterways, harming wildlife and causing "dead zones" in the Gulf of Mexico and the Chesapeake Bay.[137]
- *Pesticides.* Pesticides used to grow conventional corn, soybeans, and other feed ingredients can contaminate the environment and are widely present in the air,[138] rain,[139] and water.[140,141] These chemicals are toxic by design and have negative impacts on farmworkers,[142] rural residents,[143] wildlife,[144] and pollinators[145] that are exposed.
- *Genetically engineered crops.* There are many ethical concerns around the genetic engineering of plant seeds and crops, including the accompanying increase in pesticide use.[146] Most commercially available genetically engineered corn and soybeans are resistant to glyphosate, an herbicide that is classified as "probably carcinogenic to humans."[147,148] The application of agents such as glyphosate and other pesticides in growing these crops is not a sustainable solution for killing weeds and insects.

INDUSTRIAL FOOD WASTE AND ARTIFICIAL INGREDIENTS

Low-fiber carbohydrates (sugars), most often in the form of grain, help cattle gain weight more quickly. Cattle can also be fed artificial ingredients as a part of their diet. For example, pellets of polyethylene, or "plastic pellets," may be used as an artificial substitute for natural grass-based fiber,[149] and synthetic urea can be used to promote faster weight gain.[150] The FDA permits a long list of artificial ingredients in cattle feed.[151]

ANIMAL WASTE IN CATTLE FEED

Cattle feed can also contain byproducts of slaughtered animals and waste products from other confinement livestock operations. That includes waste products from pork and poultry slaughter plants, cattle blood and blood meal,[152] and dried manure and litter from chicken barns.[153] Feeding waste and slaughter byproducts increases the likelihood that unwanted chemicals, pesticides, animal drugs, and even human foodborne pathogens will appear in the feed.[154]

In particular, cattle byproducts may contain errant proteins called 'prions' that can infect cattle and cause bovine spongiform encephalopathy—better known as BSE or 'Mad Cow' disease. While federal regulations prohibit the use of most cattle byproducts in cattle feed, they still may be added to poultry feed.[223] Poultry litter, which includes spilled feed and feces, then may be fed to cattle.[223] In addition, the regulations allow the direct feeding of cattle blood products to other cattle.[223] These practices could allow prions in feed to infect cattle and contaminate ground beef during processing.[224] While the risk is low, prions in ground beef may infect consumers and cause an incurable and fatal neurological disorder.

ANTIBIOTICS

Antibiotics have been used in cattle production for decades to promote growth, increase feed efficiency, and prevent disease. In 2013 almost 33 million pounds of antimicrobials were sold and distributed for use in food animals, primarily to speed growth and prevent or treat disease in all food-producing animals.[155] In December 2013 the FDA finalized Guidance 213, which called on drug companies to voluntarily remove growth-promotion indications from antibiotics, and according to the FDA every manufacturer has agreed to comply.[156,157] Unfortunately, that guidance did not address prophylactic use of medically important drugs. Such use in any animal production system is a Band-Aid solution for the health conditions that arise from the way the animals are raised. Rather than feed antibiotics to healthy animals every day, Consumer Reports believes that producers should address feed, hygiene, and other welfare issues to prevent disease from occurring at the origin. Antibiotics used for production purposes are unnecessary and contribute to the emergence of antibiotic-resistant bacteria, a serious public health concern.[158] Antibiotics are not necessary to raise food animals, and alternative production systems (discussed below) demonstrate the feasibility of eliminating the daily use of antibiotics.

OTHER DRUGS AND HORMONES

Other types of drugs can also be added to cattle feed to promote rapid growth.[159] A widely used growth promotant in the livestock industry is ractopamine. It's a beta-agonist drug, similar to the type used to treat asthma. The use of this class of drugs in cattle has been linked to increased rates of lameness, increased susceptibility to heat stress,[160] and death.[161]

Synthetic growth hormones can be added to feed or implanted under the skin of beef cattle to increase the animal's growth rate.[162] Synthetic hormones have been found in runoff from cattle feedlots, raising environmental and health concerns because hormones can be endocrine disruptors.[163]

PESTICIDES

To control pests such as horn flies, cattle producers can add pesticides to cattle feed so that the chemicals pass through the digestive system and are released in the cattle's manure. When a fly deposits eggs in the manure, the pesticide in the manure kills the larvae when the eggs hatch.[164] Animals can also be exposed to pesticides through ear tags containing insecticides.[165] The use of pesticides in the production of feed crops also raises many concerns, discussed on page 14.

The Environment

Conventional beef production can have negative effects on the environment. The cost of conventional beef production's effects on the environment and public health are "externalized," meaning they are not included in the cost of production of beef. Beef producers may not pay for those costs when producing beef and pass the low cost on to consumers, but we pay for the costs as a society—whether it is the people living "downwind" or "downstream" of a polluting feedlot, or the people with bacterial infections that cannot be treated with antibiotics because of antibiotic resistance resulting from overuse of these drugs on the farm. Some of those issues have been discussed above, but there are many additional impacts of beef production.

WATER AND AIR POLLUTION

The Environmental Protection Agency (EPA) estimates that 377 million tons of manure was produced by beef cattle in 2007 in the top ten beef-producing states.[166] Manure from food-animal production facilities is not required to be treated, as municipal human waste is.[167] Manure can pollute water and air with nutrients (e.g., nitrate and phosphorous), pathogens, synthetic hormones, antibiotics, pesticides, and ammonia.[168] Nitrogen in manure can also leach into groundwater as nitrate, which can be hazardous to human health at high levels.[169]

GREENHOUSE GAS EMISSIONS

In the U.S., agriculture and forestry account for roughly 10 percent of greenhouse gas emissions, and livestock production contributes significantly to that.[170] Enteric fermentation of ruminants emits methane, a greenhouse gas. Beef cattle manure also contains nitrogen, which can be lost to the atmosphere either as ammonia or as nitrous oxide, also a greenhouse gas.[171] Pasture-based systems (discussed below), though, may have the potential to sequester carbon.[172]

WASTING WATER

Beef production requires a lot of water, which is becoming an increasingly scarce natural resource. The largest fraction of the water needs for animal production comes from growing livestock feed, especially when feed consists of corn, soybeans, and other crops that are irrigated. (Only about 1 percent of water used for beef production is to provide drinking water for the animals.)[173]

Animal Welfare and Feedlot Conditions

Conditions in feedlots can be detrimental to animal welfare. Feedlots may not provide shade,[174] even though cattle are especially susceptible to heat stress during hot weather.[175] Tens of thousands of animals die annually on cattle ranches and feedlots from extreme or unexpected weather events.[176] Cattle cannot engage in natural behaviors such as grazing in feedlots, which can become very muddy, void of vegetation, and covered in manure.[177]

PHYSICAL MUTILATIONS

Approximately 15 million male calves are castrated on beef cattle farms every year.[178] The most common castration procedure involves surgical castration with a scalpel,[179] performed without pain relief for the vast majority of calves.[180,181] Beef cattle can also undergo painful dehorning[182] and branding.[183,184]

TRANSPORTATION AND SLAUGHTER

Approximately 35 percent of cattle arrive at slaughterhouses with one or more bruises.[185] Truck drivers and slaughterhouse employees can use prods that administer electric shocks to the animals, to "prod" them to continue moving as they are loaded, unloaded, and moved into the slaughterhouse.[186]

Sustainable Beef-Production Practices

GRASS-BASED SYSTEMS

Cows are ruminants—their natural behavior consists of grazing. Allowing beef cattle to graze on well-managed pastures from birth to slaughter (often referred to as 100 percent grass-fed) is at the core of sustainable beef production. What's good for animal welfare is also good for the environment and for consumers.

The benefits of grass-based beef production stand in stark contrast to the negative effects noted in the previous section on conventional production and include:

Fewer antibiotics and drugs are required to raise grass-fed cattle. Because grass-fed cattle eat only forage, poor health that can arise from grain intensive diets is prevented. In addition, pastures can only feed herds of a certain size, and in a properly managed pasture, the stressful and crowded disease-promoting conditions of the feedlot are eliminated. Healthier, less stressed animals need fewer antibiotics and other drugs to stay healthy.

Grass-fed cattle production can sequester CO_2, an important culprit in climate change. Individual grass-fed cattle produce more methane (an important greenhouse gas) than grain-fed cattle per pound of beef produced (from enteric fermentation, or digesting high-fiber grasses).[187] But grass-based beef production systems can produce fewer greenhouse emissions than grain-fed beef production when the carbon sequestration potential of pasture and rangeland are considered.[188]

Soils of grazing land can remove carbon dioxide from the atmosphere.[189,190] Managing cattle carefully to ensure that pastures are grazed moderately means restoring soil quality and cutting greenhouse gases by keeping carbon in the soil as organic matter rather than releasing it into the atmosphere as carbon dioxide.[191,192]

Manure is well-managed and doesn't pollute the environment. Manure is most ecologically harmful in liquid form, where anaerobic (oxygen-free) conditions generate more greenhouse gas emissions.[193,194] When animals are kept at appropriate stocking rates on well-managed grasslands or pasture, their manure is distributed on the pasture at levels the pasture can handle. The nutrients can be returned to the soil and recycled and actually improve the land instead of degrading it.[195]

Fewer synthetic pesticides and fertilizers are required. Whereas grass-fed beef requires more pastureland, cattle in feedlots require vast amounts of feed, most often grown and processed elsewhere and trucked in. Major environmental costs of grain-fed cattle come from growing the corn and soybeans.[196] Synthetic nitrogen fertilizer use is lower for grass-fed beef compared with beef raised on a grain-based diet,[197] as is the use of pesticides widely used to grow corn and soybeans.

