

# Using probiotics to prevent antibiotic resistance



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Probiotics are live microorganisms that are thought to have health benefits. Probiotics consist of “ healthy” bacteria and some types of yeast. Common probiotic bacteria include strains of *Lactobacillus* and *Bifidobacterium* . Some yeast are also considered to be probiotics like *Saccharomyces boulardii* (“ Probiotics: In Depth”). Foods and dietary supplements are products typically sold that contain probiotics. Many microorganisms help the body function properly to maintain a healthy lifestyle, and the human body naturally houses many of these bacteria. The naturally occurring bacteria in the human intestines, for example, help with food digestion, destroying disease-causing microorganisms, and producing vitamins. The majority of helpful bacteria for humans live in the intestines or gut.

Many of the probiotic products that can be purchased are the same or similar to the body’s natural bacteria. There are numerous studies that discuss the possible benefits of using probiotics to treat health issues including: digestive disorders, antibiotic-associated diarrhea, irritable bowel syndrome, inflammatory bowel disease, allergic disorders such as atopic dermatitis and allergic rhinitis, tooth decay, periodontal disease, colic in infants, liver disease, common colds, and prevention of necrotizing enterocolitis in very low birth weight infants (“ Probiotics: In Depth”). Considering every individual has a unique gut microflora, it is difficult to determine which probiotic will be beneficial or not. The benefits of what each bacteria strain can offer to the human body are still unknown. There are still many unanswered questions concerning probiotics; however, there is some evidence supporting their benefits. It is still difficult to determine their exact impact though.

There has been research supporting the use of probiotics to combat antibiotic resistance. The concept of using probiotics in general has been developing over past few decades. Although the ideas show some promise, the central theories to be tested and the tools necessary to test them are lacking (Blaser). Antibiotics are antimicrobial drugs that fight infections caused by bacteria in humans and animals, yet they can only fight off certain infections. Antibiotics fight against infections by killing bacteria or making it hard for the bacteria to grow and reproduce. Antibiotic resistance happens when bacteria develop the ability to defeat the antibiotic drug that was designed to kill them. Bacteria will continue to grow and multiply when they become resistant to antibiotics (“ The Development Of Antibiotic Resistance Bacteria”). If a person becomes infected with certain bacterial infections and that bacteria becomes resistant to the prescribed antibiotic drug, the infected person will have to try a different antibiotic. In some cases, people can become completely antibiotic resistant and must seek alternative medical treatments to treat infections. In the United States, the CDC estimates that more than two million people every year become ill with antibiotic-resistant infections, and more than 23, 000 people die each year from it (“ CDC. Gov”). Taking antibiotics is the one of the most important factors attributing to the antibiotic resistance epidemic around the world. Being one of the most overly prescribed drugs in human medicine, antibiotic resistance is extremely common. A large majority of antibiotics prescribed by doctors are not even necessary, like for the common cold. Taking antibiotics when it is not necessary increases the chances of antibiotic resistance.

Many things can contribute to antibiotic resistance including misuse or overuse. Humans can also become antibiotic resistant after consuming animals that have previously been treated with antibiotics. Antibiotics are used in animals to prevent, control, and treat disease, and to promote growth of food-producing animals (“ CDC. Gov”). Antibiotics are important for treating infections, yet the use of antibiotics can lead to antibiotic-resistant infections in people and animals. Antibiotic-resistant bacteria found in our food can cause infections in humans after consumption. The majority of bacteria will be killed off after taking antibiotics, but the resistant bacteria will be able to survive. This is true in both humans and animals. Resistant bacteria from meat animals can survive and infect humans when they are consumed (“ Antibiotic Resistance and Food Are Connected”). Staying healthy is vital to our own protection against antibiotic use. Also, it is important to be wary of the food we consume. Bacteria will continue to find ways to resist the antibiotics that are already developed; therefore, it is best to prevent an infection from initially happening (“ Antibiotic Resistance and Food Are Connected”).

Antibiotic-resistant bacteria can be life threatening and expensive to treat, since they are difficult to kill off. Using antibiotics as prescribed is important, as well as, being aware of overuse of antibiotics. Preventing infections is one of the most efficient ways to prevent antibiotic resistance. Maintaining a healthy gut microflora creates a defense against dangerous, pathogenic bacteria. Ingesting probiotics could offer benefits by maintaining a healthy balance between the friendly and pathogenic bacteria (Wheddon). They provide a natural means to improve intestinal health and immune response.

Several people experience antibiotic-associated diarrhea, and some studies have shown that probiotics can prevent that as well.

The medical field and agriculture industry both use probiotics today.

