

VETERINARY BACTERIOLOGY

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Contents

1. Introduction
 2. Animal Health
 - 2.1. Cattle
 - 2.2. Sheep
 - 2.3. Pigs
 - 2.4. Horses
 - 2.5. Dogs
 - 2.6. Cats
 - 2.8. Fish
 3. Zoonoses
 - 3.1. Anthrax
 - 3.2. Brucellosis
 - 3.3. Tuberculosis
 - 3.4. Tularemia
 - 3.5. Psittacosis
 4. Food Safety
 - 4.1. *Escherichia coli* O157:H7
 - 4.2. *Salmonella* spp.
 - 4.3. *Listeria monocytogenes*
 - 4.4. *Vibrio parahaemolyticus*
 - 4.5. *Staphylococcus aureus*
 5. Preventive Measures
 6. Conclusion
- Glossary
Bibliography
Biographical Sketch

Summary

The field of *Veterinary Bacteriology* plays a major role in veterinary medicine, human health, and economics. This overview describes representative bacteria that are pathogenic and can cause infectious diseases to animals.

Others are potential infectious agents to humans, and they can threaten public health. In addition, the outcome of a disease may lead to an economic loss, especially for farm animals, wildlife, and companion animals.

1. Introduction

Several major groups of bacteria are considered very significant in animal health and welfare. Some of these bacteria are very pathogenic, their severe pathogenicity cause different kinds and levels of infections to livestock, pets and wildlife.

Generally, bacteria are classified according to *Bergey's Manual* into different groups. The classification is based on the specific characteristic features and uniqueness of the bacteria.

In veterinary bacteriology, it is very important to identify the nature of the bacteria that cause the infection in animals. There is a broad range of laboratory protocols, methods, and techniques that facilitate the microbiological analysis. Specimens should be obtained from infected animals. Consequently, the appropriate laboratory analysis will lead to the identification of the unknown bacteria that are the causative agent(s) for the infection.

Specimens for laboratory diagnosis include samples like blood, urine, feces, milk, semen, nasal discharge, wound or abscess swabs, aborted fetus, biopsy specimens and necropsy specimens. Samples for necropsy involve liver, kidney, brain, lymph nodes, spleen, lung, and even intestines. The laboratory methods and techniques start with a good sampling procedure, collection, and transportation of samples to the bacteriology laboratory. In most cases, it is essential to start with a direct microscopic examination for the sample. However, pure culture technique is a must.

In most of the laboratory investigations, *Grams Staining* is the first step to be considered. In this respect, the bacteria can be classified either gram-positive “purple color” or gram-negative “pink color”. In certain cases, there is weak or no reaction with gram staining due to the lack of cell wall, as in mycoplasma. The results from gram staining will help to select further tests to identify the pathogen.

Pure culture techniques are very important and they are required to perform different tests. In pure culture, it is possible to obtain a single type of bacterial colony. This will facilitate the identification of the unknown microorganism. Some bacteria such as chlamydia and spirochaetes will not grow in laboratory media, but they require tissue cultures or laboratory animals to propagate their numbers.

The use of biochemical tests in bacterial identification is very helpful, and it is an important segment in the diagnostic laboratory. Biochemical tests involve carbohydrate, amino acid, and lipid metabolisms. In addition, these tests depend on the presence or absence of specific bacterial enzymes.

Oxygen requirements for bacterial growth vary according to the type of bacteria. Therefore, bacteria can be classified either aerobic as *Bacillus anthracis*, or facultative anaerobic as *Escherichia coli*, or anaerobic as *Clostridium tetani*, or microaerophilic as *Mycobacterium bovis*.

There are numerous immunological tests that are normally used in bacterial diagnostic

laboratory. The tests are based on antibody-antigen reactions such as precipitation, agglutination, complement fixation and toxin neutralization. Other examples are fluorescent antibody techniques, and enzyme immuno-sorbent assay (ELISA). There are other valuable methods which assist in the identification and/or classification of bacteria; DNA base composition, polymerase chain reaction (PCR), and fatty acid profiles.

2. Animal Health

This section illustrates the importance of veterinary bacteriology in animal health [cattle, sheep, pigs, horses, dogs, cats, poultry, and fish]. There are several bacterial diseases that can infect these animals. Infectious disease could be specific to one organ(s) or system(s). However, in this overview, only few bacterial species and their respective diseases are mentioned.

2.1. Cattle

2.1.1. Mastitis

Mastitis is inflammation of the udder. Udder infection in dairy cattle leads to a major economic impact. Etiology of the disease can be any of the following bacterial species that are potential pathogens. Species like *Streptococcus agalactiae*, *Streptococcus dysgalactiae*, and *Streptococcus uberis* are all gram-positive cocci arranged in chains. On the other hand, *Staphylococcus aureus* is also gram-positive cocci, but their arrangement is in clusters. Other pathogens that are considered to be causative agents in environmental mastitis are *Escherichia coli* and *Enterobacter aerogenes* - both are gram-negative short rods. Mycoplasma mastitis caused by some species belongs to the genus *Mycoplasma*. It is very contagious.

2.1.2. Collibacillosis

Collibacillosis is also known as calf scours. It is a disease that affects dairy and beef calves. The disease targets the intestinal tract and causes severe diarrhea. It is usually caused by *Escherichia coli*. Another bacteria that can cause scours is *Salmonella* spp. *Collibacillosis* is not limited to calves, but can also occur in piglets and lambs.

