

Fermented foods: connecting human and food microbiomes with science, craft, and education

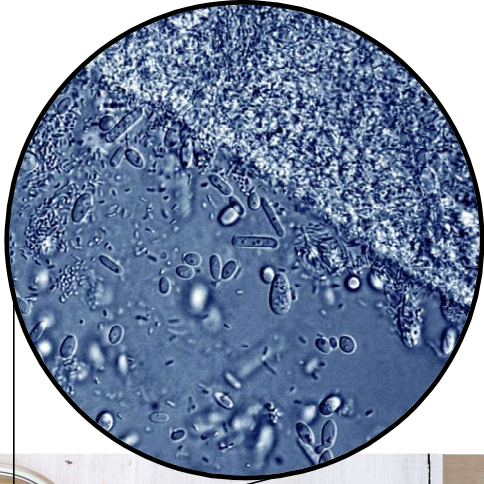
Benjamin E. Wolfe

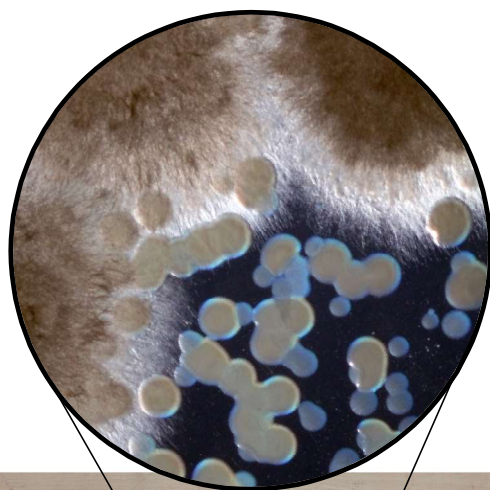
Associate Professor
Department of Biology, Tufts University

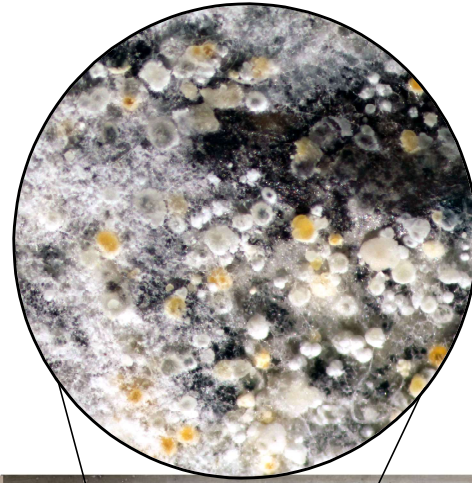
 @benwolfe.bsky.social













What are fermented foods? A recent consensus

CONSENSUS STATEMENT

OPEN



The International Scientific Association for Probiotics and Prebiotics (ISAPP) consensus statement on fermented foods

Maria L. Marco¹, Mary Ellen Sanders², Michael Gänzle³, Marie Claire Arrieta⁴, Paul D. Cotter^{5,6,7}, Luc De Vuyst⁸, Colin Hill⁹, Wilhelm Holzapfel¹⁰, Sarah Lebeer¹¹, Dan Merenstein¹², Gregor Reid¹³, Benjamin E. Wolfe¹⁴ and Robert Hutkins¹⁵✉

Abstract | An expert panel was convened in September 2019 by The International Scientific Association for Probiotics and Prebiotics (ISAPP) to develop a definition for fermented foods and to describe their role in the human diet. Although these foods have been consumed for thousands of years, they are receiving increased attention among biologists, nutritionists, technologists, clinicians and consumers. Despite this interest, inconsistencies related to the use of the term 'fermented' led the panel to define fermented foods and beverages as "foods made through desired microbial growth and enzymatic conversions of food components". This definition, encompassing the many varieties of fermented foods, is intended to clarify what is (and is not) a fermented food. The distinction between fermented foods and probiotics is further clarified. The panel also addressed the current state of knowledge on the safety, risks and health benefits, including an assessment of the nutritional attributes and a mechanistic rationale for how fermented foods could improve gastrointestinal and general health. The latest advancements in our understanding of the microbial ecology and systems biology of these foods were discussed. Finally, the panel reviewed how fermented foods are regulated and discussed efforts to include them as a separate category in national dietary guidelines.

Fermented foods and beverages accompanied and likely facilitated the transition from hunter-gatherer communities to sessile agricultural communities in the Neolithic revolution about 14,000 years ago¹⁻³. They have remained staples of human diets for centuries and are an increasingly popular food category. Yet, their emergent popularity in the past 20 years has led to numerous misunderstandings and questions. What constitutes fermentation? Do fermented foods necessarily contain live microorganisms? Are fermented foods the same as probiotic foods? Do microorganisms in fermented foods become established in the gut or influence the gut micro-

(a category that includes fermented beverages). The main goals of this Consensus Statement are to provide researchers, health-care providers, industry, regulators and consumers with a clear and concise definition of fermented foods, to differentiate between fermented foods and probiotics, and to summarize what is known about the health effects and safety of fermented foods. This Consensus Statement also discusses the mechanistic rationale for how fermented foods could improve gastrointestinal and systemic health, the advancements in knowledge on the microbial ecology and systems biology of those foods, and the current regulatory considerations and position



“...foods made through desired microbial growth and enzymatic conversions of food components.”

Nature Reviews Gastroenterology & Hepatology
18: 196–208 (2021)

**Raw food
material**

**Microbial
metabolism**

**Fermented
product**



**Lactic acid
bacteria**

lactose

lactic acid



**Lactic acid
bacteria**

dextrose

lactic acid



**Lactic acid
bacteria**

**glucose
fructose
sucrose**

lactic acid

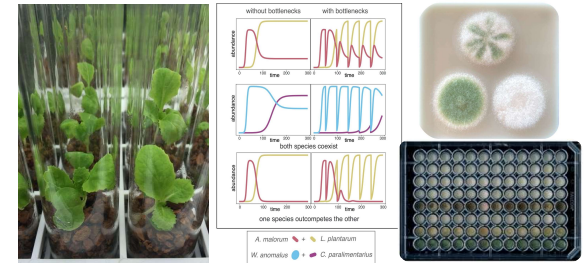


Basic science

Humans (& their microbiomes) ↔ Fermented food microbiomes

What **ecological/evolutionary processes** control microbiome assembly and function?

How do fermented food microbiomes interact with **human microbiomes**?



Practicing/ Crafting

How do **practitioners/practices** affect the ecology and evolution of food microbes?

Why do some food microbiomes **fail**, and how can broken food microbiomes be **fixed**?

Can we use microbial ecology/evolution to develop **novel ferments**?



Education

How can we use fermented foods to promote **microbial literacy**?

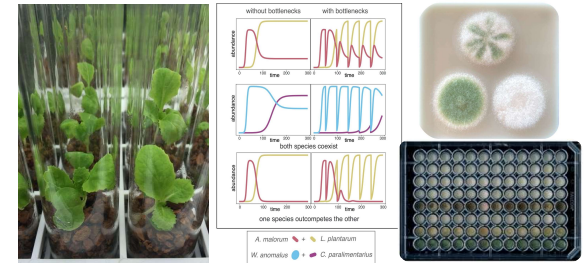


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Microbiome Assembly in Fermented Foods

Nicolas L. Louw,¹ Kasturi Lele,¹ Ruby Ye,¹
Collin B. Edwards,^{1,2} and Benjamin E. Wolfe¹

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email: nicolas.louw@tufts.edu, kasturi.lele@tufts.edu, ruby.ye@tufts.edu,
collin.edwards@tufts.edu, benjamin.wolfe@tufts.edu

²School of Biological Sciences, Washington State University, Vancouver, Washington, USA

Generalizable principles of microbiome assembly across ferments

Annu. Rev. Microbiol. 2023. 77:381–402

The *Annual Review of Microbiology* is online at
micro.annualreviews.org

<https://doi.org/10.1146/annurev-micro-032521-041956>

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Keywords

microbiome, community assembly, fermented food, cheese, sourdough, fermented vegetables

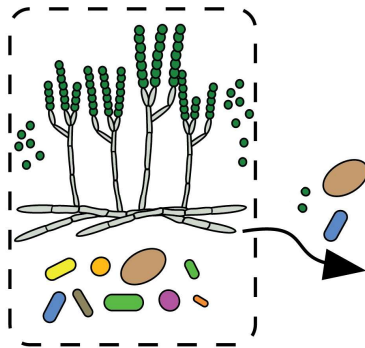
Abstract

For thousands of years, humans have enjoyed the novel flavors, increased shelf-life, and nutritional benefits that microbes provide in fermented foods and beverages. Recent sequencing surveys of ferments have mapped patterns of microbial diversity across space, time, and production practices. But a mechanistic understanding of how fermented food microbiomes assemble has only recently begun to emerge. Using three foods as case studies (surface-ripened cheese, sourdough starters, and fermented vegetables), we use an ecological and evolutionary framework to identify how microbial communities assemble in ferments. By combining in situ sequencing surveys with in vitro models, we are beginning to understand how dispersal, selection, diversification, and drift generate the diversity of fermented food communities. Most food producers are unaware of the ecological processes occurring in their production environments, but the theory and models of ecology and evolution can provide new approaches for managing fermented food microbiomes, from farm to ferment.



