Probiotics: Properties, Sources, Mechanisms, Types, Uses

Summary:

Probiotics are live microorganisms, often called "good" bacteria, which confer health benefits when consumed in adequate amounts. They are commonly found in fermented foods like yogurt, kefir, sauerkraut, and dietary supplements. The primary role of probiotics is to support the balance of gut microbiota, promoting a healthy digestive system.

Probiotics are widely used for a variety of health applications. They help restore gut bacteria's natural balance after disturbances, such as during or after antibiotic treatments. They are known to alleviate symptoms of irritable bowel syndrome (IBS), diarrhea, and constipation. Probiotics also have immunomodulatory effects, boosting the immune system and protecting against harmful pathogens.

Beyond gut health, emerging research suggests that probiotics may benefit mental health, through the gut-brain axis, potentially helping to reduce symptoms of anxiety and depression. There is also evidence to suggest that probiotics may contribute to skin health, supporting conditions like eczema or acne.

Despite their numerous benefits, the effectiveness of probiotics can vary depending on the strain used, and not all probiotic products are equal in quality. Consulting healthcare professionals before starting probiotic supplementation is recommended, particularly for individuals with underlying health conditions.

Learning Measures:

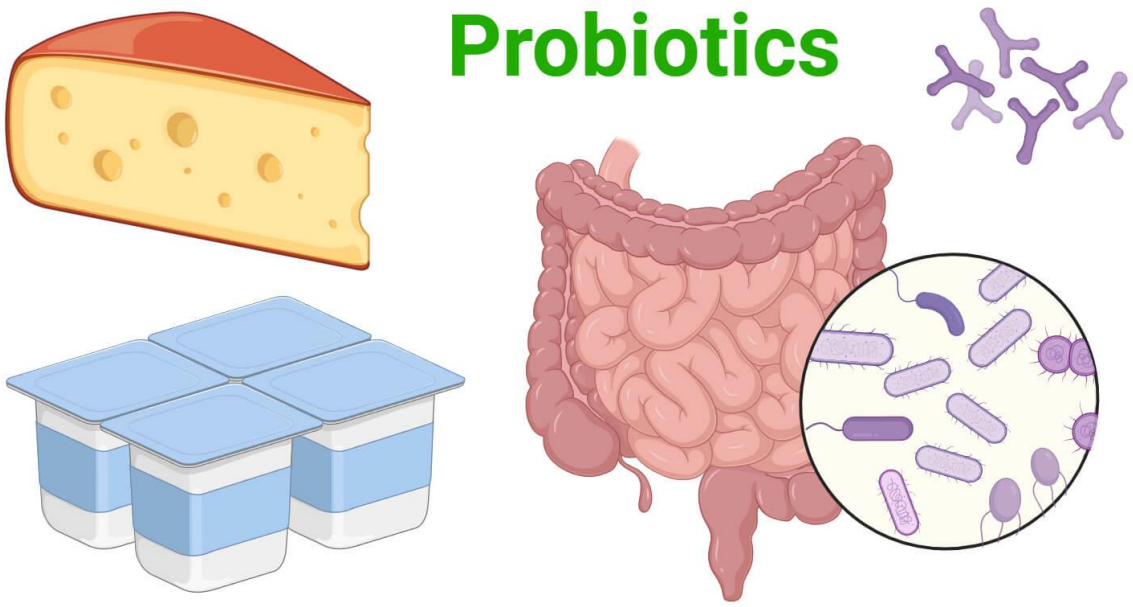
Learning Objective: To understand the definition, of various sources of probiotics for exploring the mechanisms of probiotics to maintain gut health, and evaluate the potential therapeutic applications of probiotics in managing health conditions.

Learning Outcomes: Identify common probiotic strains and the foods that contain them. Understand how probiotics contribute to digestive health and immune system regulation. Apply knowledge of probiotics to suggest appropriate applications for improving health and wellness.

Introduction:

Probiotics are live microorganisms (bacteria and yeasts) present in foods, such as yogurt and sauerkraut, and supplements, which are innocuous (not harmful) to our human health and host.

