ENZYME SCIENCE®

THE PRACTITIONER DIVISION OF ENZYMEDICA

Beyond Digestion: Clinical Application of Enzymes

OVERVIEW

by Leyla El Moudden

About Enzyme Science

- Strict quality standard adherence for all ingredients in our finished product.
- Ingredients are derived from natural sources produced under strict cGMP-controlled environments.
- No artificial fillers and binders.
- Enzyme Science continually verifies product quality including purity, efficacy, and safety by evaluating products via our on-site laboratory and through accredited third-party facilities.

Addresses food intolerance molecules

Potent intestinal anti-inflammatory SCFA

Stomach Acid Support

Erodes bacterial protective layers

Entry Level - Mild with Live Bacteria

Erodes the candida cell wall

Learning Objectives

- Understand digestive enzymes beyond nutrient breakdown
- Identify when enzyme therapy may benefit gut ecology
- Recognise the role of enzymes in biofilm disruption
- Integrate enzyme strategies into cclinical protocols for dysbiosis
- Apply enzyme support in cases of Candida overgrowth and inflammatory gut patterns

The Clinical Problem

Many patients present with:

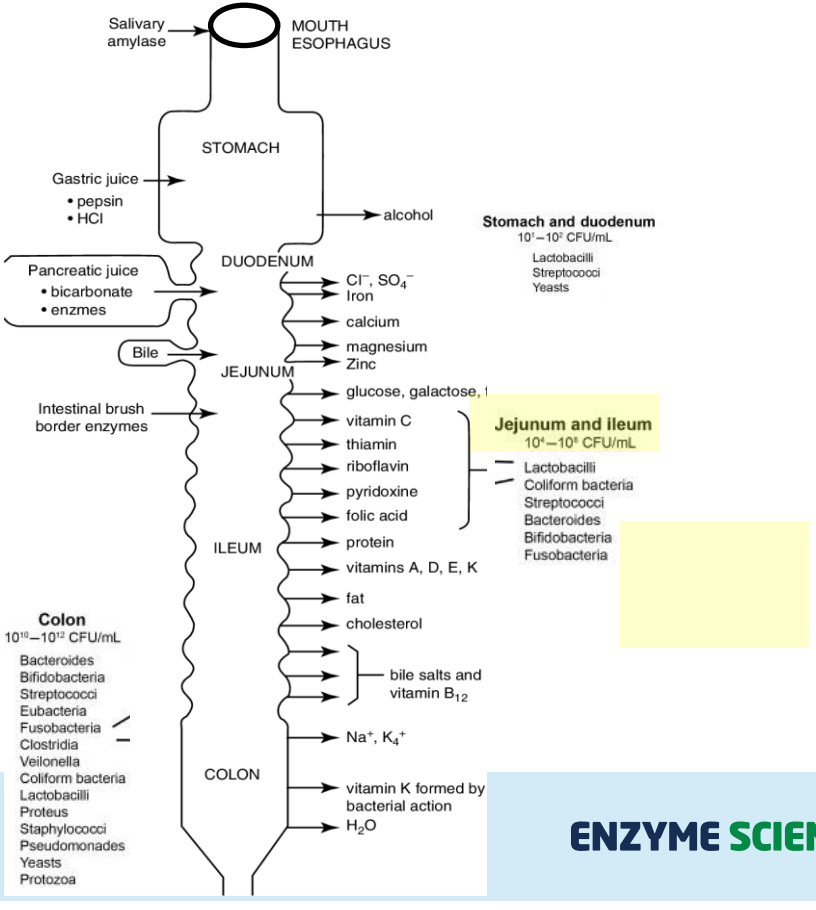
- Partial response to antimicrobial protocols
- Persistent bloating, gas, or dysbiosis
- Recurrent Candida patterns
- Ongoing inflammatory signalling (LPS-driven inflammation)
- Relapsing SIBO or dysbiosis

What mechanisms might we be missing?

