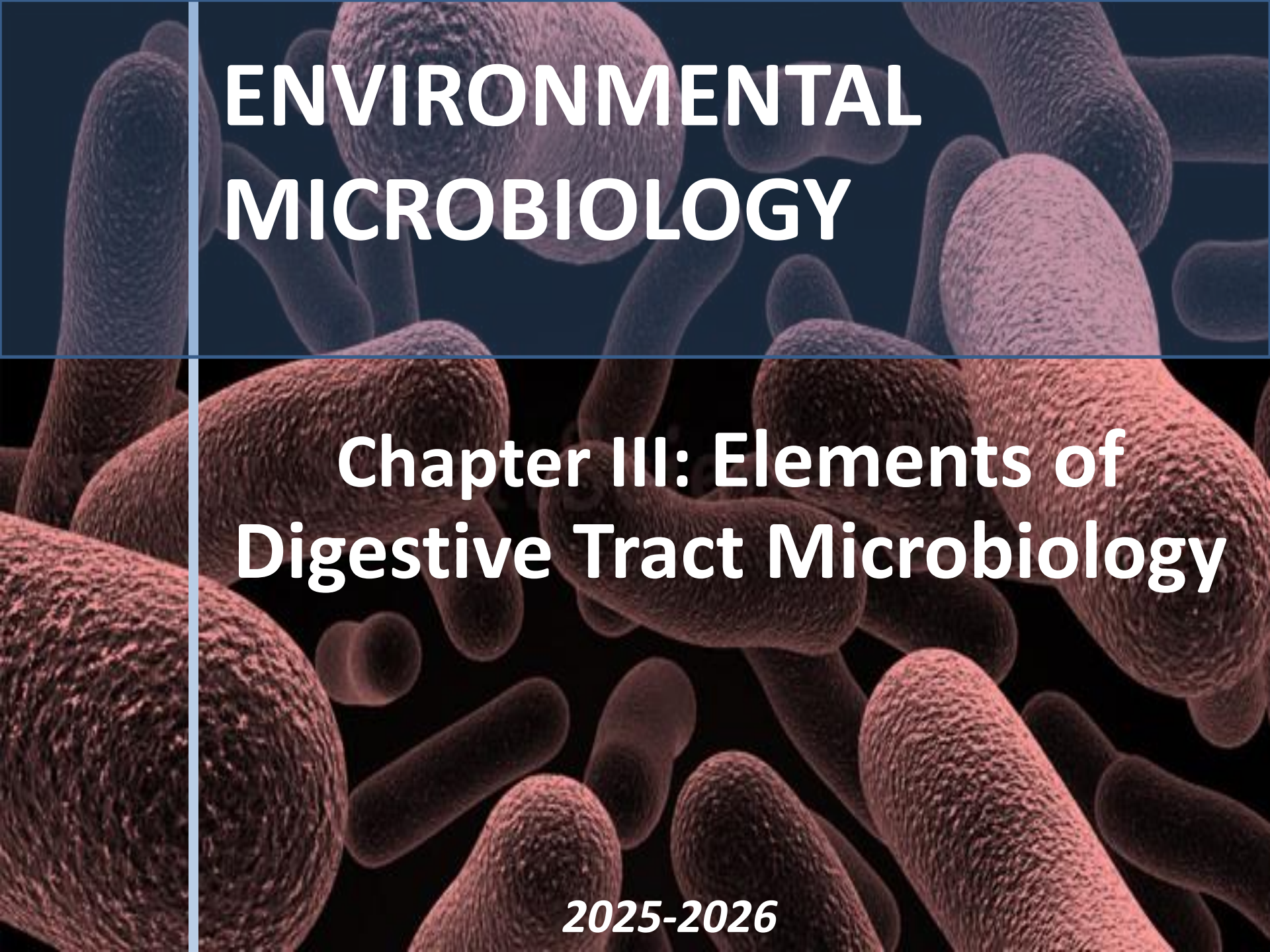


ENVIRONMENTAL MICROBIOLOGY

Chapter III: Elements of Digestive Tract Microbiology

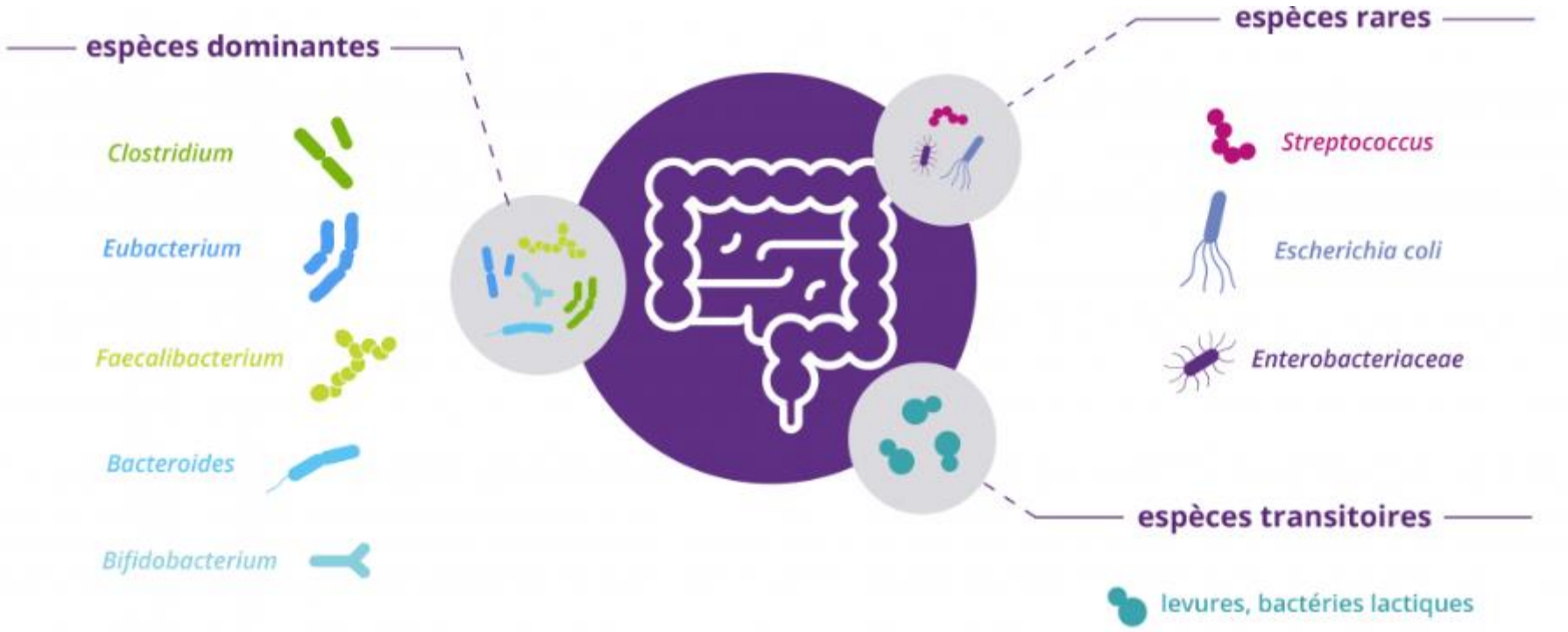
2025-2026

I. Human digestive microbiota

Digestive microbiota refers to all the microorganisms, such as bacteria, viruses, parasites, and non-pathogenic fungi, that colonize the different parts of the digestive tract. In humans, the intestinal microbiota is the densest microbial community in the body compared with other microbiota, such as those of the mouth, lungs, or vagina. It contains approximately 10^{12} to 10^{14} microorganisms. It is mainly located in the small intestine and the