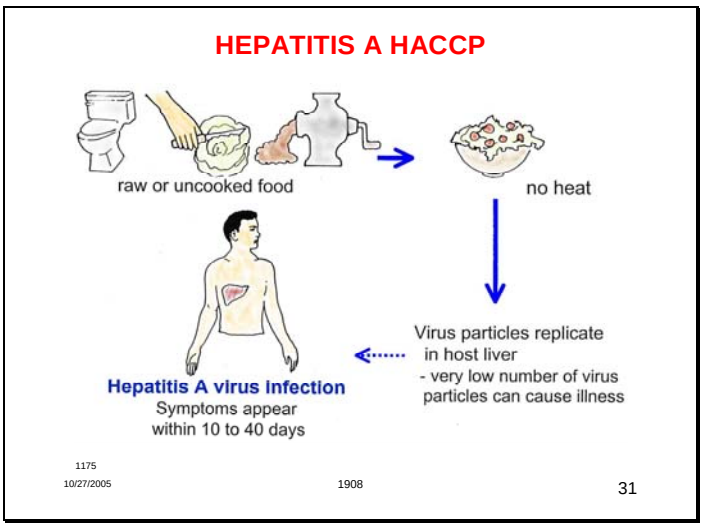


1175

Hepatitis A Virus Food Infection

Hepatitis A virus is very small. Purified virus particles are 27 nanometers in diameter and possess single-stranded RNA (nucleic acid). Hepatitis A virus is the cause of the highest number of reported viral food-associated illnesses. The virus is found in feces, urine, and blood of infected persons. The illness caused by hepatitis A virus is also known as infectious hepatitis and is completely unrelated to illness caused by hepatitis B virus (serum hepatitis), which is usually only transmitted by blood-to-blood contact.

Hepatitis A virus does not grow on food. It replicates itself in the liver of its human host and is passed in the feces, urine, and blood of infected individuals (who may be without symptoms). It is also found in waters containing raw sewage and in seafood taken from these polluted waters.

Hepatitis A Virus Transmission

Hepatitis A viral foodborne illness is most often associated with raw foods. It can also be associated with prepared foods that become contaminated during further processing or serving.

Infectious hepatitis can be caused by relatively few virus particles, probably as few as 5 to 10 per gram of food. The disease is transmitted by an infected food handler or food harvester who is either ill at the time of transmission, or who is a carrier. This person excretes the virus in the feces and urine. When fingertips and fingernails are not washed carefully and adequately, the virus is spread to food.

Viruses are also transmitted through contaminated water. Shellfish (oysters, clams, and mussels) taken from waters contaminated with raw sewage are a source of hepatitis a virus.

Symptoms

The onset of symptoms is usually abrupt and is characterized by fatigue, fever / chills, loss of appetite, nausea, vomiting, pain in the liver area, abdominal pain, jaundice, dark urine, and light-colored stools. Jaundice occurs because the virus invades the liver and affects its function. As a result, the pallor or skin tone of infected individuals takes on a yellow color.

The illness may be mild in some cases and only last from 1 to 2 weeks. The most important factor affecting the severity of the disease is age. Children less than one year old rarely show clinical signs of illness. This means that parents and child-care workers handling soiled diapers can catch or transmit the disease without knowing they have been exposed. Clinical manifestations of hepatitis A often pass unrecognized in children younger than two years of age. In most younger people, there is complete recovery with no long-term effects. A clearly recognizable illness due to hepatitis A develops in the majority of infected older children and adults. In some cases, the illness can be severely disabling, can last for several months, and may cause some permanent liver damage. The severity of the illness is usually greatest in elderly people and may cause death. An estimated 100 deaths occur in the U.S. each year from hepatitis A.

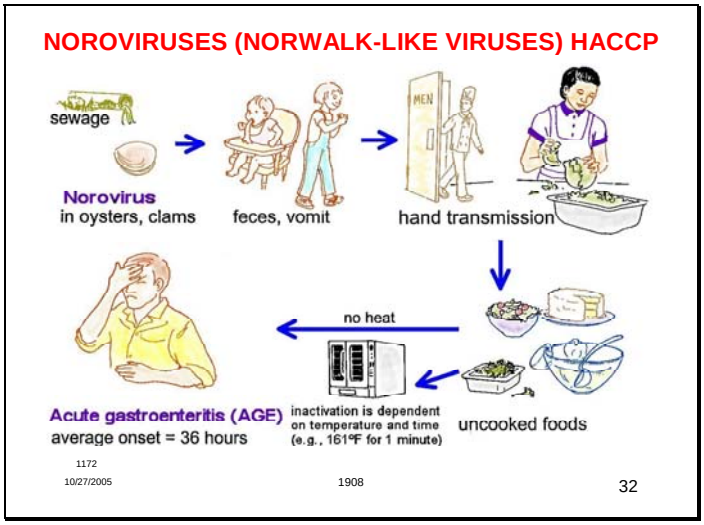
Hepatitis A Virus Control

Raw fruits and vegetables must be double washed in a sanitized sink. The water dilutes and removes the viruses on the surface to a level low enough that the hazard is controlled.