The Clinical Problem

Proteases	**Lipases**	**Amylases**
Lactase	**Cellulases**	**Beta-glucanases**

Produced primarily by the pancreas, stomach and small intestinal brush border



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When Enzyme Function is Compromised

Factors that reduce enzyme production:

- Chronic stress
- Ageing
- Gastric hypochlorhydria
- Pancreatic insufficiency
- Chronic inflammation
- Gut dysbiosis

Factors that reduce enzyme activation

- pH
- Brush Border Inflammation
- Maldigestion
- Intestinal infection
- Leaky gut
- Nervous system

Practical Takeaways

Digestive enzymes may support:

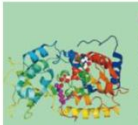
- Nutrient digestion
- Gut microbial balance
- Biofilm disruption strategies
- Improved outcomes in dysbiosis protocols

The Expanding Role of Enzymes

Traditionally viewed as digestive aids

- Microbial ecology modulation
- Mucosal barrier function support
- Inflammatory signalling regulation
- Biofilm integrity disruption

Microbial Modulation



Enzymes

Consensus definition

Enzymes are proteins or RNAs synthesized by living cells that catalyze chemical reactions involving their substrates with high efficiency and specificity, without undergoing any chemical change themselves.

Simple way to conceptualize

Synthesized by living cells, highly efficient and specific catalytic activity, proteins or RNA

Classification according to sources

1. Enzymes derived from microorganisms

Proteases:
Bacteroides and *Clostridium* are capable of producing a variety of proteases that help break down dietary proteins to provide usable amino acids.

Cellulases:
These enzymes can alter the carbon source of the intestinal environment, affecting the growth of other microorganis--ms and the fermentation process.

2. Host-originated enzymes

Trypsin and Pepsin:
Produced by the pancreas and stomach, begining to break down proteins in the upper GI tract.

Amylase and Lipase:
Derived from saliva and pancreas, acts on the breakdown of starch and fat.

3. Microbial enzymes interact with microbial communities and hosts

Regulation of microbial communities by microbial enzymes:
Enzyme activity can lead to changes in the microenvironment, such as changes in pH, which can affect the ecology.

Regulation of the host by microbial enzymes:
Metabolites of enzymes (e.g., vitamins, SCFAs) can directly affect the host's immune system and metabolic processes.

Host regulation of microbial communities:
Some enzymes produced by the host (e.g., pancreatic enzymes) can indirectly affect the bacteria's metabolic activities.

4. Regulation from external factors

Dietary enzyme supplementation:
Lactase supplementation can help lactose intolerant individuals digest lactose.
Cellulase supplementation enhances host utilisation of dietary fibre.

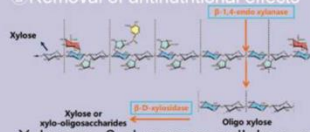
Other external factors:
The use of antibiotics, probiotics or prebiotics can also affect enzyme activity and distribution.

Nutritional function

①Direct catalytic hydrolysis of nutrient substrates

Protease, amylase, lipase, etc.

②Removal of antinutritional effects

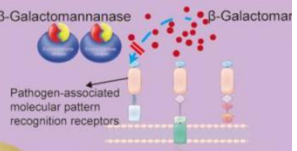


Xylanase, β-glucanase, cellulase, e

①Antibacterial function and inhibiting pathogens

Glucose oxidase, lysozyme, quenching enzyme, etc.

②Immune modulation



β-mannanase, protease, galactosidase etc.

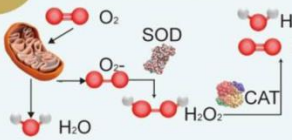
Non-nutritional function

③Maintains intestinal microbiota balance and gut health

intestinal epithelial cell

Xylanase, beta-glucanase, cellulase etc.

④Anti-oxidative stress



Superoxide dismutase (SOD)
Catalase (CAT), etc.

Supporting Natural Enzyme Secretion

1. Gastric signalling

Adequate stomach acid stimulates pancreatic enzyme release via CCK and secretin

2. Cephalic phase digestion

Smelling, tasting and chewing food stimulates vagal signalling

3. Adequate protein intake

Protein strongly stimulates pancreatic protease secretion

4. Bitter compounds

Bitter foods and herbs stimulate digestive secretions (rocket, dandelion, gentian, artichoke)

5. Micronutrient sufficiency

Zinc, B vitamins and magnesium support enzyme synthesis

Always support physiology before relying on supplementation

Clinical Consequences of Reduced Enzymes

Maldigestion

↓

Fermentation & Microbial Overgrowth

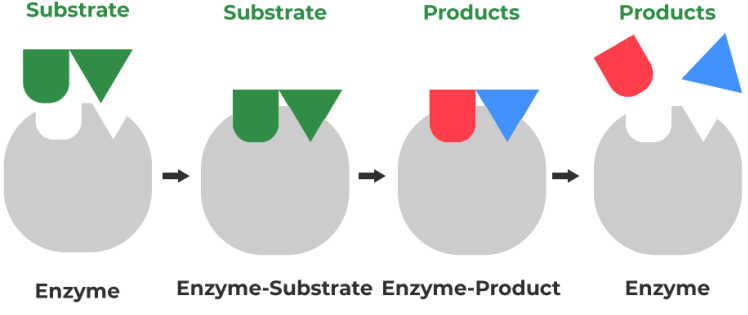
↓

Immune Activation & Barrier Impairment

Enzymes and Gut Ecology

Undigested food substrates may:

- Feed opportunistic microbes
- Shift microbial balance
- Promote dysbiosis



Dysbiosis and Persistent Gut Symptoms

Common Clinical Patterns:

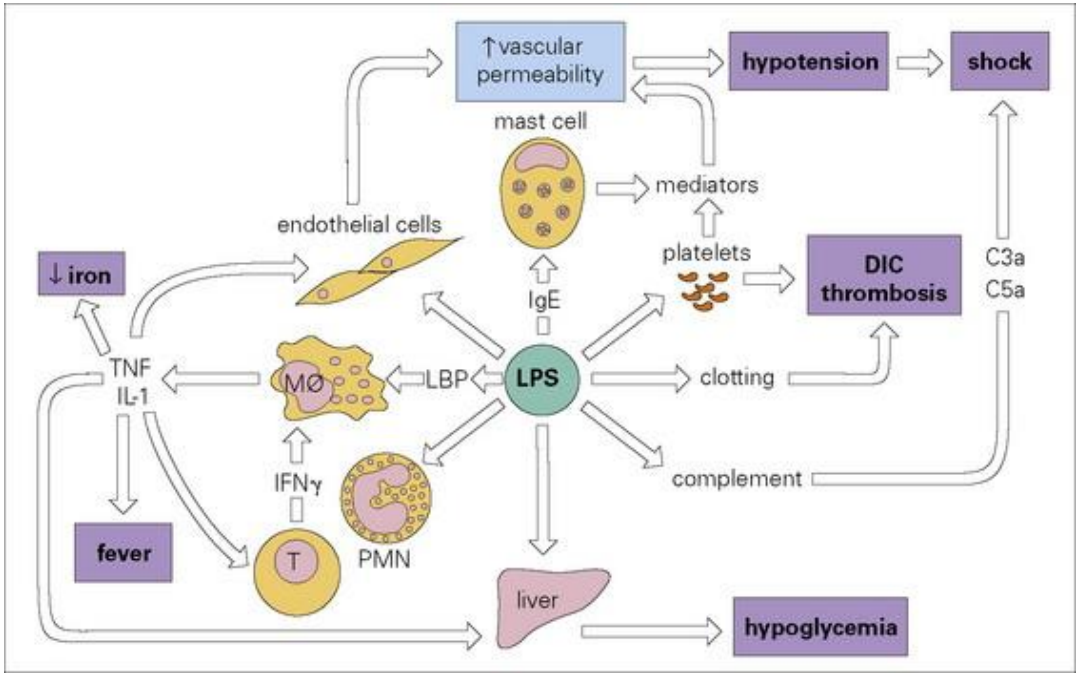
- Candida overgrowth
- SIBO relapse
- Food intolerance
- LPS

LPS and Inflammatory Signalling

> Lipopolysaccharide (LPS) is an endotoxin from Gram-negative bacteria

LPS can trigger:

- Immune activation
- Gut barrier disruption
- Systemic inflammation


↑vascular permeability
hypotension
shock
mast cell
mediators
endothelial cells
platelets
DIC thrombosis
C3a
C5a
↓iron
IgE
TNF
IL-1
MØ
LBP
LPS
clotting
IFNγ
complement
fever
T
PMN
liver
hypoglycemia

High LPS

1. Stop the leak
2. Reduce the inflammation
3. Handle Oxidative Stress
4. Increase aminos
5. Manage stress

What we did:

Butyrate

Absorb Elements Elemental Shake

Aminos

Nervine Tonic

Then when she was out of the danger zone

Proteolytic Enzymes

Digestive enzymes with meals

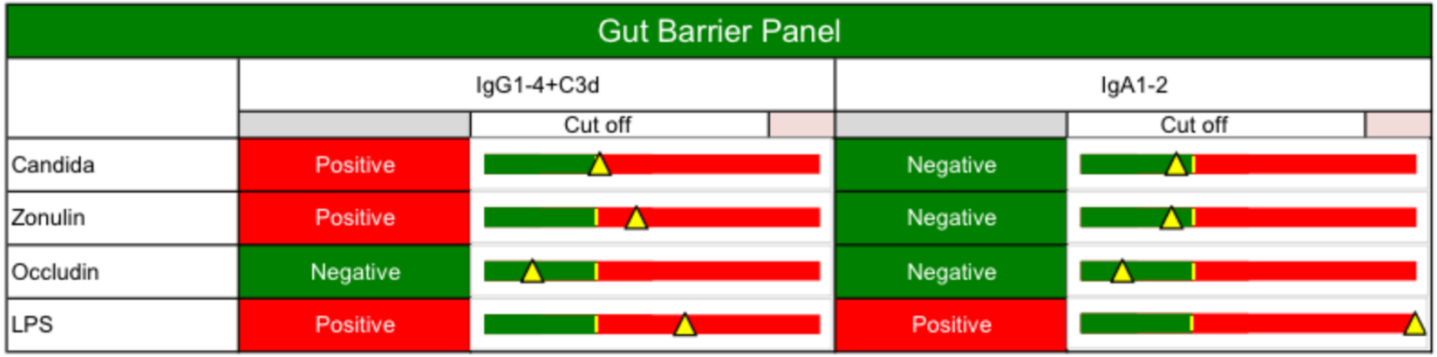
Nervine Tonic

Today – Aminos only, occasional sleep support

High LPS

Systemic Response

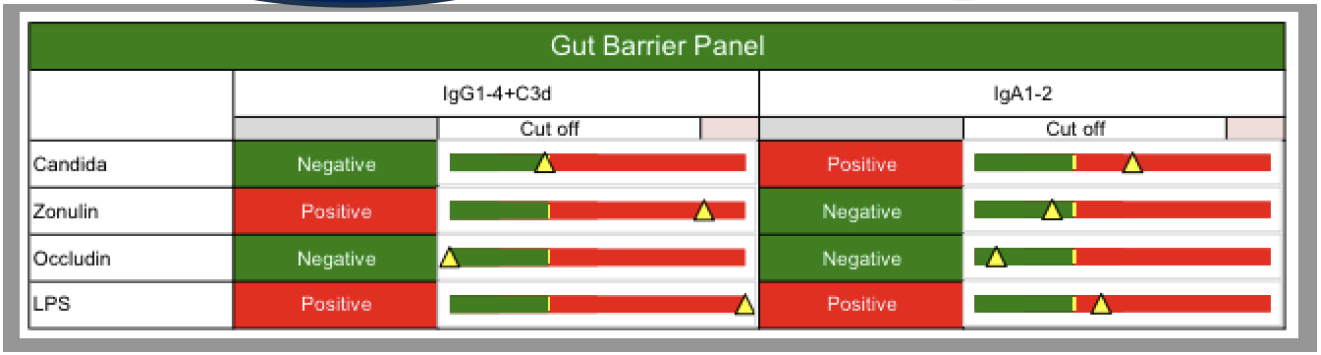
Mucosal Response



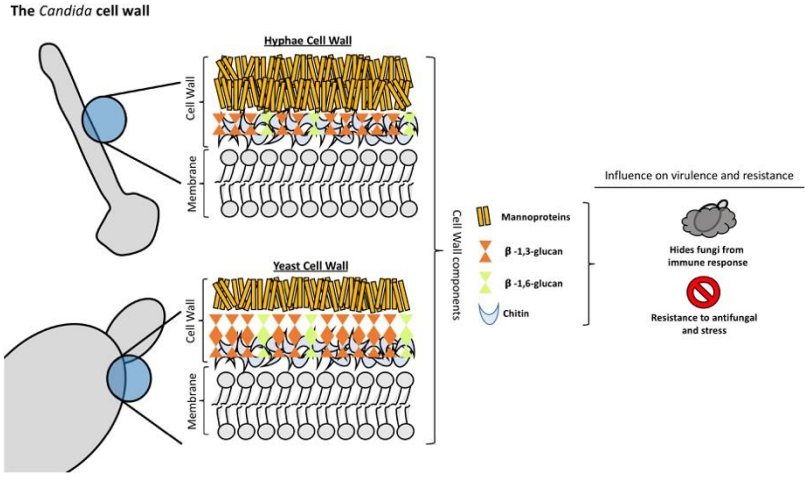
LPS