2.1.3. Foot Rot

Foot Rot in cattle is caused by *Fusobacterium necrophorum*. This bacterial species is aerobic gram-negative rods with variable lengths. The pathogen is usually acquired from soil and enters the body through skin abrasions and wounds. In addition, *F. necrophorum* can cause liver abscesses and mastitis.

2.2. Sheep

2.2.1. Enterotoxaemia

Enterotoxaemia in sheep usually affects lambs. This clinical condition is due to toxins

produced by *Clostridium perfringens*. The bacterial species is anaerobic gram-positive rods, and endospore-forming. Type D affects lambs in feedlots. Other types of *C. perfringens* cause enterotoxemia in calves, kids, piglets, and foals.

2.2.2. Paratuberculosis

Paratuberculosis is also known as *Johne's disease*. It is a chronic infectious disease of sheep, goats, and cattle. Infection occurs when the animal ingests feed and water contaminated by fecal material of infected animals. On some farms, it is not unusual for *Johne's disease* to become endemic. The causative agent for the disease is *Mycobacterium paratuberculosis*. It is very slow growing, non-motile, gram-positive, and acid-fast positive (red in color). The shape of *M. paratuberculosis* is short straight non-branching rods. The bacterial arrangement is either in singles or clumps. Special growth media and lengthy incubation periods are required.

2.2.3. Infectious Necrotic Hepatitis

Infectious necrotic hepatitis in sheep is also known as *black disease*. It is a fatal disease caused by *Clostridium novyi* Type B, which are anaerobic gram-positive rods. The bacteria form endospores and produce exotoxins. The transmission of *C. novyi* occurs via ingestion. The infection usually follows initial destruction in the liver tissues. This destruction is mainly caused by young liver flukes, as a predisposing factor for the disease. In this respect, the exotoxins that are produced by *C. novyi* will be absorbed and cause more tissue damage in the liver. The exotoxins can circulate via blood and induce hemorrhages in different organs. Older sheep are most affected with a high mortality rate.

2.3. Pigs

2.3.1. Pneumonia

Pneumonia of pigs is also called enzootic pneumonia of swine. It is caused by *Mycoplasma hyopneumoniae*, a pathogen that lacks a cell wall. The disease is contagious and easily spread among pig farms. Sometimes, it can become complicated with the presence of other bacteria.

2.3.2. Atrophic Rhinitis

Atrophic rhinitis is another infectious disease in swine. The infection is due to the bacterial species *Bordetella bronchiseptica*. This pathogen is an aerobic gram-negative short rods, and β -hemolytic on blood agar plates. It causes chronic and debilitating disease in pigs. Bronchopneumonia is very common, and in young pigs may cause twisted snout.

2.3.3. Erysipelas

Erysipelas is a disease caused by *Erysipelothrix rhusiopathiae*. This bacterial species is gram-positive rods or pleomorphic and filamentous pending on its two types of colonies

(smooth or rough). The bacteria are found on the mucous membrane of pigs and other animal species, and in contaminated soil and water. They can resist and survive adverse environmental conditions. The infection is transmitted via direct contact. The disease has more than one form; skin form also called diamond skin, the painful arthritic form, and the cardiac form.

2.3.4. Greasy Pig Disease

Greasy pig disease is caused by *Staphylococcus hyicus*, a facultative anaerobic gram-positive cocci, producing DNAase enzymes, and forming non-pigmented colonies on plated culture media. In addition, it is non-hemolytic on blood agar plates. The disease is characterized with the formation of exudative and crusty skin lesions that can cover most of the body. It is highly contagious and it is more severe in young pigs. The infection is mainly through wounds or abrasions in the skin due to the fact that *S. hyicus* is always found on the pig's skin.

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Bibliography

Brown, C., and C. Bolin. 2000. *Emerging Diseases of Animals*. ASM Press. Washington D.C. [Good reference book on bacterial diseases in animals].

Carter, G.R., and D.J. Wise. 2003. *Essentials of Veterinary Bacteriology and Mycology*. 6th edition. Iowa State University Press. [A comprehensive discussion on bacteria of veterinary importance].

Gyles, C.L., J.F. Prescott, J.G. Songer, and C.O. Thoen. 2004. *Pathogenesis of Bacterial Infections*. John Wiley and Sons. [A comprehensive discussion on bacterial diseases in animals].

Hirsh, D.C., N.J. MacLachlan, and R.L. Walker. 2004. *Veterinary Microbiology*. John Wiley and Sons. [This book provides good information on veterinary bacteriology].

Krauss, H., A. Weber, M. Appel, B. Enders, H.D. Isenberg, H.G. Schiefer, W. Slenczka, A.V. Graevenitz, and H. Zahner. 2003. *Zoonoses: Infectious Diseases Transmissible from Animals to Humans*. 3rd edition. ASM Press. Washington D.C. [The book is very informative and contains an excellent section on bacterial zoonoses].

Songer, J.G. 2004. *Veterinary Microbiology: Bacterial and Fungal Agents of Animal Disease*. Saunders. [A comprehensive discussion on bacteria of veterinary importance].

Biographical Sketch

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