Fermentation

Beyond Probiotics

Workshop

Who Currently Eats Fermented Foods On A Regular Basis?

What Do You Consume?
What Portion Size & How Often?

Why Probiotics Are Only Part of the Story

Most people think fermented foods are valuable because they contain live bacteria.

That belief has shaped:

- How fermented foods are marketed
- How probiotics are evaluated
- How people decide whether a food is “working”

But this focus misses the most important part of fermentation.

Fermentation doesn’t just add microbes to food — it fundamentally changes the food itself.

And many of those changes matter even if no bacteria survive digestion.

Why “Live Bacteria” Became the Dominant Narrative

The modern probiotic narrative grew out of:

Advances in microbiology and culturing techniques

The supplement industry’s need for measurable, countable benefits

The idea that “more bacteria = better gut health”

This led to:

CFU counts are becoming the primary marker of value

Fermented foods are being judged by survivability, not function

Confusion when benefits occur without colonization

In reality, live microbes were simply the most visible and measurable part of fermentation, not the most important one.

The Limits of Probiotic-Only Thinking

When fermentation is reduced to “adding bacteria,” several problems emerge:

- Colonization expectations
- People assume microbes must take up residence to have an effect.
- Survival obsession
- If bacteria don’t survive stomach acid, the food is seen as useless.
- Oversimplified outcomes
- Benefits are attributed only to microbial presence, ignoring biochemical changes.
- Tolerance confusion

People don’t understand why they feel better with some fermented foods and worse with others.

This framework can't explain why:

Pasteurized fermented foods still have effects

Small amounts of fermented foods can be impactful

Benefits appear before microbial changes are measurable

Why Fermented Foods Can Work Even Without Live Microbes

Many benefits of fermented foods remain even when microbes don’t survive digestion, because fermentation creates:

Organic acids that influence digestion and pH

Bioactive compounds that interact with gut and immune signaling

Enzymatic changes that alter how food is broken down

Modified fibers and proteins that behave differently in the gut

These effects happen before the food is eaten.

Fermentation is a form of external processing — a transformation that changes how the body interacts with food.

A more accurate way to understand fermentation is this:

Fermentation changes food first. Microbes are one outcome — not the goal.

During fermentation:

Carbohydrates are partially broken down

Proteins are pre-processed

Plant compounds are transformed into more bioactive forms

New compounds are created that didn’t exist in the original food

These changes affect:

Digestive workload

Sensory signaling (taste, smell, appetite)

Microbial behavior downstream

Individual tolerance

This is why fermented foods act differently from raw, cooked, or supplemented foods — even when ingredients look the same on paper.

New Compounds Formed During Fermentation

1. Organic acids

Examples: lactic acid, acetic acid, propionic acid

Why they matter: lower pH, influence gastric emptying, support bile and enzyme activity

2. SCFA precursors

Examples: lactate, acetate

Why they matter: support microbial cross-feeding and later butyrate production

3. Bioactive peptides

Examples: ACE-inhibitory peptides, opioid-like peptides (e.g., casomorphin fragments), signaling peptides

Why they matter: influence satiety hormones (GLP-1, PYY), gut barrier signaling, gut–brain communication

4. Modified polyphenols

Examples: phenolic acids, de-glycosylated flavonoids, urolithin precursors

Why they matter: increase bioavailability and strengthen anti-inflammatory signaling

5. Biogenic amines (food-level)

Examples: histamine, tyramine, putrescine

Why they matter: influence gut motility, secretion, and sensory signaling (dose-dependent)

6. Enzyme residues

Examples: amylases, proteases, phytases

Why they matter: support digestion and improve mineral absorption

7. Vitamins & cofactors

Examples: B2 (riboflavin), B6, folate, vitamin K2

Why they matter: support metabolic reactions, microbial function, and signaling pathways

8. Volatile compounds

Examples: esters, aldehydes, trace alcohols

Why they matter: activate sensory and vagal pathways that prime digestion

Different fermented foods have different effects depending on where they act in the digestive tract.

Fermentation is not one single process — it influences digestion and microbial activity at different stages.

Some fermented foods act EARLY, during digestion.

Some fermented foods act LATER, during colonic fermentation.

Both are valuable — they support different phases of gut function.

