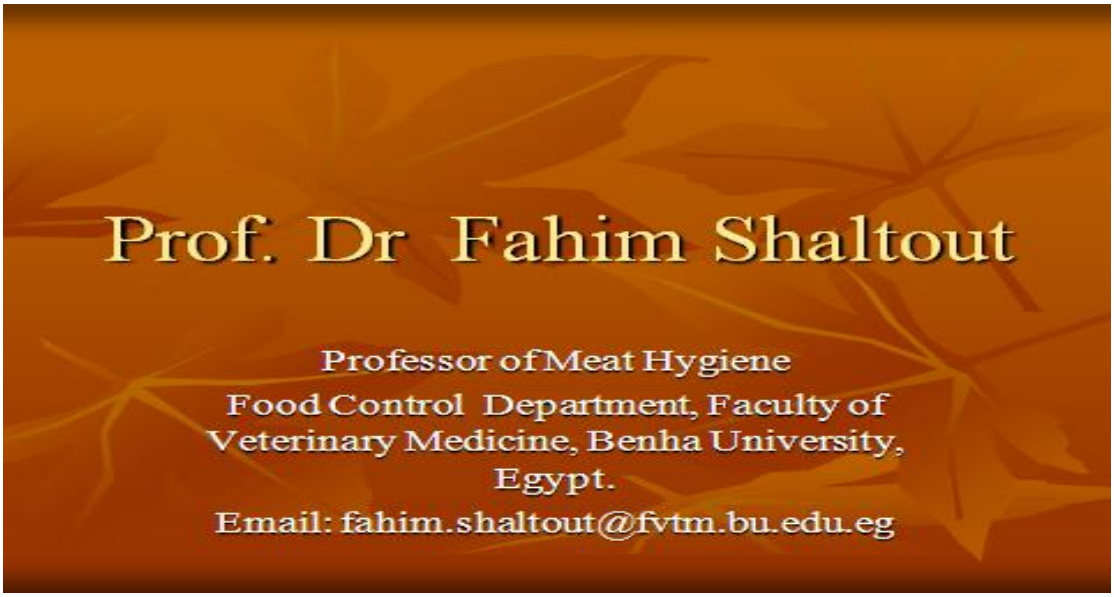


Brucella

is a genus of Gram-negative bacteria,

They are small (0.5 to 0.7 by 0.6 to 1.5 µm), non-encapsulated, non-motile, facultatively intracellular coccobacilli.

Brucella is the cause of brucellosis, which is a zoonosis transmitted by ingesting contaminated food (such as unpasteurized milk products),

direct contact with an infected animal, or inhalation of aerosols. Transmission from human to human,

for example through sexual intercourse or from mother to child, is exceedingly rare, but

possible. Minimum infectious exposure is between 10 and 100 organisms.

The different species of *Brucella* are genetically very similar,

although each has a slightly different host specificity. Hence, the NCBI taxonomy includes most *Brucella* species under *B. melitensis*.

Transmission

Zoonosis affecting domestic animals is caused by contact with milk, urine, and genital organs, which concentrate the causative organisms.

Some reservoirs include buffalo and other animals, but mostly cattle.

In humans, the disease is acquired from:-

- unpasteurised milk and products
- undercooked meat (consumers)
- laboratory inhalation (lab workers)
- accidental skin penetration or abrasion (farmers, slaughterhouse workers

- rarely conjunctival contact, blood transfusion
- transplacental,
- and person-to-person.

Human disease

Brucellosis can affect any organ, and 90% of patients have a cyclical (undulant) fever. Though variable,

Symptoms

include these clinical signs:-

- headache, weakness, arthralgia, depression, weight loss, fatigue, and liver dysfunction. Foul-smelling perspiration is considered a classical sign.