colon, where it is distributed between the intestinal lumen and the protective biofilm formed by the intestinal mucus lining the inner wall of the digestive tract.

I. Human digestive microbiota

The intestinal microbiota is specific to each individual, both in terms of composition and quantity. Among the approximately 160 bacterial species found on average in the microbiota of a healthy person, only about half are generally shared from one individual to another.



I. Human digestive microbiota

a. Composition

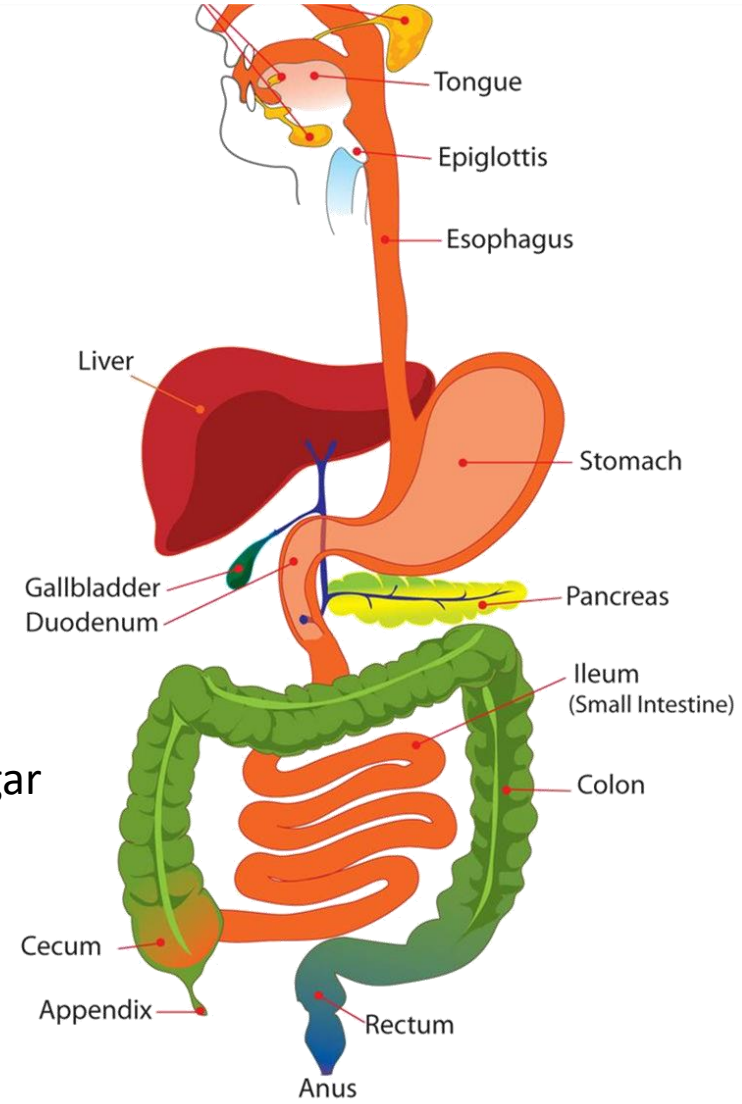
Oral Cavity

The oral cavity includes teeth, tongue, gingival crevices, buccal mucosa, palate, and saliva.