Fermented Foods That Act Earlier (During Digestion)

These fermented foods release bioactive compounds that act in the mouth, stomach, and small intestine — before fiber reaches the colon.

They influence:

- Gastric emptying

- Enzyme and bile signaling

- Gut–brain (vagal) communication

- Enteroendocrine hormone release (GLP-1, PYY)

Examples:

- Yogurt, kefir, cultured dairy (tzatziki, labneh)

- Fermented vegetable brine (sauerkraut brine, carrot brine, kimchi liquid)

- Small amounts of fermented vegetables (carrots, turnips, pickles)

- Fermented chili pastes (traditional ferments)

Strained Yogurt

Still provides:

- Lactic acid → early digestive signaling
- Bioactive peptides → GLP-1 & satiety support
- Fat + protein → better meal coordination

What changes with straining:

- Liquid whey removed → thicker texture
- Casein protein concentrated → stronger satiety signaling
- Slightly slower movement through the stomach

Fermented Foods That Act Later
(In the Colon)

These fermented foods still contain fiber and structure. Their primary effects depend on colonic microbes metabolizing them.

They mainly influence:

- Gas production and tolerance

- SCFA output (acetate, propionate, butyrate)

- Microbial balance and efficiency

- Stool form and transit over time

Examples:

- Fermented legumes (fermented chickpeas, lentils, soy)

- Fermented whole grains (sourdough rye, fermented oats)

- Whole fermented vegetables (sauerkraut solids, kimchi vegetables)

- Fermented root vegetables (sweet potato, cassava)

Why these act later:

- Fiber remains intact
- Benefits depend on microbial fermentation
- Effects develop hours later in the colon

Why This Matters in Layered Meals

In complex meals that contain fiber, fat, spices, and protein:

- Early-acting fermented foods help coordinate digestion and signaling
- Later-acting fermented foods help microbes handle fermentation efficiently

Putting It Together (GLP-1)

Early phase (minutes–hours after eating):

Early-acting fermented foods (e.g., yogurt, fermented brine) provide acids and small bioactives that stimulate L-cells in the small intestine → initial GLP-1 release (better timing, satiety, glucose handling).

Later phase (hours later):

Fiber reaches the colon → microbes make SCFAs (especially acetate/butyrate) → activate colonic L-cells → ongoing GLP-1 production.

GLP-1 works best with two signals: an early trigger and a later sustained one.

Reframing the Role of Microbes

Microbes matter — but not in the way most people think.

Instead of asking:

Do the microbes survive?

Do they colonize?

More useful questions are:

What did fermentation create?

How does this food behave differently now?

What signals does it introduce to the system?

Microbes are agents of change, not the benefit themselves.

Fermentation is not about delivering bacteria.

It is about transforming food in ways that:

Reduce digestive effort

Alter biochemical signaling

Change how the body and microbes respond

Microbes are only one possible outcome of that process — not the defining feature.

This shift in understanding sets the foundation for everything that follows.

Food is information

Fermentation changes the message

The vagus nerve is one of the key listeners

Unfermented foods rely on the gut to create signals.

Fermented foods deliver part of the signal already created.