- Between 20 and 60% of cases have osteoarticular complications - arthritis, spondylitis, or osteomyelitis. Hepatomegaly may occur, as can gastrointestinal complications.
- Neurological symptoms include depression and mental fatigue.
- Cardiovascular involvement can include endocarditis resulting in death.
- Chronic brucellosis is hard to define; length, type, and response to treatment are variable. Localized infection can occur. Blood donations of infected persons should not be accepted.
- Congenitally infected infants can exhibit low birth weight, failure to thrive, jaundice, hepatomegaly, splenomegaly, respiratory difficulty, and general signs of sepsis (fever, vomiting). Some cases are asymptomatic

Diagnosis

Test	*B. melitensis*	*B. abortus*	*B. suis*	*B. neotomae*	*B. ovis*	*B. canis*
Need to CO_2	-	+	-	-	+	-
production of H_2S	-	+	+	+	-	-
Growth on basic fushin 0.002%	+	+	-	-	+	-
Growth on thionin 0.004%	-	-	+	-	+	+
Growth on thionin 0.002%	+	-	+	+	+	+
Destroy withTb phage	-	+	-	-	-	-

Host specificity and animal brucellosis

Brucella species have been found primarily in mammals

Species	Host
B. melitensis	goats and sheep
B. abortus	cattle
B. canis	dogs
B. suis	pigs
B. ovis	sheep
B. neotomae	desert woodrat (*Neotoma lepida*)
B. pinnipedialis	seal
B. ceti	dolphin, porpoise, whale
B. microti	common vole (*Microtus arvalis*)
B. inopinata	unknown
B. papionis	baboon
B. vulpis	red fox (*Vulpes vulpes*)

Clinical manifestations

The gastrointestinal tract is affected in about 70% of cases, including: anorexia, abdominal pain, vomiting, diarrhea, constipation, hepatomegaly, and splenomegaly.

The liver is involved in most cases, but function tests are normal or mildly abnormal. Granulomas (*B. abortus*), hepatitis (*B. melitensis*) and abscesses (*B. suis*)are seen.

The skeletal system is affected in 20–60% of cases, including: arthritis (hip, knee, and ankle), spondylitis, osteomyelitis, and sacroiliitis (most common). Lumbar vertebrae can be affected showing the classical radiological sign of vertebral erosion.

Neurological symptoms include meningitis, encephalitis, radiculopathy, and peripheral neuropathy, intracerebral abscesses, and acute or chronic neck rigidity (<50%), and the cerebrospinal fluid can show lymphocytic pleocytosis, low sugar, increased protein, positive bacterial culture (<50%), and agglutination (positive in >95%).

Cardiovascular involvement is low (endocarditis at 2%), but is the major cause of mortality. Often, valve replacement and antibiotics are needed. Pericarditis and myocarditis are seen, too.

Pulmonary infection can be from inhalation or hematogenous sources, and can cause any chest syndrome.

Rarely is *Brucella* isolated from sputum. Genitourinary infection can include epidydemoorchitis or pyonephrosis (rare). Cutaneous involvement is not specific.

Hematological signs include anemia, leukopenia, and thrombocytopenia

Treatment

No clinical trials exist to be relied on as a guide for optimal treatment, but an at least six-week course of rifampicin or gentamicin and doxycycline twice daily is the combination most often used, and appears to be efficacious the advantage of this regimen is that it is oral medication with no injections; however,