More water is conserved in grass-based systems compared with conventional ones. The water footprint of concentrated grain-based feed in industrial systems is generally about five times larger than the water footprint of roughages in grazing systems.[198]

Well-managed pasture-based production systems are better for animal welfare. There is a clear intersection between what's good for animal welfare and the environment,[199] food safety, and nutrition when it comes to changing a system from fragmented and concentrated (feedlots) to one that is integrated and diverse (well-managed grazing). For many consumers, animal welfare is important.[200] There are a number of labels that guarantee high welfare standards discussed on pages 18 - 23.

Grass-fed beef isn't just better for animals, public health, and the planet; it may be healthier for individual consumers as well. Research suggests that beef from cattle on a 100 percent grass-based diet over the course of its lifetime has a more favorable fatty-acid composition and higher levels of healthy antioxidants.[201] Several studies have also found that the meat from grass-fed or grass-finished cattle can have significantly lower levels of total fat compared with grain-finished cattle.[202]

Labels Found on Ground Beef: Making Sustainable Choices

There are a variety of labels found on packages of ground beef at the market. Some of them provide added value to consumers, and some do not. We have reviewed the standards behind the labels on meat and rate them based on how meaningful they are. The most meaningful labels tell consumers that the meat is produced in a highly sustainable manner. Those labels have published standards that are well above the conventional baseline, are verified by independent third parties that are free from conflict of interest, and are consistent across products. Labels that are not meaningful have no standards or standards that do not go beyond the industry baseline. Labels that are not verified are also not meaningful. Often those labels sound like they should be meaningful (for example, "natural"), and although they may sometimes cost more, they offer no advantages over the conventional baseline. This section reviews our ratings of labels from the most meaningful to those that are not meaningful. Consumers should also be aware that there are multiple grassfed labels, which range from "somewhat meaningful" to "highly meaningful."

Some programs have several labels, which may have different ratings.

Highly Meaningful Labels

Animal Welfare Approved.

HIGHLY MEANINGFUL. VERIFIED.

The Animal Welfare Approved (AWA) standards require humane treatment from birth to slaughter, which includes requirements for continuous access to pasture and prohibits feedlots. (Continuous access to pasture is required, but producers can supplement the cattle's diet with grain.) Standards require that steps be taken to ensure humane treatment during transport to slaughter and in the slaughterhouse. The AWA standards are the only ones that require stunning cattle prior to slaughter without allowing exceptions.

Animals may not be treated with growth hormones or organophosphate pesticides, and antibiotics can be administered only to treat sick animals. Some physical alterations such as branding and dehorning are prohibited; others, such as disbudding (removing the tip of the horn) and castration are permitted without pain relief before a specified age (7 days for disbudding and 2 months for castration).

Farms must have pasture-management plans in place, and liquefied manure handling systems are prohibited. The use of genetically engineered feed is discouraged although not prohibited, and herbicides and pesticides can be used as a last resort.

Animal Welfare Approved Grassfed.

HIGHLY MEANINGFUL. VERIFIED.

Producers have to meet all of the requirements for Animal Welfare Approved (described above). In addition, the Animal Welfare Approved Grassfed label means that ruminants raised for meat were given a 100 percent grass- and forage-based diet, with the exception of milk prior to weaning. Animals were not fed grain.

Demeter Biodynamic.

HIGHLY MEANINGFUL. VERIFIED.

Demeter Biodynamic farms are managed as a self-reliant and self-sustaining biological entity. Meeting the certified organic standards (see below) is a prerequisite for meeting the biodynamic standards. Antibiotics, growth hormones, synthetic pesticides, and parasiticides are prohibited. Biodynamic standards recognize the important role that animals play on a farm by providing soil fertility. Cattle must have outdoor access year-round and access to pasture during the grazing months, when the majority of their feed must be fresh green material, such as grazing pastures. At least half of the animals' feed must be obtained from the farm itself. There are standards for responsible manure management to prevent environmental contamination and stocking rates to ensure that the available land base can support the livestock.

Biodynamic standards prohibit dehorning of cattle but permit castration without pain relief (most pain relief is a synthetic drug, which raises a dilemma in standards prohibiting synthetic drugs).

GAP Step 5-5+.

HIGHLY MEANINGFUL. VERIFIED.

GAP Step 5 and 5+ are the highest steps in the Global Animal Partnership's animal-welfare rating program. Feedlots are prohibited, and cattle live on pasture their entire lives, although supplementing their diet with grain while the cattle are on pasture is permitted. Cattle cannot be given growth hormones, organophosphate pesticides, and antibiotics for growth promotion or disease prevention. Sick cattle must be treated, but if antibiotics are administered, they cannot be sold as GAP-certified.

In terms of animal welfare, physical alterations including castration, dehorning or disbudding, and branding are prohibited. There are protections during transport to the slaughterhouse, and Step 5+ requires on-farm slaughter. There are no standards while the cattle are in the slaughterhouse.

GAP standards do not comprehensively address environmental issues such as pasture management, sustainable feed production (such as organic feed), and manure management.

PCO Certified 100% Grassfed.

HIGHLY MEANINGFUL. VERIFIED.

The label means beef is both certified organic and 100 percent grass-fed, with no grain in the diet. Since the label requires organic certification, the animals are not treated with antibiotics, growth hormones, or synthetic pesticides. The pasture on which they graze, as well as the forage crops they are given when grazing is not possible (e.g., winter months), is not genetically engineered or treated with synthetic pesticides and synthetic fertilizers.

There are no standards for transport to slaughter or for what happens in the slaughterhouse.

Meaningful Labels

American Grassfed Association.

MEANINGFUL. VERIFIED.

The American Grassfed label means that the animals were grass-fed throughout their entire lives (after weaning), with no grain ever. The animals had continuous access to pasture, and when grazing on pasture was not possible because of weather conditions, they were given a grass-based forage. The standards also prohibit antibiotics, growth hormones, and the use of certain parasiticides.

Standards allow the use of pesticides and herbicides on pasture, as well as genetically engineered alfalfa. Other than requiring continuous access to pasture, which is a benefit to the health and welfare of the animals, there are no standards for how the animals are treated, including during transport and slaughter.

Certified Humane.

MEANINGFUL. VERIFIED.

Certified Humane standards allow finishing cattle in feedlots on a grain-based diet. The standards aim to improve the conditions in the feedlots, such as requiring protection from extreme weather (e.g., shade, sprinklers, and windbreaks), access to dry bedding at all times, and minimizing mud. When animals are castrated, pain medication is required. Feed cannot contain animal waste and slaughter byproducts, antibiotics, and other drugs for growth promotion. Growth hormones are prohibited. Standards also aim to improve conditions during transport and in the slaughterhouse.

Certified Humane standards do not comprehensively cover other aspects of sustainable beef production such as sustainable feed production, prohibition of the use of pesticides, and manure management.

Food Alliance Grassfed.

MEANINGFUL. VERIFIED.

The label means that the animals raised for beef were raised on pasture, range, or paddocks for their entire lives, and were not fed supplemental grain for more than four days each year. Confinement cannot exceed 30 days, and animals in confinement must be given grass-based feed. The standards also prohibit antibiotics and growth hormones. When animals are sick and need antibiotics, they must be treated, but their meat cannot be sold as Food Alliance Grassfed.

To qualify for the Food Alliance Grassfed label, the farm or ranch must also meet the requirements for the general Food Alliance label, which are somewhat meaningful for reducing pesticide use, soil and water conservation, animal welfare, wildlife and biodiversity conservation, and fair working conditions.

GAP Step 4.

MEANINGFUL. VERIFIED.

GAP Step 4 requires that cattle spend at least three-fourths of their lives on pasture when seasonal conditions permit. There are no requirements for continuous grazing or a grass-based diet, so finishing with grain either in a feedlot or on pasture is permitted. Standards aim to improve conditions in feedlots, for example, by requiring protection from extreme weather, requiring areas that are free from mud, and giving access to dry bedding. Like all other GAP steps (1-5+), cattle cannot be given growth hormones, organophosphate pesticides, or antibiotics for growth promotion or disease prevention. Sick cattle must be treated, but if antibiotics are administered, they cannot be sold as GAP-certified.

GAP Step 4 allows castration of calves younger than 3 months without pain medication. Dehorning is prohibited, and disbudding is permitted only prior to age 6 weeks and only with appropriate pain control. Standards include space requirements during transport, which must not exceed 16 hours, and a requirement to protect animals from extreme weather during transport.

GAP standards do not address welfare in the slaughterhouse and do not address other aspects of sustainable beef production, such as manure management, pasture management, and sustainable feed production.

Organic.

MEANINGFUL. VERIFIED.

The organic label is backed by comprehensive USDA standards, which are verified by USDA-accredited certifying agencies. For beef cattle, the organic label means the animals were raised on organic farms that used no antibiotics, no growth hormones, no synthetic pesticides, and no other daily drugs. Feed contains certified organic ingredients, grown without pesticides and synthetic fertilizers and without genetically engineered organisms.

Organic standards for beef cattle require access to pasture for most of the animal's life but allow feedlots and grain feeding during the last months of the animal's life. Standards also do not cover humane treatment of the animals, and there are no standards for the humane treatment during transportation and slaughter.

USDA Process Verified Never Ever 3.

MEANINGFUL. VERIFIED.

The USDA's Agricultural Marketing Service (AMS) offers optional "USDA Process Verified" claims, including "Never Ever 3" which means no antibiotics, no growth hormones, and no animal byproducts in feed.