Probiotics are becoming a popular substitute for antibiotics, especially in the agriculture industry. This is because of the stricter standards our country places on meats. In an attempt to control antibiotic resistance, many countries are attempting to regulate the use of antibiotics in animals that will be consumed. However, some countries do not even regulate antibiotic use in animals, nor do they require veterinary prescriptions for animal antibiotics. In the study “ Nothing Fishy about Probiotics”, researchers at Washington State University and the University of Idaho developed a probiotic strain that prevents disease in fish. By studying the natural probiotics found in the digestive tracts of fish, they developed a probiotic strain specifically to benefit the fish. The research focused on reducing antibiotic resistance in the fish. The study found that by improving animal health reduces the need for antibiotics, and the use of probiotics was cheaper than antibiotics. The probiotics reduced the need for antibiotics by keeping the fish healthier, as a result, those who consume fish would also benefit because of the antibiotic-free fish. The use of probiotics in the fish can be used as a preventative measure against diseases delivering cost efficiencies to the fish industries. Consumers, producers and animals all benefitted (“ Nothing Fishy About Probiotics | USDA”).

In the study “ Probiotics Protect Poultry from Pathogens”, researchers tested probiotic’s ability to out compete bad bacteria strains in a laboratory. Then these probiotics were used to protect poultry against pathogens,

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*Campylobacter* and *Salmonella*. *Campylobacter* and *Salmonella* are two common causes of foodborne illness from poultry consumption. The goal was to use probiotics to prevent pathogen infections from occurring in poultry by building up the good bacteria in intestinal tracts before they are exposed to pathogens. The nonpathogenic bacteria are able to colonize the gut first; therefore, reducing the chances of pathogenic bacteria infecting the intestines. They have managed to create a starter culture that can be sprayed over newborn chicks that initially prevents the growth of *Salmonella* and *Campylobacter*. It is still waiting on approval from the FDA. The researchers are now studying the use of probiotics to outcompete pathogens in vitro. They have had some success, yet one issue was that the cultures utilized were undefined. The initial culture created was a combination of 29 different organisms ("Probiotics Protect Poultry from Pathogens"). Many studies have had the same unanswered question: what types of probiotic strains are the best, and what is the correct amount that should be consumed. Researchers have yet to discover what abilities differing strains of probiotic bacteria have. They also do not know how much is healthy to consume to receive optimal benefits. The researchers from "Probiotics Protect Poultry from Pathogens" have been working on tests to identify the best probiotics by plating individual microbes and examining their ability to fight off potentially harmful microflora. They hope to create a cheap strain that can be grown with cheap media. Producing probiotics is a lot cheaper than producing antibiotics. This would be beneficial to those who raise animals for food and those who consume meat. The probiotics could save producers from losing money to antibiotics, and it could potentially save consumers from eating meat with possible antibiotic resistant bacteria or

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other harmful pathogens. If probiotics can prevent any infectious pathogens, the need for antibiotics will be reduced therefore reducing antibiotic resistance.

One issue with using probiotics along with antibiotics is that probiotic bacteria strains could gain antibiotic resistant genes. The study "Detection of Antibiotic Resistance in Probiotics of Dietary Supplements" found that the use of probiotic bacteria combined with antibiotic use or misuse can, overtime, establish a "reservoir" of antibiotic resistant genes in probiotic bacteria. Probiotics can help restore the gut microflora while taking antibiotics; however, there is the threat that resistant genes can be transferred to the pathogenic bacteria (Wong). The study identified, "while the detection of antibiotic resistance in probiotic strains from food and biological sources have intensified, such reports from dietary supplements have remained somewhat elusive. This is surprising considering the fact that probiotic dietary supplements contain high amount and often a heterogenous population of probiotic bacteria both of which, are conditions that encourage the trafficking of resistant genes. Therefore, we hypothesize that antibiotic resistant probiotics may be present in dietary supplements" (Wong). This study indicates that probiotic bacteria strains in commercially sold dietary supplements have the ability to carry antibiotic-resistant genes. Probiotics have the ability to take on the characteristics of those bacteria that are antibiotic-resistant which would be more detrimental than beneficial to the host. Antibiotic resistance genes can be vertically transferred from one generation to another. Microbes are able to conduct horizontal gene transfer through the use of mobile genetic elements, and, in the human

body, the gastrointestinal tract is a prime candidate for conducting studies on horizontal gene transfer (Imperial).