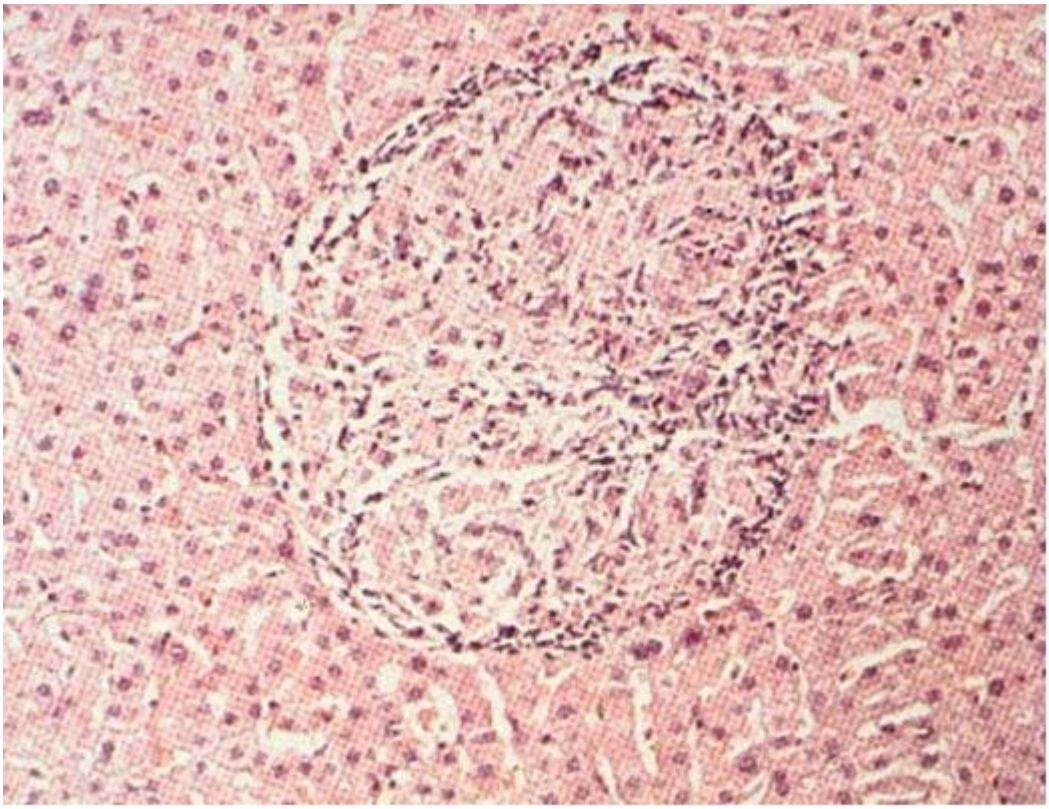
a high rate of side effects (nausea, vomiting, loss of appetite) has also been reported.[22]

. It would primarily be used to immunize members of the military in case of exposure to weaponized *Brucella* on the battlefield

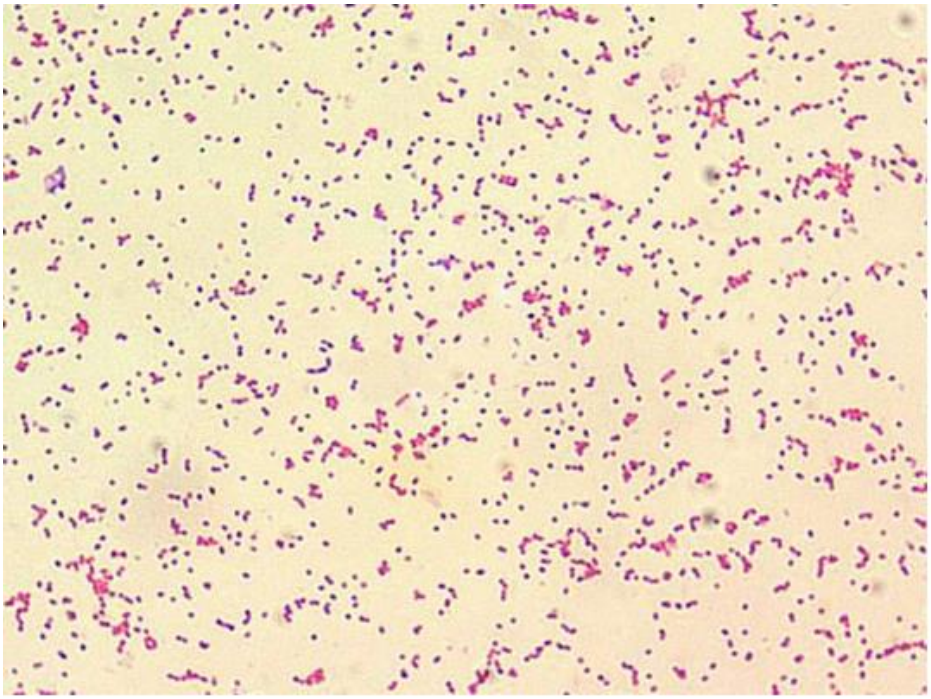
How can consumers protect themselves from food-borne brucella infection

Consumers can protect themselves from *Brucella* infection from food by refraining from consuming raw milk and meat.

