

Q.1 What is disinfectant decay and bacterial inactivation kinetics? Explain with mathematical expression.

Answ In drinking water disinfection by chlorine it has been demonstrated that the growth of heterotroph plate count of bacteria followed first order kinetics in the water phase of pipe system containing bacterial nutrients.

This is valid for a limited stretch of pipe, where the concentration, on the other hand, has been demonstrated to follow a modified Chick's law, in which the concentration of the germicidal agent is incorporated in the first order.

This is valid during the disinfection process, and does not take initial and final effects into consideration. In a study, the effect of growth assumed first order kinetics with respect to the bacterial number, while inactivation assumed first order with respect to both bacterial number and concentration of disinfectant.

These may be combined in one expression

$$\frac{dN}{dt} = \mu N - \lambda NC^r$$

Where $N \rightarrow$ density

$t \rightarrow$ time

$\mu \rightarrow$ Growth rate constant

$\lambda \rightarrow$ Rate constant

$C \rightarrow$ Concentration of disinfectant.

Disinfectant Decay Kinetics

$$-\frac{dc}{dt} = ksc$$

$$-\frac{ds}{dt} = -\frac{dc}{dt}$$

or

$$s = c - (c_a - s_a)$$

by substitution

$$\frac{dc}{dt} - k(c_a - s_a)c = -kc^2$$

Bernoulli's equation

$$c = \frac{c_a - s_a}{1 - \frac{s_a}{c_a} e^{-k(c_a - s_a)t}}$$

$$\frac{dN}{N} = \left\{ M - \frac{\lambda(c_a - s_a)}{1 - \frac{s_a}{c_a} e^{-k(c_a - s_a)t}} \right\} dt$$

$$N = N_0 (1 + KC_a) t^m$$

Q.2 Explain the following terms with examples:

(a) Pathogenic Fungi with one example of disease (causative agent, symptoms and treatments)

Ans Pathogenic fungi are fungi cause disease in humans or other organisms. Approximately 300 fungi are known to be pathogenic to humans. markedly more fungi are known to be pathogenic to plant life than those of the animal kingdom.

Fungus is any organism that is eukaryotic has a rigid cell wall containing glucans and chitin and are incapable of producing food that they alergy with animals are heterotrophs as opposed to organisms such as plants that can produce their own food from an external non-organic energy source and which are called autotrophs. Their cellular structure is actually very important in both defining what a fungus is as well as understanding the mechanisms used by antifungal medications.

Example of disease

Histoplasmosis

It is an infection caused by a fungus called Histoplasmosis. The fungus lives in the environment,

Particularly in soil that contains large amounts of bird or bat droppings.

Re people can get histoplasmosis after after in the microscopic fungal spores from the air. Although most people who breathe in the spores don't get sick, those who do may have a fever, Cough, and Fatigue. Many people who get histoplasmosis will get better on their own without medication, but in some people who has weak immune systems, the infection can become severe.

Symptoms of Histoplasmosis

- (a) Fever
- (b) Cough
- (c) Fatigue
- (d) Chills
- (e) Headache
- (f) Chest pain
- (g) Body Pain

Symptoms of histoplasmosis may appear b/w 3 and 17 days after a person breathes in the fungal spores.

Treatment for Histoplasmosis

Some people, the symptoms of histoplasmosis will go away without treatment. However, Prescription antifungal medication is needed to treat severe histoplasmosis in the antifungal mosis in the lungs, Chronic histoplasmosis, and infections that have spread from the lungs to other part of the body.

Itraconazole is one type of antifungal medication that's commonly used to treat histoplasmosis. Depending on the severity of the infection and the person's immune status, the course of treatment can range from 3 months to 1 year.

(b) Sulfa drugs:-

Sulfa drug, also called sulfonamide, and member of a group of synthetic antibiotics containing the sulfonamide molecular structure. Sulfa drugs were the first chemical substances systematically used to treat and prevent bacterial infections in humans.

Their use has diminished because of the availability of antibiotics that are more effective and safer and because of increased instances of drug resistance.

Sulfonamides are still used, but largely for treating urinary tract infections and preventing infection of burns.