What species are
available to build
a microbiome?

Dispersal



How do
microbial species
fit together?

Interactions

How do
microbiomes
change over time?

Evolution



Basic science

Cheese rind microbiomes

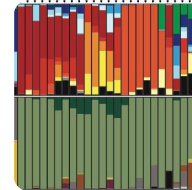


Cheese rind microbial communities



Biofilm

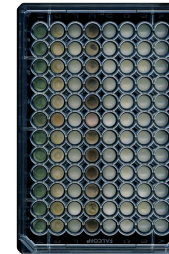
Curd



A limited diversity of easy-to-culture fungi and bacteria

Wolfe et al., *Cell*, 2014

Saak et al., *mSystems*, 2023



Synthetic communities behave like 'wild' communities

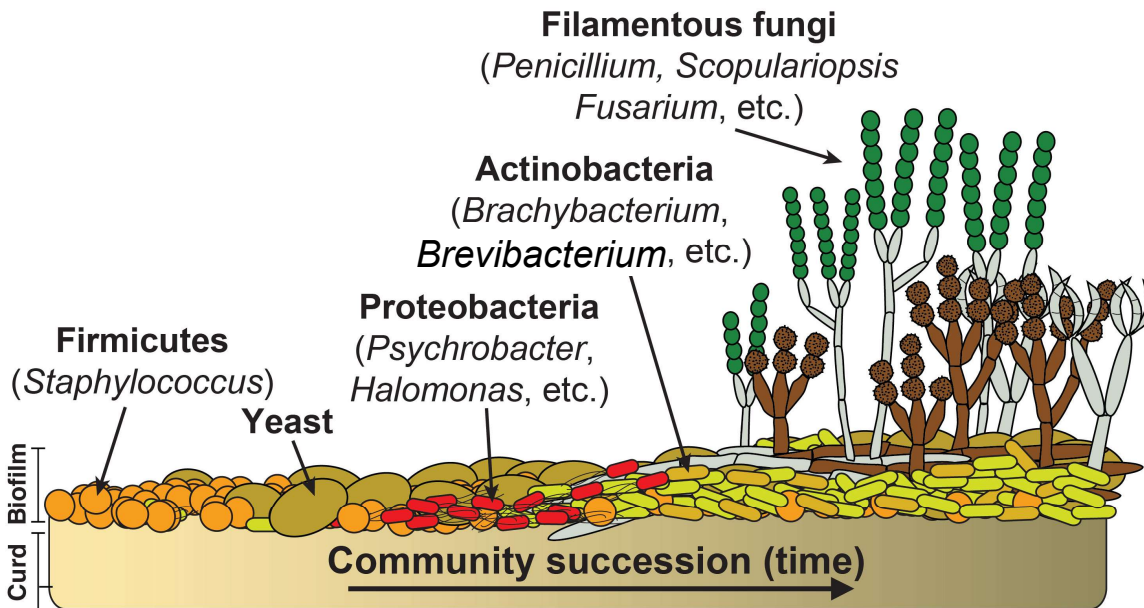
Wolfe et al., *Cell*, 2014

Niccum et al., *mSystems*, 2020

Cosetta & Wolfe, *Curr. Prot. Microbio.*, 2020

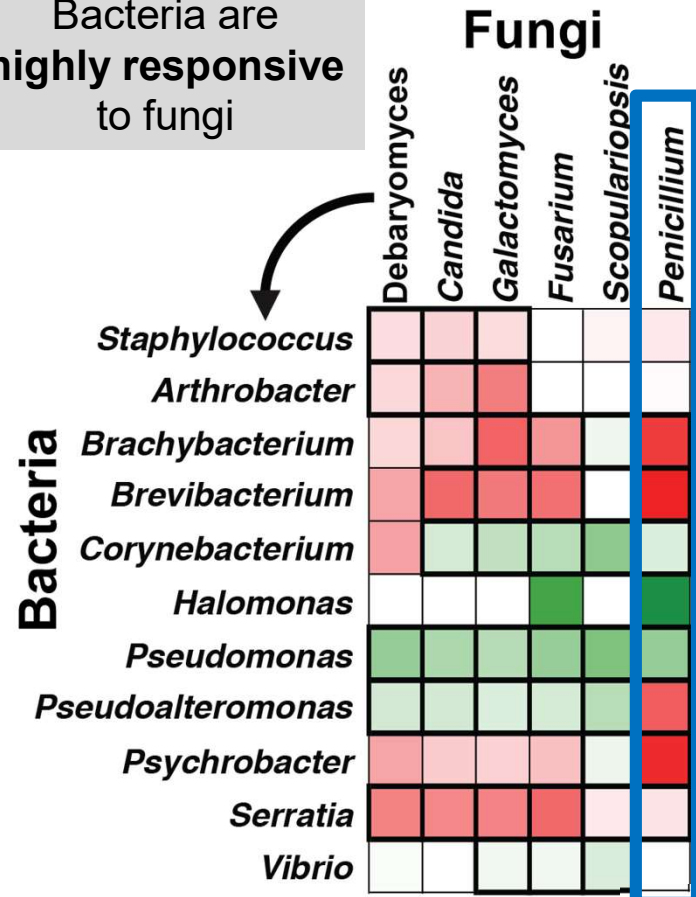


Fungi are keystone species in cheese rind microbiomes

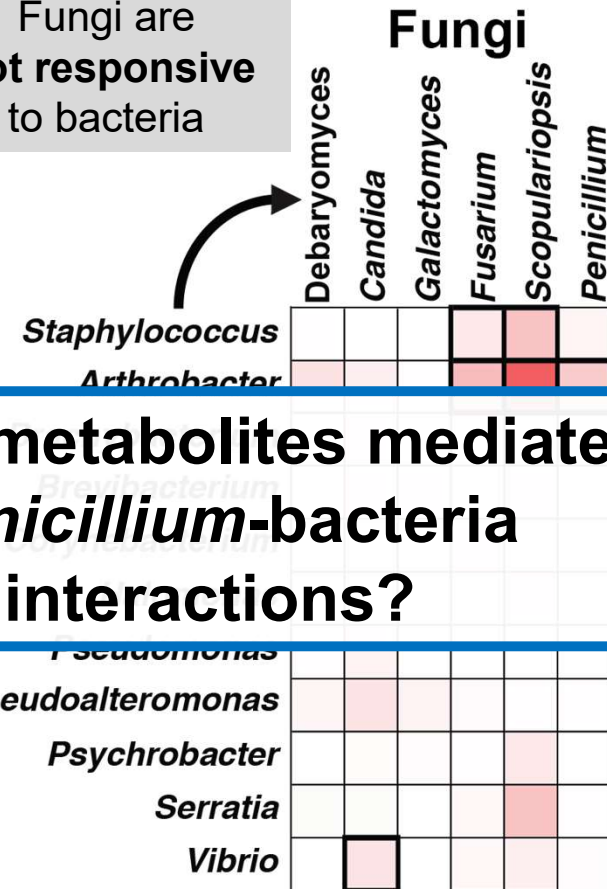


Fungi strongly affect the growth of bacteria in cheese rinds

Bacteria are highly responsive to fungi



Fungi are not responsive to bacteria

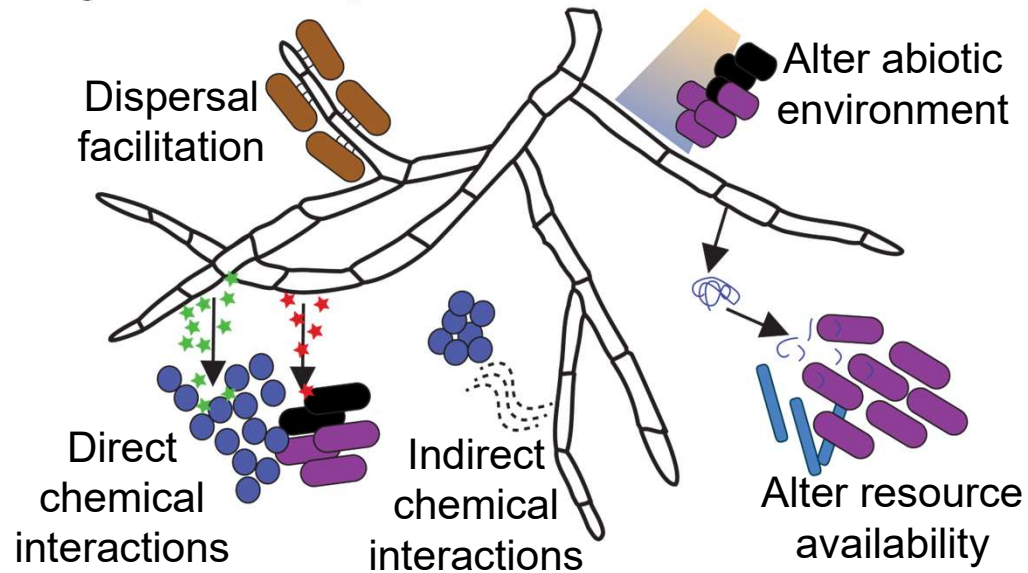


What metabolites mediate *Penicillium*-bacteria interactions?

