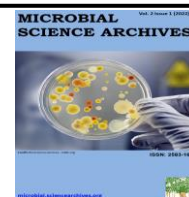




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Role of some microbes and fungal species to treat different infections caused by other microorganisms

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Abstract

Microbes are infectious agents that are invisible to the naked eye and are found all over the world. Some of them cause sickness in humans. Bacteria, fungi, viruses, prions, and protozoa are the different types. Microscopic parasites are also included. The microbiology laboratory's diagnosis of infection serves two major purposes: clinical and epidemiological. Antibiotics function by reducing the growth of the infecting organism and are used to treat infectious diseases both therapeutically and prophylactically. Some are 'broad spectrum,' which means they function against a wide range of pathogenic bacteria, while others are more specific. Despite a large number of antibiotics available, many infecting and disease-causing bacteria remain resistant to them. Many diseases of the developing world fall into this group. Evidence for a protective effect Treatment of normal animals with antibiotics reduces or removes their commensal bacteria and this allows pathogens to infect mucous surfaces more easily. In humans, after treatment with antibiotics for various diseases, secondary infections arise, e.g. oral and vaginal thrush due to *Candida albicans*, pseudomembranous colitis due to *Clostridium difficile*, and nasal infections with *Staphylococcus aureus*.

Keywords Microbes, Laboratory's diagnosis, Disease-causing bacteria, Secondary infections

Introduction

Microbes are microscopic organisms that can't be seen with the naked eye. Bacteria, fungi, viruses, prions, and protozoa are the different types of microorganisms. The group also includes macroscopic parasites. Germs are found everywhere in nature, whether as free-living creatures in the environment or as harmful microbes on/in plants, animals, and humans (causing diseases). While certain bacteria are restricted to a single host, the majority of microorganisms in nature can live on/in a variety of hosts. Plant germs do not cause disease in people, while animal bacteria can (so-called zoonotic diseases) cause illness in humans (Baron et al., 2013). Colonization occurs when a microorganism comes into contact with a new host and begins to multiply. No sickness will emerge if the microbe maintains a healthy relationship with the host.

Infectious diseases, on the other hand, are caused by microbes that cause injury and sickness (infection). Primary pathogenic microorganisms are bacteria that normally cause disease in a vulnerable host. Opportunistic pathogens are microbes that dwell in the normal flora of humans or in the environment and do not cause disease in otherwise healthy hosts (can cause disease in an immunocompromised host). Contamination occurs when we come into contact with atypical bacteria on our skin or non-living surfaces (Brooks, 2012).

Asymptomatic or symptomatic infection is possible. Microbes can be shed from an infected host during asymptomatic infections, as well as during the incubation period in symptomatic infections; the host is infectious but may not recognize it. Microbes can remain in the host for a long period after infection and then be expelled, even if the individual is clinically

healthy. This is known as a "carrier condition," and such people are known as "carriers" (Brown, 2014).

Endogenous infection occurs when the infection is caused by bacteria that are part of a person's normal flora; exogenous infection occurs when the infection is caused by microbes that are not part of that person's normal flora. Microbes can spread from one host to another by a variety of routes, including air, water, food, live vectors like mosquitos, indirect contact with infected things or surfaces, or direct contact between hosts, such as the hands of healthcare workers (HCW) (Damani, 2012).

A germ must first enter the human body (portal of entry) to produce an infectious disease, either through the respiratory, gastrointestinal, or genitourinary tracts or through damaged or even undamaged skin. The germ multiplies at the point of introduction, then enters the tissue and occasionally blood through mucous membranes. The bacteria can travel throughout the body and into any sensitive organ once it enters the bloodstream (Diekema & Pfaller, 2015). Microbes depart the body (portal of exit) after multiplication and seek a new host through respiratory, gastrointestinal, or genitourinary discharges. Insect vectors that feed on human blood are used to transmit some pathogens. A clinical diagnosis requires knowledge of the disease's progression. It's also crucial for ordering the right samples for microbiological testing and taking the proper precautions to prevent the spread of microorganisms. Recognition of who might become ill as a result of a certain bacterium (susceptible host) aids in disease prevention (Diekema & Saubolle, 2011).