∴ symptoms?

- (a) Skin rash or hives
- (b) Itchy eyes
- (c) Itchy skin
- (d) Congestion
- (e) Swelling of the mouth
- (f) Swelling of the throat

⇒ Treatment Options

If you have an allergic reaction to sulfa drugs, treatment will be centered on relieving your symptoms. Your doctor may prescribe antihistamines or corticosteroids to relieve hives, rash, and itching. A bronchodilator may be prescribed if you have respiratory symptoms.

Both anaphylaxis and Stevens-Johnson syndrome require immediate medical attention. If you're having an anaphylactic reaction, epinephrine will usually be given.

If you develop Stevens-Johnson syndrome, you'll likely be admitted to an intensive care unit.

Treatment for Stevens-Johnson syndrome includes:

- Corticosteroids to control inflammation
- Antibiotics to prevent or control skin infections.
- Infac
Intravenous immunoglobulins to halt the progress of the disease.

C Sexually transmitted disease, explain with example.

The term sexually transmitted disease is used to refer to a condition passed from one person to another through sexual contact. A person can contract an STD by having unprotected vaginal, anal, or oral sex with someone who has the STD.

An STD may also be called a sexually transmitted infection (STI) or venereal disease (VD).

That doesn't mean sex is the only way STDs are transmitted. Depending on the specific STD, infections may also be transmitted through sharing needles and breastfeeding.

Example of STDs is Chlamydia

What is Chlamydia?

It is a STD caused by a bacterial called Chlamydia trachomatis.

⇒ Symptoms of Chlamydia:

Many people with Chlamydia don't have any symptoms. If you do get symptoms, if you do get symptoms, you may not notice them until several weeks after infection. Other people might not have any symptoms for several months.

Signs of Chlamydia in women include

- Increase in vaginal discharge
- Pain or burning when urinating
- Pain during sex and/or bleeding after sex
- Pain in the lower stomach - especially when having sex
- Bleeding between periods and/or heavier periods.

Signs of Chlamydia in men include:

- White, cloudy or watery discharge from the penis.
- Pain during or burning when urinating.
- Pain and/or swelling the testicles.

How is Chlamydia treated?

Chlamydia can be easily treated with a short course of antibiotics. You may be able to take all the antibiotics in one day, or over a week, depending on the type of treatment you are prescribed.

It's important to not have sex until you and your partner have finished treatment.

Remember that if you've been treated for Chlamydia, you are not immune and you can get infected again.

Long-term effects of untreated Chlamydia.

If left untreated, Chlamydia can lead to other, sometimes serious, health problems.

In women, untreated Chlamydia can cause Pelvic inflammatory disease (PID). PID can cause pelvic pain, infertility, and ectopic pregnancy which can be life-threatening. PID can be treated with antibiotics.

In men untreated Chlamydia can cause swelling and pain in the testicles, and pain when urinating or during sex. Rarely, it can cause infertility in men.

(d) Nitrogen metabolism and Fixation

Ans.

Nitrogen metabolism

Nitrogen metabolism is a set of chemical processes, which is carried out to convert the substances into a usable energy form.

Nitrogen metabolism is mainly based on the recycling of ammonia (NH_3) into the neutral or charged form ammonium ion (NH_4^+). The main part of nitrogen metabolism is the Nitrogen Cycle.

Nitrogen Fixation

Nitrogen fixation is the essential biological process and the initial stage of the nitrogen cycle. In this process, nitrogen in the atmosphere is converted into ammonia by certain bacterial species like Rhizobium, Azotobacter, etc. and by other natural phenomena.

Plants are the main sources of food. The nutrients obtained from plants are synthesized by plants using various elements which they obtain from the atmosphere as well as from the soil. This group of elements includes nitrogen as well. Plants obtain nitrogen from the soil and utilize in the process of protein synthesis.

Q3 What are Food and Water born disease, explain each with example?

Ans Foodborne or water born diseases are caused by Consuming Contaminated Food or beverages. Food and water borne infections can also cause serious and sometimes Chronic Conditions.

