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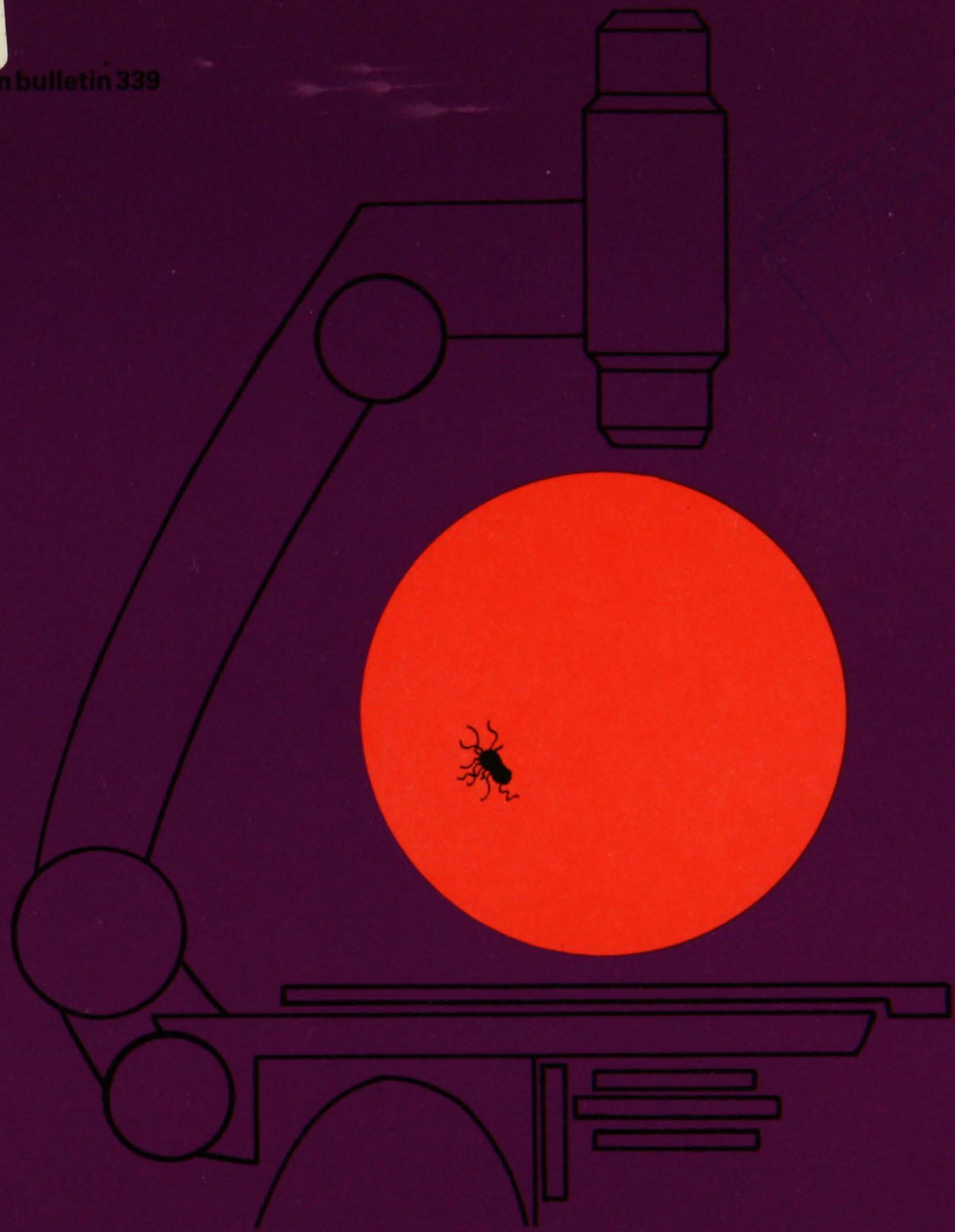

salmonellosis

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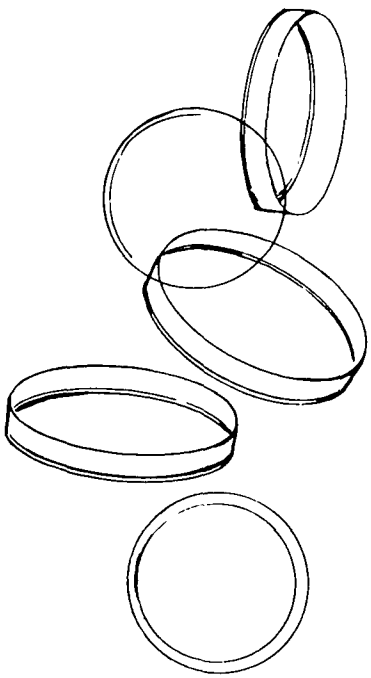
Cycles and Symptoms