Food should be heated to 72 °C for at least two minutes. This recommendation is particularly relevant for raw goat and sheep milk and raw milk products derived therefrom such as cheese produced in endemic areas. This recommendation not only applies when travelling to these areas but also to the consumption of foods that are exported from these regions,



Well-formed hepatic granuloma from patient with brucellosis.



Brucella species are poorly staining, small gram-negative coccobacilli (0.5-0.7 × 0.6-1.5 µm) and are seen mostly as single cells with an appearance resembling "fine sand."

Tuberculosis (TB)

is an infectious disease usually caused by the bacterium *Mycobacterium tuberculosis*,

Mycobacterium tuberculosis

is an obligate[1] pathogenic bacterial species in the family Mycobacteriaceae and the causative agent of tuberculosis

, *M. tuberculosis* can appear either Gram-negative or Gram-positive.[

The physiology of *M. tuberculosis* is highly aerobic and requires high levels of oxygen. Primarily a pathogen of the mammalian respiratory system,

it infects the lungs. The most frequently used diagnostic methods for tuberculosis are the tuberculin skin test, acid-fast stain, culture, and polymerase chain reaction

Signs and symptoms

Tuberculosis may infect any part of the body, but most commonly occurs in the lungs (known as pulmonary tuberculosis).

Extrapulmonary TB occurs when tuberculosis develops outside of the lungs, although extrapulmonary TB may coexist with pulmonary TB.

General signs and symptoms:- include fever, chills, night sweats, loss of appetite, weight loss, and fatigue. Significant nail clubbing may also occur.

Pulmonary

If a tuberculosis infection does become active, it most commonly involves the lungs (in about 90% of cases).

Symptoms may include chest pain and a prolonged cough producing sputum. About 25% of people may not have any symptoms (i.e. they remain "asymptomatic").

Occasionally, people may cough up blood in small amounts, and in very rare cases,

The infection may erode into the pulmonary artery or a Rasmussen's aneurysm, resulting in massive bleeding.

Tuberculosis may become a chronic illness and cause extensive scarring in the upper lobes of the lungs.

The upper lung lobes are more frequently affected by tuberculosis than the lower ones.