Log₁₀ fold change in growth compared to growth alone



Fungi are keystone species in cheese rind microbiomes



Mold networks are superhighways for rind bacteria

Zhang et al.
2018, *Nat. Comm.*



***Penicillium* molds kill rind bacteria via antibiotics**

Tannous et al.
2023, *mBio*



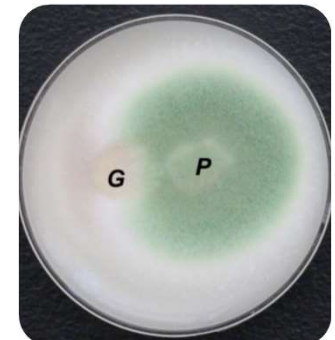
Fungal volatiles promote bacterial growth

Cosetta & Wolfe,
2020, *Env. Micro.*



Fungal resource provisioning promotes bacteria

Kastman et al.
2016, *mBio*

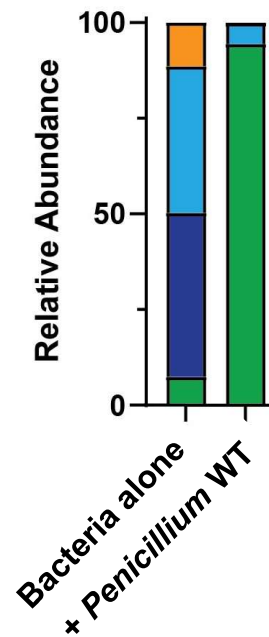


Bacteria and fungi compete for scarce metals

Cleary et al.
2018, *mSystems*

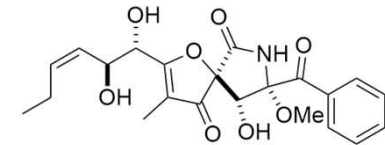
Fungal antibiotics can shape cheese rind communities

Community-level consequences



Mechanism

pseurotin



Penicillium sp.
strain MB.



Joanna
Tannous

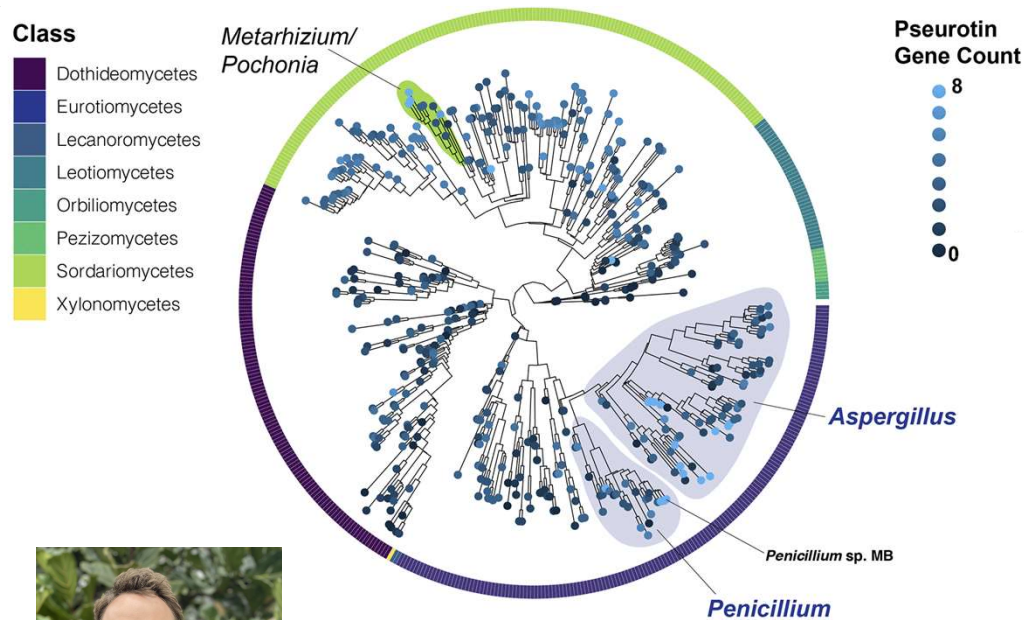


Nancy
Keller

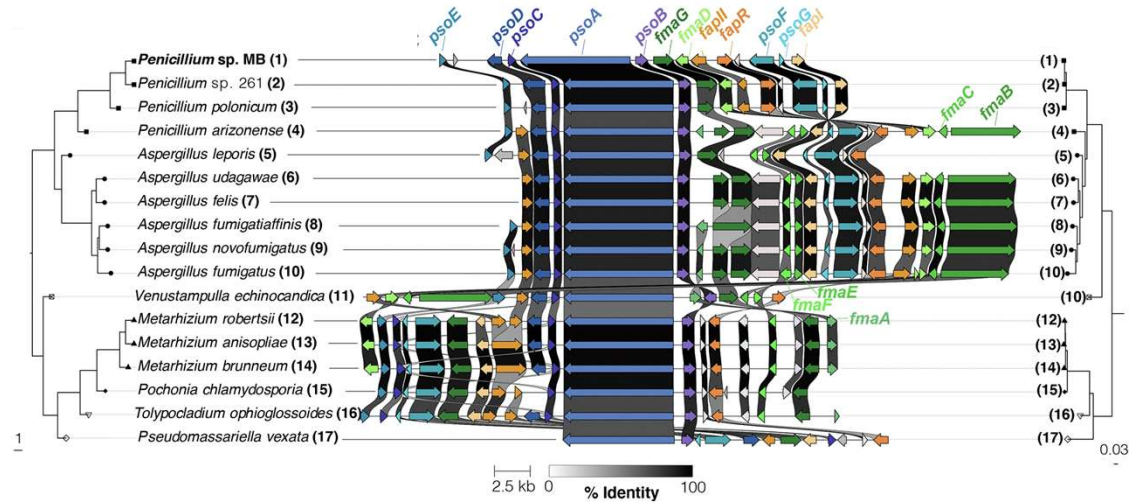
Basic science

Tannous et al., *mBio*, 2023

The pseurotin BGC is widespread in fungal genomes, and may be impacting bacterial communities in other systems