Salmonellosis is one of the major foodborne illnesses affecting man today. Caused by microorganisms called salmonellae which, when ingested, live and grow in the intestinal tract, this disease spreads easily, passing in a continuous infecting cycle from animal to man, man to man, man to animal. Salmonellae can be picked up at any time during the various stages of production, processing, storage, or preparation of foods for human or animal consumption. Foods and/or beverages so contaminated are primary agents of disease transmission; infected persons or animals are secondary ones, transferring bacteria to one another under unsanitary environmental conditions or through improper personal hygiene.

Attacking humans anywhere from 8 to 72 hours after the ingestion of contaminated food or beverage, salmonellosis is characterized by an abrupt onset of diarrhea, nausea, abdominal pain, prostration, chills, fever, and vomiting. Symptom intensity varies from slight to severe discomfort and, in extreme cases, can result in death. Outbreaks of salmonellosis may involve a great many people, but the mortality rate is low (less than 1 percent) and generally is confined to infants, older people, and those suffering from other diseases.

Resurgence of an Old Disease

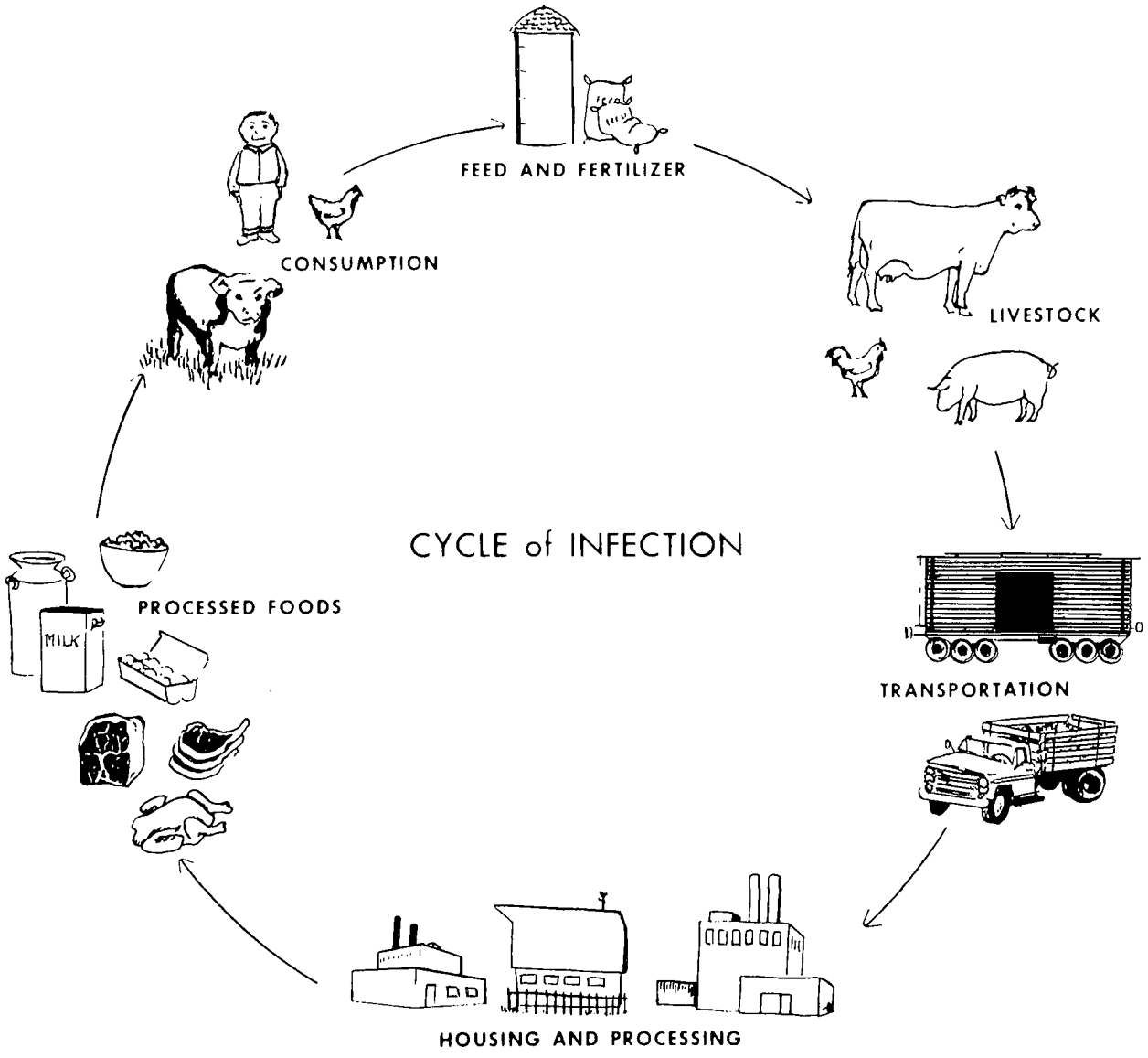
Over 1,300 different species of the genus *Salmonella* have been isolated from man and animal, many of which cause salmonellosis in man. This is not a new disease: the first species of *Salmonella* was isolated in 1885 by Dr. D. E. Salmon (for whom it was named), then Chief of the Bureau of Animal Industry of the U.S. Department of Agriculture (USDA). Medical reports of that day indicate that this was a common disease problem.