The prohibition against the use of antibiotics includes additional drugs such as sulfonamides and ionophores (ionophores as coccidiostats for parasite control can be used), and the prohibition against growth promotants includes natural hormones, synthetic hormones, estrus suppressants, beta-agonists (including ractopamine). If animals become sick and have to be treated with antibiotics, they must be removed from the program and their meat cannot be sold with the label.

The prohibition against the use of animal byproducts in the feed includes mammalian and avian slaughter byproducts as well as animal waste such as used poultry litter. Fish byproducts and vitamin and mineral supplementation are permitted.

Somewhat Meaningful Labels

American Humane Association.

SOMEWHAT MEANINGFUL. VERIFIED.

The American Humane Association standards reflect the industry standard for raising beef and do not require substantial changes to the system. There are no requirements for a grass-based diet or access to pasture, and cattle can be finished on a grain-based diet in feedlots. Feed can contain genetically engineered alfalfa, corn and soybeans, animal waste and slaughter byproducts, synthetic urea, and synthetic insecticides. Though synthetic growth hormones and antibiotics for growth promotion are prohibited, antibiotics can be administered to an entire herd for disease prevention.

The standards aim to improve the conditions in feedlots by requiring shelter and protection from extreme weather, minimizing mud, and giving cattle access to dry bedding. Branding is prohibited, and pain control is required during castration or disbudding of calves older than 7 days. There are standards to improve conditions during transport and slaughter, although there is no maximum duration of transport. Standards do not cover sustainable feed production, manure management, or other environmental issues.

Food Alliance.

SOMEWHAT MEANINGFUL. VERIFIED.

The Food Alliance standards have certain baseline requirements and a scoring system, which means that many standards are encouraged but not required. It is not possible for consumers to know which optional standards were met. For beef, fixed requirements include a prohibition on animal waste in feed, antibiotics for growth promotion and disease prevention (sick animals must be treated and undergo a withdrawal period that is twice the licensed period), and growth hormones.

Food Alliance standards for beef do not require continuous access to pasture or range and do not require a grass-based diet. Standards encourage but do not require that cattle in feedlots be protected from extreme weather, that feedlots be managed in a way that minimizes mud, or that animals have access to dry bedding.

GAP Step 1-2.

SOMEWHAT MEANINGFUL. VERIFIED.

GAP Step 1 and Step 2 (there is no Step 3 for beef) reflect the industry baseline in many areas. There are no requirements for a grass-based diet, although standards do require that fibrous foods such grass, hay, haylage, or silage must be continuously available. Cattle can be removed from pasture or range for up to one-third of the animal's life, confined in a feedlot and given a grain-based diet for rapid growth. Standards aim to improve the conditions in the feedlot by requiring shelter and protection from extreme weather, areas that are free from mud, and access to dry bedding. Like all other GAP steps (1-5+), cattle cannot be given growth hormones, organophosphate pesticides, and antibiotics for growth promotion or disease prevention. Sick cattle must be treated, but if antibiotics are administered, they cannot be sold as GAP-certified.

Like GAP Step 4, Step 2 allows castration of calves younger than 3 months without pain medication. Step 1 allows calves as old as 6 months to be castrated without pain relief. Like GAP Step 4, dehorning is prohibited, and disbudding is permitted only prior to age 6 weeks and only with appropriate pain control when using a hot iron. Standards include space requirements during transport, which must not exceed 16 hours for Step 2 and 25 hours for Step 1, and a requirement in all GAP step levels to protect animals from extreme weather during transport.

GAP standards do not address welfare in the slaughterhouse and do not address other aspects of sustainable beef production, such as manure management, pasture management, and sustainable feed production.

Grassfed/100% Grassfed.

SOMEWHAT MEANINGFUL. AFFIDAVIT AND OTHER DOCUMENTATION SUBMITTED TO USDA FOR DESK AUDIT.

The Food Safety and Inspection Service (FSIS) of the USDA reviews and approves all labels on meat and poultry. The FSIS requires that producers using the "grassfed" or "100% grassfed" label on meat comply with the USDA Grass (Forage) Fed standard. The standard prohibits grain in the diet and requires access to pasture during the grazing season. Other than written documentation and a signed affidavit supplied by the producer, there is no independent verification of the label.

No antibiotics administered / Raised without antibiotics.

SOMEWHAT MEANINGFUL. AFFIDAVIT AND OTHER DOCUMENTATION SUBMITTED TO USDA FOR DESK AUDIT.

The Food Safety and Inspection Service (FSIS) of the Department of Agriculture (USDA) reviews and approves all labels on meat and poultry to verify that the products are properly labeled. The USDA approves "no antibiotics administered" and "raised without antibiotics" claims if the company provides paperwork, including feed tags and affidavits, showing that no antibiotics are administered throughout the lifetime of the animals. There is no independent verification of the claims. Other drugs given for growth promotion, such as ractopamine, are allowed. The USDA does not approve "antibiotic free" claims.

USDA Process Verified Grassfed.

SOMEWHAT MEANINGFUL. VERIFIED.

The USDA's Agricultural Marketing Service (AMS) offers optional "USDA Process Verified" claims, including "grassfed." The USDA's Grass (Forage) Fed standard requires that the animals were fed grass, hay, silage, or other nongrain crops throughout their entire life, with the exception of milk prior to weaning. The animals were never fed grain.

But the standard does not mean that the animals lived on pasture or had continuous access to pasture. The animals can be confined during the nongrowing season as long as their diet consists of grass, hay (dried grass), silage (grass stored in airtight conditions in a silo), forbs (e.g., legumes and brassica), browse, or cereal grain crops in the vegetative (pregrain) state. Animals may also be treated with antibiotics and other drugs.

Labels That Are Not Meaningful

We have come across the following labels and claims on beef, which are not verified and not meaningful on their own. When not accompanied by a meaningful label, consumers should not pay more for beef with these claims:

“Natural”

“Humanely raised”

“Environmentally friendly”

“Agriculturally sustainable”

Consumer Reports Campaign to Ban the “Natural” Label

The current definition of “natural” used by the USDA to approve the label on meat and poultry addresses only the absence of artificial ingredients in the final product and minimal processing.[203] There are no standards addressing how the animals are raised.

The Consumer Reports National Research Center conducted nationally representative surveys of U.S. consumers in 2007, 2008, and April 2014, which strongly suggest that a majority of U.S. consumers are misled by the “natural” label on meat and poultry, and have consistently expected the “natural” label on meat and poultry products to mean more than just “minimal processing” and “no artificial ingredients.”[204]

Our 2014 survey shows that 68 percent of U.S. consumers think that the “natural” label means that the animal was not given growth hormones, 60 percent think no antibiotics or other drugs were given to the animals, 64 percent think that feed did not contain genetically engineered organisms, and 60 percent think the feed contained no artificial ingredients. Those numbers suggest that the “natural” label on meat and poultry currently misleads the majority of U.S. consumers, because the “natural” label does not guarantee that those requirements were met.

In our 2007 survey, 83 percent of consumers expected meat and poultry labeled “natural” to come from an animal that was raised in a natural environment. In 2008, 85 percent of consumers responded that they think the “naturally raised” claim should mean the animal was raised in a natural environment, and 77 percent believed that the animal should have access to the outdoors.

When asked what they think the “natural” label should mean in our 2014 survey, 89 percent believe the animal should not be given growth hormones, 85 percent believe the animals’ diet should have no artificial ingredients and no genetically modified organisms (GMOs), 81 percent believe the animal should not be given antibiotics or other drugs, and 66 percent believe that the animals should be able to go outdoors (Figure N1).

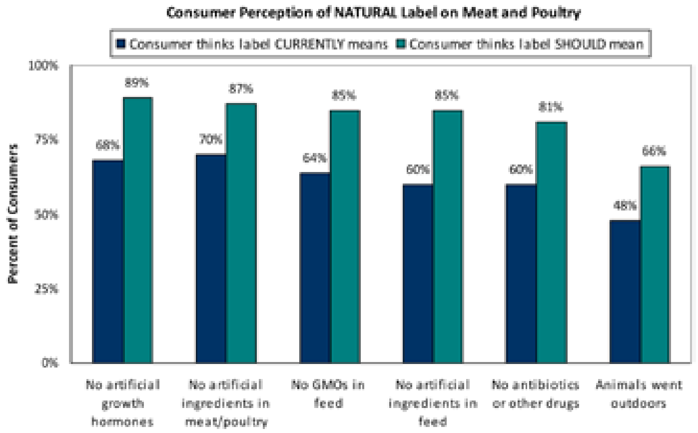


Figure N1. Consumer perception of “natural” label on meat and poultry, 2014 survey results.

Those survey results suggest that almost two-thirds of U.S. consumers are misled by the “natural” label on meat and poultry products and that almost 90 percent expect it to mean much more than it does.

We believe that there’s a drastic difference between the USDA’s current definition of “natural” for meat and poultry and what people think the “natural” label should mean, and we have asked the USDA to prohibit the use of the term on meat and poultry. We have also asked the FDA to prohibit the use of the “natural” label on products that it regulates.