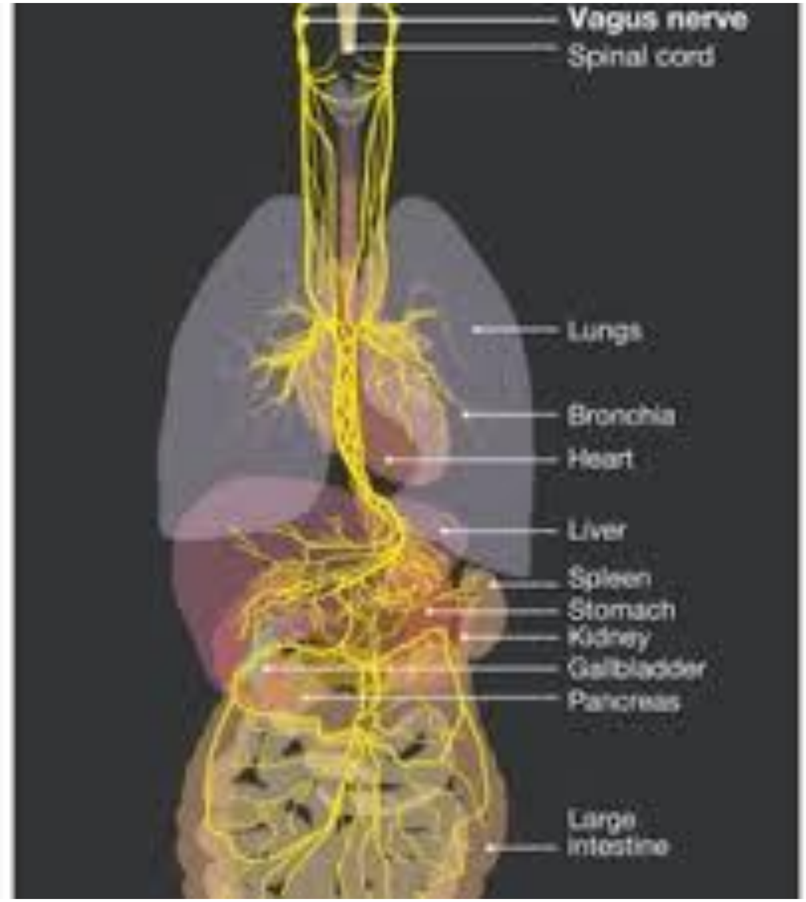
The GI Tract Is a Signaling System

Not just a digestive tube

Food sends information from mouth to colon

Signals affect digestion, appetite, comfort, and stress responses

The nervous system is one of the key interpreters of these signals

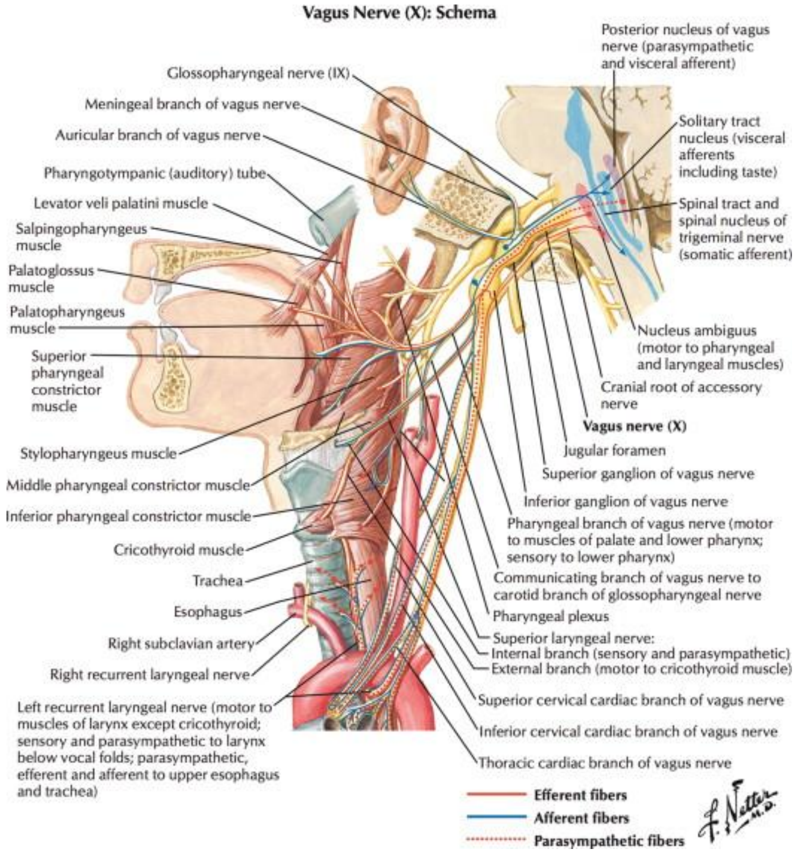


Major communication pathway between the gut and the brain

Most signals travel from gut to brain

Responds to chemical, hormonal, immune, and sensory input

Helps regulate motility, appetite, calmness, and coordination



What the Vagus Nerve Responds To

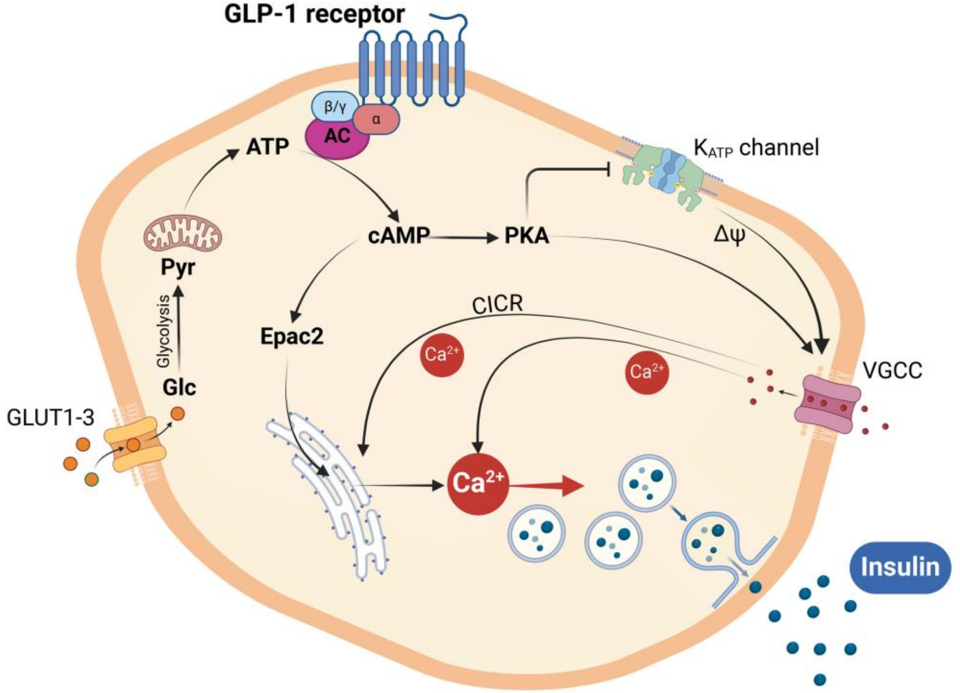
Gut hormones (GLP-1, CCK, PYY, serotonin)

Chemical environment (acids, pH, metabolites)

Immune and gut-barrier signals

Activity of the enteric (gut) nervous system

It does not respond to food directly — it responds to the environment food creates.



CCK (Cholecystokinin)

Released in the small intestine in response to fat & protein

Stimulates bile and pancreatic enzyme release

Signals fullness via the vagus nerve

PYY (Peptide YY)

Released from the ileum & colon after meals

Slows digestion and reduces appetite

Works with GLP-1 to signal satiety

How Unfermented Foods Influence the Vagus Nerve:

Indirectly

Require digestion and microbial processing

Signaling compounds are created after eating

Effects depend on:

Microbial diversity

Motility and transit time

Gut lining integrity

Inflammatory tone

Signals emerge later and vary from person to person.

How Fermented Foods Influence the Vagus Nerve

More directly

Contain microbial compounds already formed

Alter the gut’s chemical environment quickly

Interact earlier with gut sensors and hormone-releasing cells

Less dependent on existing microbial capacity

Signals arrive sooner and with less digestive work.

Why Fermented Foods Can Feel More Noticeable

Faster feedback — even from small amounts

Clearer signaling to the nervous system

Can influence comfort, appetite, and motility quickly

This does not mean they are “better” — they are more biologically active.

Fermented vs Unfermented Foods: Signaling Comparison

Unfermented foods:

Signals must be created by the gut

Strongly dependent on gut condition

Slower, cumulative effects

Fermented foods:

Some signals arrive pre-formed

Less dependent on gut capacity

Earlier, more noticeable effects

Important Clarifier

Supporting vagus nerve signaling ≠ stimulating the vagus nerve

More fermented food is not better

Context, timing, and dose matter

Fermented foods shape the environment the vagus nerve responds to

Cooking fermented foods can improve tolerance

Reduces live microbial activity and gut stimulation

Preserves many fermentation-created compounds

Changes the food matrix in a gentler way

Often better tolerated by sensitive individuals

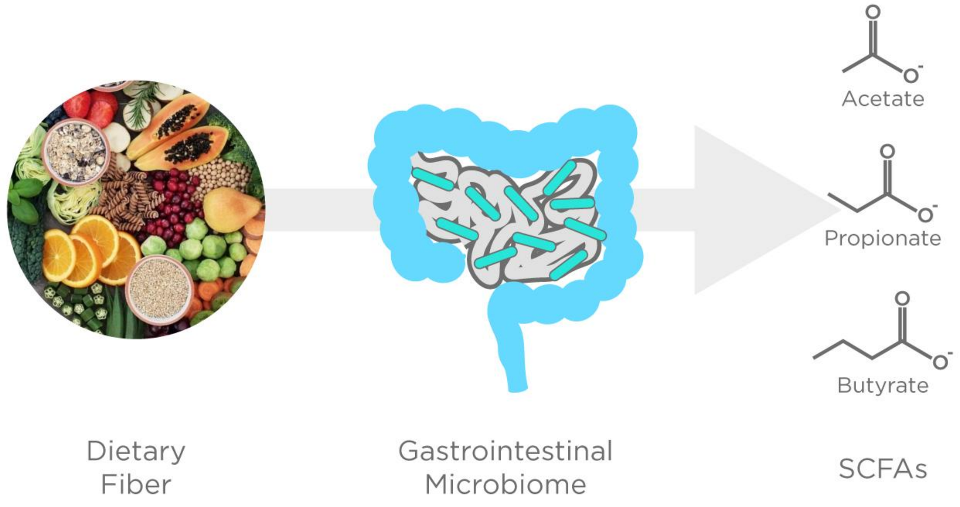
Key takeaway:
Fermented foods don’t need to be raw or “probiotic” to be useful.

Why Fermented Foods Help in Some Situations… and Not in Others

Research is actively exploring how fermentation-created compounds

Microbial metabolites (including SCFAs) may influence, for example, stress pathways like cortisol and gut–brain signaling.

Evidence isn’t definitive yet, but it’s strong enough to explain why fermented foods can feel supportive in some situations—and not in others.



Fermented foods are not “one intervention”

They contain fermentation-created compounds + food matrix + sometimes live microbes

Your response depends on context

Food matrix = how nutrients and bioactive compounds are packaged together in a food, which changes how the body responds.

Each food has a different food matrix

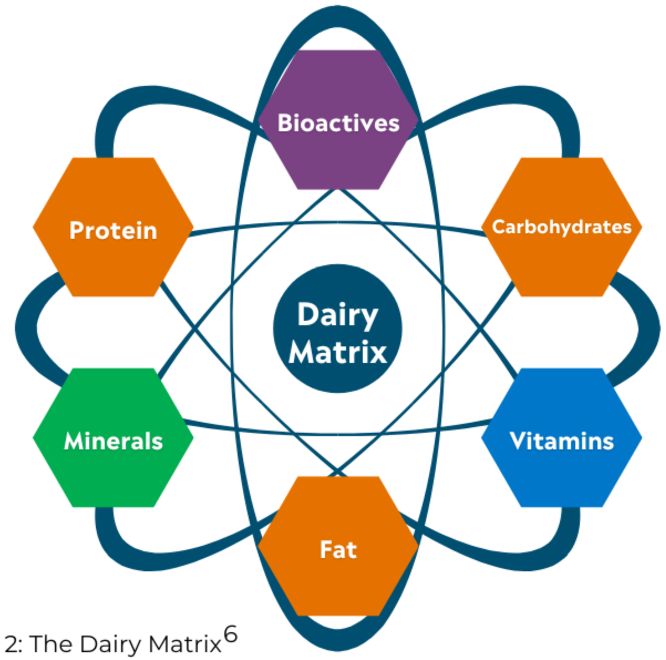


Figure 2: The Dairy Matrix[6]

Why the food matrix matters

It influences how quickly compounds are released during digestion

It affects where and how compounds interact in the gut and beyond

It shapes how food signals the nervous system, immune system, and metabolism

It helps explain why the same fermented compound can feel helpful in one food and not another

Key takeaway:

Fermented foods don’t just deliver compounds — they deliver them within a structure that changes their effects.