Pharmaceutical companies have no motivational means to create new antibiotics due to the low market profit, yet it is expensive to conduct the research necessary to create new antibiotics. Bacteria strains will forever continue to alter their genes creating new resistance to antibiotics, so new antibiotics will always be necessary. Probiotics are being studied as a possible preventative measure for infection over anything. Considering probiotic bacteria can take on antibiotic resistant genes while taking antibiotics for an infection, it is still questionable how beneficial they could be. Therefore, probiotics are best used as a preventative measure against infection. Within the past few years, there has been an increase in demand for natural methods as an alternative to prescription medications. Evidence shows that probiotics have the ability to increase the guts health which could increase the body's natural defense against possible infectious bacterium. The only issue with the increasing production of probiotics in dietary supplements, foods, and drinks is the risk of selling bacteria that contains antibiotic resistant genes. Probiotic supplements are not FDA approved, which could be a concern for consumers. One study does mention that, " by limiting the use of antibiotics, probiotic use may help decrease the rate of development of antibiotic-resistant strains secondary to widespread and rampant antibiotic use" (Imperial). Probiotics could offer some relief from the antibiotic resistant bacteria epidemic, yet it could also be a problem if probiotics came into contact with antibiotic resistant bacteria.



In the US, one must receive a prescription to get antibiotics, yet in other countries, they can be acquired via over the counter. When people can freely buy and take antibiotics, the chances of bacteria becoming antibiotic resistant increases significantly due to over usage. “ By limiting the use of antibiotics, probiotic use may help decrease the rate of development of antibiotic-resistant strains secondary to widespread and rampant antibiotic use” (Imperial). In 2015, the Obama administration released The National Action Plan for Combating Antibiotic-Resistant Bacteria. The plan came about because of the increase in drug resistant bacteria and our inability to treat the bacterial infections. The antibiotic resistance also threatens animal health, agriculture, and the economy (“ FACT SHEET: Obama Administration Releases National Action Plan to Combat Antibiotic-Resistant Bacteria”). The plan calls the for our Nation to challenge antibiotic resistance in order to potentially reduce the number of deaths each year.

“ The Action Plan outlines Federal activities over the next five years to enhance domestic and international capacity to prevent and contain outbreaks of antibiotic-resistant infections; maintain the efficacy of current and new antibiotics; and develop and deploy next-generation diagnostics, antibiotics, vaccines, and other therapeutics” (“ FACT SHEET: Obama Administration Releases National Action Plan to Combat Antibiotic-Resistant Bacteria”). In order for the plan to work, everyone, including “ individuals, groups, public and private sector partners, healthcare providers, healthcare leaders, veterinarians, agriculture industry leaders, manufacturers, policymakers, and patients”, must put in effort (FACT SHEET). The goal is to save the lives of thousands.

Using antibiotics wisely in both the healthcare and agricultural setting is necessary to slow down the increasing amounts of antibiotic resistance. The objectives of The National Action Plan for Combating Antibiotic-Resistant Bacteria include:

- “ Slow the Emergence of Resistant Bacteria and Prevent the Spread of Resistant Infections.
- Strengthen National One-Health Surveillance Efforts to Combat Resistance,
- Advance Development and Use of Rapid and Innovative Diagnostic Tests for Identification and Characterization of Resistant Bacteria.
- Accelerate Basic and Applied Research and Development for New Antibiotics, Other Therapeutics, and Vaccines.
- Improve International Collaboration and Capacities for Antibiotic Resistance Prevention, Surveillance, Control, and Antibiotic Research and Development.”

(“ FACT SHEET: Obama Administration Releases National Action Plan to Combat Antibiotic-Resistant Bacteria”)

Probiotics could potentially work as a therapeutic means to help reduce the antibiotic resistance problem. Clinical tests and studies have shown promising potential for probiotics as a way to increase one’s health and consequently improve the body’s ability to fight off pathogenic bacteria.

Antibiotics kill the good and bad bacteria in the body. Our bodies naturally house many microbes that work to keep us healthy and alive, yet taking or consuming antibiotics destroys the normal microbiota and risks bacteria

becoming antibiotic resistant (Reid). Probiotics have the ability to replenish the natural gastrointestinal tract microflora with nonpathogenic organisms (Rodgers). The overuse of antibiotics is a problem despite their ability to save lives. If antibiotics are overused, humans suffer from antibiotic resistance which could potentially be life threatening. When the body becomes antibiotic resistant, and an infection arises, it can be difficult or impossible to treat. Antibiotics are overused in the livestock we consume. They are also overused in treating infections (Reid). According to “ Probiotics to Prevent the Need For, And Augment the Use Of, Antibiotics”, there are three areas in which probiotics could act as aides to antibiotics: probiotics can decrease the risk of antibiotic-induced superinfections, secrete antibacterial substances that lower pathogenic bacterial populations in the body, making it easier for antibiotics to function, and by enhancing general immunity. The best preventative measure against antibiotic resistance is to stay healthy. Further research is necessary for using probiotics as an aid for antibiotic resistance.

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