Mickey Drott

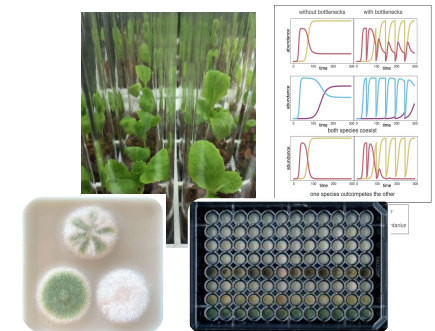


Basic science

Humans (& their microbiomes) ↔ Fermented food microbiomes

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Practicing/ Crafting

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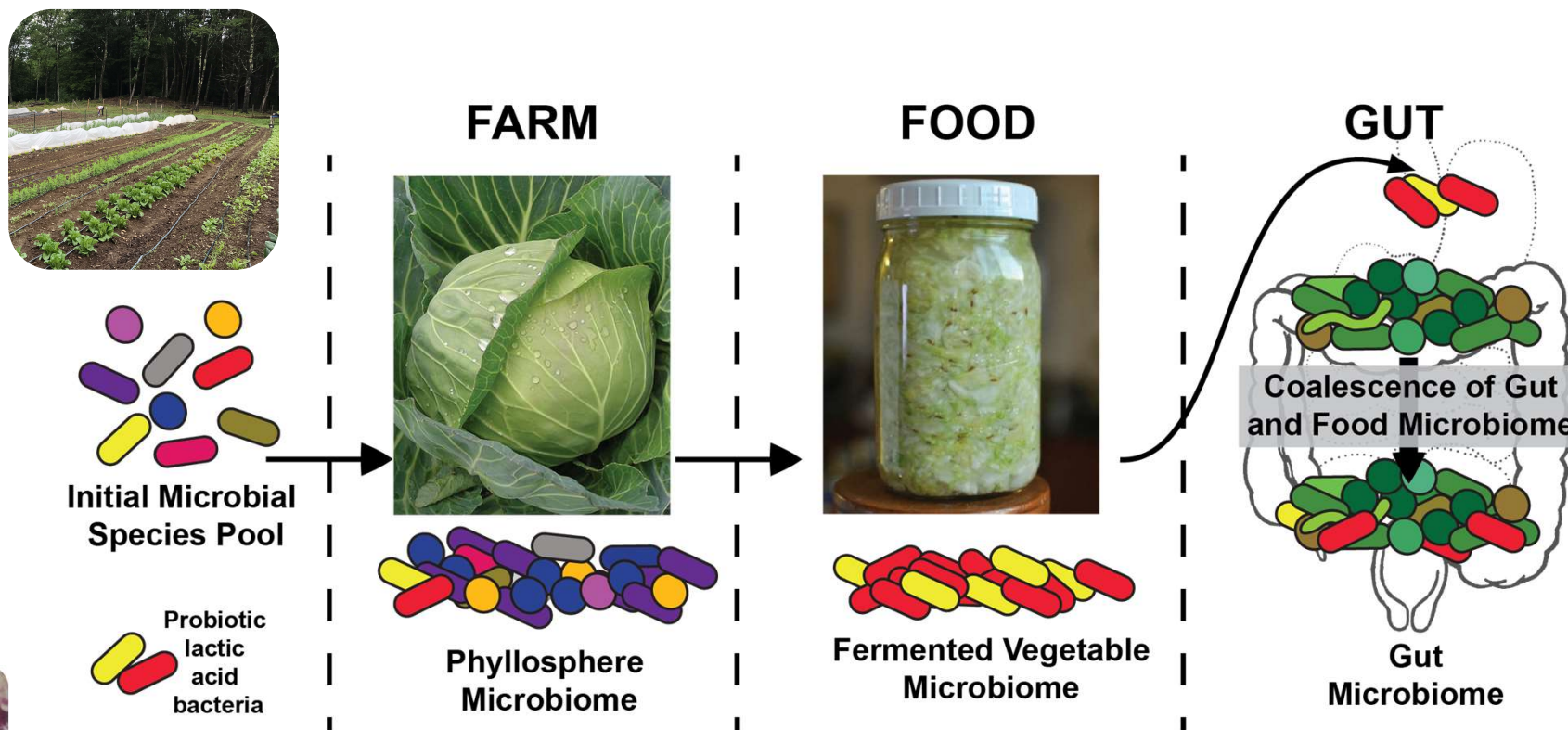


Learning/ Teaching

How can we use fermented foods to promote **microbial literacy**?



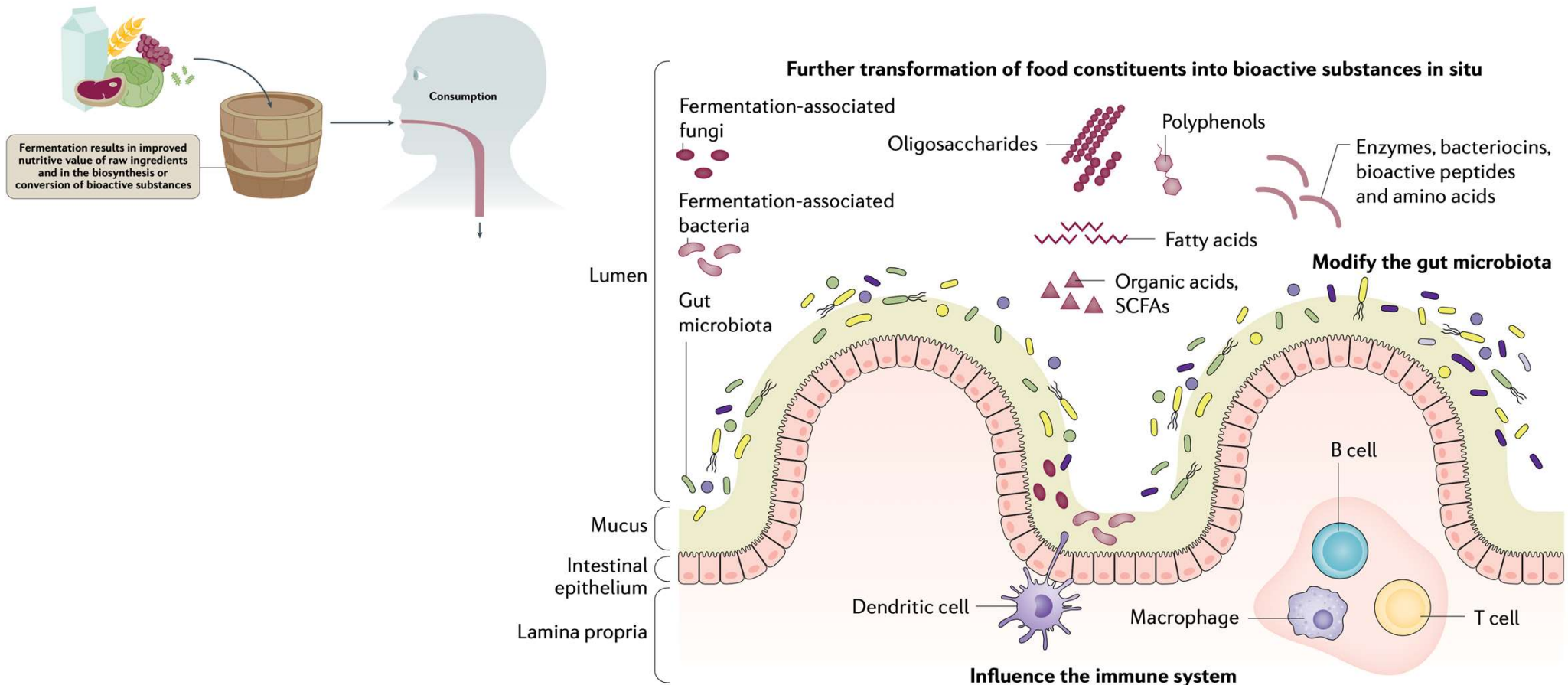
Fermented foods are a farm-to-gut microbial pipeline



Esther Miller

How do fermented food microbes affect human microbiomes?

Positive probiotic functions



How do fermented food microbes affect human microbiomes?

Potential negative functions



Available online at www.sciencedirect.com

ScienceDirect

Current Opinion in
Food
Science



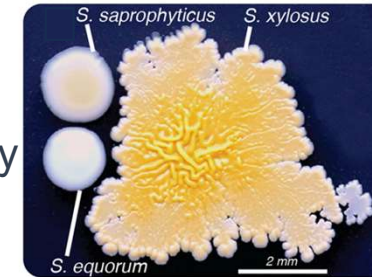
Are fermented foods an overlooked reservoir of antimicrobial resistance?

Benjamin E Wolfe

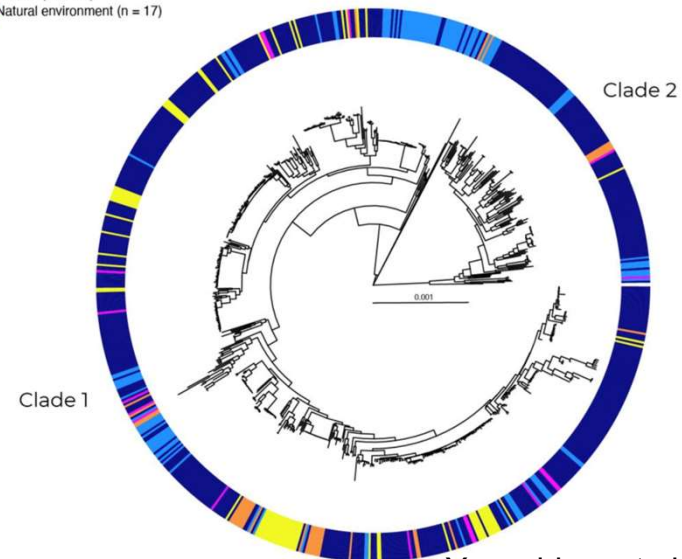
Despite their many cultural, culinary, and health benefits, fermented foods may amplify and disseminate antimicrobial resistance in our food supply. This review summarizes our current understanding of the diversity, distribution, and potential risks of antimicrobial resistance in fermented foods and beverages. Most studies have focused on antibiotic resistance genes (ARGs) in lactic acid bacteria and coagulase-negative *Staphylococcus* species. Resistance to tetracyclines