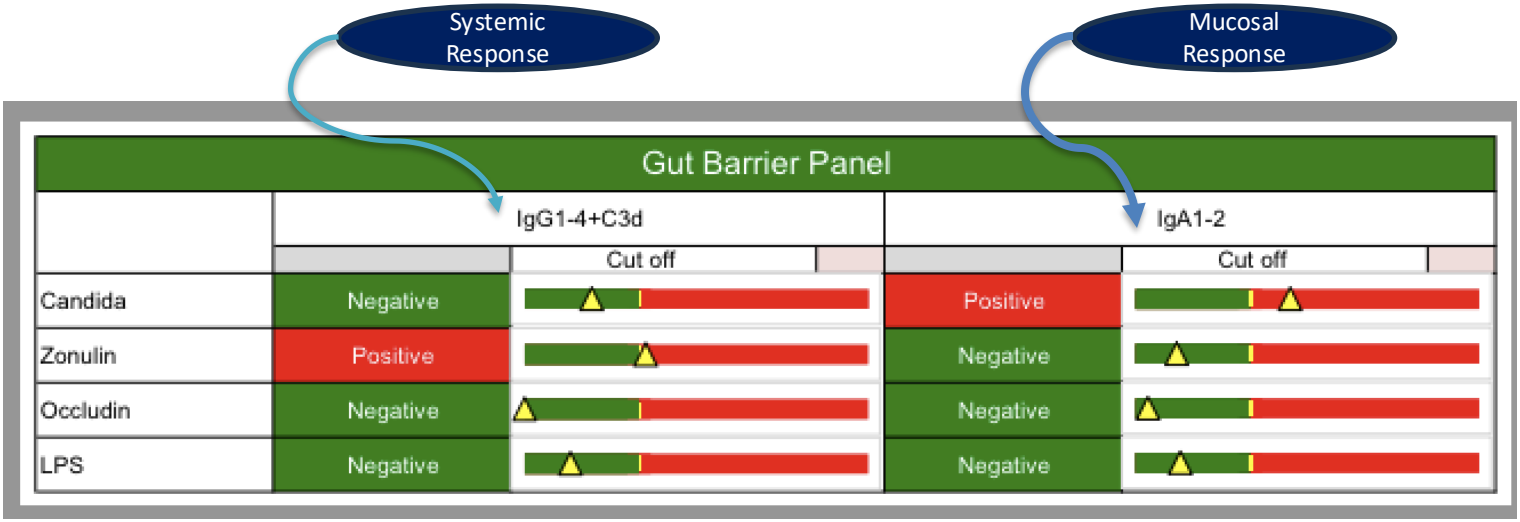
Systemic Response

Mucosal Response



What is candida?

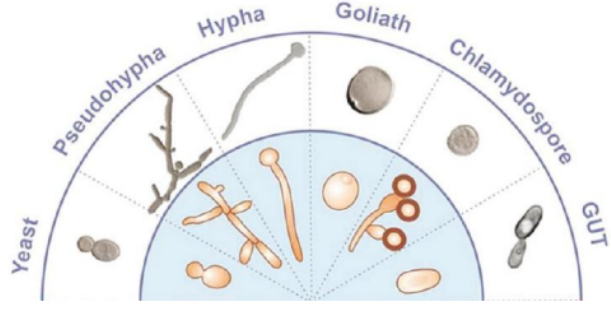



Systemic Response
Mucosal Response
Gut Barrier Panel
IgG1-4+C3d
IgA1-2
Cut off
Cut off
Candida
Negative
Positive
Zonulin
Positive
Negative
Occludin
Negative
Negative
LPS
Negative
Negative

Candida as an amplifier of intolerance

The mucosa moves from “tolerogenic” (calm) → “reactive” (primed).