LABELS GUIDE

ConsumerReports
FOOD SAFETY & SUSTAINABILITY CENTER

🔴 NO
🟢 YES
🟡 PARTIAL

LABEL	VERIFICATION	FEED			PRUDENT DRUG USE		SUSTAINABLE AGRICULTURE				ANIMAL WELFARE							
	Is It Verified?*	Do standards require 100% grass-based feed?	Do standards prohibit animal waste in feed?	Do standards prohibit pesticides as feed additives?	Do standards prohibit antibiotics or require that antibiotics be used only to treat individual sick animals?	Do standards prohibit artificial growth hormones and other drugs to promote growth?	Do standards prohibit synthetic fertilizers and synthetic pesticides on pasture and in feed?	Do standards prohibit GMOs in pasture and in feed?	Do standards address responsible manure management?	Do standards require responsible pasture management?	Do standards prohibit feedlots?	Do standards require protection from extreme weather?	Do standards require access to dry bedding?	Do standards require pain relief during castration?	Do standards prohibit dehorning and disbudding or require pain relief?	Do standards address animal welfare during transit to the slaughterhouse?	Do standards prohibit the use of electric prods?	Slaughterhouse design for improved welfare - independently verified
Environmental Sustainability Labels																		
Demeter Biodynamic	🟢	🟡	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟡	🟢	🟡	🟡	🔴
USDA Organic	🟢	🟡	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟡	🔴	🟢	🟡	🟡	🔴	🔴	🔴
Certified Naturally Grown	🟢	🟡	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🔴	🟢	🟡	🟡	🔴	🔴	🔴
Food Alliance (also see FA Grassfed)	🟢	🔴	🟢	🟡	🟢	🟢	🟡	🟡	🟡	🟡	🔴	🟡	🟢	🟡	🔴	🟡	🟡	🔴
Non-GMO Project Verified	🟢	🔴	🔴	🔴	🔴	🔴	🔴	🟢	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴
Humane Labels																		
Animal Welfare Approved (also see AWA Grassfed)	🟢	🟡	🟢	🟡	🟢	🟢	🟡	🟡	🟢	🟢	🟢	🟢	🟢	🟡	🟢	🟢	🟢	🟢
GAP Step 5	🟢	🟡	🟢	🟡	🟢	🟢	🔴	🔴	🟢	🔴	🟢	🟢	🔴	🟢	🟢	🟢	🟡	🔴
GAP Step 5+	🟢	🟡	🟢	🟡	🟢	🟢	🔴	🔴	🟢	🔴	🟢	🟢	🔴	🟢	🟢	🟢	🟡	🔴
Certified Humane	🟢	🔴	🟢	🔴	🟢	🟢	🔴	🔴	🟡	🔴	🔴	🟢	🟢	🟢	🟢	🟡	🟡	🟢
GAP Step 4	🟢	🟡	🟢	🟡	🟢	🟢	🔴	🔴	🟢	🔴	🔴	🟢	🟢	🔴	🟢	🟡	🟡	🔴
American Humane Certified	🟢	🔴	🔴	🔴	🟡	🟢	🔴	🔴	🔴	🔴	🔴	🟢	🟢	🟢	🟢	🟡	🟡	🟢
GAP Step 2	🟢	🔴	🟢	🟡	🟢	🟢	🔴	🔴	🔴	🔴	🔴	🟢	🟢	🔴	🟢	🟡	🟡	🔴
GAP Step 1	🟢	🔴	🟢	🟡	🟢	🟢	🔴	🔴	🔴	🔴	🔴	🟢	🟢	🔴	🟢	🟡	🟡	🔴
Humanely Raised and Handled	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴

* yellow dot:
USDA Desk Audit

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LABELS GUIDE

ConsumerReports
FOOD SAFETY & SUSTAINABILITY CENTER

LABEL	VERIFICATION	FEED			PRUDENT DRUG USE		SUSTAINABLE AGRICULTURE				ANIMAL WELFARE							
🔴 NO 🟢 YES 🟡 PARTIAL	Is It Verified?*	Do standards require 100% grass-based feed?	Do standards prohibit animal waste in feed?	Do standards prohibit pesticides as feed additives?	Do standards prohibit antibiotics or require that antibiotics be used only to treat individual sick animals?	Do standards prohibit artificial growth hormones and other drugs to promote growth?	Do standards prohibit synthetic fertilizers and synthetic pesticides on pasture and in feed?	Do standards prohibit GMOs in pasture and in feed?	Do standards address responsible manure management?	Do standards require responsible pasture management?	Do standards prohibit feedlots?	Do standards require protection from extreme weather?	Do standards require access to dry bedding?	Do standards require pain relief during castration?	Do standards prohibit dehorning and disbudding or require pain relief?	Do standards address animal welfare during transit to the slaughter-house?	Do standards prohibit the use of electric prods?	Slaughterhouse design for improved welfare - independently verified
Grassfed Labels																		
Animal Welfare Approved Grassfed	🟢	🟢	🟢	🟡	🟢	🟢	🟡	🟡	🟢	🟢	🟢	🟢	🟢	🟡	🟢	🟢	🟢	🟢
PCO Certified 100% Grassfed	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟡	🔴	🟢	🟡	🟡	🔴	🔴	🔴
Food Alliance Grassfed	🟢	🟢	🟢	🟡	🟢	🟢	🟡	🟡	🟡	🟡	🟢	🟡	🟢	🟡	🔴	🟡	🟡	🔴
American Grassfed Association	🟢	🟢	🟢	🟡	🟢	🟢	🔴	🔴	🟢	🟡	🟢	🔴	🔴	🔴	🔴	🔴	🔴	🔴
Grassfed/ 100% Grassfed	🟡	🟢	🟢	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴
Grassfed - USDA Process Verified	🟢	🟢	🟢	🟡	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴
General Claims																		
Never Ever 3- USDA Process Verified	🟢	🔴	🟢	🔴	🟢	🟢	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴
No antibiotics administered/ Raised without antibiotics	🟡	🔴	🔴	🔴	🟢	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴
No growth hormones	🟡	🔴	🔴	🔴	🔴	🟢	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴
Conventional - no label	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴
Natural	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴
Kosher	🟢	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴

* yellow dot:
USDADesk Audit

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Carl's Jr. "All-Natural" Burger

The "All-Natural Burger" from the fast-food chain Carl's Jr. contains a beef patty from cattle that are grass-fed and grass-finished, and raised without the use of antibiotics, hormones, and steroids. The beef is sourced from Australian ranches. There is no third-party certification to assure consumers that those claims are verified.

The cattle, though not treated with hormones, antibiotics, and steroids, are not certified to organic or other standards that prohibit other materials that would not be considered "natural," such as synthetic pesticides. In addition, there are no standards prohibiting the use of synthetic fertilizers and pesticides on the range or pasture on which the cattle graze.

According to Carl's Jr., at this time the "All-Natural" label is meant to refer only to the beef patty. A review of the ingredients that make up the rest of the burger reveals that they are not all consistent with consumer expectations of the "natural" label. The burger as a whole contains many artificial ingredients, as well as milk and eggs without organic or any other certification. Artificial ingredients in the bread, mayonnaise, and other components of the "All-Natural" burger include:

- artificial preservatives (e.g., calcium disodium EDTA)
- artificial colors (e.g., Yellow 5 and unspecified "artificial color")
- artificial sweeteners (e.g., neotame, acesulfame potassium, maltitol)
- artificial flavors
- highly processed ingredients, such as high fructose corn syrup, hydrolyzed soy protein and hydrogenated oil, which can be processed with synthetic processing aids, such as hexane
- ingredients that are likely derived from genetically engineered ingredients, such as corn syrup and soybean oil

Beef Vocabulary

In the grocery store aisle, a package of beef can say many things. Some terms have specific meanings that may not be obvious at first glance. To help make shopping easier, here are some definitions:

GROUND BEEF. This can come from meat and fat trimmings from multiple animals, as well as other beef components, such as esophagus, diaphragm, or cheek of the animal. The maximum amount of fat by weight it can contain is 30 percent.

HAMBURGER. This is made from meat trimmings and other beef components. It can't exceed 30 percent fat, but unlike ground beef, pure beef fat can be added to reach the desired level of fat content.

PURE BEEF PATTIES. Also called 100 percent beef patties, these are similar to ground beef but can contain partially defatted chopped beef. Regular "beef patties" can also contain defatted beef, and organ meats, water, binders, fillers, and extenders. Those latter ingredients must be listed on the label.

GROUND CHUCK. When you see a cut of beef denoted on the label—such as chuck, round, or sirloin—the meat and meat trimmings come from that part of the animal. No beef components can be added. However, it can still contain meat from multiple animals.

80/20. This refers to the percent of lean meat and fat by weight in the ground beef. Common lean-to-fat percentages are 70/30, 80/20, and 90/10. That doesn't tell you the percent of calories from fat in the beef, however. For example, 51 percent of the calories in 90/10 beef come from fat.

LEAN/EXTRA LEAN. "Lean" must have less than 10 grams of total fat and less than 4.5 grams of saturated fat per 3.5-ounce serving. "Extra Lean" meat must contain less than 5 grams of total fat and less than 2 grams of saturated fat.

USDA Grading Found On Beef

There are two types of grades for beef: quality grades and yield grades. Quality grades are for "tenderness, juiciness, and flavor," according to the USDA, and are based on the amount of marbling, color, and maturity. (Marbling is white flecks of fat within the meat muscle.) Yield grades are for the amount of usable lean meat on the carcass and are not something consumers typically see.[205]

According to the USDA the grades mean the following:

Prime: Abundant marbling. Generally only available in restaurants and hotels. About 2 percent of graded beef is Prime.

Choice: High quality, but less marbling than Prime.

Select: Very uniform in quality, leaner than the higher grades. Less marbling. May lack some of the juiciness and flavor of the higher grades.

Standard and Commercial: Generally sold as ungraded or "store brand" meat.