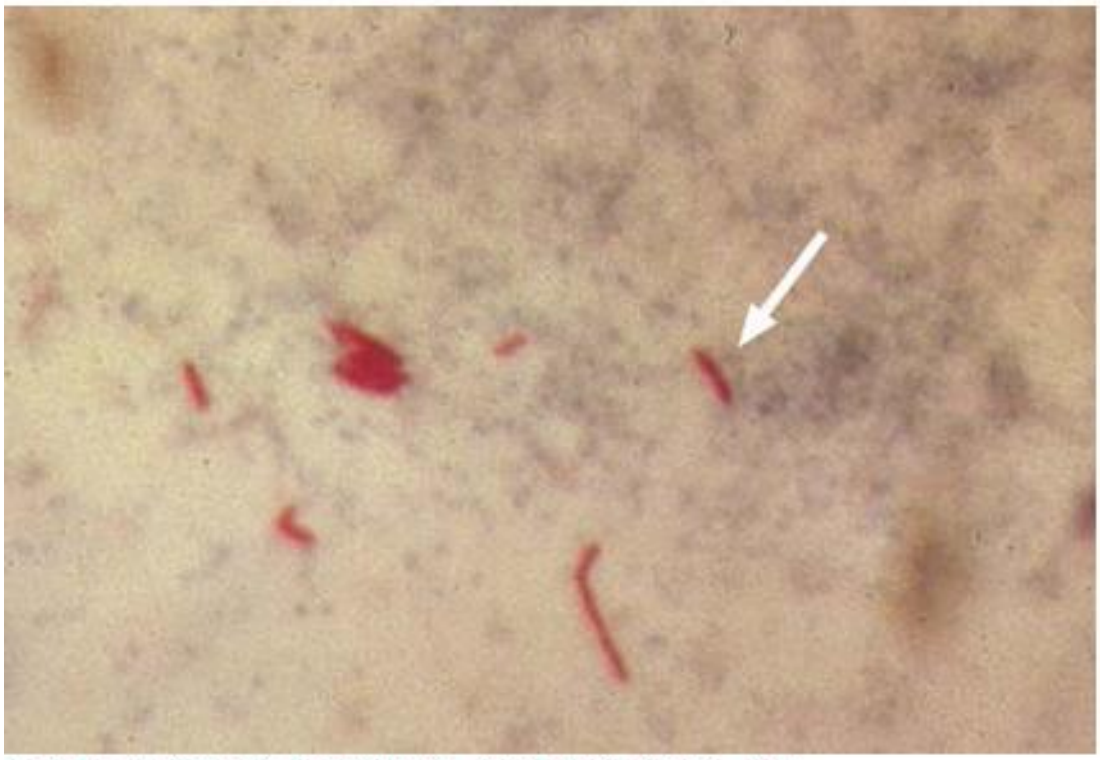
Transmission

When people with active pulmonary TB cough, sneeze, speak, sing, or spit, they expel infectious aerosol droplets 0.5 to 5.0 μm in diameter. A single sneeze can release up to 40,000 droplets. Each one of these droplets may transmit the disease, since the infectious dose of tuberculosis is very small (the inhalation of fewer than 10 bacteria may cause an infection).

People with prolonged, frequent, or close contact with people with TB are at particularly high risk of becoming infected, with an estimated 22% infection rate. A person with active but untreated tuberculosis may infect 10–15 (or more) other people per year. Transmission should occur from only people with active TB – those with latent infection are not thought to be contagious. The probability of transmission from one person to another depends upon several factors, including the number of infectious droplets expelled by the carrier, the effectiveness of ventilation, the duration of exposure, the virulence of the *M. tuberculosis* strain, the level of immunity in the uninfected person, and others. The cascade of person-to-person spread can be circumvented by segregating those with active ("overt") TB and putting them on anti-TB drug regimens. After about two weeks of effective treatment, subjects with nonresistant

active infections generally do not remain contagious to others. If someone does become infected, it typically takes three to four weeks before the newly infected person becomes infectious enough to transmit the disease to others

Colonies of *Mycobacterium tuberculosis* on Lowenstein-Jensen medium. CDC.



Mycobacterium tuberculosis. Acid-fast stain. CDC.

Prevention

Tuberculosis prevention and control efforts rely primarily on the vaccination of infants and the detection and appropriate treatment of active cases.

The World Health Organization has achieved some success with improved treatment regimens, and a small decrease in case numbers. The US Preventive Services Task Force (USPSTF) recommends screening people who are at high risk for latent tuberculosis with either tuberculin skin tests or interferon-gamma release assays.

Vaccines

The only available vaccine as of 2011 is Bacillus Calmette-Guérin (BCG). In children it decreases the risk of getting the infection by 20% and the risk of infection turning into disease by nearly 60%.[81]

It is the most widely used vaccine worldwide, with more than 90% of all children being vaccinated. The immunity it induces decreases after about ten years.

As tuberculosis is uncommon in most of Canada, the United Kingdom, and the United States, BCG is administered to only those people at high risk.

Part of the reasoning against the use of the vaccine is that it makes the tuberculin skin test falsely positive, reducing the test's use in screening. A number of new vaccines are currently in development

Prevention

TB is largely a preventable disease. Isolation of patients and adequate ventilation are the most important measures to prevent its transmission in the community. In the United States, healthcare providers try to identify people infected with *M. tuberculosis* as early as possible, before they have developed active TB.