•Common genera include:

- *Streptococcus*
- *Actinomyces*
- *Veillonella*
- *Neisseria*
- *Haemophilus*
- *Prevotella*
- *Fusobacterium*

The oral microbiota contributes to biofilm formation, sugar metabolism, and resistance against external microorganisms.



I. Human digestive microbiota

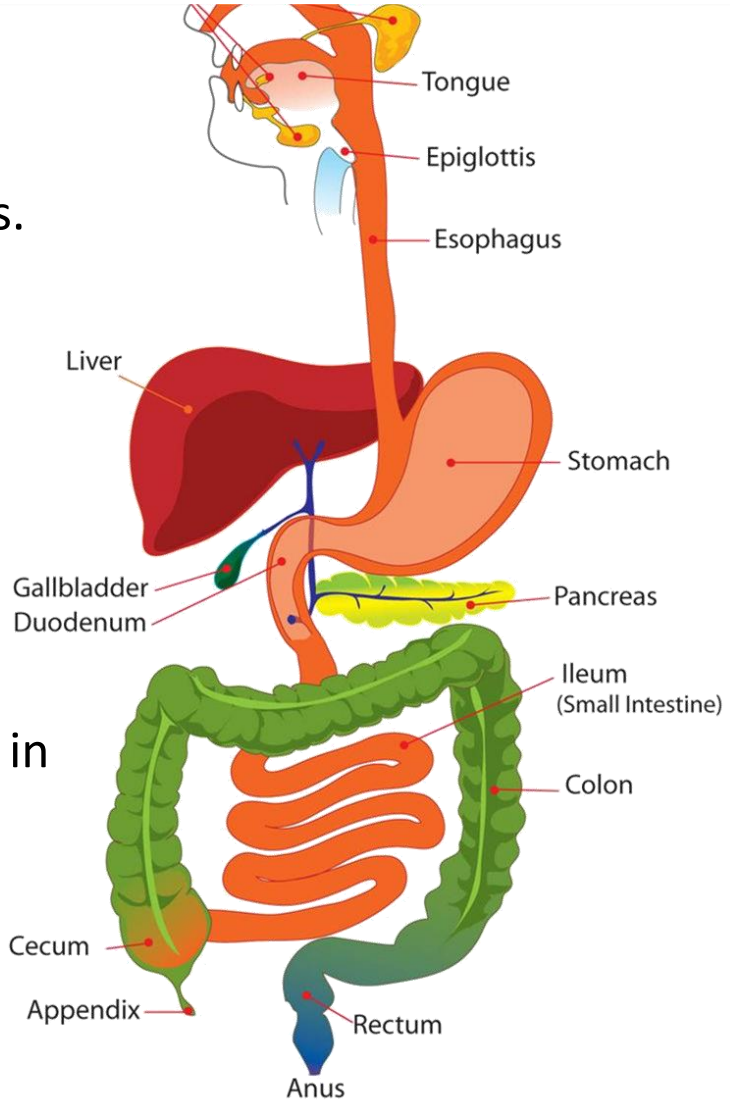
a. Composition

Pharynx and esophagus

- Mainly act as conduits.
- Their microbiota often resembles oral communities.
- Main roles: transient colonization and ecological competition.

Stomach

- Acidic, mechanically active environment.
- Low microbial biomass.
- Acid-tolerant or transient taxa may be present.
- *Helicobacter pylori* is a specialized gastric colonizer in infected individuals.
- The stomach acts mainly as a microbial filter.