- It helps to improve the normal microflora present in the body. It is also available as a dietary supplement, such as a capsule or powder.
- Researchers have been researching probiotics and the relationship between normal microflora and disease. They have been researching novel and advanced probiotics with better benefits.
- Although probiotics are recommended in a healthy diet, they might lead to side effects, but it's rare. Additionally, probiotics are used as a form of medicine.



Probiotics

- Many organisms stay in the human body, such as the gastrointestinal tract, nose, and genitals, and have fruitful bodily properties and functions. Similarly, beneficial microorganisms like probiotics live in the body, which helps to control and enhance immunity against infectious pathogens, germs, or dirt particles.
- Although microorganisms are already present in the human body, there are also different ways to have probiotic products inside your body, like ingesting oral supplements that pass into our gastrointestinal tract and another one is applying topical products on your skin surface or to the mucous membrane inside your body cavities such as nose or genitals.

Interesting Videos:

for Mechanism of Probiotics-
https://www.youtube.com/watch?v=y2uk6TfK3dw

What Are Probiotics Good For? -
https://www.youtube.com/watch?app=desktop&v=H5qYgagDvcM

History of Probiotics

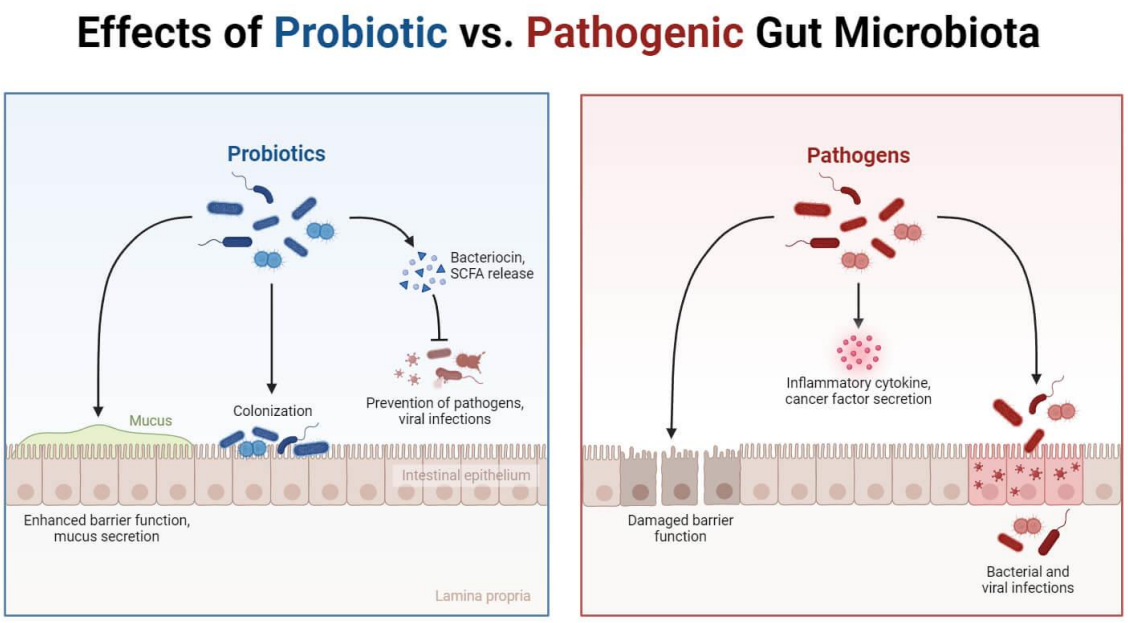
The term probiotic was obtained from the Greek word that means "for life."