But in the past three decades the incidence of salmonellosis has increased dramatically—particularly when contrasted with typhoid fever, which is caused by another species of *Salmonella*. In 1950 there were 2,484 reported cases of typhoid fever and 1,233 cases of salmonellosis; in 1977 only 398 cases of typhoid fever were reported in comparison to 27,850 cases of salmonellosis.

Why this startling increase in salmonellosis?

Improved methods of detection and identification of bacterial presence in man and animal (the bacteria are very small and difficult to isolate in an environment) and more efficient reporting of cases to the proper authorities have made us more aware of the incidence of salmonellosis. Contemporary eating habits and bulk preparation and mass distribution of human and animal foods on the national and international level help spread any contamination with great efficiency.

We are eating out a great deal more than ever before, subjecting ourselves to the possibility of unsanitary food preparation in quantity cooking; while at home, premixed, ready-cooked, improperly processed convenience-type foods can be an easy source of infection. Also, national geographic areas which grow, process, and distribute foods for both animal and human consumption are more centralized today, contributing to a buildup of salmonellae in livestock and poultry as animals pass from farm to processing plant to food distributor to consumer.

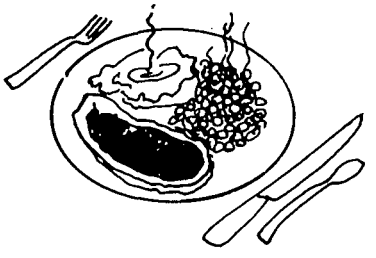


Factors Causing Illness Vary

A series of feeding experiments carried out on healthy, human adult male volunteer prisoners indicated that the number of organisms causing illness varied greatly with the kind of *Salmonella* and the susceptibility of the individual. (The administered infecting dose varied from 125,000 to 16,000,000 microorganisms.) Other factors such as type of food, time from contamination to ingestion, and food storage conditions also affect the severity of the illness.

But the mere presence of salmonellae in food, regardless of number, is cause for alarm.

Foods Frequently Contaminated



Foods for human consumption most commonly contaminated with salmonellae include:

1. poultry, meat, and meat products such as meat pies, precooked rare roast beef, pressed beef, sausages; cold cooked meats; reheated meats, and gravies

2. eggs (including duck and turkey eggs) and egg products such as dried egg powder, egg albumen, frozen egg, and synthetic cream often prepared from frozen egg

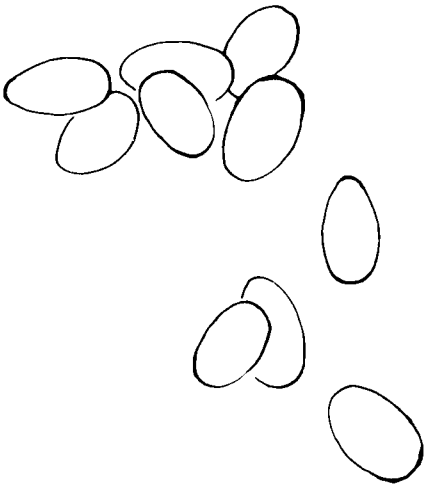
3. raw milk and raw milk products such as ice cream, cream, custard, cream-filled confectionaries, and salad creams

4. fish, prepared fish dishes, and shellfish—especially oysters obtained from uncontrolled beds

Salmonellae usually do not affect the appearance, smell, or taste of the food within which they grow. The most vulnerable foods are those which are subjected to excessive handling or processing and those which are lightly cooked or utilized without any further cooking. Once any foodstuff is contaminated, conditions may develop enabling bacteria to grow, and under some conditions they grow and reach numbers sufficient to cause illness in a relatively short period of time.