Example:- Include disease caused by the Parasite *Toxoplasma gondii*, and the bacteria *Listeria monocytogenes*

Cause :-

Foodborne illness is caused by Consuming Contaminated food or beverages. Many different disease-causing microbe or Pathogens can Contaminate foods, so there are many different types of foodborne illnesses.

Most Foodborne diseases are infections caused by a variety of bacteria, viruses, and Parasites. Other diseases are poisonings caused by harmful toxins or chemicals that have contaminated food.

Norovirus :-

If you've ever eaten out at a restaurant only to come down with a case of the stomach flu, you've had the non-norovirus.

The most common known pathogen, the Norwalk virus is responsible 5.4 million cases of food poisoning each year.

Chalk up its prevalence to how easily it can be transmitted. People infected with the virus can spread it directly to other people or cross-contaminate food or drinks they prepare, but others.

Norovirus can survive on contaminated surfaces and is resistant to both freezing and hot temperatures. It also is resistant, including disinfectants with chlorine or alcohol.

To avoid infection:-

- Wash hands with soap and warm water for at least 20 seconds, particularly after using the bathroom and before preparing food.
- Clean and disinfect food preparation equipment and surfaces using a bleach-based household cleaner as directed on the label.

- Wash fruits and vegetables, and thoroughly cook oysters and shellfish before eating them. These foods are most commonly contaminated by the norovirus.
- If you believe you have contracted the norovirus, do not cook, prepare or serve food for others.
- Wash soiled clothing or linens immediately. Remove items carefully to avoid spreading the virus. Machine wash, ideally with bleach, and dry.

What are Waterborne Diseases?

Waterborne diseases are illnesses caused by microscopic organisms, like viruses and bacteria, that are ingested through contaminated water or by coming in contact with feces.

If every person on the planet was able to practice safe sanitation and hygiene and have access to clean water, these diseases would not exist. Government, NGOs, and communities themselves have made great strides in the past 20 years to end waterborne diseases. Still, there is much to be done.

Typhoid fever

Although rare in industrialized Countries, typhoid fever is well-known in extremely Poor Parts or developing nations; it's estimated that up to 20 million people worldwide suffer from the illness each year. It's spread through Contaminated food, Unsafe water, and Poor sanitation, and it is highly contagious.

Symptoms include :-

- A fever that increases gradually
- Muscle aches
- Fatigue
- Sweating
- Diarrhea or Constipation

Prevention that

Prevention and Treatment

Vaccines are recommended for people who are traveling in areas where poor sanitation and unsafe water are common. The vaccine can be injected via a shot or taken orally for a number of days. To prevent it, refrain from drinking any water that isn't bottled and sealed, and do not eat food from villages or street vendors. Typhoid is treated with antibiotics.

Q.4 What are antibiotics? Explain Penicillin and Cephalosporins and their action. What is broad spectrum antibiotics?

Antibiotics are medicines that fight bacterial infection in people and animals. They work by killing the bacteria or by making it hard for the bacteria to grow and multiply.

Antibiotics can be taken in different ways:

- Orally. This could be pills, capsules, or liquid.
- Topically. This might be a cream, spray, or ointment that you put on your skin. It could also be eye or ear drops.
- Through an injection or intravenously. This is usually for more serious infection.

Penicillin's mechanism of action

Penicillin and other antibiotics in the beta-lactam family contain a characteristic four-membered beta-lactam ring. Penicillin kills bacteria through binding of the beta-lactam ring to D,D-transpeptidase, inhibiting

its cross-linking activity and preventing new cell wall formation. Without a cell wall, a bacterial cell is vulnerable to outside water and molecular pressures, which causes the cell to quickly die.

- Gram-Positive bacteria have thick cell walls containing high levels of Peptidoglycan, while gram-negative bacteria are characterized by thinner cell wall low levels of Peptidoglycan.

Mechanism of action

Cephalosporins are bactericidal and have the same mode of action as other β -lactam antibiotics, but are less susceptible to β -lactamases. Cephalosporins help disrupt the synthesis of the Peptidoglycan layer forming the bacterial cell wall. The peptidoglycan layer is important for cell wall structural integrity. The final transpeptidation step in the peptidoglycan is facilitated by Penicillin-binding Proteins.