- First, Lilly and Stillwell used the term probiotics in 1965, where he described an organism that secretes a substance that helps to stimulate the growth of another.
- The definition of probiotics changes with time and the development of knowledge.
- In 2001, Schrezenmeir and De Vrese described probiotics as "a preparation of or a product containing viable, defined microorganisms in sufficient numbers, which alter the microflora by implantation or colonization, in a compartment of the host and by that, exert beneficial effects on host health."
- In 2002, Food and Agriculture Organization (FAO) and World Health Organization (WHO) experts described probiotics as "live microorganisms, which when administered in adequate amount confer a health benefit on the host." It means if taken in proper amounts, it will provide health benefits to the host.
- In 2009, the World Gastroenterology Organisation (WGO) defined probiotics as living organisms that benefit consumer health when ingested in adequate concentration.

Properties of Probiotics

1. In probiotics preparation, they should be generally recognized as safe (GRAS).
2. It should possess a desirable antibiotic susceptibility testing-antibiogram profile.
3. They should be non-pathogenic, non-allergic, non-mutagenic, and not promote inflammation in individuals.
4. They should have resistance properties against bile, hydrochloric acid, and pancreatic juice.

5. They exhibit anti-carcinogenic activity.
6. They should have the strength to boost the immune system and decrease intestinal permeability.
7. They should be able to produce lactic acid.
8. They should survive in both acidic conditions of the stomach and alkaline conditions of the duodenum.
9. They should possess genetic stability and have no mechanism for transferring plasmids.
10. Strains must be capable of rapid multiplication with good viability and stability in the product during storage.
11. Probiotic foods must contain enough live probiotic cells to deliver health benefits to consumers, which provide better quality.
12. Probiotic strains must have good sensory properties.
13. They should originate from human origin.
14. They should possess metabolic activity.
15. For the bacteria to thrive in the colon, they must be able to attach themselves to and colonize the lining of the epithelial cells.



Effects of Probiotic vs. Pathogenic Gut Microbiota

Sources of Probiotics

The sources of probiotics are fermented food, unfermented food, and dietary supplements. Some of the sources are:

1. Sourdough bread
2. Yogurt
3. Tempeh, Natto, Kefir
4. Commercial pickles
5. Pickled onions, Pickled beets, Pickled cucumbers (if fermented but not canned)
6. Cultured buttermilk
7. Fermented fish (utonga-kupsu)
8. Apple cider vinegar
9. Kimchi (a Korean fermented cabbage dish)
10. Cheese and deli meats
11. Kombucha (a fermented tea)
12. Sauerkraut (fermented cabbage)
13. Miso (a fermented soybean-based paste)
14. Unfermented foods (milk, juices, smoothies, cereals, nutrition bars, and infant and toddler formulas)
15. Dietary supplements ((in capsules, powders, liquids)

Fermented Food

- Fermented food, obtained by the growth and metabolic activity of the cultural strains, contains live microorganisms.
- Fermented foods (such as yogurt, pickles, and so on) that contain organisms have health benefits. These organisms can survive for the entire duration of their shelf life in the product.
- The most common probiotics are Lactic acid bacteria (LAB) and Bifidobacterium.

Unfermented Foods

- Unfermented foods such as juices, nutrition bars, and so on also contain microorganisms, which can also be considered probiotics.

Dietary supplements

- Dietary supplements such as capsules, powders, and so on contain a variety of mixed stains. It is taken as a medicine also.
- One of the probiotic medicines is bifilac.
    - This medicine helps boost the immunity of the digestive tract, which enhances the ability to absorb nutrients from digested food.
    - It also controls diarrhea and helps to balance the gut microflora, such as bacteria and yeast.