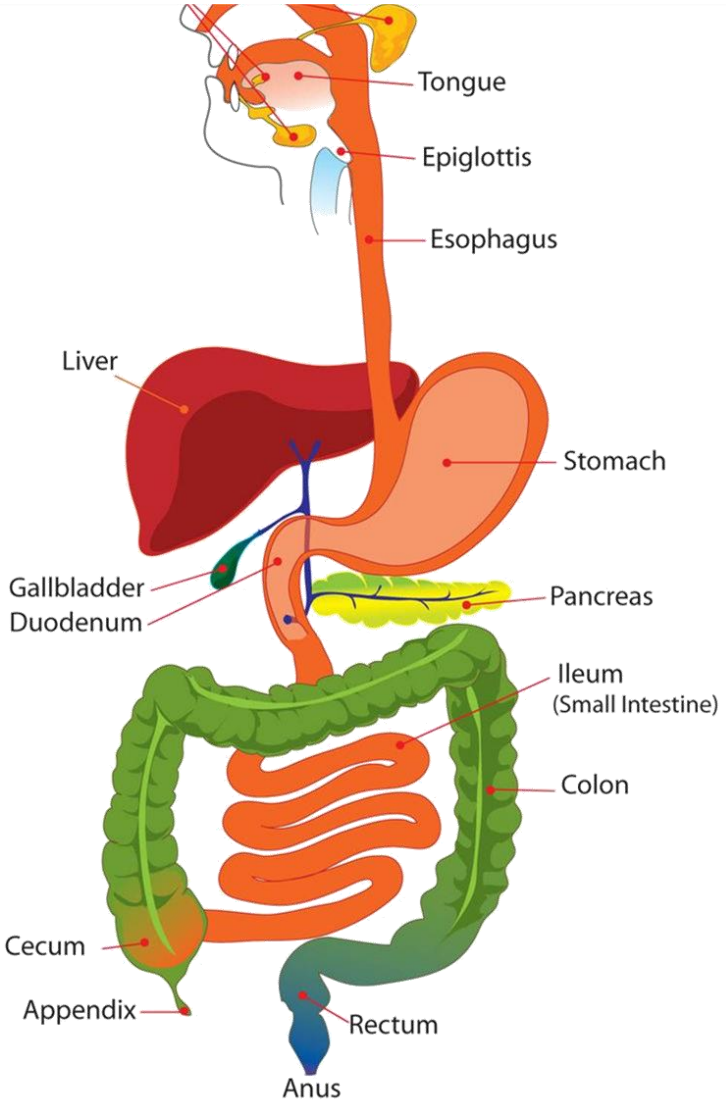


I. Human digestive microbiota

a. Composition

Small Intestine

- Major site of digestion and absorption.
- Exposed to pancreatic enzymes, bile salts, and continuous peristalsis.
- These conditions limit excessive bacterial growth.
- Duodenum and jejunum contain relatively low microbial densities.
- Common taxa include:
  - *Streptococcus*
  - *Lactobacillus*
  - *Enterococcus*
- The ileum is a transition zone between the small intestine and colon.