In addition to their many potential benefits, fermented foods may also harbor microbes with undesirable traits that could pose long-term risks for human microbiomes. Microbes in the food supply that are resistant to antimicrobials have received increased scrutiny over the past several decades as human and animal pathogens have become resistant to clinically important antibiotics [6]. Food may be an important reservoir of both resistant

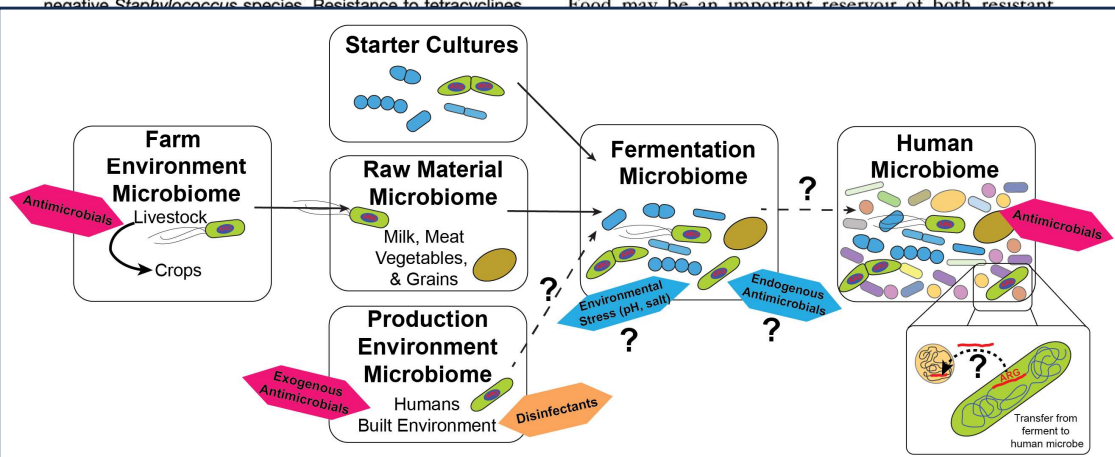
Staphylococcus saprophyticus can cause UTIs and fermented foods may be a source of this bacterium



Isolation Source
 Animal (n = 32)
 Built environment (n = 67)
 Food (n = 105)
 Human (n = 559)
 Natural environment (n = 17)



Youngblom et al., *BioRxiv.*, 2023



Basic science

How do fermented food microbes affect human microbiomes?

Potential negative functions

RESEARCH

MICROBIOTA

Debaryomyces is enriched in Crohn's disease intestinal tissue and impairs healing in mice

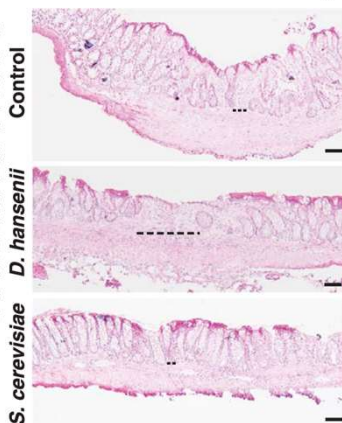
Umang Jain¹, Aaron M. Ver Heul^{1,2}, Shanshan Xiong^{1*}, Martin H. Gregory², Elora G. Demers³, Justin T. Kern¹, Chin-Wen Lai^{1,4}, Brian D. Muegge^{1,2,5}, Derek A. G. Barisas¹, J. Steven Leal-Ekman¹, Parakkal Deepak², Matthew A. Ciorba², Ta-Chiang Liu¹, Deborah A. Hogan³, Philip Debbas⁶, Jonathan Braun⁶, Dermot P. B. McGovern^{6,7}, David M. Underhill^{6,7}, Thaddeus S. Stappenbeck^{1,8†}

Alterations of the mycobiota composition associated with Crohn's disease (CD) are challenging to link to defining elements of pathophysiology, such as poor injury repair. Using culture-dependent and -independent methods, we discovered that *Debaryomyces hansenii* preferentially localized to and was abundant within incompletely healed intestinal wounds of mice and inflamed mucosal tissues of CD human subjects. *D. hansenii* cultures from injured mice and inflamed CD tissues impaired colonic healing when introduced into injured conventionally raised or gnotobiotic mice. We reisolated *D. hansenii* from injured areas of these mice, fulfilling Koch's postulates. Mechanistically, *D. hansenii* impaired mucosal healing through the myeloid cell-specific type 1 interferon–CCL5 axis. Taken together, we have identified a fungus that inhabits inflamed CD tissue and can lead to dysregulated mucosal healing.

When a tissue is injured, appropriate wound healing is necessary to regain function. Wounds can remain chronically nonhealed or inflamed owing to a persistent injury stimulus and/or failure of repair. This occurs in inflammatory bowel disease (IBD), including Crohn's disease (CD) and ulcerative colitis (UC) (1), and is associated with shifts in luminal microbial populations (2–6). The potential link between specific microbes and inflammation in IBD has been of long-standing interest.

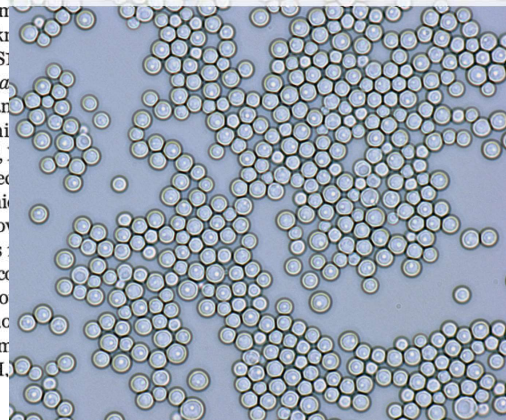
To test the role of microbes in intestinal mucosal repair, we and others have used a biopsy injury model where the timing and site

(7, 8). In phase 1, we characterized and identified that the clinical, necrotic (VNAM) mice of (Fig. 1, A) role for the host prior type in (B to D).



and no significant difference in the relative abundance of any detectable fungal genera in the mycobiota composition when we compared control and VNAM-treated mice (fig. S3). However, similar analysis of ITS amplicons from mucosal wounds showed a single dominant genus, *Debaryomyces*, in the VNAM-pretreated mice but not controls (Fig. 2, A and B). These data from wounds are in contrast to the luminal data, where *Debaryomyces* was low to undetectable in all mice (fig. S3).

To determine if *D. hansenii* was live or dead fungi, we cultured wound beds using fungicide-free Sabouraud agar (SDA) plates (Fig. 2A) (14). We found that only VNAM-pretreated mice contained viable fungal colonies (Fig. 2, C and D). To confirm the identity of the fungus, we performed ITS sequencing of pooled colonies (Fig. 2E). Additional sequencing of the ITS region was performed to identify species and show



Are food yeasts associated with ulcerative colitis treatment outcomes?



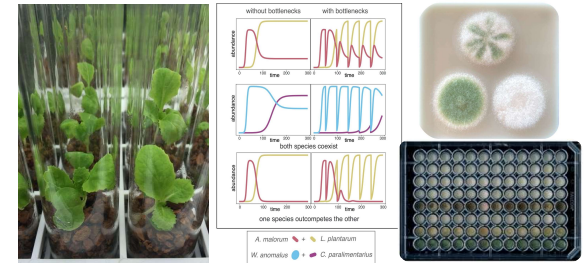
Sushrut Jangi,
Tufts Medicine

Basic science

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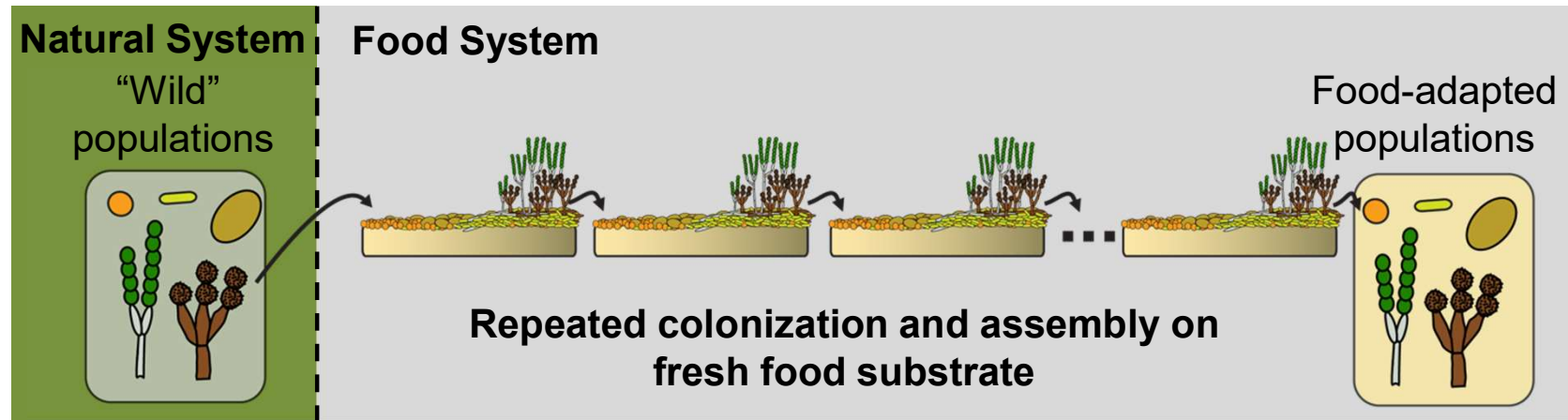


Education

How can we use fermented foods to promote **microbial literacy**?