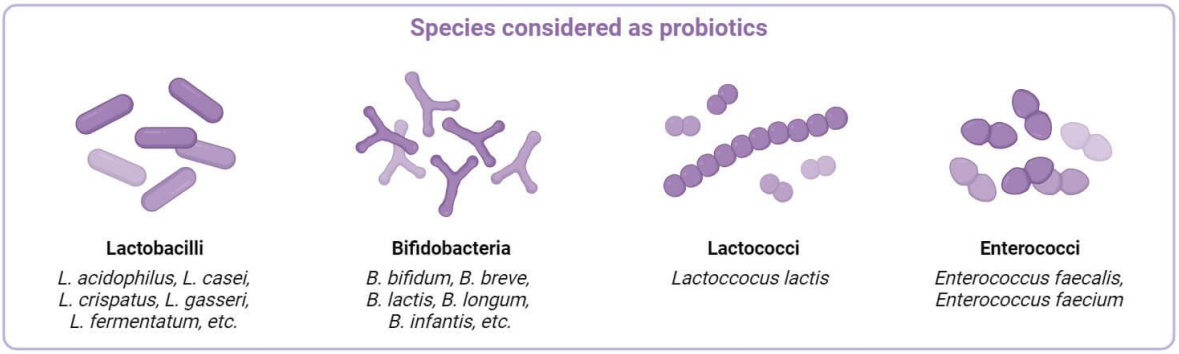
    - The ingredients used in the Bifilac capsule are from mixed cultures such as *Lactobacillus sporogenes*, *Streptococcus faecalis*, *Clostridium butyricum*, and *Bacillus mesentericus*.
    - You can find this product in the market in such a way as: Bifilac Capsule, Bifilac HP Capsule, Bifilac Dry Syrup – for Children, Bifilac Lozenges, and Bifilac Sachet.
- Probiotics can be measured in colony-forming units (CFU), indicating the number of viable cells.

What do probiotics do?

- Probiotics are food products that are present within our gut. It improves the properties of microflora and balances the gastrointestinal microbiome.
- It strengthens the body's natural defense mechanisms, promoting the growth of beneficial microorganisms and suppressing harmful bacteria.
- Probiotic gets attached to the intestinal mucosa. Metabolic by-products like acid, hydrogen peroxide, and bacteriocins such as lactocidin and acidophilin are the products that exhibit antibiotic properties and hinder the growth of a broad range of pathogens.
- Probiotics produce essential metabolites- beneficial by-products- that help us in a proper digestion process.
- Lactic acid bacteria hinder the growth of pathogenic microorganisms.
- It produces short-chain fatty acids such as acetic, propionic, butyric, lactic, and formic acids and reduces intestinal pH. It exhibits antimicrobial activity against yeasts, molds, and bacteria.
- During fermentation in the colon by the microflora, the short-chain fatty acid production helps prevent colorectal cancer.
- Probiotic helps to treat dysbiosis. Dysbiosis is the imbalance of the microbiome present in the gastrointestinal tract and gut that causes changes in functional and metabolic properties- leading to problems such as chronic diseases like IBD, IBS, diabetes, cancer, gut, vagina itching, skin, oral areas- bad breath, upset stomach, and diarrhea.
- Each microbe has a different role within the body. It might bear side effects for some people, but it's a relatively rare occurrence.
- Besides, it also helps to balance good and bad microflora that keep your body healthy and properly functioning.

Types of Probiotics and Microorganisms

Many microorganisms are involved in probiotics that show no harmful effect on human health, such as *Lactobacillus (The first and largest group of microorganisms), Bifidobacterium, Saccharomyces, Streptococcus, Enterococcus, Escherichia,* and *Bacillus.*



Probiotics and Microorganisms

The most common are:

1. Lactic acid bacteria such as *Lactobacillus*, *Streptococcus thermophilus,* and so on
2. *Bifidobacterium* sps.
3. *Sachharomyces boulardii*

a. Lactic acid bacteria

- Lactic acid bacteria, carbohydrate fermenters, are gram-positive, aerotolerant, non-spore-forming lactic acid-producing bacteria. The production of lactic acid is an essential product of fermentation.
- LAB is a group of bacteria that is essential for industrial purposes. Mainly, lactic acid bacteria as a dairy starter culture are applied in the dairy industry for dairy products such as milk powders, yogurt, soft-, semi-hard, hard cheese, and ice cream.
- Non-dairy products such as malt-based beverages and fruit juices are also available for lactose-intolerant people. The development of soy-based probiotic foods has prompted the market.
- Consumers can obtain probiotic LAB strains from both traditional fermented foods and supplements.
- These products provide an appropriate environment for the growth and survival of probiotics.