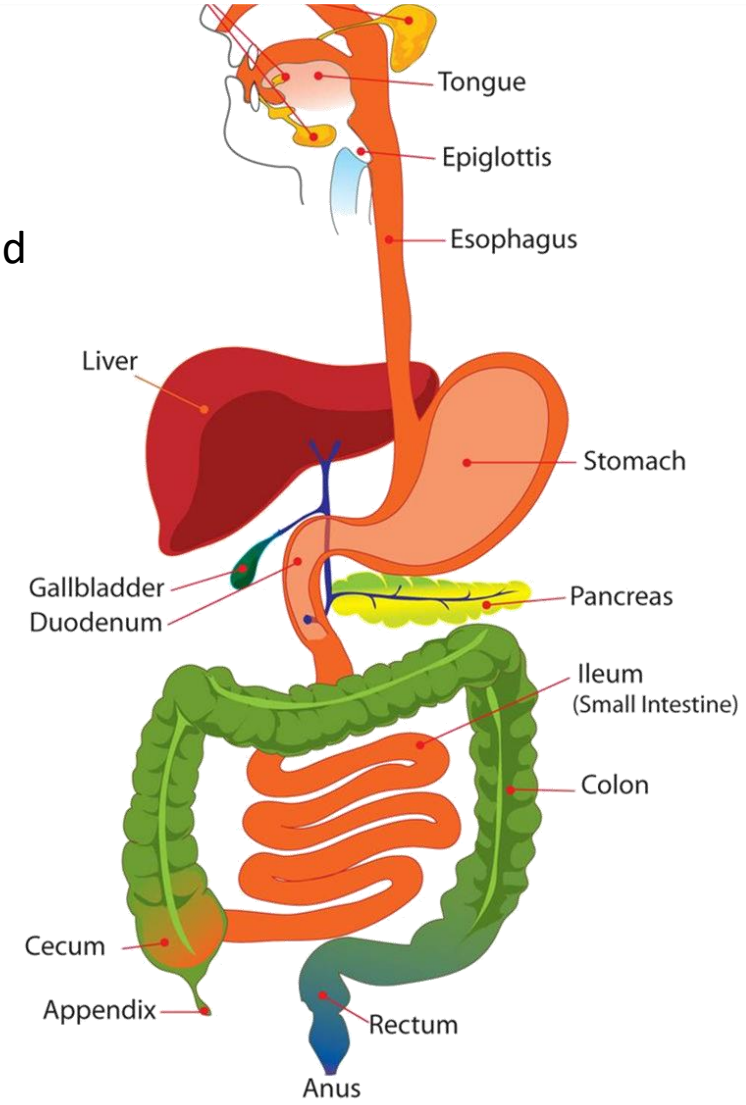


I. Human digestive microbiota

a. Composition

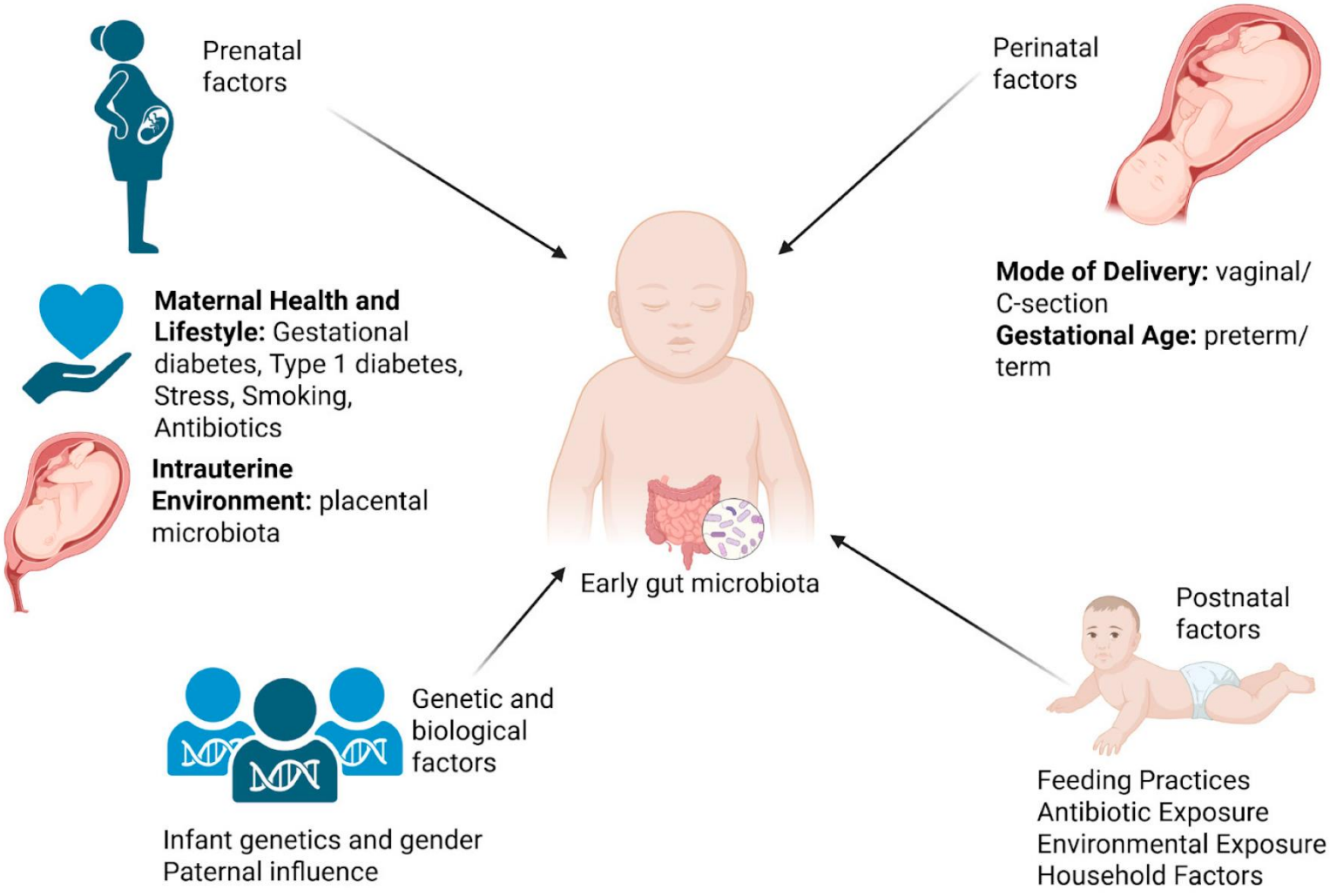
Large Intestine: Cecum and Colon

- The colon is the main site of dense microbial colonization.
- It has low oxygen tension, slow transit, mucus layers, and undigested residues.
- Dominant groups:
  - Bacillota/Firmicutes
  - Bacteroidota/Bacteroidetes
- Important genera:
  - *Bacteroides*
  - *Faecalibacterium*
  - *Roseburia*
  - *Ruminococcus*
  - *Blautia*
  - *Prevotella*
  - *Bifidobacterium*



I. Human digestive microbiota

b. Développement



Factors influencing the early gut microbiota **(Mogoş ety al., 2025)**

I. Human digestive microbiota

b. Développement

1. Fetal period

Lactobacillus and *Curvibacter* in amniotic and vaginal fluids

Bacillus, *Escherichia*, and *Shigella* in meconium

Bacteroides and *Faecalibacterium* in maternal feces

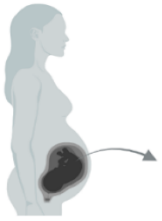
Streptococcus and *Prevotella* in maternal saliva

2. Delivery

Vaginal

Lactobacillus, *Prevotella*, *Bifidobacterium*, *Bacteroides*, *Lachnospiraceae*, *Escherichia coli*

C-section



Staphylococcus, *Corynebacterium*, *Enterococcaceae*, *Enterobacteriaceae*, *Propionibacterium*, *Clostridium perfringens*, *Escherichia coli*, Low *Bifidobacterium* and *Bacteroides*