Utility, Cutter, Canner: The lowest grades. Not generally sold at retail but used to make ground beef and processed products.

Consumer Reports Test

Sample Procurement

We purchased samples of raw ground beef (not preformed patties) from 26 metropolitan areas across the U.S. over a three-week period in October 2014. Samples were purchased at retail from large chain supermarkets, big-box stores, and "natural" food stores. All samples purchased were prepackaged. Samples were kept cold and shipped overnight to our testing lab.

A total of 300 ground beef samples were purchased for microbiological analysis. Samples represented a variety of production label claims, product types (i.e., "ground chuck" and "ground sirloin"), lean points (i.e., 85/15 and 90/10), countries of origin, and packaging types (tray overwrap, case ready tray, case ready chub, and vacuum packs).

181 of the 300 samples were ground beef from conventionally raised cattle (i.e., no sustainable label claims) and are referred to as conventional samples in this report (Figure S1).

116 of the 300 samples had production-label claims of organic or no antibiotics, and in addition, many of those had grass-fed claims (either "grass fed" or "100% grass fed"); together, those are referred to as "more sustainably produced" samples. Three additional more sustainably produced samples had a grass-fed claim but did not have a no-antibiotics production-label claim. We could not verify whether those three were raised with or without antibiotics, so we included them in parts of our prevalence analysis but excluded them in the analysis of antibiotic resistance.

The table below (Table S1) shows the number of samples with each claim and how the claims overlapped.

Table S1. Numbers and proportions of samples by no-antibiotics and grass-fed production label claims.

No-Antibiotics Claim	Number (%) of Samples With Grass-Fed Claim			
	No Grass-Fed Claim		Grass-Fed Claim	
None	181	(60%)	3	(1%)
'No Antibiotics'	40	(14%)	31	(10%)
'Organic'[a]	14	(5%)	31	(10%)

[a] Organic standards prohibit the use of antibiotics.

The misleading "natural" label claim was also found on the packaging of 108 ground beef samples in our test. 58 conventional samples made that claim, as did 47 more sustainably produced products. Of the 47 more sustainably produced samples, all had a no-antibiotics claim, seven were organic, and five grass-fed. USDA allows the term natural for meat if it is minimally processed and has no added artificial ingredients, as discussed on page 25, but that falls far short of consumer expectations.

COUNTRY OF ORIGIN AND LABELING

In terms of country of origin, more than 91 percent of samples listed the U.S. as one of the countries of origin, and 38 percent overall listed the U.S. exclusively (Figure S2). An additional 28 percent were labeled as originating in Canada and the U.S. A country of origin was not listed on the packaging for 5 percent of samples, all of which had been repacked in the store.

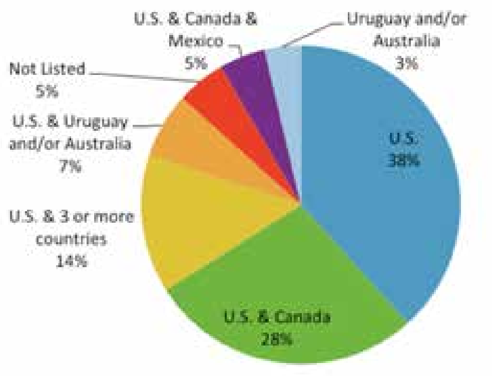

Figure S2. Percent of raw ground beef samples by countries of origin listed on packaging.

Testing Methods

MICROBIOLOGY TESTING METHODOLOGY

We tested ground beef for generic *E. coli*, *E. coli* O157:H7, the "Big 6" non-O157:H7 Shiga toxin-producing *E. coli* (STEC),[206,207] *Salmonella* species, *Staphylococcus aureus, Clostridium perfringens*, and *Enterococcus* species.

Of the organisms we tested for, *Salmonella*, toxin producing *E. coli* (STECs), *C. perfringens*, and *S. aureus* are important causes of foodborne illness. Additionally, *S. aureus* and some strains of *E. coli*, often called extra-intestinal pathogenic *E. coli* (ExPEC), have the potential to cause opportunistic infections outside of the GI tract in humans. Finally, certain *Enterococcus* species can cause extraintestinal disease in humans, although we tested for *Enterococcus* as a common indicator organism of fecal contamination.

The methods for isolating test organisms from ground beef samples were based on the FDA NARMS Program and the FDA Bacteriological Analytical Manual (BAM). For STEC *E. coli* and *Salmonella*, genetic screening methods based on the USDA Food Safety and Inspection Service (FSIS) Microbiology Laboratory Guidebook (MLG) were used prior to plating, and only samples that screened positive in the PCR screen were plated. We used matrix-assisted laser desorption/ionization time of flight (MALDI-TOF) mass spectrometry for confirmation of bacterial species identification.

Isolates of *E. coli*, *Salmonella*, and *S. aureus* were also tested to determine specific virulence. To do that:

- All *S. aureus* isolates were screened for staphylococcal enterotoxin (SE) genes A through D using real-time PCR.[208] Isolates that screened positive were tested for SE production (i.e., presence of a functional gene) by enzyme-linked fluorescent immunoassay.[209]
- All *C. perfringens* isolates were screened for the *C. perfringens* enterotoxin (CPE) gene using real-time PCR. Though there are a variety of types of *C. perfringens*, the type associated with food poisoning produces CPE.
- All *E. coli* underwent genetic testing for extra-intestinal pathogenic *E. coli* (ExPEC) virulence genes using real-time PCR.
- All *Salmonella* isolates underwent testing to identify serotypes based on the Kauffman-White Scheme and CDC guidelines. In addition, DNA "fingerprinting" by pulsed-field gel electrophoresis (PFGE) was performed based on CDC PulseNet methods.

Antibiotic susceptibility testing was performed on confirmed bacteria. Minimum inhibitory concentrations were determined by broth microdilution according to Clinical and Laboratory Standards Institute (CLSI) methods. 2014 CLSI interpretive criteria were used when available; otherwise breakpoints from the FDA NARMS 2011 Report or FDA were used.

Consumer Reports Test Results

Key Findings from Our Tests

Overall

- We found at least one of the types of bacteria we looked for on all of our samples.
- 10 percent of the samples we tested were contaminated with *Staphylococcus aureus* that had the potential to produce a heat-stable toxin that can cause food poisoning.
- There was more resistance to the classes of antibiotics we tested that had indications for growth promotion, improved feed efficiency, or disease prevention in cattle, compared with drugs without such indications.

SIGNIFICANT DIFFERENCES WERE FOUND BETWEEN CONVENTIONALLY PRODUCED BEEF AND BEEF THAT WAS MORE SUSTAINABLY PRODUCED (THOSE PRODUCED WITH NO ANTIBIOTICS AND THOSE THAT WERE ORGANIC AND/OR GRASS-FED)

- Conventional samples were more likely to be contaminated with *S. aureus* or *E. coli* than more sustainably produced samples.
- Conventional samples were more than twice as likely as more sustainably produced samples to be contaminated with bacteria resistant to two or more classes of antibiotics.
- 3 MRSA (methicillin-resistant *S. aureus*) were found on conventional samples, but none were found on the more sustainably produced samples.
- Grass-fed samples that we verified to be produced without antibiotics had three times lower likelihood of containing multidrug-resistant bacteria (6 percent) compared with conventional samples (18 percent).

Prevalence

We tested 300 samples of raw ground beef, all of which had at least one bacterial species. Almost three-quarters of our samples (218 samples, or 73 percent) had two or more types of bacteria (see Figure P1). The prevalence for each species we tested is shown in Table P1 and Figure P1.

Table P1. Percent of raw ground beef samples with each bacterial type tested.

Bacteria	Number (%) of Samples n=300	
Staphylococcus aureus	131	(43.7%)
Clostridium perfringens	56	(18.7%)
Salmonella species	3	(1.0%)
Escherichia coli	152	(50.7%)
Enterococcus species	299	(99.7%)

E. coli and *Salmonella* rates are similar to those reported for ground beef by NARMS in 2012 (57 percent of 480 samples had *E. coli,* and 0.9 percent of 1,300 samples had *Salmonella)* and, for *Salmonella*, 2013 (0.9 percent of 1,663 samples had *Salmonella).*[210,211]

HIGHER PREVALENCE OF BACTERIA ON CONVENTIONAL SAMPLES THAN ON MORE SUSTAINABLY PRODUCED SAMPLES

More *S. aureus* and *E. coli* were found on conventional samples than on more sustainably produced samples (Figure P1). The other types of bacteria we looked for were distributed similarly among conventional and more sustainably produced samples. For *Salmonella* and enterococci, there were too few samples with and without those types, respectively, to make statistical comparisons between the groups.