The most common probiotic LAB, such as *Lactobacillus* Sps., used in dairy products, are:

Lactobacillus rhamnosus, Lactobacillus paracasei, Lactobacillus casei, Lactobacillus helveticus, Lactobacillus iners, Lactobacillus

delbrueckii subsp. *delbrueckii, Lactobacillus johnsonii, Lactobacillus acidophilus, Lactobacillus plantarum, Lactobacillus jensenii, Lactobacillus crispatus, Lactobacillus gasseri, Lactobacillus pentosus, Lactobacillus salivarius, Lactobacillus brevis, Lactobacillus kefiri, Lactobacillus fermentum, Lactobacillus reuteri, Lactobacillus helveticus, L. cellobiosus, Lactobacillus curvatus.*

- *Streptococcus* sps include *Streptococcus thermophilus* and *S. salivarius* subsp. *Escherichia coli thermophilus.*
- Probiotics contain lactic acid bacteria (LAB) from genera such as *Streptococcus*, *Lactococcus, Enterococcus, Leuconostoc, Propionibacterium*, and *Pediococcus.*
- *Lactobacillus delbrueckii* subsp. *bulgaricus and Streptococcus thermophilus* = Used in milk fermentation and Important for dairy food products such as yogurt.
- *Lactobacillus rhamnosus* GG= For clinical purposes- beneficial for intestinal immunity
- *Lactobacilli species* = isolated from breast milk, meat, pineapple waste, and tomato juice
- *L. plantarum* and *L. fermentum= Plant derived LAB (*Plants Sources like papaya, yam, cassava, sugarcane, and taro leaves)
- *L. plantarum* = isolated from soybean, Turkish beverages (Boza), and fruit juices
- *L. plantarum* and *L. brevis*= isolated from dry sausage
- *L. buchneri* P2= obtained from pickle juice
- *Lactobacillus* spp. or *Leuconostoc* spp. = Isolated from Sauerkraut fermentation
- *Enterococcus* = obtained from fermented crustaceans and fishes
- *L. plantarum*, *L. pentosus,* and *L. paracasei* = isolated from green olives
- *L. mesenteroides* and *L. pentosus*= isolated from dark olives
- *L. gasseri* and *L. reuteri*= isolated from the stomach of adult humans.
- *Weissella cibaria*= isolated from kimchi, sauerkraut and pickles.

b. *Bifidobacterium*

The most common bifidobacteria species are *Bifidobacterium bifidum, Bifidobacterium breve, B. animalis subsp lactis* formerly, *B. lactis, Bifidobacterium longum, Bifidobacterium infantis,* and *Bifidobacterium adolescentis*.