Broad spectrum antibiotics

A broad-spectrum antibiotic is an antibiotic that acts on the two major bacterial groups, Gram-Positive and Gram-negative, or any antibiotic that acts against a wide range of disease-causing bacteria. These medications

are used when a bacterial infection is suspected but the group of bacteria is unknown or when infection with multiple groups of bacteria is suspected.

This is contrast to a narrow-spectrum antibiotic, which is effective against only a specific group of bacteria.

Q5 What is the disease cause by transmitted by animals? What are causative agent, symptoms and treatments of rabies and plague?

Zoonotic Diseases

A zoonosis is an infectious disease that is transmitted b/w species from animals to humans.

Rabies

It is a viral disease that is spread through the animal bite such as the dog. It is caused by the infection of rabies virus. The infection caused by this leads to encephalomyelitis the inflammation of the brain as well as the spinal cord.

The transmission of the virus happens through the saliva and affects the CNS or central nervous system. This virus belongs to a family called Rhabdoviridae. It takes the shape of a bullet.

Animals such as dogs, rabbits, cats, fox and etc. carry this virus and transmit the disease to human beings.

Symptoms of Rabies

The symptoms caused by the dog bite or rabies are given below -

- Develop fear from water
- Swelling in the brain and the spinal cord.
- Frequent headache
- Nausea
- Stomachache
- Muscle cramps
- Drowsiness
- Insomnia
- Severe fever
- Anxiety
- Hallucination
- Excess secretion of Saliva
- Difficulty in swallowing

Treatments :-

- Get rabies vaccination to prevent the infection.
- Vaccinating your pet against the disease.
- Maintain distance with the wild animals.
- Wash wounds with soap and water and maintain good hygiene.
- Keep your pets away from the other stray dogs.

Plague

Plague is caused by various means of contacts resulting in widespread of the disease.

- It is caused by means of sneezing.
- Consumption of contaminated foods or water.
- By touching the soil or any surface that is contaminated.
- It is even caused by direct physical contact with infected person.
- Bite from the insects which have previously fed on infected animals like a rat, squirrel, rodents.

Symptoms of Plague

The signs and symptoms of plague differ with the types and days of infection. Listed below are the few serious symptoms of plague.

- Fever
- Nausea
- Seizures
- Diarrhoea
- General weakness

- Vomiting sensation
- Frequent headaches
- Breathing problems
- Swelling in the joints
- Muscle and joint pains
- Pain in the abdomen region
- Severe cough with pain in the chest region.

Treatment for the Plague

As mentioned earlier, the plague is a life-threatening infection, which requires urgent care and treatment. The basic treatments for this ~~disease~~ disease require effective use of antibiotics regularly as this is a deadly kind of disease and good ~~precautions~~ measures need to be applied to stop the spreading of this disease.

6. Differentiate :

- a. Nitrate and Sulfate reduction

Nitrate reduction	Sulfate reduction
1. In anaerobic respiration, denitrification utilizes nitrate (NO_3^-) as a terminal electron acceptor in the respiratory electron transport chain.	Sulfate reduction is a type of anaerobic respiration that utilizes sulfate as a terminal electron acceptor in the electron transport chain
2. Denitrification is a microbially facilitated process involving the stepwise reduction of	

6. Differentiate :

a. Nitrate and sulfate reduction

Nitrate reduction	Sulfate reduction
<p>1. In anaerobic respiration, denitrification utilizes nitrate (NO_3^-) as a terminal electron acceptor in the respiratory electron transport chain.</p>	<p>Sulfate reduction is a type of anaerobic respiration that utilizes sulfate as a terminal electron acceptor in the electron transport chain.</p>
<p>2. Denitrification is a widely used process; many facultative anaerobes use denitrification because nitrate, like oxygen, has a high reduction potential.</p>	<p>Compared to aerobic respiration, sulfate reduction is a relatively energetically poor process, though it is a vital mechanism for bacteria and archaea living in oxygen-depleted, sulfate-rich environments.</p>