Fermented food producers create ecological and evolutionary opportunities for microbes

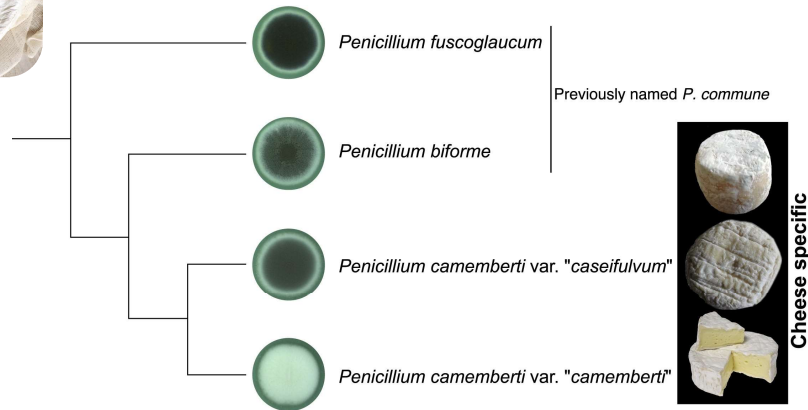


Practicing/Crafting

We know that many food microbes have been domesticated



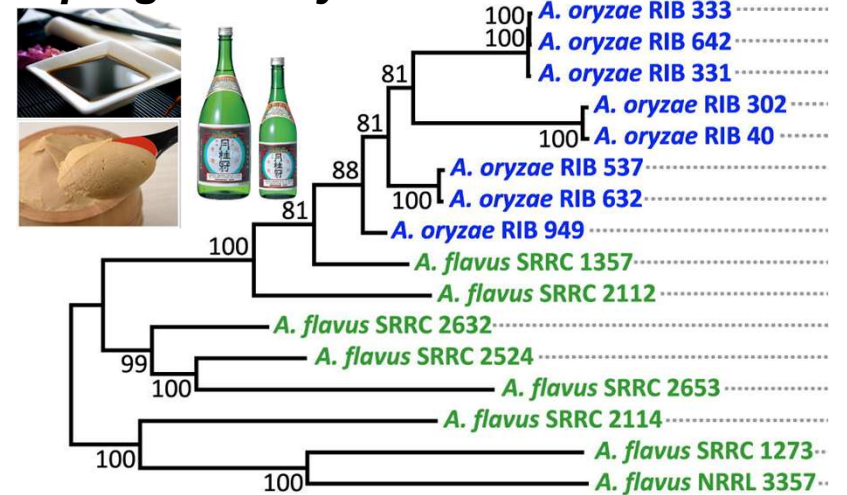
Penicillium camemberti



Ropars et al., *Current Biology*, 2020



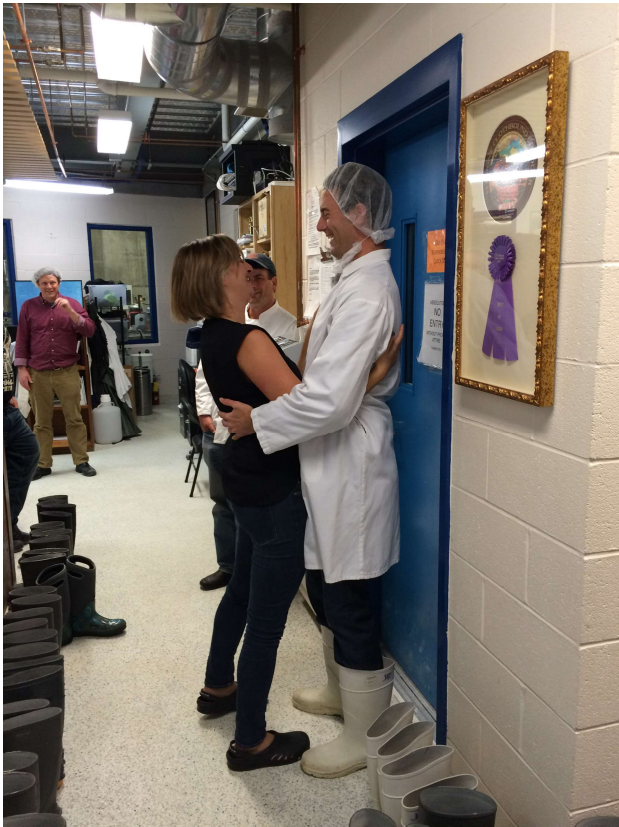
Aspergillus oryzae



Gibbons et al., *Current Biology*, 2012

Can we watch microbial domestication
happen in a food production facility?

A marriage proposal provided a microbial time capsule



Rachel Dutton says “yes!” to her future husband Charlie Kalish

2016



Bayley Hazen
Blue Cheese

Penicillium solitum



A long-term collaboration with Jas allowed us to document **unintentional microbial domestication**