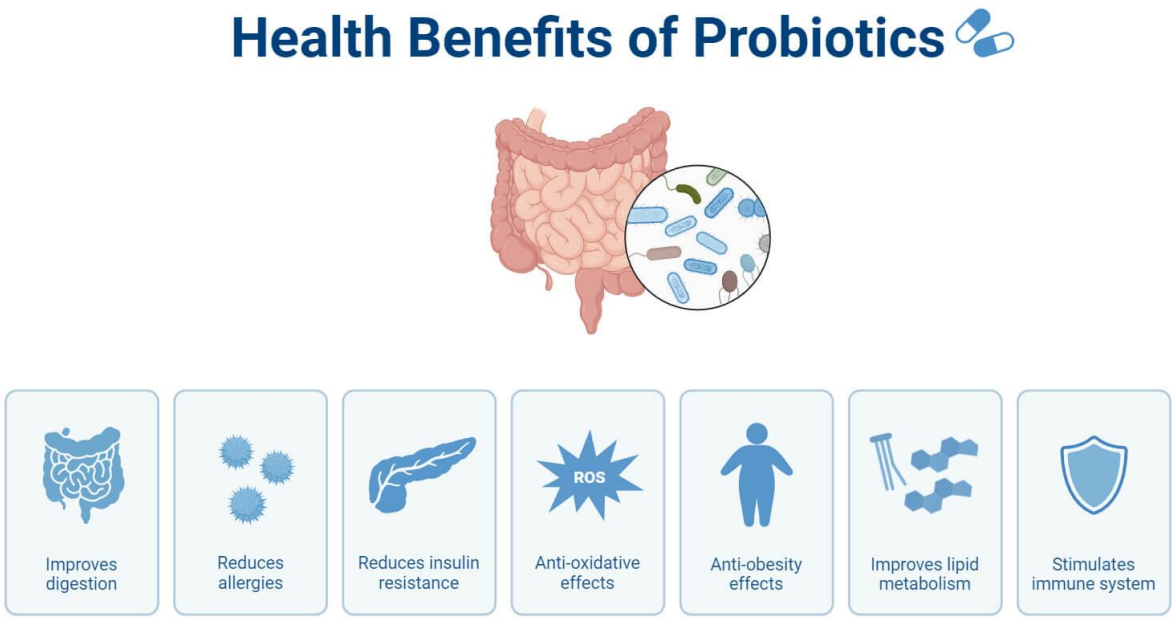
c. Yeasts

Yeasts (*Saccharomyces cerevisiae, Saccharomyces boulardii*)

Other probiotics are *Bacillus coagulan, Bacillus subtilis, and Bacillus clausii.*

Advantages / Uses of Probiotics

1. Health benefits
   - It helps to improve digestive health by the production of enzymes. Individuals who are lactose intolerant can benefit from the enzymes, such as β-galactosidase produced by the organism, which aids in breaking down or digesting lactose.
   - It helps to prevent antibiotic-resistant problems.
   - It helps to enhance immunity.
   - It helps to reduce gingivitis and decreases gum bleeding. Example: Probiotic *Lactobacillus reuteri*.
   - It helps to improve skin, vaginal health.
   - It helps to improve mental health conditions (relieve Stress and Anxiety).
   - It helps to Reduce the Risk of Developing *Clostridium difficile* Infection.
   - It helps to improve Ulcerative Colitis.
   - It helps to prevent food allergies.
   - It helps to treat diseases in infants.
   - It helps to lower blood pressure and fight against diabetes.



Health Benefits of Probiotics

2. *Lactobacillus* can be used as a food preservative, flavoring agent, and emulsifier.
3. *Lactobacillus* bacteria may lower "bad" cholesterol levels or total cholesterol, including LDL.
4. Consuming probiotic-rich food such as yogurt helps to improve bone, heart, and gastrointestinal health, reduce the risk of diabetes and colon cancer, and aid weight management.
5. *Bifidobacterium* infantis may benefit people suffering from problems like psoriasis and chronic fatigue syndrome.
6. Probiotics are essential for skin care health and help to strengthen the skin barrier, prevent and soothe acne, help to maintain skin pH levels, firm and clarify skin, and refine skin texture.

Risk of consuming Probiotics

Probiotics are generally considered safe for most people and rarely have few side effects. The "National Center for Complementary and Integrative Health Trusted Source" states that probiotics are generally safe, but those with weakened immunity systems or health issues may pose a risk.

- They might suffer infection, antibiotic resistance, and release of harmful substances.
- Some people may experience intestinal gas and bloating. If you're experiencing these side effects, this discomfort usually improves over time. You can try reducing the dosage or taking it every other day to alleviate these side effects.
- If you have any problems like intestinal damage or disease, HIV, cancer, a weakened immune system, or a higher number of bacteria in your intestines, then it's necessary to consult your doctor before using probiotics.
- If you are taking any medication or have medical issues, then it is essential to consult your doctor or health care provider before using any probiotic products.

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Questions and Answers: For Examination

Short Notes:

1. Probiotics: Definition and Benefits.

Probiotics are live microorganisms that provide health benefits when consumed in adequate amounts. They mainly consist of bacteria and yeast that promote gut health by balancing the microbiota. Common benefits include improved digestion, stronger immune function, and reduced symptoms of gastrointestinal disorders like irritable bowel syndrome (IBS). Probiotics also support mental health through the gut-brain connection.