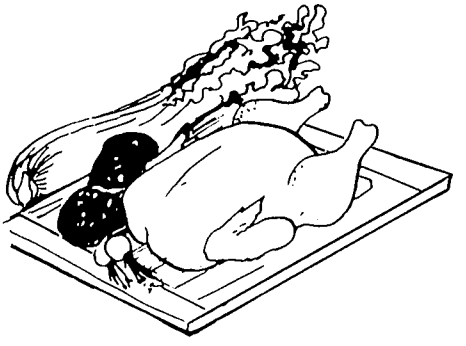
(Salmonellae also may be found in many types of animal feeds. When an infected animal is slaughtered, it contaminates the packing plant and any employees who have contact with it or the slaughter area. Slaughter-house scraps then are used as supplements in animal feed. If improperly processed, these scraps containing bacteria simply recontaminate feed and, subsequently, other animals.)

A Possible Infection Cycle



A farmer whose flock of laying hens is subclinically infected with salmonellae gathers his eggs. He picks up the disease-causing bacteria on his hands and clothes from the contaminated eggshells. Without washing his hands or changing his clothes, he milks his cows, infecting both the milk and milking equipment. The compressor on his bulk tank has not been working properly, and the milk is cooled to only about 80° F. Growth of salmonellae occurs before the milk is picked up, and by the time it arrives at the creamery, large numbers of the bacteria are present. The milk is separated and the cream pasteurized and churned to butter. The skim milk, however, is not pasteurized, and before it can be processed, it spoils and cannot be utilized.

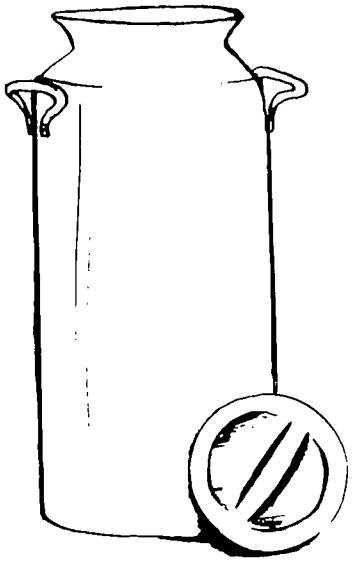
The creamery manager gives the contaminated skim milk to another farmer who uses it to feed his pigs. Now infected, the pigs shed large numbers of salmonellae in their feces, which the farmer picks up on his boots and clothes while doing chores. Again, without washing his hands or changing his clothes, he delivers chickens to the local poultry processing plant. Walking through the processing area, he leaves salmonellae wherever he goes. A knife drops to the floor in the wake of his contaminated footsteps. A worker picks it up and continues to dress birds.



Several of these contaminated, dressed birds are sold to a local housewife who puts them away in her home freezer. She decides to prepare fried chicken and potato salad for an upcoming church picnic. Thawing the chickens out on a cutting board overnight, she fries them while preparing her salad. Cutting up the cooled, boiled potatoes on the same board used to thaw the chickens, she mixes the salad ingredients, then carries her food contributions off to the church picnic.

Many outbreaks of salmonellosis occur in the warm, summer months when food is left at room temperatures for long periods of time. The picnic food waits on a table under a tree for several hours. Eight to 72 hours after the meal is consumed, a large number of people become ill with salmonellosis, among them the two farmers responsible for initially spreading the infection. Although ill, they continue to do daily farm chores, shedding salmonellae, recontaminating equipment and animals, thereby completing one and recreating another cycle.

Breaking the Cycle

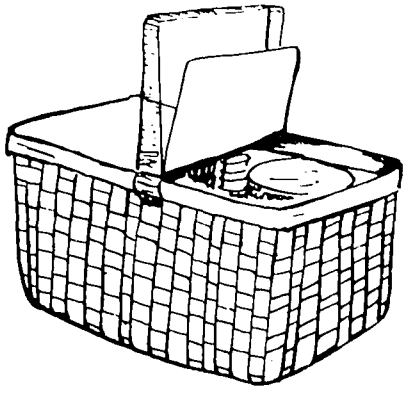


How could this outbreak of salmonellosis have been prevented? What proper control measures could have been established at any given point to break this cycle of infection?