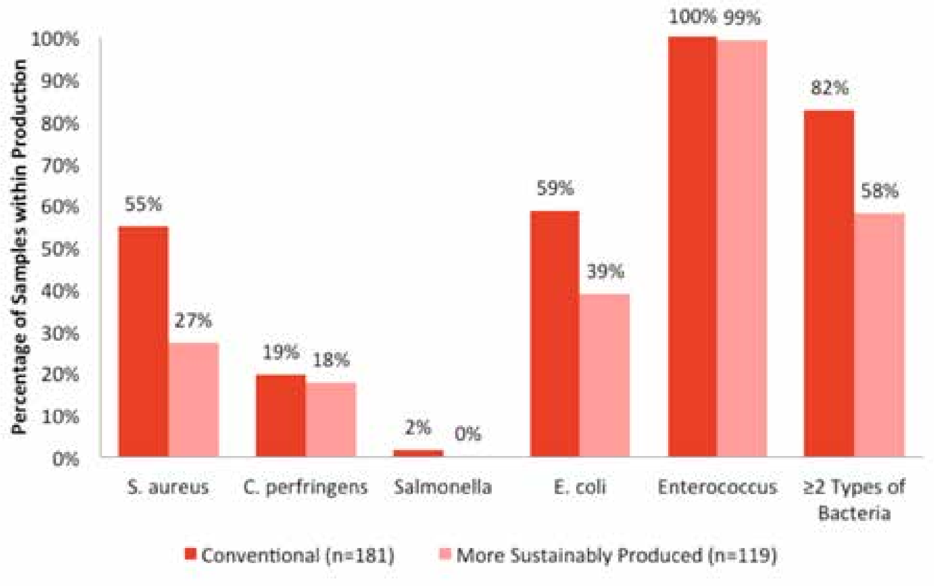

Figure P1. Percentage of conventional and more sustainably produced raw ground beef samples with target bacteria. Statistically significant difference in prevalence rates found between conventional and more sustainably produced groups for those marked with *. Note: ≥2 Types of Bacteria includes Enterococcus species plus at least one other species.

Looking more closely at the subgroupings within the more sustainably produced samples, the most noticeable difference in the proportions of samples with *S. aureus* was between conventional samples (55 percent) and the group of samples with a no-antibiotics claim (27 percent) (Table P2). The proportion of grass-fed (32 percent) samples with *S. aureus* was also lower than the proportion of conventional samples with those bacteria. For *E. coli*, the largest prevalence differences were for conventional (59 percent) and organic (33 percent) samples. Grass-fed samples were also less likely (42 percent) than conventional samples to have *E. coli* on them.

Table P2. Percent of raw ground beef samples with *S. aureus* or *E. coli* with grass-fed and/or organic label claims compared with conventional samples.

Bacteria	Number (%) of Samples							
	Conventional		More Sustainably Produced					
	(n=181)		Grass Fed (n=65)[a]		Organic (n=45)[b]		No Antibiotics (n=116)[b]	
S. aureus	99	(55%)^	21	(32%)*	20	(44%)	32	(28%)***
E. coli	106	(59%)^	27	(42%)*	15	(33%)**	45	(39%)***

[a] Includes all samples with grass-fed claim.

[b] Includes samples both with and without grass-fed claims.

For each row, statistically significant difference found between conventional group (marked with ^) and a more sustainably produced group is marked with * for grass-fed, ** for organic, or *** for no antibiotics; there was no difference compared with conventional samples for groups that are not marked.

Complete results of how many samples had *S. aureus*, *E. coli*, and at least one type of bacteria (not enterococci, which were isolated from almost every sample) are presented below according to production-label-claim subcategories (Table P3). Significant differences between conventional and subcategories of more sustainably produced are noted.

Table P3. Percentage of raw ground beef samples with *S. aureus*, *E. coli*, one or more types of bacteria (not enterococci) by production-label-claim subcategories.

Bacteria	Number (%) of Samples									
			More Sustainably Produced							
	Conventional (n=181)		No Antibiotics (n=40)		No Antibiotics Organic (n=14)		No Antibiotics Grass-Fed (n=31)		No Antibiotics Organic Grass-Fed (n=31)	
S. aureus	99	(55%)^	3	(8%)*	8	(57%)^	9	(29%)^	12	(39%)^
E. coli	106	(59%)^	15	(38%)*	4	(29%)*	15	(48%)	11	(35%)*
≥1 Type (not enterococci)	149	(82%)^	22	(55%)*	10	(71%)	22	(71%)	15	(48%)*

For each row, statistically significant difference found between groups marked with * and those marked with ^; no difference was found for other subcategories because of small group size or other factors.

S. AUREUS WITH POTENTIAL TO PRODUCE ENTEROTOXIN

We tested all *S. aureus* isolates to see whether they were able to produce staphylococcal enterotoxin (SE), which causes staphylococcal food poisoning. Because SE is not inactivated by the same heating conditions that normally kill bacteria, contamination of ground beef with SE-producing *S. aureus* poses a potential risk to consumers. But in order for people to get sick from SE, it must be present at relatively high levels. In our tests, we did not determine the quantity of *S. aureus* that was present, so we are unable to say whether any samples contained enough to make a person sick. Among the 131 samples that had *S. aureus*, 22 percent of isolates (n=29, on 10 percent of samples overall) had the potential to produce SE. In order for *S. aureus* to be present at sufficient levels to generate enough toxin to make a person sick, the meat would have to be above 40° F for a significant amount of time. The presence of SE-producing *S. aureus* underscores the importance of proper handling of meat at home as well as throughout the supply chain.

As mentioned above (see Figure P1), *S. aureus* was more likely to be found on conventional samples (55 percent) than on the more sustainably produced samples (27 percent). The proportions of conventional and more sustainably produced samples with *S. aureus* able to produce SE were 12 and 6 percent, respectively. That difference was not statistically significant.

CLOSTRIDIUM PERFRINGENS

C. perfringens was detected in 19 percent of our ground beef samples. This species is estimated to cause about one million foodborne illnesses in the U.S. each year, and according to the CDC's analysis of outbreak surveillance data for 1998 to 2010, 66 outbreaks (or 46 percent of outbreaks of *C. perfringens* foodborne illness) were associated with beef.[212] Food poisoning with *C. perfringens* is also associated with the production of a toxin. We tested the *C. perfringens* we found for the gene that would allow them to make the toxin CPE, which is associated with food poisoning caused by this bacterium, but none of the isolates had the enterotoxin gene. However, the presence of *C. perfringens* is still a concern because it is considered a major cause of food poisoning and because the bacteria also has the potential to cause other types of extra-intestinal infections in susceptible populations such as the immunocompromised.

Rates of *C. perfringens* were comparable in the conventional and more sustainably produced samples (19 and 18 percent, respectively).

SALMONELLA

Salmonella, a pathogen that has been responsible for a number of ground beef-associated outbreaks of foodborne illness in recent years, was found on three conventional samples. Although those three samples represent only 1 percent of the overall samples we tested, the presence of *Salmonella* can be concerning. The FSIS regularly tests for *Salmonella* as part of an HACCP monitoring program, and of the more than 17,000 samples tested in 2013, 1.6 percent tested positive for *Salmonella*.[213] All of the isolates from our study were *S. enterica* and belonged to the following serotypes that have been associated with infections in humans and in cattle: *Montevideo*, *Dublin*, *Kentucky*, and *Mbandaka*.

E. COLI

We used PCR to screen for *E. coli* belonging to the toxigenic serotypes that are well known for causing severe forms of foodborne illness (i.e., O157 and the Big 6 STECs). Although screening indicated presence of the toxin gene (*stx1*) in three of the ground beef samples, suggesting those bacteria were present at one point, we were not able to grow any STEC *E. coli* isolates from those samples and therefore do not count them in our prevalence rate (which includes only living bacteria). But the presence of those genes indicates the need for better farming and processing hygiene where the problems begin. Another reason we may have been unable to grow STEC from those samples could be that the STEC bacteria were not present in sufficient numbers to outcompete nontoxigenic *E. coli* and other organisms in the enrichment broth or on the selective media used.

Even though we did not isolate toxin-producing *E. coli*, we did find generic *E. coli* on more than half of the samples. Of the 152 samples with *E. coli*, three (2 percent) had isolates that were extra-intestinal pathogenic *E. coli* (ExPEC), although our test looked only for a limited set of virulence genes.

The prevalence rate for the conventional samples (59 percent) was much higher than the rate among the more sustainably produced samples (39 percent).

ENTEROCOCCI

Enterococci were recovered from all but one of the samples in our study. Only one *Enterococcus* isolate per sample was chosen for species identification: We identified *E. faecalis* from 215 samples (34 percent), *E. faecium* from 45 (7 percent), *E. durans* from 22 (3 percent), and *E. hirae* from 17 (3 percent).

The prevalence of enterococci was similar for conventional and more sustainably produced samples (100 and 99 percent, respectively).

Antibiotic Resistance

We tested the bacteria we isolated from raw ground beef samples for antibiotic resistance.

CONVENTIONAL SAMPLES SHOW RESISTANCE TO HIGHER NUMBERS OF ANTIBIOTIC CLASSES THAN MORE SUSTAINABLY PRODUCED SAMPLES

Antibiotics that work in a similar way can be grouped into families called classes. Overall, we found a significant amount of resistance to a variety of classes in our study. The use of antibiotics promotes the development of resistance in bacteria, and as one would expect, in our study we saw differences in the amount of resistance in conventional compared with more sustainably produced samples.

For the discussion that follows, the more sustainably produced group represents samples with a no-antibiotics claim. (Three of the more sustainably produced samples with a grass-fed label did not make that claim and could not be verified, so they were excluded from the antibiotic resistance analysis.)

Conventional samples had bacteria on them that were resistant to more classes of antibiotics than more sustainably produced samples: 39 percent of conventional samples contained bacteria that were resistant to two or more classes of antibiotics, and only 19 percent of samples with a no-antibiotics claim did. In addition, samples with a no-antibiotics claim appeared more likely than conventional samples to contain bacteria with no resistance (23 and 31 percent, respectively), but that was not statistically significant (Table R1).

Table R1. Antibiotic resistance (number of classes) of bacteria found on raw ground beef samples.