There are three major areas where interactions between microorganisms affect the production of infectious diseases. Firstly, the indigenous microbial flora (commensal microorganisms) on some mucous surfaces have a strong protective function against potential invaders. Secondly, some pathogenic microbes can potentiate or exacerbate the effect of others. Thirdly, microbes that are unable to cause significant disease alone can combine with other similar organisms to cause harmful, even fatal, infections. I shall take each area in turn and describe, with examples, the evidence for the occurrence of the phenomena before discussing the possible mechanisms concerned (Castmeier et al., 2006).

Antibiotic production

Fleming discovered the amazing antibacterial capabilities of penicillin, an excreted metabolite or antibiotic from the *Penicillium* fungus, more than 50 years ago. Selman Waksman coined the term antibiotic in 1941 to describe "a chemical compound obtained

from microbes capable of suppressing growth, and even eliminating other germs in dilute solutions."

Antibiotics are used therapeutically and at times prophylactically in the control of infectious diseases and act by inhibiting the growth of the infecting organism. Some are effective against a wide range of infectious organisms and are known as 'broad-spectrum, whereas others are more specific. Although the range of antibiotic therapy is prodigious, there are still, as yet no effective antibiotics for many infecting and disease-producing microorganisms. In particular, many diseases of the developing world fall into this group. Economies of scale usually allow industrialized countries to produce antibiotics for broad markets at a lower cost. As a result, in these countries, the majority of research on antibiotics and related pharmaceutical goods such as vaccines is likely to focus on diseases that occur in these industrialized areas rather than those that occur in poor countries, where the greatest need exists (Chauhan et al., 2015)

Antibiotics are a heterogeneous group of biologically active molecules with different structures and modes of action (Vandamme, 1984). Apart from their well-documented pharmaceutical uses, antibiotics are increasingly involved in other ways and, indeed, non-pharmaceutical uses now account for a large proportion of bulk sales of antibiotics. The well-documented use of antibiotics in animal feeds to boost carcass yields has been widely criticized and undoubtedly this promotes the dissemination of antibiotic-resistant bacteria.

Antibiotics such as blasticidin S are used to combat plant pathogenic bacteria, etc. Over 5000 different antibiotics have been isolated from cultures of Gram-positive and gram-negative bacteria and of filamentous fungi although only about 100 of these have been commercially used to treat human, animal, and plant diseases. The genus *Streptomyces* is responsible for the formation of more than 60% of known antibiotics (Berdy, 1974), while a further 15% are made by members of the related actinomycetes: *Micromonospora*, *Actinomadura*, *Actinoplanes*, *Nocardia*, *Streptosporangium*, *Streptoverticillum* and *Thermoactinomyces* (Martin, 1981). Many medically useful antibiotics are produced by members of the genus *Bacillus*. The classical β -lactam antibiotics, penicillin, and cephalosporin, are synthesized by the filamentous fungi *Penicillium* and *Cephalosporium*, but can also be produced by some actinomycetes and other bacteria. Thus, almost all commercially useful antibiotics are produced by three groups of microorganisms; *Streptomyces*, *Bacillus*, and the filamentous fungi.

The protective effect of commensal microorganisms on mucous surface

Some mucous surfaces, such as the upper respiratory tract, the buccal cavity, the lower bowel, the endocervix, and the vagina, abound with commensal microorganisms. Others, for example the alveoli, the upper intestine, the urethra, and uterus, are devoid or relatively free of indigenous flora. When present, commensal microbes appear to have a strong protective effect against infection. In passing, it should be noted that the skin has a commensal population that protects by processes similar to those about to be described for mucous surfaces (Mims, 1976). However, because of the overwhelming influence of the mechanical strength of the skin, the commensal microbes are much less important in overall protection against infection than for the mucous surfaces and consequently, their effects on the skin have been studied less. For these reasons, only commensal protection of mucous surfaces is discussed here.