Diseases spread easily from one farm area to another; proper sanitation practices can go a long way towards cutting down on disease incidence of all kinds. The farmer who gathered contaminated eggs should have properly washed his hands and changed his clothes before milking his cows. He also should have made sure that his refrigeration equipment for cooling raw milk was working properly by checking the temperature of the milk in bulk tank or can after milking.

The creamery should have pasteurized the skim milk before or immediately after separation in order to prevent contamination of equipment. Not only would this have destroyed the salmonellae, but it also would have lengthened the keeping quality of the milk and enabled the creamery to utilize it rather than having to give it to another farmer.

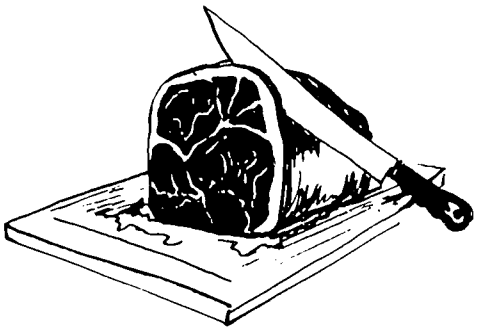
The farmer who carried pig manure on his boots and clothing into the chicken processing plant also should have washed his hands and changed his clothing before taking his birds to market. (A common source of contamination is contact with body wastes—feces or urine—from an infected animal or man.) This farmer should not have been allowed to wander freely about the plant. Unnecessary traffic around a processing area should be kept to a minimum by plant authorities.

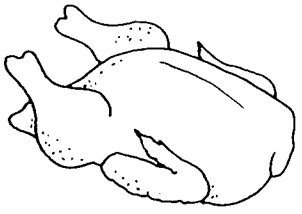


What could the housewife have done? It's always best to defrost chickens under cold water or in the refrigerator to prevent the growth of salmonellae, if present. Cooking destroyed these bacteria in the chicken, but the contaminated cutting board could have been properly cleaned with hot water, soap, and a good scrub brush to have at least reduced the possibility of contamination. A separate, clean cutting board should have been used for cutting up the potatoes. Refrigeration of the potato salad until consumed would have retarded the growth of salmonellae and reduced the incidence of illness.

Finally, the two farmers should not have been doing daily chores while sick.

Documented Outbreaks





Documented outbreaks of food contamination by salmonellae point up how simply and easily the disease is spread. In each of the following outbreaks the source was different, but the infecting organism passed from animal to food to man, then from man to man.

1. A U.S. naval bacteriologist writing in the August 1963 issue of the *American Journal of Public Health* described how work surface areas contaminated with salmonellae can play an important role in the spread of salmonellosis. In preparation for a 1962 Thanksgiving holiday meal aboard ship, frozen turkeys were thawed out on a table in the ship's galley, while roast pork was being sliced on an adjacent cutting board. Liquid from the thawing turkeys contaminated both the cutting board and the sliced pork. The turkey was cooked, however, and the salmonellae in it destroyed; but the contaminated pork became the causative food in an outbreak of salmonellosis. Then, leftover turkey made into sandwiches on the improperly cleaned cutting board occasioned a second outbreak several days later. While investigating these outbreaks, one of the officials also became ill with salmonellosis. After examining the contaminated cutting board, he smoked a cigarette, transferring sufficient salmonellae from the board to his mouth to induce illness.

These outbreaks could have been avoided if care had been taken in thawing the frozen turkeys, if the pork had not been sliced on the same table with them, and if the cutting board had been properly cleaned before making the turkey sandwiches.

2. An interstate outbreak of salmonellosis involving 53 hospitals in 13 states in 1963-64 was traced to contaminated raw or undercooked eggs as a common source of infection. In each of these hospitals *Salmonella derby* was isolated from patients, staff, and employees. The primary infection (contaminated raw or undercooked eggs) led to secondary infections transferred by human carriers to newly admitted patients through improper personal sanitary habits and the consequent handling of foodstuffs. The outbreak was controlled by no longer using raw or undercooked eggs in meal preparation.

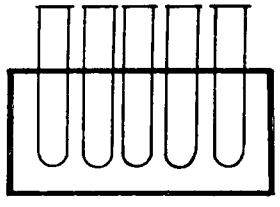
3. Homemade ice cream was responsible for several individuals becoming ill with salmonellosis following a Fourth of July celebration. The ice cream had been prepared from fresh eggs, evaporated milk, pasteurized milk, sugar, and vanilla flavoring. *Salmonella typhimurium* was isolated from the ice cream and from two of the eggs not used in making the ice cream. The same organism was isolated from stool samples obtained from the sick individuals. Further investigation showed that the eggs used were probably dirty and cracked prior to use.