Context includes:

Nervous system state (stress load, sleep, sympathetic vs parasympathetic tone)

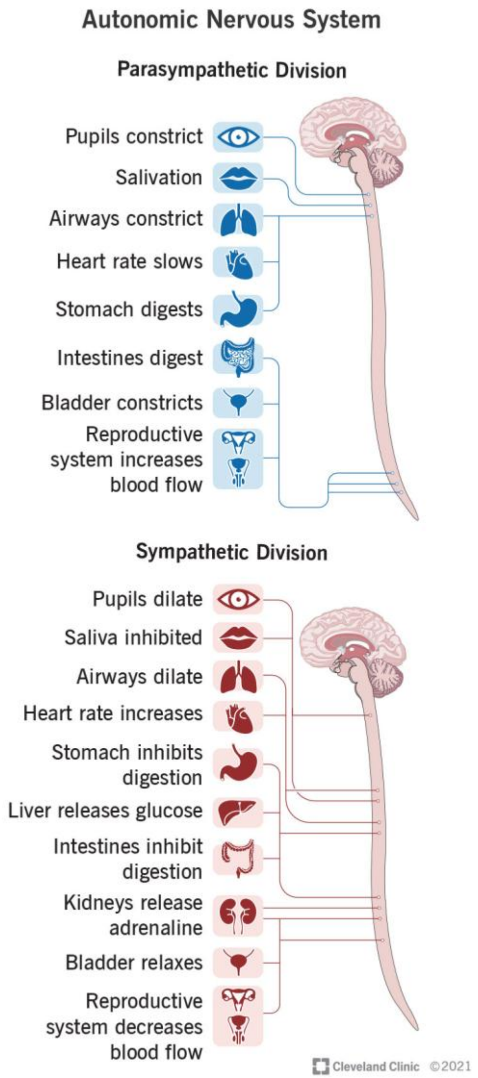
Immune tone / inflammation

Gut environment (motility, bile acids, permeability, sensitivity)

Baseline microbiome + current inputs

Medications + alcohol

The fermented food itself (type, dose, timing)



Why the same fermented food can feel different

Dose and timing change the response

“Empty stomach vs with a meal” can change signaling and tolerance

Your gut environment changes day to day (stress, sleep, hormones)

Mechanism Bucket #1: Fermentation-Created Compounds

Fermentation can generate or increase:

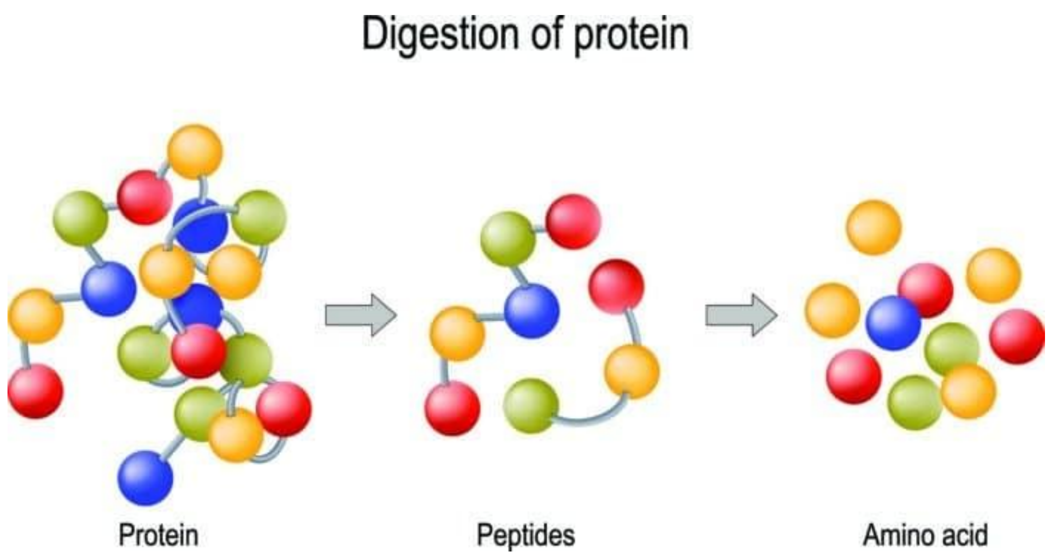
Organic acids (lactic acid, acetic acid)

Bioactive peptides (esp. fermented dairy)

Amino-acid metabolites (some calming, some stimulating)

Microbial cell components + enzymes

Point: effects aren't only about "adding bacteria"