3. Feeding mode

Breastfeeding

Staphylococcus, *Streptococcus*, *Bifidobacterium* spp. *Propionibacterium*, *Lactobacillus*

Formula-feeding

Elevated *Actinomyces*, *Prevotella*

Reduced *Bifidobacterium*

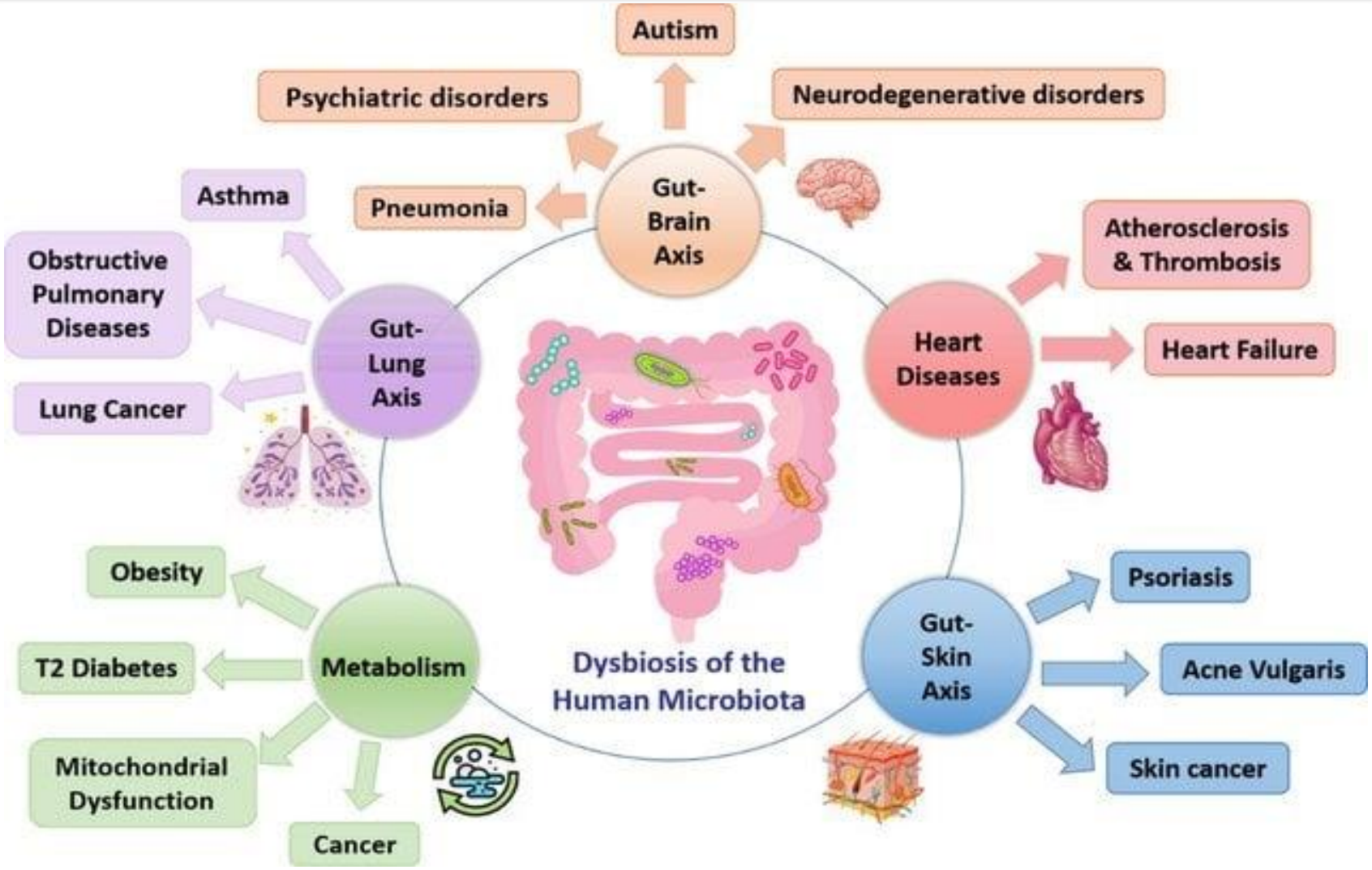
4. Introduction of solid food

Enterococci, *Enterobacteria*, *Clostridia*, *Bacteroides*, *Lachnospiraceae*, *Ruminococcaceae* spp.