This example of an outbreak points out the need to clean eggs as quickly as possible and the need to use only clean, graded eggs in preparing uncooked egg foods such as this ice cream. Cooking of the mixture to be made into ice cream would have destroyed the salmonellae organisms and prevented the outbreak. Records from the Center for Disease Control (CDC) in Atlanta, Georgia (a division of the Public Health Service, U.S. Department of Health, Education, and Welfare), indicate that usually when raw eggs are involved in an outbreak of salmonellosis, they are ungraded and not cleaned. Commercially cleaned and graded eggs rarely are responsible for an outbreak of salmonellosis.

4. American consumers' interest in rare roast beef has brought about an increased amount of this food being prepared commercially for sale in fast food outlets and delicatessens. In 1975, 1976, 1977, and 1978, several outbreaks of salmonellosis occurred which were caused by commercially prepared rare roast beef. These outbreaks occurred in several states and involved hundreds of individuals.

In commercial preparation of rare roast beef, the beef roasts are cooked slowly at a low temperature (between 140-150° F.) to an internal temperature that will produce rare meat (135-140° F.). This process takes over 12 hours. (This is a commercial process and should not be done in the home using domestic equipment.) Investigation of the outbreaks mentioned showed that the meat had not been cooked properly and the internal temperature of the beef was less than 135° F. Regulations of the Meat Inspection Division of the USDA require that precooked roast beef be cooked to an internal temperature of not less than 145°F. Proper cooking of this meat following USDA regulations would have prevented these outbreaks.

Increased Awareness



An interstate outbreak of salmonellosis in which the causative organism was isolated, tracked down to its source, with control measures instituted to prevent further epidemic spread, illustrates how increased awareness of the disease and greater diligence in reporting outbreaks can help to combat the problem.

As part of its routine procedure, the CDC maintains records of countrywide salmonellosis outbreaks, receiving isolations of specific types of *Salmonella* from state laboratories. In 1965 and 1966 an outbreak of 29 cases of salmonellosis attributed to *Salmonella new-brunswick* was recognized. Review of available information indicated that about a six-fold increase in human isolations of this previously rare organism had occurred during 1965, with isolations randomly distributed throughout the states. Investigation suggested that instant nonfat dry milk, a commercial product not previously implicated in salmonellosis, was the common infection vehicle. Contamination of dry milk by this species of *Salmonella* was confirmed by isolation of the organism from shelf samples of a specific brand of instant nonfat dry milk. Then several government and private laboratories isolated several species of *Salmonella* (including *S. new-brunswick*) from many different brands of dried milk as well as from environments within and close to milk drying plants. In some cases, these findings prompted market recall of large quantities of nonfat dry milk, a necessary precaution to aid the control and prevention of further salmonellosis outbreaks.

Preventing Contamination

Prevention of salmonellosis only can be achieved when the causative microorganism is eliminated. The following general practices should be observed in handling food to prevent the contamination of human and animal foods with salmonellae.

Good Sanitation Practices

People preparing foods either at home or in food processing plants should observe good sanitation practices in order to minimize opportunities for contamination. All buildings and equipment used for processing food should be designed so that thorough cleaning is easy and practical. Processing plant personnel should be encouraged to practice sound personal hygiene and to report any illness. Every effort should be made to prevent carriers from handling and thereby "seeding" food.

Those handling prepared foods should:

1. always work with clean hands, washing them thoroughly after going to the toilet and after handling raw foods.
2. keep kitchen equipment well-scrubbed to prevent cross-contamination between raw and cooked foods.
3. never work around food when sick.
4. keep hands away from mouth, nose, and hair.
5. cover coughs and sneezes with tissues.
6. do not use cooking utensils to taste food while cooking or serving, or lick fingers or eat while preparing food.

Low Temperature Storage

While storing foods at low temperatures by either freezing or refrigeration is effective in preventing the growth of salmonellae, this will not destroy the organisms. Once the food is placed in a more favorable temperature, growth recurs. Prepared foods not to be consumed immediately, such as our church picnic potato salad, should be refrigerated as quickly as possible so that the center of the food reaches 50° F. within a short time.

Cold weather will not destroy salmonellae present in and around a farm or home. Freezing only protects and preserves the bacteria; when warm weather returns, they may be as dangerous as when first shed.