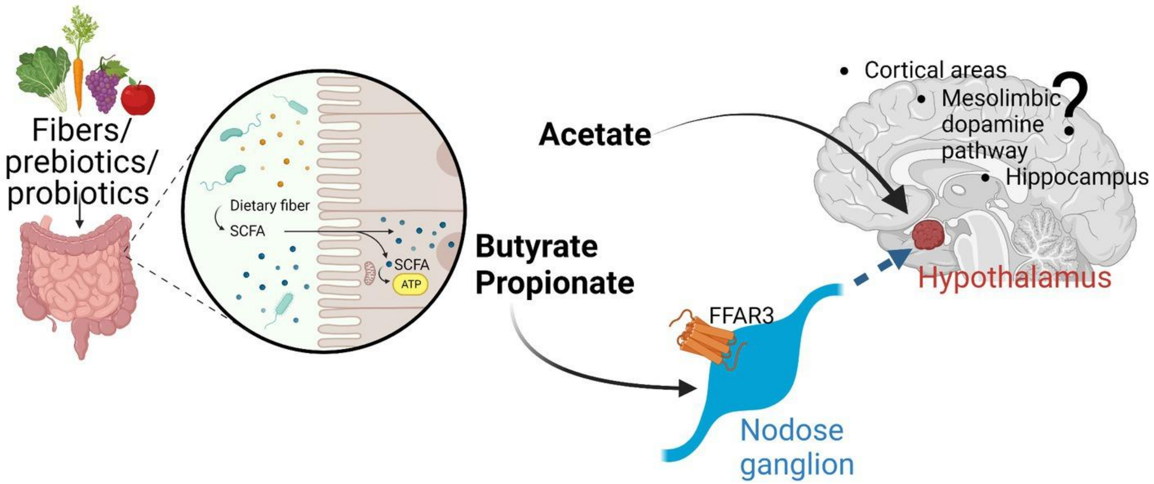


Mechanism Bucket #2:
SCFAs and Stress Signaling
(what we know)

SCFAs are key microbial metabolites (acetate/propionate/butyrate)

Human trial: colon-delivered SCFAs reduced cortisol response to stress

Scientists are mapping how gut-derived metabolites can influence stress physiology.

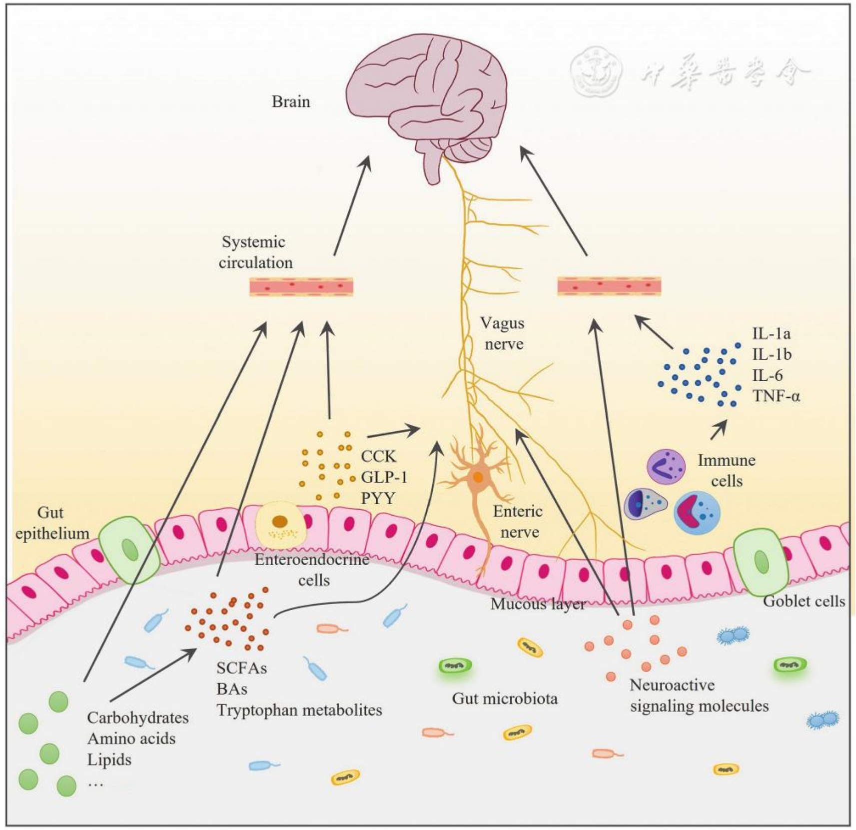


SCFAs + vagus nerve signaling (what's being studied)