Evidence for a protective effect Treatment of normal animals with antibiotics reduces or removes their commensal bacteria and this allows pathogens to infect mucous surfaces more easily. In humans, after treatment with antibiotics for various diseases, secondary infections arise, e.g. oral and vaginal thrush due to *Candida albicans* (Odds, 1979), pseudomembranous colitis due to *Clostridium difficile* (Rolfe, 1981), and nasal infections with *Staphylococcus aureus* (Wannamaker I., 1980). Experimentally, treatment of laboratory animals with antibiotics has enhanced subsequent enteric infections with *C. albicans*, *Vibrio cholerae*, *Shigella* spp., and salmonellae (Savage, 1972). Mucosal infection of gnotobiotic animals with pathogens is reduced by mixing with the whole flora of normal animals or members of it. Examples of such experiments using gnotobiotic mice are; the inhibition of intestinal infection by the C25 strain of *Escherichia coli* and its translocation to the mesenteric lymph gland by the normal flora of SPF mice (Berg & Owens, 1979); the inhibition of intestinal infection with *Shigella* spp. by components of normal human intestinal flora (Maier & Hentges, 1972); and the reduction of alimentary tract candidiasis by *E. coli* (Nishikawa *et al.*, 1969). Newly hatched chickens have been protected from infection with food poisoning salmonellas by oral administration of the caecal contents of adult birds or anaerobic cultures of them (Barnes *et al.*, 1980). The protective caecal material contained lactobacilli, coliforms, faecal streptococci, and anaerobes but attempts to protect with lactobacilli alone or mixed with various anaerobes failed (Barnes *et al.*, 1980).

Less relevant than the above experiments with animals but offering supporting evidence for a protective effect of commensal microbes are the results of mixed cultures

in vitro involving pathogens and members of the mucosal flora. For example, the multiplication in vitro of *Pseudomonas aeruginosa*, various enterobacteria, and *Shigella flexneri* was inhibited by normal intestinal bacteria (Hentges & Maier, 1970; Levison, 1973). Also, the growth of gonococci in vitro was reduced by aerobic and facultatively anaerobic members of human endocervical flora in one study (Saigh *et al.*, 1978) and by strict anaerobes in another (Morin *et al.*, 1980). *Cl. difficile* was inhibited in vitro by strains of six bacterial species present in human gut flora particularly lactobacilli and group D enterococci (Rolfe *et al.*, 1981).

The mechanisms of protection Production of low oxygen tension, competition for nutrients, limiting adherence by the occupation of mucosal space, and formation of inhibitors all probably contribute to protection against pathogens, but the evidence is often circumstantial rather than solid. Usage of oxygen by commensals can produce anaerobic microenvironments not only in sites like the lower bowel but in oxygenated areas such as the teeth and gums (Savage, 1977). In these anaerobic environments, both commensal and pathogenic anaerobes (clostridia, *Bacteroides* spp., and *spirochaetes*) can flourish, but pathogens requiring oxygen for significant growth would be restricted.

Conclusion

Antibiotics work by limiting the growth of the infecting organism and are used both therapeutically and prophylactically in the treatment of infectious disorders. Some are 'broad spectrum,' meaning they work against a wide range of pathogenic germs, while others are more particular. Despite the vast array of antibiotics available, there are still no effective antibiotics for many infecting and disease-causing microbes. In particular, many diseases of the developing world fall into this group. Experimentally, treatment of laboratory animals with antibiotics has enhanced subsequent enteric infections with *C. albicans*, *Vibrio cholerae*, *Shigella* spp., and salmonellae. Mucosal infection of gnotobiotic animals with pathogens is reduced by mixing with the whole flora of normal animals or members of it.

Conflict of Interest

The author hereby declares no conflict of interest.

Consent for publication

The author declares that the work has consent for publication.

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