In those parts of the world where the disease is more common, the World Health Organization recommends that infants and children receive a vaccine called BCG (Bacille Calmette Guerin). BCG is made from live weakened *Mycobacterium bovis*, a bacterium related to *M. tuberculosis*. BCG vaccine prevents *M. tuberculosis* from spreading within the body, thus preventing TB from developing.
BCG has drawbacks. It is reasonably effective in preventing development of active disease in children. However, it does not protect against TB in adults. In addition, BCG may interfere with the TB (PPD) skin test, showing a positive skin test reaction in people who have received the vaccine. BCG is used for children in countries where TB is endemic. Consequently, much of the population would have a positive TB test regardless of the vaccine. However, many countries where BCG vaccine is used have a limited infrastructure and public health system Consequently, the problem is not as important as it would be in countries without endemic TB

Bacillus anthracis

is the etiologic agent of anthrax—a common disease of livestock and, occasionally, of humans—and the only obligate pathogen within the genus *Bacillus*. *B. anthracis*is a Gram positive, endospore-forming,

rod-shaped bacterium, with a width of 1.0–1.2 μm and a length of 3–5 μm.[1] It can be grown in an ordinary nutrient medium under aerobic or anaerobic condit ions

Bioterrorism

A biological attack, or bioterrorism, is the intentional release of viruses, bacteria, or other germs that can sicken or kill people, livestock, or crops. *Bacillus anthracis*, the bacteria that causes anthrax, is one of the most likely agents to be used in a biological attack.

Strains

The 89 known strains of *B. anthracis* include:

- Sterne strain (34F2; aka the "Weybridge strain"), used by Max Sterne in his 1930s vaccines
- Vollum strain, formerly weaponized by the US, UK, and Iraq; isolated from a cow in Oxfordshire, UK, in 1935
  - Vollum M-36, virulent British research strain; passed through macaques 36 times
  - Vollum 1B, weaponized by the US and UK in the 1940s-60s
  - Vollum-14578, used in UK bio-weapons trials which severely contaminated Gruinard Island in 1942
  - V770-NP1-R, the avirulent, nonencapsulated strain used in the *BioThrax* vaccine
- Anthrax 836, highly virulent strain weaponized by the USSR; discovered in Kirov in 1953
- Ames strain, isolated from a cow in Texas in 1981; famously used in AMERITHRAX letter attacks (2001)
  - Ames Ancestor
  - Ames Florida
- H9401, isolated from human patient in Korea; used in investigational anthrax vaccines

Pathogenesis

B. anthracis possesses an antiphagocytic capsule essential for full virulence.

The organism also produces three plasmid-coded exotoxins: edema factor, a calmodulin-dependent adenylate cyclase, causes elevation of intracellular cAMP, and is responsible for the severe edema usually seen in *B.*

anthracis infections; lethal toxin is responsible for tissue necrosis; protective antigen (so named because of its use in producing protective anthrax vaccines) mediates cell entry of edema factor and lethal toxin.

Cutaneous anthrax symptoms can include:

- A group of small blisters or bumps that may itch
- Swelling can occur around the sore
- A painless skin sore (ulcer) with a black center that appears after the small blisters or bumps
  - Most often the sore will be on the face, neck, arms, or hands

How do people get infected with anthrax?

People get infected with anthrax when spores get into the body. When anthrax spores get inside the body, they can be "activated." When they become active, the bacteria can multiply, spread out in the body, produce toxins (poisons), and cause severe illness.

This can happen when people breathe in spores, eat food or drink water that is contaminated with spores, or get spores in a cut or scrape in the skin. It is very uncommon for people in the United States to get infected with anthrax.

Certain activities can also increase a person's chances of getting infected. For more information, see

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Where is anthrax found?

Anthrax is most common in agricultural regions of Central and South America, sub-Saharan Africa, central and southwestern Asia, southern and eastern Europe, and the Caribbean.