2. Applications of Probiotics in Medicine and Health.

Probiotics have numerous applications in the treatment of digestive disorders like diarrhea, constipation, and inflammatory bowel diseases (IBD). They are used in managing antibiotic-associated diarrhea and in reducing the risk of infections in vulnerable populations. Probiotics are also being researched for their potential to support metabolic health, enhance skin conditions, and alleviate symptoms of anxiety and depression.

One-Line Questions and Answers:

Q1. What are probiotics?

Ans.- Probiotics are live microorganisms that offer health benefits when consumed in sufficient quantities.

Q2. How do probiotics benefit gut health?

Ans.- They restore the balance of good bacteria in the gut, improving digestion and reducing inflammation.

Q3. What is a common source of probiotics?
Ans.- Yogurt, kefir, and fermented foods like kimchi and sauerkraut are common sources.

Q4. Can probiotics help with antibiotic-associated diarrhea?
Ans.- Yes, probiotics can help restore gut balance and reduce the risk of diarrhea caused by antibiotics.

Q5. What is the role of probiotics in mental health?
Ans.- Probiotics may influence the gut-brain axis, potentially reducing symptoms of anxiety and depression.

Q6: **What are probiotics?**
Ans.- Probiotics are live microorganisms that provide health benefits when consumed in adequate amounts.

Q7: **How do probiotics benefit gut health?**
Ans.- Probiotics balance the gut microbiota, improving digestion and supporting the immune system.

Q8: **Can probiotics help with diarrhea?**
Ans.- Yes, certain probiotics can help reduce the duration and severity of diarrhea, especially antibiotic-associated diarrhea.

Q9: **Are probiotics useful for irritable bowel syndrome (IBS)?**
Ans.- Yes, some probiotics may alleviate IBS symptoms like bloating, gas, and abdominal discomfort.

Q10: **Do probiotics support immune function?**
Ans.- Yes, probiotics enhance the immune system by promoting the production of protective antibodies and stimulating immune cells.

Q11: **Can probiotics prevent urinary tract infections (UTIs)?**
Ans.- Probiotics may help prevent UTIs by maintaining a healthy balance of bacteria in the urinary tract.

Q12: **Are there any risks associated with probiotics?**
Ans.- For most people, probiotics are safe, but those with weakened immune systems should consult a doctor before use.

Q13: **Can probiotics help with mental health?**
Ans.- Some research suggests that probiotics may improve mood and reduce symptoms of anxiety and depression by influencing the gut-brain axis.

Q14: **Can probiotics be taken with antibiotics?**
Ans.- Yes, taking probiotics with antibiotics can help maintain gut flora balance and reduce the risk of antibiotic-associated diarrhea.

Q15: **Are all probiotics the same?**
Ans.- No, different strains of probiotics offer unique health benefits, so choosing the right strain for specific health issues is important.
Q16: **What is the most common probiotic species used in dairy products?**
Ans.- *Lactobacillus acidophilus* is the most common probiotic species used in dairy products like yogurt.

Q17: **How does *Bifidobacterium bifidum* benefit gut health?**
Ans.- *Bifidobacterium bifidum* helps in maintaining a healthy balance of gut bacteria and improving digestion.

Q18: **Which probiotic species is commonly used to reduce symptoms of irritable bowel syndrome (IBS)?**
Ans.- *Lactobacillus plantarum* is often used to reduce symptoms of irritable bowel syndrome (IBS).

Q19: What is the role of *Saccharomyces boulardii* in treating diarrhea?
Ans.- *Saccharomyces boulardii* is effective in treating both antibiotic-associated and traveler's diarrhea by restoring gut flora.

Q20: Can *Lactobacillus rhamnosus* be beneficial for women's health?
Ans.- Yes, *Lactobacillus rhamnosus* is often used to promote vaginal health and prevent urinary tract infections.