Mateo Kehler



Nicolas Louw

2016



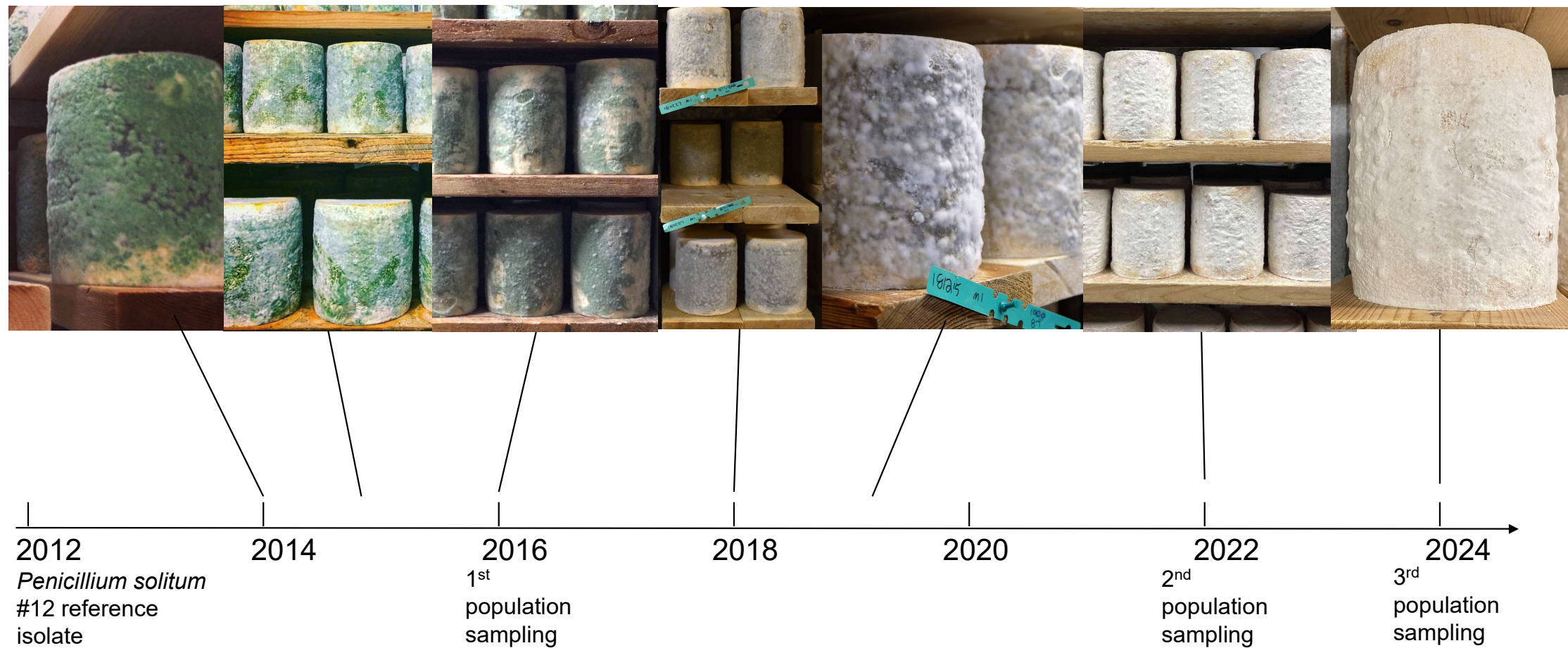
Penicillium solitum



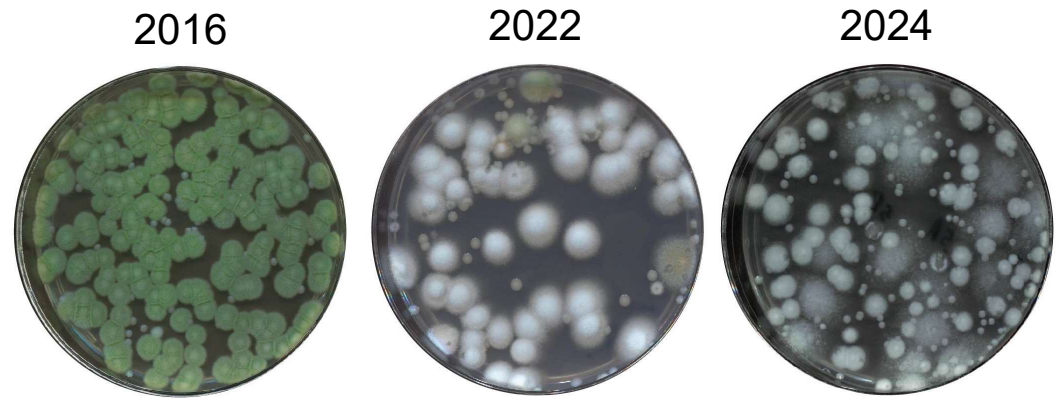
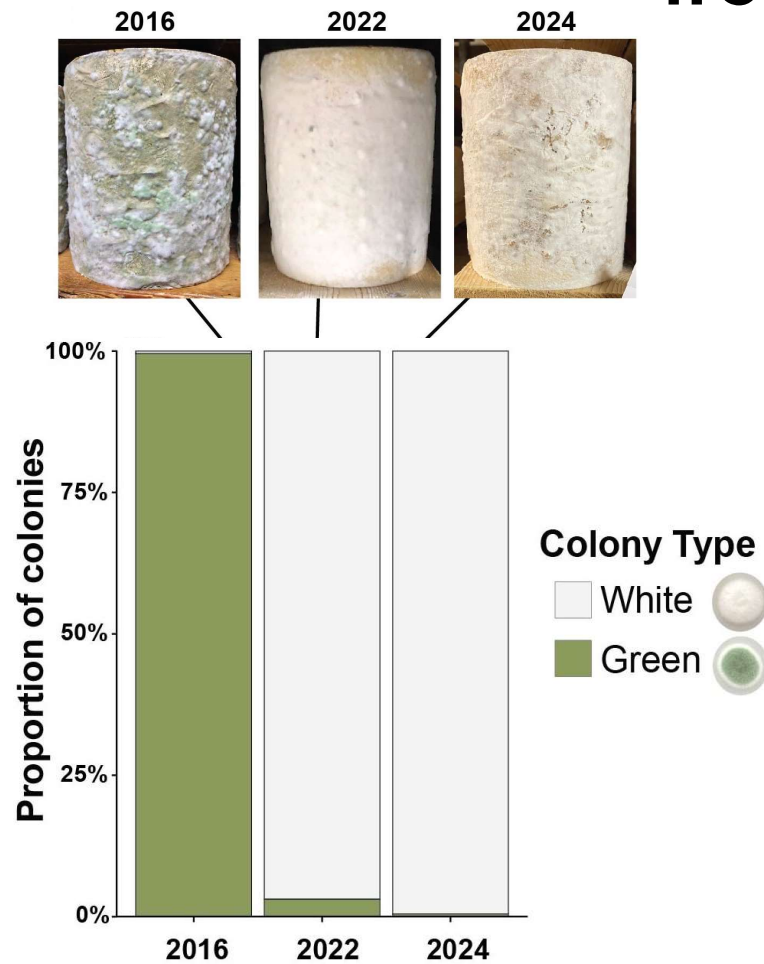
**Bayley Hazen
Blue Cheese**



Social media helped us confirm the green to white transition of *Penicillium solitum*

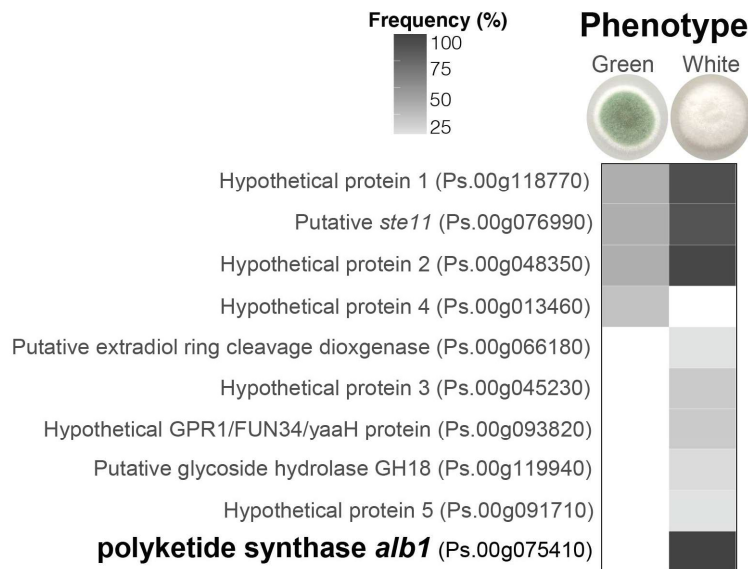


A phenotypic shift in *Penicillium solitum* from green to white



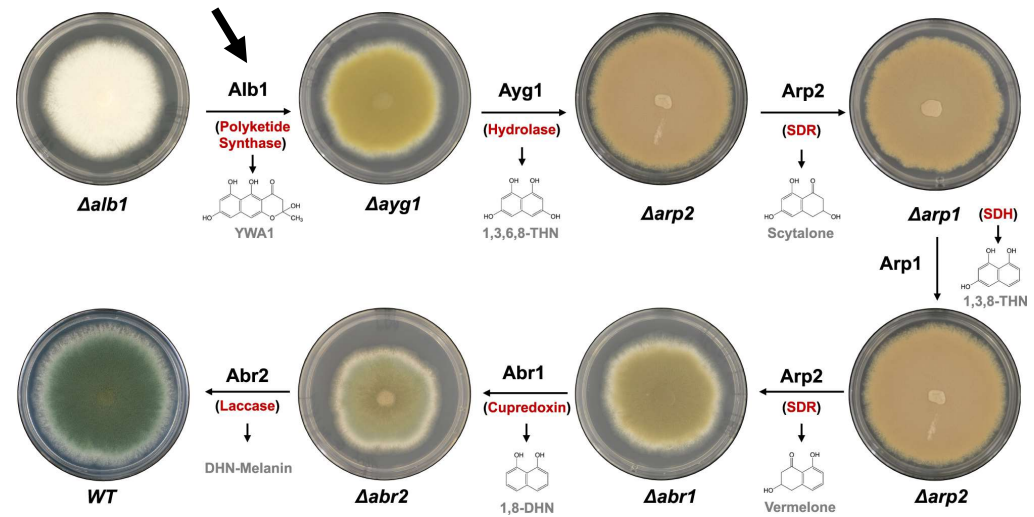
White mutant molds have altered melanin biosynthesis

The only gene with mutations in all white strains (and no green strains) was *alb1*



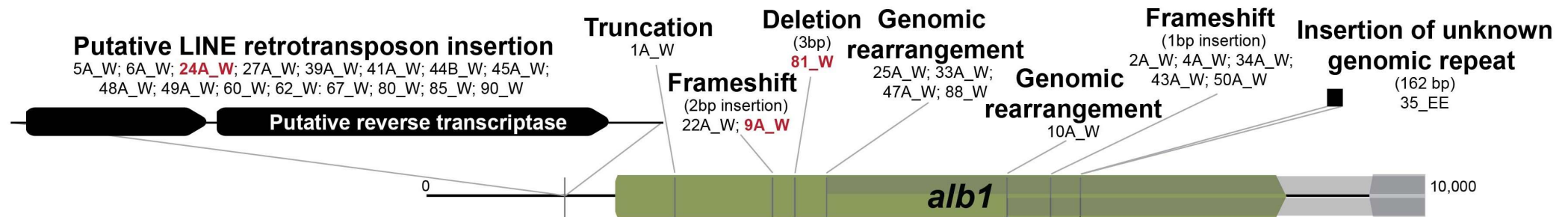
Louw *et al.*, *Curr. Biol.*, 2025

alb1 encodes the first enzyme in the DHN-melanin pathway



Cleere *et al.*, 2024, *npj Sci Food*

A transposable element insertion upstream of *alb1* is the most common mutation in white *Penicillium solitum* strains



P. solitum strain #12



We also experimentally evolved white strains from green strains

Knockout created by Justin Eagan in Keller Lab confirms *alb1* control of pigmentation

Louw *et al.*, *Curr. Biol.*, 2025



Low light levels of cheese caves = loss of melanin?