Anthrax is rare in the United States, but sporadic outbreaks do occur in wild and domestic grazing animals such as cattle or deer. Anthrax is more common in developing countries and countries that do not have veterinary public health programs that routinely vaccinate animals against anthrax. In the United States, yearly vaccination of livestock is recommended in

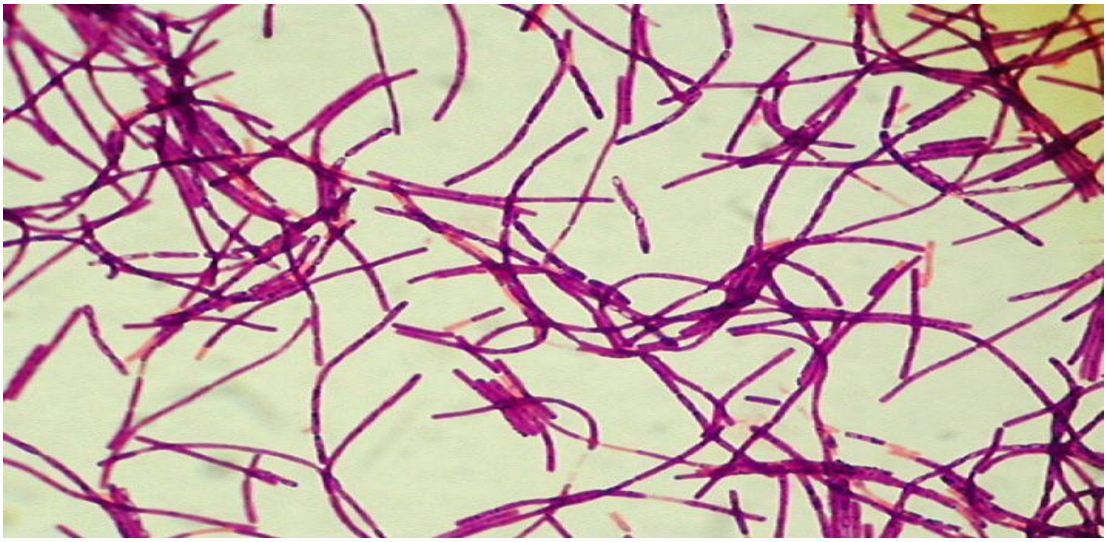
areas where animals have had anthrax in the past. For more information

Laboratory research

Components of tea, such as polyphenols, have the ability to inhibit the activity both of *B. anthracis* and its toxin considerably; spores, however, are not affected.

The addition of milk to the tea completely inhibits its antibacterial activity against anthrax.

Activity against the *B. athracis* in the laboratory does not prove that drinking tea affects the course of an infection, since it is unknown how these polyphenols are absorbed and distributed within the body.




Bacillus anthracis
1000x

susceptible people

Anyone who has come in contact with anthrax spores could be at risk of getting sick. Most people will never be exposed to anthrax. However there are activities that can put some people at greater risk of exposure than others.

- People Who Handle Animal Products
- Veterinarians
- Livestock producers
- Travelers
- Laboratory Professionals
- Mail handlers, military personnel, and response workers who may be exposed during a bioterror event involving anthrax spores

vaccination

The anthrax vaccine is currently provided only to people who are at an increased risk of coming in contact with anthrax spores, such as members of the U.S. military, certain laboratory workers, and some people who handle animals or animal products (for example, farmers, veterinarians, and

livestock handlers). The vaccine is not licensed for use in children under age 18, adults over age 65, or pregnant and nursing women

Laboratory Testing

Laboratory systems are set up in the United States to quickly confirm or rule out whether a patient has anthrax or whether the environment is contaminated with *Bacillus anthracis*, the type of bacteria that causes anthrax. These labs are vital to the early identification of anthrax, especially in the case of a bioterrorism attack using anthrax.

However, the labs at CDC are always hard at work, not just during a bioterrorism event. They are working every day to conduct research that enhances the scientific understanding of anthrax. Laboratory scientists at CDC routinely strive to provide accurate information and efficient testing.

Labs at CDC work to:

- Study and describe *Bacillus anthracis*
- Provide anthrax reference diagnostics
- Create new tests (including assays and diagnostics) to quickly identify anthrax
- Test prevention and treatment options for anthrax

- Provide epidemiological support and training to other labs and partners

All research with *Bacillus anthracis* is conducted in laboratories with the appropriate degree of containment to ensure public safety. The design of the secure laboratory facilities protects both scientists and the surrounding environment.