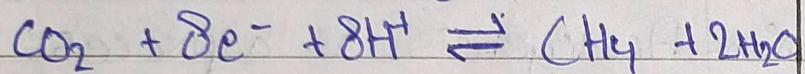
3. Denitrification is a microbially facilitated process involving the stepwise reduction of nitrate to nitrite (NO_2^-) nitric oxide (NO), nitrous oxide (N_2O), and eventually, to dinitrogen (N_2) by the enzymes nitrate reductase, nitrite reductase, nitric oxide reductase, and nitrous oxide reductase. The complete denitrification process can be expressed as a redox reaction:
- $$\text{On : } 2 \text{NO}^{3-} + 10\text{e}^- + 12 \text{H}^+ \rightarrow \text{N}_2 + \text{Sulfur (SO)}_4^{2-}, \text{ Sulfite (SO}_3^{2-}), \text{ and Thiosulfate (S}_2\text{O}_3^{2-}) \text{ to produce both hydrogen sulfide (H}_2\text{S) and Sulfite (SO}_3^{2-}).$$
- Many sulfate reducers are obligately aerobic, using carbon compounds, such as lactate and pyruvate [among many others] as electron donors, while others are lithotrophs, and use hydrogen gas (H_2) as an electron donor. Some unusual autotrophic sulfate-reducing bacteria can use elemental sulfur as an electron acceptor, whereas others are capable of disproportionation using elemental sulfur (S) to produce both hydrogen sulfide (H_2S) and sulfite (SO_3^{2-}).
4. Protons are transported across the membrane by the initial NADH reductase, quinones and nitrous oxide reductase to produce the electrochemical gradient critical for respiration.

b. Methanogenesis and acetogenesis

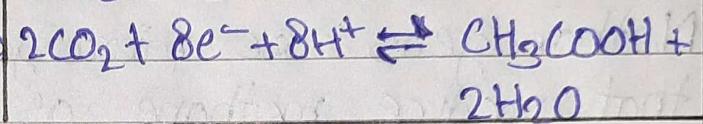
Methanogenesis	Acetogenesis
<p>Methanogens are microorganisms that produce <u>methane</u> as a <u>metabolic</u> byproduct in hypoxic conditions. They are <u>prokaryotic</u> and belong to the <u>domain</u> of <u>archaea</u>.</p>	<p>Acetogenesis is a process through which acetate is produced either by the reduction of CO_2 or by the reduction of organic acids.</p>
<p>Methanogenesis is an <u>anaerobic</u> respiration that generates methane as the final product of metabolism.</p>	<p>Acetogenesis is the third step of anaerobic digestion.</p>
<p>In aerobic respiration, organic matter such as glucose is oxidized to CO_2, and O_2 is reduced to H_2O. In contrast, during <u>fermentation</u>,</p>	<p>Products from fermentation (organic acids, alcohols) are converted into hydrogen (H_2), carbon dioxide (CO_2) and acetic acid (CH_3COOH).</p>

Methanogenesis, H_2 is oxidized to H^+ , and CO_2 is reduced to CH_4 .

reactions involved



reactions involved



Q.6(c)

AIDS

1) Disease that can develop in people with HIV most advanced stage of HIV

2) AIDS can develop through sexual contact used needle or breast feeding

3) Person is vulnerable to a widely range of illness like pneumonia

(i) HIV kill cell healthy adult generally have a CD4 cell count of 500 to 1000 per cubic mm.

Tuberculosis

Infection disease that usually affect the lung although can affect any organ

A person may develop TB after mycobacterium tuberculosis bacteria

People can spread symptoms of TB.

O.G.D

Rickettsias

- 1) These infection are caused by multiple bacteria from generally rickettsias
- 2) Do not stain well in gram stain and take characteristic red colour when stained by amisa
- 3) occur by life of parasites that infections fluid in their

Malaria

Malaria is a life threat living disease spread through life of anopholes mosquites.

There are four type of malaria that can effect the humans.

Typically found in tropical and subtropical climates where parasite can live.