Bacterial Resistance	Number (%) of Samples			
	Conventional (n=181)		More Sustainably Produced (n=116)	
None	41	(23%)	36	(31%)
1 Antibiotic Class	70	(39%)	58	(50%)
2 Antibiotic Classes	39	(22%)	11	(9%)
3 Antibiotic Classes	22	(12%)	10	(9%)
More than 3 Antibiotic Classes	9	(5%)	1	(1%)

Looking at the subcategories of more sustainably produced samples, the most notable difference was for the group of 62 grass-fed/no-antibiotics samples (some of these were also organic; see Table S1 above). Bacteria from those samples were resistant to fewer classes on average (less than 1.0) compared with conventional samples (1.4). The same group (grass-fed/no-antibiotics) was also much less likely than conventional samples to have bacteria resistant to two or more classes of antibiotics. Only 13 percent of the grass-fed samples were resistant to two or more classes of antibiotics, and 39 percent of conventional samples were. Table R2 provides additional details on resistance to classes for more sustainably produced subgroups.

Table R2. Antibiotic resistance (number of classes) of bacteria found on raw ground beef samples by label-claim subcategories.

Bacterial Resistance	Number (%) of Samples									
			More Sustainably Produced							
	Conventional (n=181)		No Antibiotics (n=40)		No Antibiotics Organic (n=14)		No Antibiotics Grass-Fed (n=31)		No Antibiotics Organic Grass-Fed (n=31)	
None	41	(23%)	12	(30%)	3	(21%)	8	(26%)	13	(42%)
1 Antibiotic Class	70	(39%)	19	(48%)	6	(43%)	19	(61%)	14	(45%)
2 Antibiotic Classes	39	(22%)	5	(13%)	2	(14%)	2	(6%)	2	(6%)
3 Antibiotic Classes	22	(12%)	4	(10%)	2	(14%)	2	(6%)	2	(6%)
More than 3 Antibiotic Classes	9	(5%)	0	(0%)	1	(7%)	0	(0%)	0	(0%)
Average Number of Classes	1.4^		1.0*		1.4		0.9*		0.8*	

For Average Number of Classes, statistically significant difference found between groups marked with * and those marked with ^; no difference was found for other subcategories because of small group size or other factors.

MULTIDRUG-RESISTANT ISOLATES FEWEST IN GRASS-FED SAMPLES

Bacterial isolates that are resistant to three or more classes of antibiotics are called multidrug-resistant (MDR). *S. aureus* that are resistant to methicillin/oxacillin, known as MRSA, are also considered MDR. Overall, 14 percent (n=43) of ground beef samples had at least one MDR *isolate*. There were 22 samples with MDR *E. coli* and 13 with MDR *S. aureus* (Table R3). Three of the MDR *S. aureus* were MRSA, a medically significant human pathogen that can cause serious infections, and all three were found on conventional samples.[214,215]

Table R3. Proportion of raw ground beef samples with multidrug-resistant *isolates* by type of bacteria.

Bacteria	Number (%) of Samples with MDR Isolate	
Staphylococcus aureus (n=131)	13	(9.9%)
Clostridium perfringens (n=56)	0	(0%)
Salmonella species (n=3)	1	(33.3%)
Escherichia coli (n=152)	22	(14.5%)
Enterococcus species (n=299)	10	(3.3%)

Note: MDR = MRSA or bacterial isolate resistant to ≥1 drug in ≥3 antibiotic classes.

MDR bacterial isolates were twice as likely to be found on conventional samples (18 percent) as on the more sustainably produced samples (9 percent). That difference was marginally significant (Figure R1A). The difference was mainly driven by the grass-fed samples, which were three times less likely than conventional samples to contain MDR isolates (6 percent for grass-fed compared with 18 percent for conventional) (Figure R1B). More sustainably produced samples that had a no-antibiotics claim but did not have a grass-fed claim were not statistically different from conventional (13 percent vs. 18 percent).

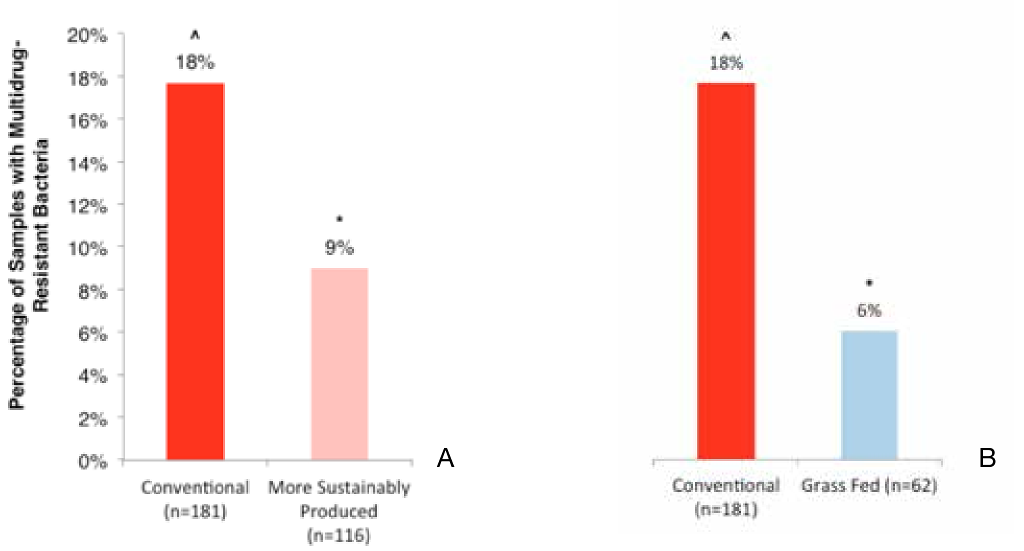

Figure R1. A. Percentage of conventional samples and more sustainably produced samples with multidrug-resistant bacteria. B. Percentage of conventional samples and more sustainably produced samples with a grass-fed label claim with multidrug-resistant bacteria. Statistically significant difference found between groups marked with * and those marked with ^.

MORE RESISTANCE TO CLASSES THAT HAD APPROVALS FOR GROWTH PROMOTION AND DISEASE PREVENTION IN CATTLE COMPARED WITH CLASSES THAT HAD NO SUCH APPROVALS

Our testing showed that there was more resistance to classes that had approvals for production purposes only (growth promotion, improved feed efficiency, or disease prevention) for cattle than there was to classes that either had no approvals or approvals for treatment only. In fact, for our entire sample we found resistance in 22 percent of the classes that we tested that were permitted for production purposes compared with resistance in only 6 percent of classes that were not.

Recommendations

FDA

The FDA should not permit the use of antibiotics for disease prevention in food-producing animals.

The overuse of antibiotics increases the development of antibiotic resistance and decreases the life of these medically important drugs. Healthy animals do not need to be fed antibiotics on a regular basis. That practice is a Band-Aid solution for a production problem that can be prevented by improving sanitation and reducing animal density. Our results show that there is less resistance to antibiotics in production systems that don't use them. We also saw more resistance to drugs that are approved for production purposes than drugs that are not.

USDA

The USDA should ban the "natural" label.

In June 2014, we filed a petition with the USDA to ban the "natural" label on meat. The USDA allows meat to be called natural if it is minimally processed and has no added artificial ingredients. Unfortunately, that falls far short of consumer expectations. According to our 2014 consumer survey, the majority of consumers think the "natural" label on meat means more than it does—68 percent think it means no artificial growth hormones, 70 percent think it means no artificial ingredients, 64 percent think it means no GMOs in feed, 60 percent think it means no artificial ingredients in feed, and 60 percent think it means no antibiotics or other drugs. An overwhelming majority of consumers think that the "natural" label on meat and poultry should mean no artificial growth hormones (89 percent), no artificial ingredients (87 percent), no GMOs in feed (85 percent), no artificial ingredients in feed (85 percent), and no antibiotics or other drugs (81 percent).[216]

The USDA should add animal-welfare standards to the organic label.

Consumers expect organic to mean that animals are raised in high welfare systems, and the label should meet that expectation. In our survey, more than half of consumers thought that the organic label meant that the animals had adequate living space and went outdoors, and more than 70 percent thought it should provide those assurances.[217]

The USDA should not approve humane or animal-welfare claims without adequate standards.

The USDA should require products to carry a "raised *with* antibiotics" label and specify whether animals were given antibiotics and for which production purposes.

Animal Legal Defense Fund (ALDF) filed a petition with the USDA in 2013, requesting mandatory disclosure of antibiotic use by meat and poultry producers.[218] Specifically, meat from animals that received antibiotics for growth promotion or disease prevention should be labeled with the language: "From animals raised with antibiotics" or "from animals fed antibiotics." Our 2014 national survey found that the vast majority of consumers (83 percent) think that if an animal was routinely given antibiotics, it should be labeled as "raised with antibiotics."[219]

The USDA and Congress should continue to fight to keep COOL labeling regulations as they are now. (see discussion on p.7)

Congress should not cave to pressure from the WTO. COOL labeling regulations provide important and useful information that consumers demand about their food. Despite the WTO decision regarding COOL, Congress and the USDA should maintain the regulations as is.

The USDA should update *Salmonella* performance standards.

Current performance standards of 7.5 percent are well above the prevalence rate for these dangerous bacteria. Despite low prevalence compared with other bacteria, *Salmonella* is still a significant cause of foodborne illness from beef. Reducing performance standards could decrease illness from these bacteria.

The USDA should not provide prior notice to plants when taking samples for STECs or *Salmonella.*

Prior notice provides the opportunity for plants to change behavior and improve test results on a temporary basis.

The USDA should require producers to test for *Salmonella* and STECs, not just generic *E. coli.*

Generic *E. coli* is a good measure of fecal contamination, but it is not a proxy for STECs and *Salmonella*. Required testing would lead to improved information about the prevalence of these contaminants that could be used to decrease illness rates.