SCFAs can influence gut–brain communication routes, including vagal pathways

Vagal neurons express SCFA receptors (FFAR3), supporting a direct "signal route" concept

This shows fermented foods have the potential to support the vague nerve



Why fermented foods don’t work for everyone: biogenic amines

Biogenic amines are compounds formed during fermentation when microbes break down amino acids

Some fermented foods can be high in histamine/tyramine (varies widely)

Sensitivity varies: enzymes, gut health, meds, alcohol

For some people, the “fermented” signal can feel like: wired, headachey, flushy, or unsettled

Why outcomes vary: the product variability problem

"Fermented foods" include many categories (dairy, vegetables, grains, drinks)

Some have live microbes; some are processed after fermentation

Different strains/conditions → different metabolites

Bottom line: you can't assume the same effect across foods (or brands).

Evidence: Fermented foods can shift inflammation markers (but not uniformly)

RCT: Fermented-food diet increased diversity + lowered inflammatory markers (high consumption)

Real-life takeaway: “Fermented foods can be supportive, but responses differ—personal context matters.”

Current Research in Fermented Foods: Bridging Tradition and Science - ScienceDirect

When a fermented food helps:

Right food + right amount + right timing + right body state

When it doesn't:

Mismatch (dose, timing, sensitivity, amines, stress state, etc.)

Practical approach: start small, observe, match to situation

Why small amounts work:

- Organic acids and fermentation metabolites are already in solution

- Signals are detected early in digestion

- Effects are regulatory, not dependent on fiber fermentation

Practical Plan

Step 1

Start with function, not fermentation

Before introducing fermented foods, clarify why they're being considered:

Nervous system support

Digestion or appetite support

Immune or inflammatory balance

Food enjoyment / variety

Key principle: fermented foods are tools, not requirements.

Step 2

Choose low-intensity fermented foods first

Not all fermented foods behave the same.

Start with foods that are lower-intensity and familiar

(e.g., fermented dairy, lightly fermented vegetables, fermented grains).

Avoid starting with highly aged, acidic, carbonated ferments

Or introducing multiple fermented foods at once.

Step 3

Micro-dose (this is critical)

Use food amounts, not serving sizes.

A starting dose might be:

- 1–2 teaspoons
- Or a few spoonfuls

Frequency matters more than quantity.

Small amounts allow the body to “read” the food without being overwhelmed.

Step 4

Control the context

This is where many people run into trouble.

Introduce fermented foods:

- With meals, not on an empty stomach
- Earlier in the day rather than late evening
- When stress is lower, not during acute overwhelm

Avoid introducing:

- During high stress or poor sleep periods
- Alongside alcohol
- Alongside multiple new foods or supplements

Why Fermented Foods Are Better Earlier in the Day

Stimulate digestion (acid, bile, enzymes)

Activate gut–brain signaling (GLP-1, PYY, vagus nerve)

Can increase alertness and gut activity

Histamine clearance is lower at night

Slower evening motility → bloating, reflux, disrupted sleep

Bottom line:
Fermented foods *turn digestion and signaling on*—daytime supports this, evenings do not.

Step 5

Observe body signals, not symptoms alone

Encourage people to look for patterns, not isolated reactions.

Useful questions:

How did appetite respond?

Was digestion easier, unchanged, or harder?

Any changes in calmness, sleep, or energy?

Did the response feel supportive, neutral, or disruptive?

One experience ≠ a conclusion.

Step 6

Adjust one variable at a time

If something doesn't feel supportive:

Reduce the amount (don't increase it)

Change timing (with food vs earlier in the day)

Change the fermented food (not all behave the same)

Avoid:

Stacking multiple fermented foods

Increasing dose to "push through" discomfort

Step 7

Build consistency before variety

Once a fermented food feels neutral or supportive:

- Keep the same food
- Same amount
- Same timing

for several days or a week before adding anything new.

Consistency creates predictability, which matters for nervous system tolerance and for the microbes.

Step 8

Remember: fermented foods are optional

If fermented foods don’t feel supportive right now:

- Pause
- Revisit later

Or support the same function through non-fermented foods

This avoids turning fermented foods into a source of stress.