All employees in foodservice and food production must practice good hygiene. Employees must use the double hand wash procedure that uses a fingernail brush and soap and to scrub hands and fingernails after using the toilet. This virus can be shed in the feces and urine days or weeks before a person feels ill and goes to the doctor.

Food preparers and servers must use only clean, sanitized equipment and utensils to mix and serve food.

Viruses, although incapable of multiplying in food, may remain viable in food for weeks and in frozen food for months. Food containing hepatitis A virus must be heated to temperature above 180ºF.



1172

Noroviruses Food Infection

Noroviruses (Norwalk-like viruses) are small, round-structured viruses. A virus of this type was first isolated in 1972 in Norwalk, Ohio. Since that time, these viruses have been identified as a cause of gastroenteritis in many countries throughout the world. The amount of norovirus needed to cause illness is unknown, but probably very low, perhaps 1 to 10 virus particles. The annual estimated incidence of illnesses due to noroviruses is over 9,000,000 cases. These viruses are thought to be responsible for more foodborne illnesses in the U.S. than any other bacterial, parasitic, or viral agents.

Transmission

Noroviruses do not multiply in food but may be acquired through direct contact with an ill person and/or carried by air, water, or uncooked food to a human in which the virus will multiply. Humans are the source of these viruses by way of fecal-oral transmission. Children and staff members can spread these viruses in day-care centers through changing of diapers and inadequate hand washing after touching fecal material and other body fluids.

These viruses are recognized as an important cause of waterborne illness. Under naturally occurring conditions in a contaminated water supply, routine chlorination alone will not inactivate these viruses. If drinking or recreational water is suspected as being an outbreak source, high-level chlorination may be required for adequate disinfection; however, even this method may be insufficient in some cases.

Noroviruses have been transmitted on oysters, cold precooked ham slices, icing, salads, and water. Reported inactivation of suspended caliciviruses used to simulate noroviruses has been shown to be temperature and time dependent in the range from 0 to 100ºC (32 to 212ºF). According to Duizer et al. (2004), a 1,000-to-1 reduction was noted at 71.3ºC (160.3ºF) for 1 minute.

Virus transmission is a concern in products that receive no heat processing after contamination (e.g., salads, sandwiches, any cold foods). Noroviruses can survive refrigeration and even freezing.

Infection Characteristics

The illness causes extreme discomfort but is rarely fatal. Noroviruses are very infective. Symptoms include nausea, abdominal pain, anorexia, headache, and sometimes fever. The nausea produces much vomiting in children, but in adults tends to produce diarrhea. Symptoms are due to infection of the intestinal lining. Usually the symptoms appear within 24 to 48 hours of ingestion of the virus but can occur within 12 hours of exposure. It can last from 24 to 60 hours. Once an infected person has recovered, the disease may be passed to others for up to 2 weeks after recovery. This way, the illness can spread easily through schools, camps, and families.

All individuals who ingest the virus and who have not recently (within 24 hours) had an infection with the same or related strain, are susceptible to infection and can develop symptoms of gastroenteritis (FDA, 1993).

The annual estimated incidence of illnesses due to noroviruses is over 9 million cases (Mead et al., 1999). These viruses are thought to be responsible for more foodborne illnesses in the U.S. than any other bacterial, parasitic, or viral agents.

Outbreaks

1. A sick baker returning from a bathroom contaminated an 80-quart bowl of icing with hands that did not appear to be dirty. The icing made over 5,000 people ill when it was used for wedding cakes and other items sold by the bakery.
2. Sick salad preparation worker did not wash her hands properly after using the bathroom. As a result, the salads were contaminated with the virus and over 3,000 customers became ill from the contaminated salads, which were sold and consumed over a 3-day period.
3. An elementary school student vomited on a floor in an open classroom. In about 30 hours, 60% of the other students were ill from the airborne transmission of a norovirus.