Key stages of microbiota colonization and development in the first 1000 days of life. (Mogoş ety al., 2025)

I. Human digestive microbiota

Dysbiosis



Dysbiosis (_Gebrayel_et al., 2025)

I. Human digestive microbiota

Nutritional and Metabolic Roles

The digestive microbiota contributes to:

•Production of short-chain fatty acids: Acetate, Propionate, Butyrate

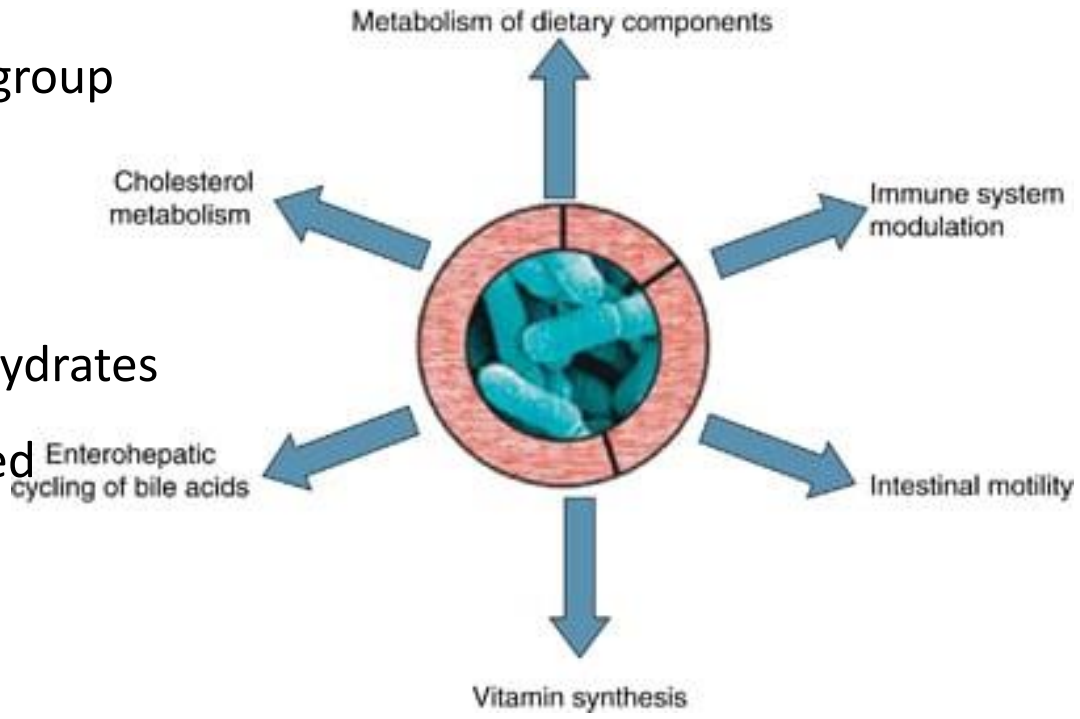
•Synthesis of vitamin K and several B-group vitamins.

•Fermentation of dietary fibers.

•Degradation of non-absorbed carbohydrates such as starch, pectin, and host-derived glycoproteins.

•Metabolizes xenobiotics.

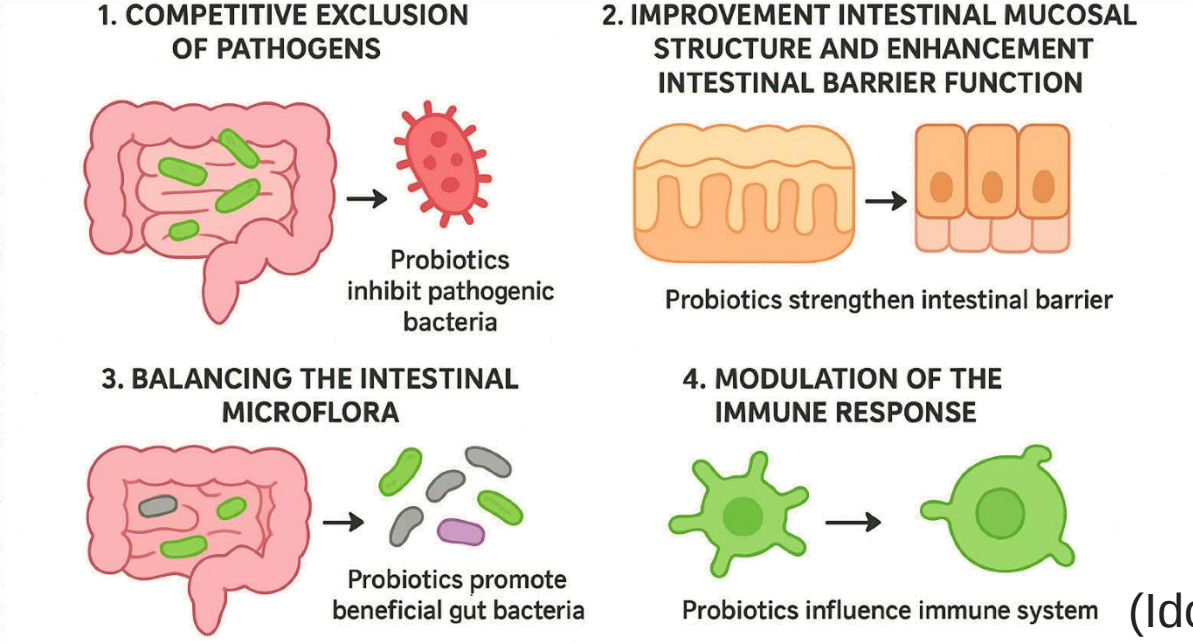
•Transforms bile acids



I. Human digestive microbiota

Barrier Effect of the Digestive Microbiota

- Competition for nutrients and adhesion sites.
- Production of inhibitory compounds such as organic acids and bacteriocins.
- Reinforcement of mucus secretion and epithelial barrier integrity.
- Modulation of host immune responses.