- Creates a **pro-inflammatory mucosal microenvironment** characterised by:
- ↑ **IL-6**, **IL-1β**, **TNF-α**, **IL-23**
- ↑ **IL-17**, **IL-22** (Th17 cytokines)
- ↓ **IL-10**, **TGF-β** (tolerance cytokines
  ↑ **Zonulin release**, increasing permeability
- ↑ **sIgA consumption** (because IgA binds yeast antigens)



- Symptoms started after antibiotics
- Sugar craving
- Bloating
- White-coated tongue
- Anal itching

DX: Intestinal Candida

Candida

Week 1 - 2	Week 2-4	Week 4+	Timeframe
Candidase Pro + Digestive Enzyme + Antifungals Dietary Adjustment – LOW sugar, instead of no sugar If Herx: Lower the dose temporarily Add binders (charcoal, chlorella) Support the liver (NAC, milk thistle)	Prokinetics Between Meals Add Biofilm protocol if indicated	Inhibiting regrowth Candidase Pro + Diet + S. boulardii, L. plantarum, L. rhamnosus, B. breve Gut Repair – Mucus Membrane	Mild – 3-4 weeks Moderate – 6-8 weeks Recurrent – 12+ weeks

Disclaimer
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These clinical trees are guidelines only - and practitioners should discern and make their own judgements regarding patient care.

Candida and Biofilms

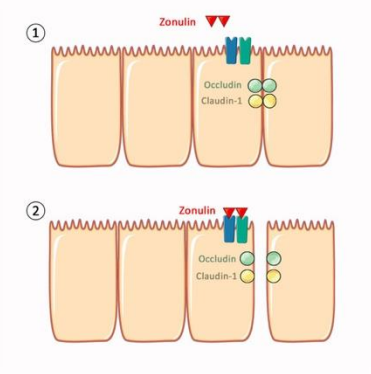
Candida species frequently form biofilms which:

- Enhance survival
- Resist antifungal agents
- Contribute to relapse

> Targeting the biofilm matrix may improve outcomes

Zonulin

Gut Barrier Panel				
	IgG1-4+C3d		IgA1-2	
		Cut off		Cut off
Candida	Negative		Positive	
Zonulin	Positive		Negative	
Occludin	Negative		Negative	
LPS	Negative		Negative	



Zonulin – “Open” Signal

Epithelial stress, inflammation— tell the gut barrier to “open the gates.”

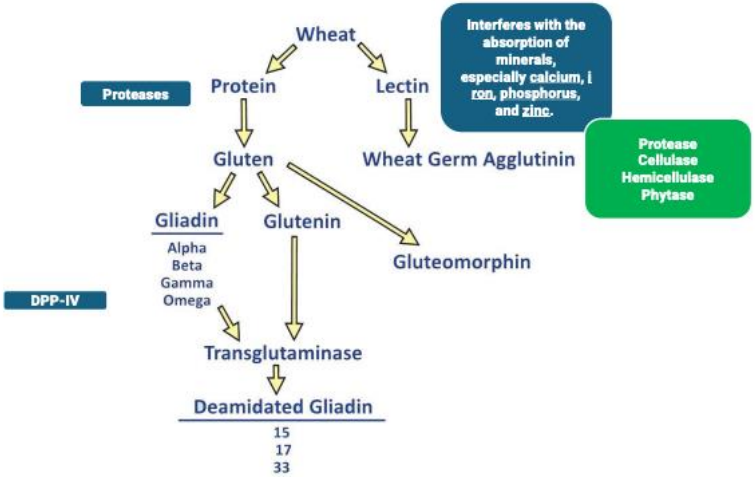
Foods that can elevate Zonulin:

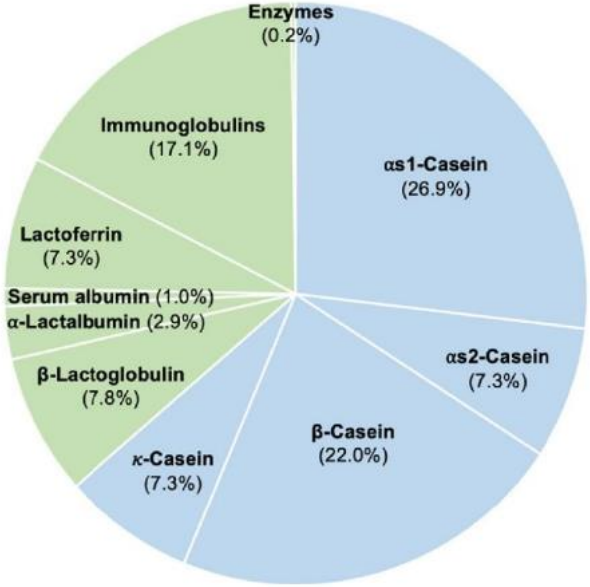
Gluten (gliadin) (strongest)
Conventional A1 (dairy)
Processed foods with emulsifiers
High sugar or high alcohol intake
Excess fructose / FODMAPs
Poorly cooked legumes / lectin-rich grains
High-saturated-fat, low-fibre diets