From January 1996 through November 2000, there were 348 outbreaks of norovirus gastroenteritis reported to the Centers for Disease Control.

Control

Noroviruses are usually transferred to food by people's hands and contaminated water. Therefore, in order to control outbreaks of this illness:

1. Foodservice workers must use good personal hygiene and practice the two-step hand washing procedure, using a fingernail brush to scrub hands and fingernails after using the toilet.
2. Foods that are to be served uncooked (e.g., raw vegetables and fruits) must be washed thoroughly in flowing water, using a safe water supply.
3. Suppliers of seafood should certify that their seafood products were obtained from safe waters.
4. To ensure the destruction of the virus in seafood products and other heated food products, these products should be heated to about 161°F for 1 minute.
5. Clean, sanitized equipment should be used to mix, serve, and store food.

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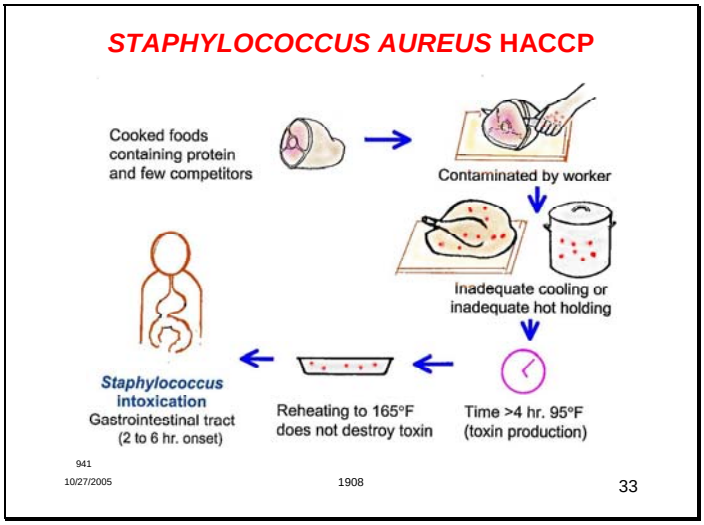


941

Staphylococcus aureus Food Intoxication

Staphylococcus aureus is common in man. These bacteria are characterized by a group of cocci combined in grape-like clusters. It can be found in the noses of 30 to 50 percent of healthy people and on the hands of 20% of healthy people. *Staphylococcus aureus* is also commonly found in the throat, on hair, in feces, and on skin of people and animals. It grows in the presence or absence of air. Thus, it can grow on the surface of many food products. It requires protein to grow and will grow well in meat, milk, poultry, fish, eggs, and custards. It is very tolerant of salt and sugar and can multiply in foods with high salt and sugar concentrations, such as hams and cream-filled pastry products, which are not suitable for the growth (multiplication) of many other bacteria. It does not compete well with spoilage bacteria. Hence, it is usually a problem in cooked, pasteurized food where other competitive microorganisms have been destroyed.

The viable cells of *S. aureus* require about twice as much time for inactivation as *Salmonella* spp. at specified temperatures. However, it is not the ingestion of the viable *S. aureus* cells that causes the illness. Individuals can consume 1,000 *S. aureus* cells per gram in food without becoming ill. The illness is due to ingestion of foods containing the toxin produced when viable cells multiply within or on food products, usually over 1,000,000 per gram, and produce enough toxin to make normally healthy persons ill. The toxin can survive hours of boiling.

Because *S. aureus* and other some other types of pathogenic bacteria produce toxin that is not destroyed by the normal reheating temperature of 165°F, it is not possible to guarantee that reheated food is safe at 165°F. To assure safety of food, particularly cooked food for which there is no spoilage bacterial competition, it must be handled in such a way that there is no chance of toxin production. The FDA Food Code recommends cooling food from 135 to 70°F in 2 hours and within a total of 6 hours from 135 to 41°F, or serving within 4 hours if the food is at warm temperatures. [USDA Guidelines recommend continuously cooling food, within 90 minutes after cooking, from 120°F to 55°F within 6 hours, followed by further cooling to 40°F (no time limit) before boxing.]