Adequate Cooking

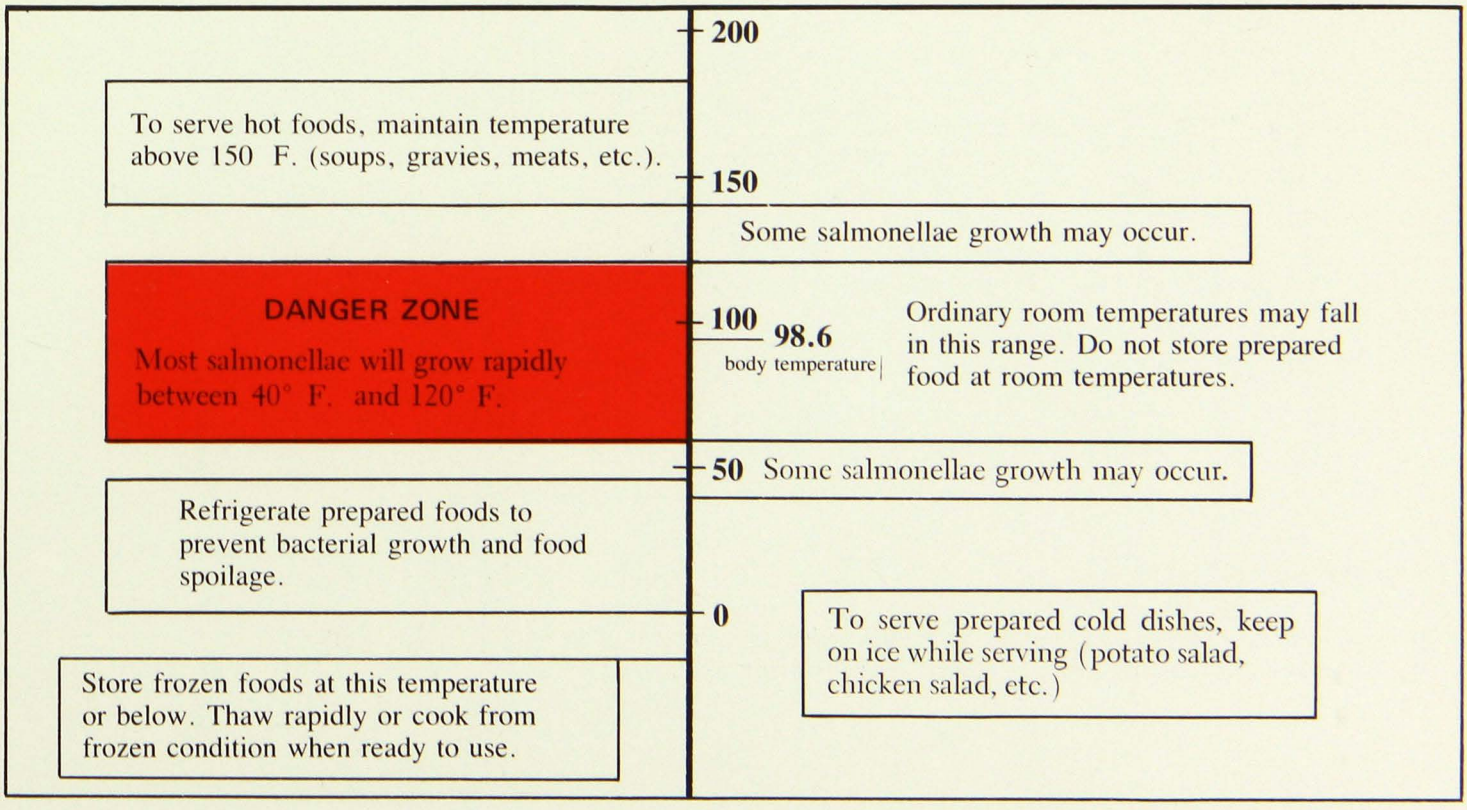
Heat destroys salmonellae. Milk pasteurization is more than adequate for the destruction of these bacteria (145° F. for 30 minutes or 161° F. for 16 seconds). But regardless of the temperature to which the food is heated, recontamination of the food after the heat treatment often occurs.

Incubation Danger Zone

Holding foods at temperatures that encourage the growth of salmonellae should be avoided. When foods are exposed to temperatures between 50° F. and 110° F., holding time should be kept to a minimum (see food temperature guide). All foods should be refrigerated promptly after a meal or cooking and should be held at 40° F. or below.