The USDA should declare disease-causing multidrug-resistant *Salmonella*, and MRSA as adulterants in beef and other meats.

Even though bacteria are killed by adequate cooking, foodborne illness is still a major problem in the U.S. The USDA should declare the most dangerous bacteria adulterants, which would make it illegal to sell products that contain them, to better protect public health.

Consumers

Consumers should look for beef produced in more sustainable and humane ways.

GRASS-FED

From a food-safety perspective, grass-fed beef has advantages. Our tests show that it is less likely to be contaminated with multidrug-resistant bacteria. Look for the grass fed or 100% grass fed label on beef. Remember, though, that those grass-fed claims alone do not guarantee that healthy animals were not given antibiotics regularly. So look for grass-fed claims with an accompanying no-antibiotics label, or even better, the organic label. A step above a simple grass-fed label are the verified labels backed by comprehensive and meaningful standards that prohibit long-term confinement and require grazing, which the grass-fed label doesn't necessarily cover. Those labels include: American Grassfed Association, PCO Certified 100% Grassfed, Animal Welfare Approved Grassfed, and Food Alliance Grassfed. Some labels do not have a requirement for a 100 percent grass-based diet but require cattle to be raised on well-managed pasture: GAP Step 5-5+, Animal Welfare Approved, and Demeter Biodynamic.

HUMANE

Grazing, and a grass-based diet, is a cornerstone of treating beef cattle humanely. Some labels provide additional assurance that the animals are treated humanely throughout their life, including during transportation and in the slaughterhouse. Look for Animal Welfare Approved as the most comprehensive humane label. Certified Humane and American Humane Association do not require grazing and allow grain feeding in feedlots, but their standards aim to improve the conditions in the feedlots and ensure humane treatment during transportation and slaughter.

ECOLOGICALLY SUSTAINABLE—BIODYNAMIC, ORGANIC, CERTIFIED NATURALLY GROWN

Ecologically sustainable farms aim to increase biological diversity and self-reliance while reducing their reliance on off-farm inputs, especially potentially harmful inputs including synthetic fertilizers, synthetic pesticides, and genetically engineered crops. The Demeter Biodynamic label comprehensively covers those attributes. Organic and Certified Naturally Grown prohibit the use of almost all synthetic inputs and genetically engineered organisms and have some standards for manure management and pasture management.

RAISED WITHOUT ANTIBIOTICS AND OTHER DRUGS

Look for the Raised Without Antibiotics or No Antibiotics Administered labels. But those labels don't necessarily mean the animals were raised without the use of other drugs such as ractopamine. Labels that require prudent antibiotic use and also prohibit the daily use of other drugs for growth promotion include: Animal Welfare Approved, Certified Organic, GAP Step 1-5+, Demeter Biodynamic, Food Alliance, and USDA Process Verified Never Ever 3.

Consumers Should ignore labels that are meaningless

The following labels and claims are either not independently verified or not meaningful when they appear without a meaningful certification.

- "Humanely raised"
- "Environmentally friendly"
- "Agriculturally sustainable"
- "Natural"

Consumers should know labels about quality

Ground beef labeled "sirloin," "ground round," or "chuck" is made from those cuts, and any trimmings used must come primarily from that cut of beef as well. Ground beef without the cut specified or labeled "ground beef" may contain ground beef components, including raw beef esophagus meat, diaphragm, or cheek meat.[220]

Up to 30 percent fat content is allowed in either "hamburger" or "ground beef," but pure beef fat without meat may be added only to products labeled as "hamburger," not to products labeled "ground beef."[221]

Quality grade labels such as "Prime" and "Choice" are used only on cuts, not generally on ground beef. Those quality grades are based primarily on the amount of marbling (flecks of fat within the meat) which affects the meat's tenderness, juiciness, and flavor. The lowest grades—Utility, Cutter, and Canner—are generally used to make ground beef.[222]

Consumers should always handle beef and other meats carefully to reduce the risk of foodborne illness.

Make meat your last purchase at the store and keep it below 40° F until you are ready to cook. Be careful of inadvertently cross-contaminating sinks and other surfaces with your hands after handling raw meat. Always wash your hands with soap and water after handling raw meat, as well as any surfaces or cutting boards that came in contact with the meat. Clean plastic cutting boards in the dishwasher. Don't put foods intended to be eaten raw on surfaces touched by raw meat. To be safe, cook ground beef to a temperature of 160° F measured with a meat thermometer.

PHOTOGRAPH BY EVAN KAFKA

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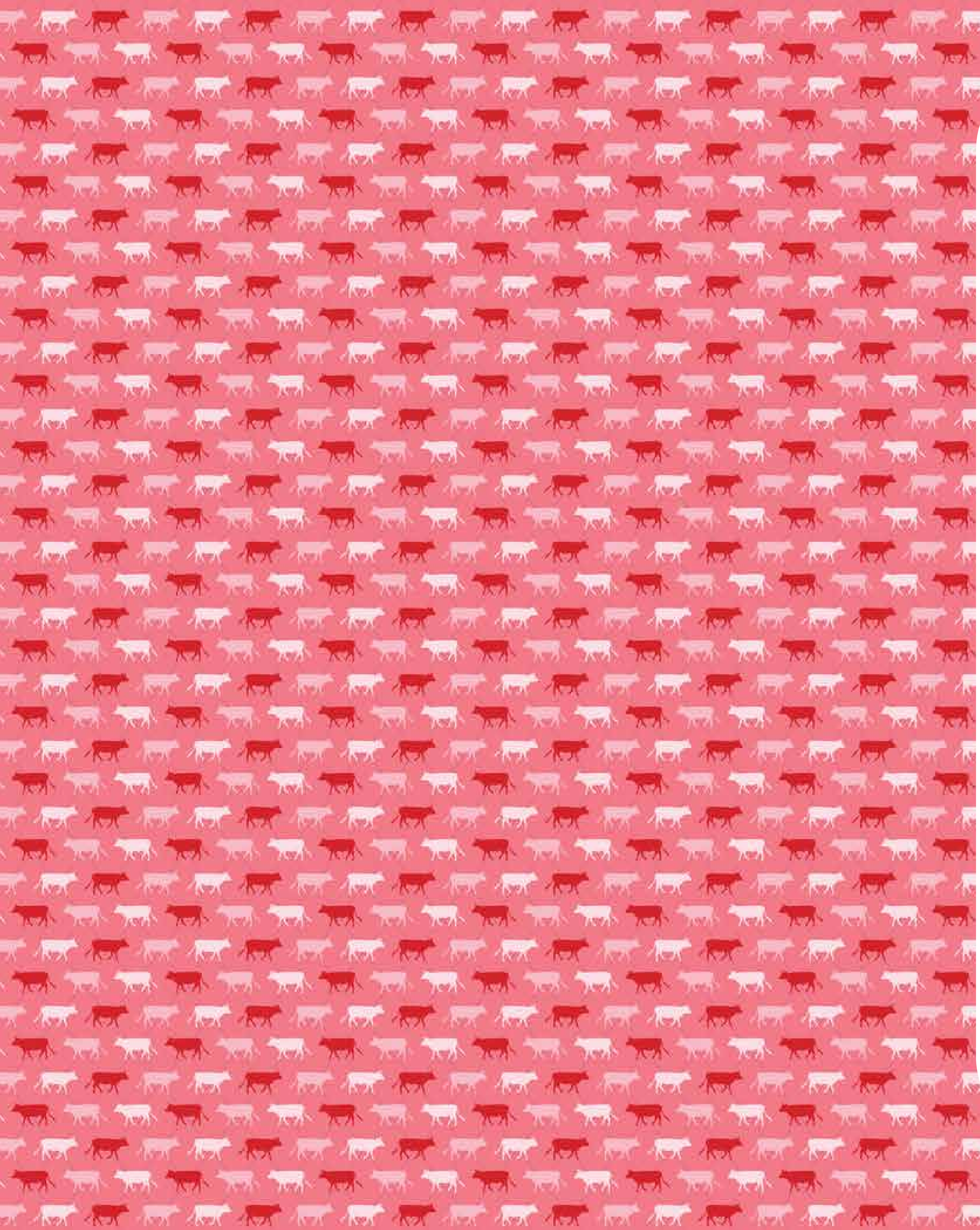
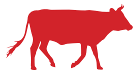


About Consumer Reports' Food Work and Its Food Safety and Sustainability Center

Consumer Reports has been concerned about the quality and safety of the food supply since its earliest years. It did pioneering research on the presence of nuclear fallout in the American diet (Strontium-90) in the 1950s and 1960s, which helped build support for the Test Ban Treaty of 1963. The magazine's 1974 landmark series on water pollution played a role in the Safe Drinking Water Act. The organization has been testing meat and poultry for pathogens and antibiotic resistance for more than 15 years and has used its research to successfully fight for reforms such as the 2010 campylobacter standard for chicken and turkey, the 2011 Food Safety Modernization Act, and improvements to the salmonella standards.

In 2012, Consumer Reports launched its Food Safety and Sustainability Center to fight for sweeping, systemic change and address the root causes plaguing the food system. The Center's work focuses on issues including foodborne illness and antibiotic resistance; pesticide use; heavy metals (mercury, lead, arsenic); truth and transparency in labeling; and promoting more sustainable agricultural practices that advance the marketplace, such as animal welfare, organic farming, and fair trade. At the core of the Center's work is the principle that there is a clear intersection between how food is produced and the impact on public health.



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