Staphylococcus aureus Transmission

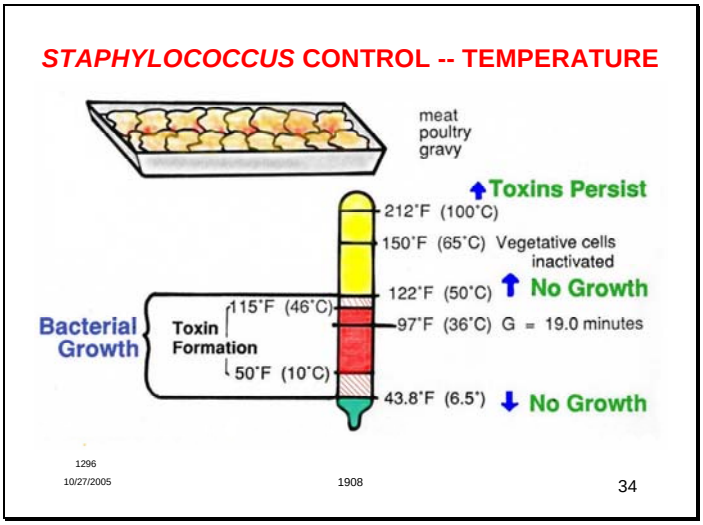
Staphylococcus aureus is often present in products of animal origin. It is a normal skin contaminant of animals, and when they are slaughtered, it is common to find 10 to 100 bacteria per gram in meat. At this level the bacterial count is too low to produce enough toxin to make persons ill.

Other major sources are infected cuts on employees' hands. In this case the food usually becomes contaminated during mixing, slicing, or poor handling procedures. In these circumstances, high numbers of vegetative cells introduced into food can produce enough toxin in 6 to 9 hours to cause illness.

If food contaminated with *S. aureus* is allowed to remain at room temperature for long periods of time (e.g., 9 hours at 75ºF), held in warming tables or cabinets at 80 to 110°F, or stored in warm, large containers that take many hours to cool in refrigerators (e.g., making salads with warm ingredients), the viable cells of *S. aureus* will multiply and produce enough toxin to cause foodborne illness when the food is eaten.

Illness Characteristics

The ingestion of food containing the toxin can cause people to become ill within 2 to 4 hours. Symptoms of the illness are nausea, vomiting, abdominal cramps, and diarrhea. The symptoms can be violent for a short period of time. *S. aureus* intoxication rarely causes death.



1296

Staphylococcus aureus Control

Most meats, poultry, and many other foods have 10 to 100 *Staphylococcus aureus* per gram. The *S. aureus* must not be allowed to multiply to greater than 1,000,000 per gram because that amount can produce enough toxin to make the average person ill. At low levels (less than 1,000 per gram) *S. aureus* is not a threat. The vegetative cells of *S. aureus* are slightly more difficult to inactivate than those of *Salmonella* spp. in cooking, so there can easily be low levels of *S. aureus* in foodservice items.

Multiplication of this microorganism is possible during cooling when contaminated ingredients are mixed and the food does not cool quickly enough. Manipulation of temperature is an effective method of control. There is no multiplication of *S. aureus* below 43°F or above 122°F. Most rapid multiplication occurs at 97°F (e.g., one generation of growth in milk every 19 minutes). A key hazard control is the fact that toxin is formed between 50 and 115°F.

To inactivate (kill) vegetative cells of *S. aureus*, cook food to above 140°F according to the *Salmonella* spp. time-temperature kill standards. To control the growth of this microorganism, cool food according to the FDA Food Code or the USDA Guidelines.

The key to controlling the growth of *S. aureus* in foods, particularly salads, is the fact that it does not produce a toxin below 50°F. For example, when salads must be mixed by hand to maintain the integrity of the ingredients, the hands will introduce a few *S. aureus* (probably less than 10 per gram), but this is not a problem until the *S. aureus* multiplies. When each salad ingredient is cooled individually before mixing, the ingredients can be mixed safely if the temperature of the mixture is kept below 50°F. A good professional standard to use in preparing salads is to cool all ingredients to 41°F and then mix all cold ingredients so that the salad mixture stays below 50°F. Never cut up food in the range of 80 to 115°F, mix it, fill up a deep container such as a 5-gallon plastic pail, and then try to cool the food. It will take days. This makes it easy for *S. aureus*, added to the food from the hands, to produce a toxin in the salad during cooling. The higher the temperature, the less the acid in the salad dressing acts as a hurdle to prevent the growth of *S. aureus*.

Since it can multiply as quickly as once every 19 minutes, food can become hazardous in just a few hours at optimum growth temperatures.

The control of foodborne illness caused by *S. aureus* should include use of good sanitary precautions by foodservice employees (i.e., proper hand washing techniques after touching pimples and infected cuts as well as raw meat products). Foods should be pasteurized correctly and cooled correctly. Salads should be prepared with ingredients at less than 50°F and maintained at temperatures that do not permit production of *S. aureus* toxin.