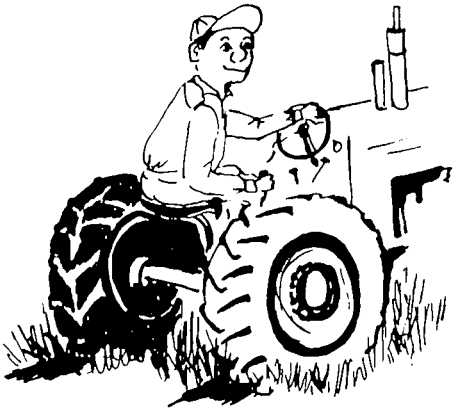
(Poultry dressings, sandwich fillings with meat, fish, or egg, and potato salad should not be allowed to stay at temperatures between 40° F. and 120° F. Never stuff birds the night before cooking and never partially cook a stuffed bird. Do not use dirty, cracked, or soiled eggs in raw or slightly cooked egg dishes such as eggnog, sauces, or meringues. Cook dried egg products thoroughly and use only pasteurized milk and milk products for cooking or direct consumption.

Food Temperature Guide



It Can Be Done

The elimination of salmonellosis will require the full cooperation and concentrated effort of farmers, food processors (management and employees), consumers, regulatory agencies, physicians, and veterinarians. Here are a few things that each of us can do to help check the spread of this disease:



The farmer can:

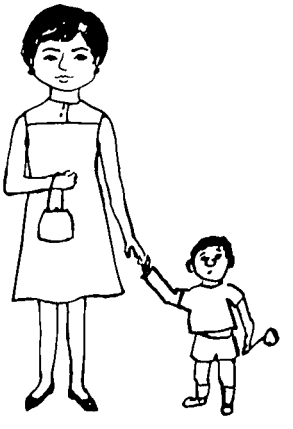
- maintain disease-free animals.
- practice sound sanitation procedures around the farm, particularly when salmonellae are a recognized problem.
- use only feeds tested and found free of salmonellae.
- prevent contamination of animals or food commodities before or during transfer from farm to market.

The food processor and distributor can:

- utilize wholesome food products.
- maintain quality production from raw material to finished product.
- maintain a sanitary environment throughout the processing plant.
- employ technically competent personnel as supervisors.
- educate employees to observe and follow proper personal hygiene practices.
- keep nonessential traffic in a food processing area to a minimum.
- have effective rodent and insect control.

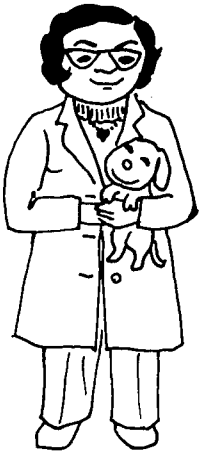
The homemaker can:

- emphasize family health practices, particularly hand washing.
- use proper methods in storing, preparing, and serving food.



The private physician can:

- seek laboratory confirmation of suspected salmonellosis in humans.
- report all infections of salmonellae to the proper health authorities.
- inform patients of necessary precautions to prevent the spread of salmonellae.

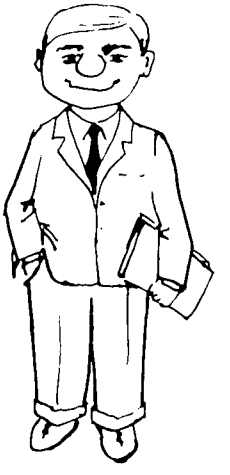


The veterinarian can:

- seek laboratory confirmation of suspected salmonellosis in animals.
- report all cases to the proper animal disease authorities.
- conduct inspections of slaughterhouses, poultry processing plants, and other food processing establishments.
- inform food processing plant employees of proper sanitation practices.
- help farmers maintain disease-free animals and clean environments in which to raise them.

The public health official can:

- keep local physicians informed of suspected outbreaks of salmonellosis.
- follow-up reported cases and investigate reported outbreaks of salmonellosis.
- take special care to obtain proper specimens for laboratory examination.
- impress upon food processors the need for proper sanitation control.
- create public awareness of salmonellosis.
- promote prevention and control measures.



The laboratory scientist can:

- adopt standardized methods for isolating salmonellae.
- be aware of new, improved techniques for their isolation.
- make certain all isolations of salmonellae are serotyped and reported to the proper authorities.
- handle cultures of salmonellae with proper precaution to prevent the spread of organisms from the laboratory.
- maintain a close liaison with clinicians and epidemiologists.

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