Foods that reduce Zonulin:

High-fibre vegetables, prebiotics (inulin, resistant starch)
Fermented foods (short-chain fatty acid producers)
Omega-3 fats
Polyphenols (curcumin, quercetin)
Butyrate or glutamine (barrier support)

Problematic Proteins





Understanding Biofilms

> Protective microbial matrices that allow microbes to evade immune responses and resist antimicrobials

Biofilm Components:

- Polysaccharides
- Proteins
- Lipids
- Extracellular DNA

Clinical Relevance of Biofilms

Biofilms may contribute to:

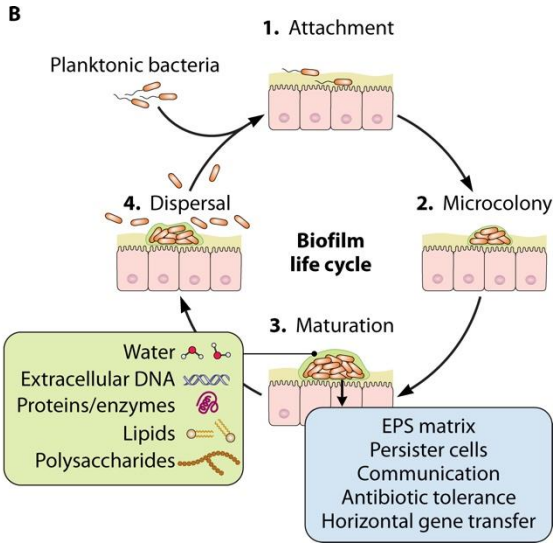
- Persistent dysbiosis
- Antimicrobial resistance
- Chronic gastrointestinal symptoms
- Ongoing inflammatory signalling

Enzymes as Biofilm Disruptors

Certain enzymes can degrade biofilm structures
May increase microbial susceptibility to treatment

Biofilm-Disrupting Enzymes:

- Proteases
- Cellulases
- Hemicellulases
- Beta- glucanases



BioFilm

DX: Resistance

2x Daily Until You Get The Result – av. 2 weeks

First dose	30 mins later	1 hour later	Daily
Take 2 capsules of Nattokinase. Take 2 caps Serrapeptase Pro Take a strong chelator alongside the enzymes (e.g., calcium disodium EDTA or modified citrus pectin)	Take one antimicrobial per day — rotate through the following options: Herbal: berberine, artemisinin, citrus seed extract, black walnut hulls, artemisia, echinacea, goldenseal, gentian, tea tree oil, fumitory, galbanum oil, oregano oil, neem.	Take binders to mop up die-off debris and toxins: - Chitosan, citrus pectin, special bicarbonate formula, organic germanium, chlorella, and others	Use buffering agents such as buffered vitamin C. Purpose: Counteract acidity created during microbial die-off and support pH balance. Assess and replete essential minerals such as magnesium, zinc, and others based on individual need

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Enzymes and Gut Barrier Integrity

> Improved digestion reduces antigen exposure and immune activation

This can support:

Enhanced mucosal integrity

Reduced endotoxin exposure

Improved inflammatory balance

Timing and Strategy

Digestive enzymes	Typically taken with meals
Biofilm-targeting enzymes	Often used away from meals

Clinical strategy depends on therapeutic goal

Example Clinical Pattern

Patient Presentation:

- Chronic bloating
- History of Candida
- Partial response to antifungals

Possible Contributing Factors:

- Biofilm protection
- Undigested substrates feeding microbes

Enzyme interactions?

Enzymes may be combined with:

Antimicrobials	Probiotics
Prebiotics	Mucosal support nutrients
Dietary interventions	

Clinical Indicators for Enzyme Use

Consider enzymes when patients present with:

- Bloating after meals
- Undigested food in stool
- Protein intolerance
- Chronic dysbiosis
- Incomplete response to antimicrobials

Safety Considerations

- Appropriate dosing
- Patient sensitivity assessment
- Medication interactions
- Professional supervision required

Key Clinical Questions

When patients relapse or plateau, ask:

Is digestion adequate?

Are microbes protected by biofilms?

Are inflammatory triggers still present?

Summary

Digestive enzymes have roles beyond digestion

They may influence:

- Microbial ecology
- Inflammatory signalling
- Biofilm integrity
- Gut barrier function

Questions

Thank you for your attention

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