(Idowu et al., 2025)

I. Human digestive microbiota

Possible Harmful Effects

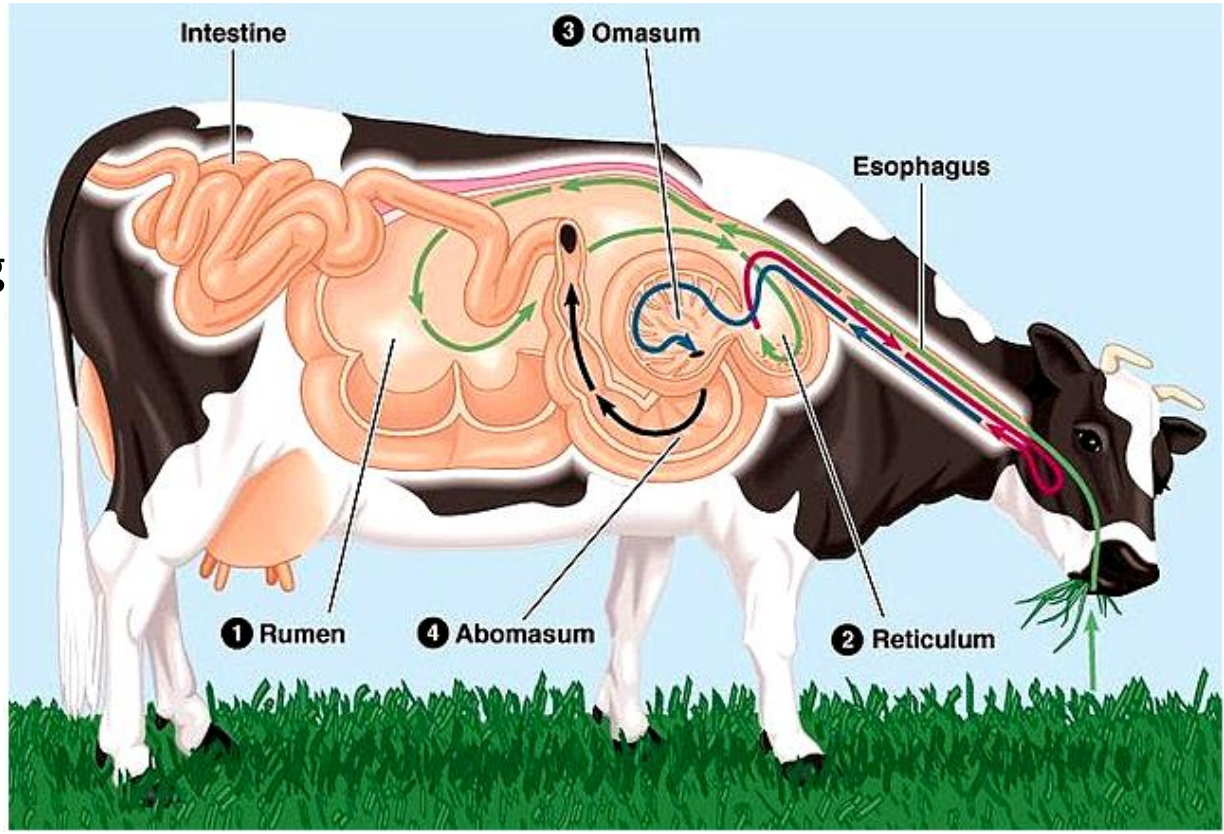
Under certain conditions, intestinal microorganisms may contribute to:

- Release of toxic or potentially carcinogenic compounds.
- Formation of nitrosamines from nitrogen-containing compounds.
- Inactivation or reactivation of some drugs.
- Production of toxic metabolites from xenobiotics.

II. Ruminant Digestive Tract

Anatomy

- **Mouth:** ingestion and mechanical breakdown of feed.
- **Esophagus:** transports food to the stomach.
- **Rumen:** largest compartment; major fermentation chamber.
- **Reticulum:** sorting and filtering of digesta.
- **Omasum:** absorption of water, minerals, and fermentation products.
- **Abomasum:** true stomach; secretes acid and digestive enzymes.
- **Intestines:** nutrient absorption and feces formation.



II. Ruminant Digestive Tract

Rumen Microbial Ecosystem

The rumen contains a complex anaerobic microbial ecosystem:

- **Bacteria:** degrade fibers and starch.
  - Fibrolytic bacteria: *Fibrobacter*, *Ruminococcus*
  - Amylolytic bacteria: *Streptococcus*, *Ruminobacter*
- **Protozoa:** digest feed particles and prey on bacteria.
- **Anaerobic fungi:** degrade plant cell walls.
  - *Neocallimastix*
  - *Piromyces*
  - *Caecomyces*
- **Archaea:** produce methane from hydrogen and carbon dioxide.