Primary and secondary metabolites are often used in industrial microbiology for the production of food, amino acids, and antibiotics.

Learning Objectives

- Describe how primary and secondary metabolites can be used in industrial microbiology to obtain amino acids, develop vaccines and antibiotics, and isolate chemicals for organic synthesis

Key Points

- Primary metabolites are considered essential to microorganisms for proper growth.
- Secondary metabolites do not play a role in growth, development, and reproduction, and are formed during the end or near the stationary phase of growth.
- These metabolites can be used in industrial microbiology to obtain amino acids, develop vaccines and antibiotics, and isolate chemicals necessary for organic synthesis.

Key Terms

- **bradycardia**: the slowing of the heartbeat to below average

Bacterial metabolism can be classified into three major categories: the kind of energy used for growth, the carbon source, and the electron donors used for growth. Pathogenic bacteria are capable of exhibiting various types of metabolism. Metabolites, the intermediates and products of metabolism, are typically characterized by small molecules...
with various functions. Metabolites can be categorized into both primary and secondary metabolites. These metabolites can be used in industrial microbiology to obtain amino acids, develop vaccines and antibiotics, and isolate chemicals necessary for organic synthesis.

**Primary Metabolites**

Primary metabolites are involved in growth, development, and reproduction of the organism. The primary metabolite is typically a key component in maintaining normal physiological processes; thus, it is often referred to as a central metabolite. Primary metabolites are typically formed during the growth phase as a result of energy metabolism, and are deemed essential for proper growth. Examples of primary metabolites include alcohols such as ethanol, lactic acid, and certain amino acids. Within the field of industrial microbiology, alcohol is one of the most common primary metabolites used for large-scale production. Specifically, alcohol is used for processes involving fermentation which produce products like beer and wine. Additionally, primary metabolites such as amino acids— including L-glutamate and L-lysine, which are commonly used as supplements— are isolated via the mass production of a specific bacterial species, *Corynebacteria glutamicum*. Another example of a primary metabolite commonly used in industrial microbiology includes citric acid. Citric acid, produced by *Aspergillus niger*, is one of the most widely used ingredients in food production. It is commonly used in pharmaceutical and cosmetic industries as well.

![Figure: Aspergillus niger](https://bio.libretexts.org/Bookshelves/Microbiology/Book%3A_Microbiology_(Boundless)/17%3A_Industrial_Microbiology/17.1…)

**Secondary Metabolites**

Secondary metabolites are typically organic compounds produced through the modification of primary metabolite synthases. Secondary metabolites do not play a role in growth, development, and reproduction like primary metabolites do, and are typically formed during the end or near the stationary phase of growth. Many of the identified secondary metabolites have a role in ecological function, including defense mechanism(s), by serving as antibiotics and by producing pigments. Examples of secondary metabolites with importance in industrial microbiology include atropine and antibiotics such as erythromycin and bacitracin. Atropine, derived from various plants, is a secondary metabolite with important use in the clinic. Atropine is a competitive antagonist for acetylcholine receptors, specifically those of the muscarinic type, which can be used in the treatment of bradycardia. Antibiotics such as erythromycin and bacitracin are also considered to be secondary metabolites. Erythromycin, derived from *Saccharopolyspora erythraea*, is a commonly...
used antibiotic with a wide antimicrobial spectrum. It is mass produced and commonly administered orally. Lastly, another example of an antibiotic which is classified as a secondary metabolite is bacitracin. Bacitracin, derived from organisms classified under *Bacillus subtilis*, is an antibiotic commonly used a topical drug. Bacitracin is synthesized in nature as a nonribosomal peptide synthetase that can synthesize peptides; however, it is used in the clinic as an antibiotic.

Figure: **Erythromycin tablets.** Erythromycin is an example of a secondary metabolite used as an antibiotic and mass produced within industrial microbiology.