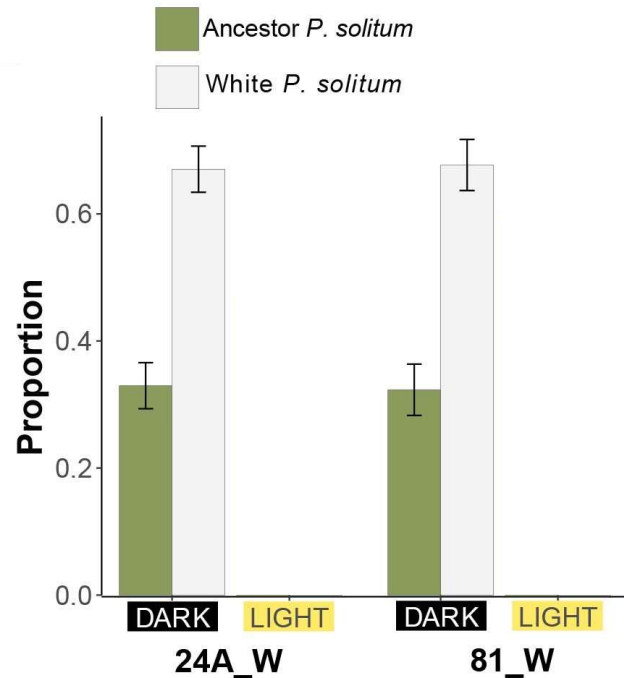


Practicing/Crafting

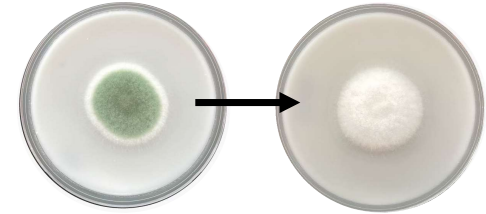
Dark cave environments lead to relaxed selection on melanin production



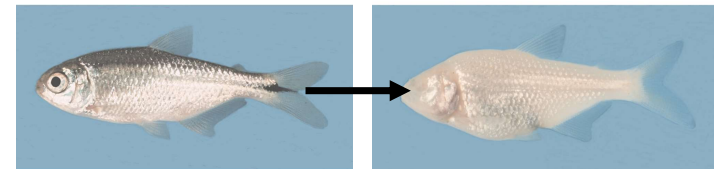
Louw et al., Curr. Biol., 2025



Penicillium solitum



Blind and de-pigmented cavefish



Jeffery et al., (2004)

Practicing/Crafting

Can we harness this **unintentional domestication** process to provide new starter cultures?

The Washington Post
Democracy Dies in Darkness

Food Recipes News How To Dining Newsletter Instagram

Will brie and Camembert cheeses go extinct? Here's what scientists say.

March 6, 2024
CNN travel Destinations Food & Drink News More Watch Listen

Travel / Food & Drink

France's favorite cheese is facing an 'extinction' crisis. Not everyone is worried

By Xiaofei Xu, CNN

6 minute read · Published 5:31 AM EST, Wed March 6, 2024

9 comments



Camembert's distinctive white rind is created by a fungus that scientists say is in increasingly short supply. BSIP/Universal Images Group/Getty Images

Paris (CNN) — When Napoleon first encountered a Camembert cheese, legend has it, he



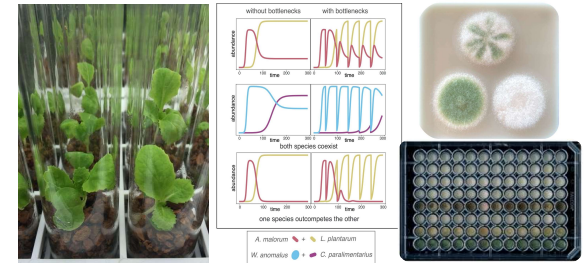
Practicing/Crafting

Basic science

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Some fermented food microbiomes fail, and these failures provide opportunities to learn microbial ecology

Practicing/Crafting

An emerging fungal problem in New England cheese caves

Aspergillus westerdijkiae



<https://doi.org/10.1016/j.fm.2019.05.007>



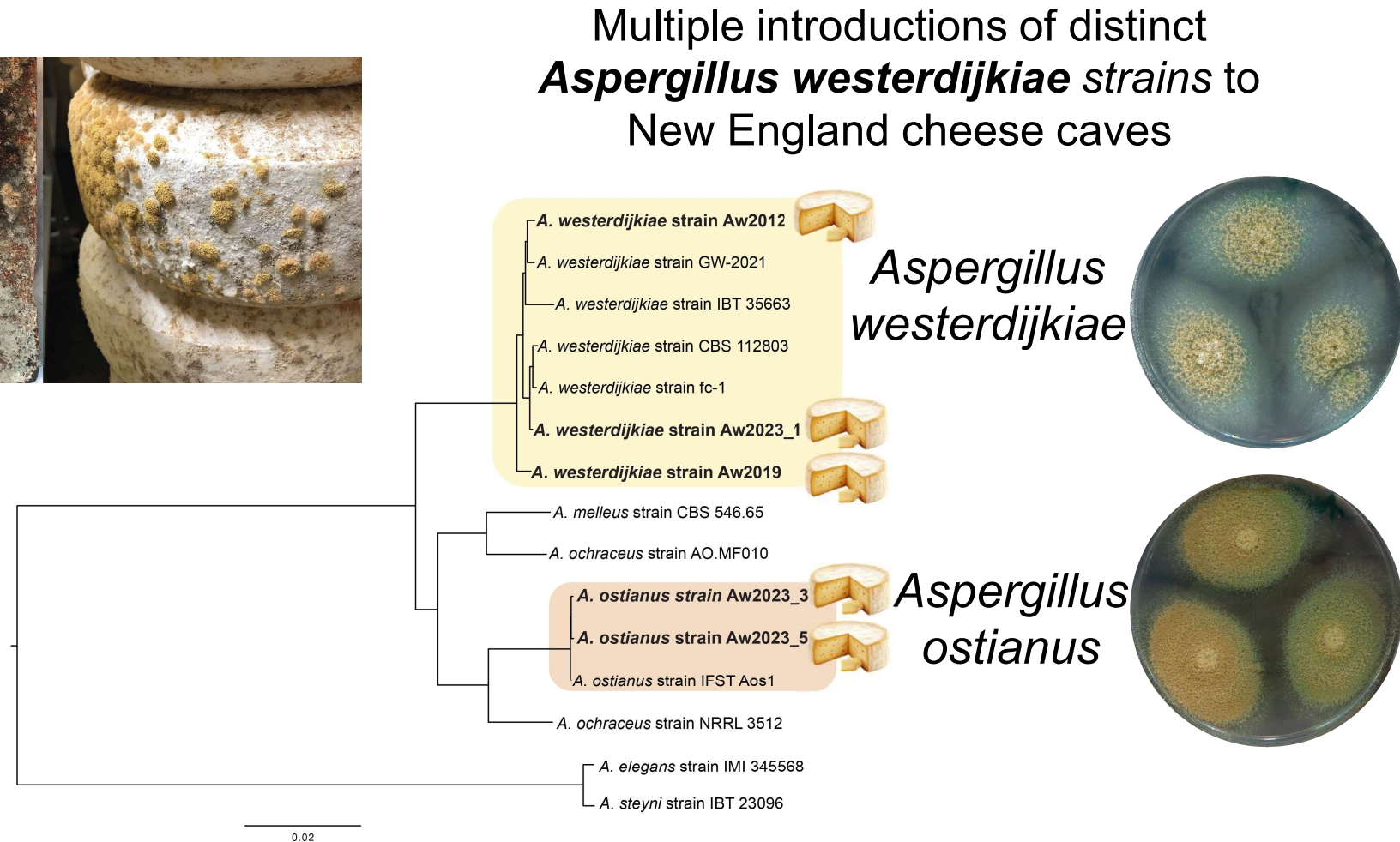
<https://twitter.com/CranMycology>

- Often found in carbon-rich environments such as **coffee**, **cereals**, and **plants**.
- It can also colonize the outside surfaces of aged **meats** and **cheeses**.
- Distinct appearance of yellow dust is due to the production of **yellow conidiophores**
- Produces large quantities of **ochratoxin A**

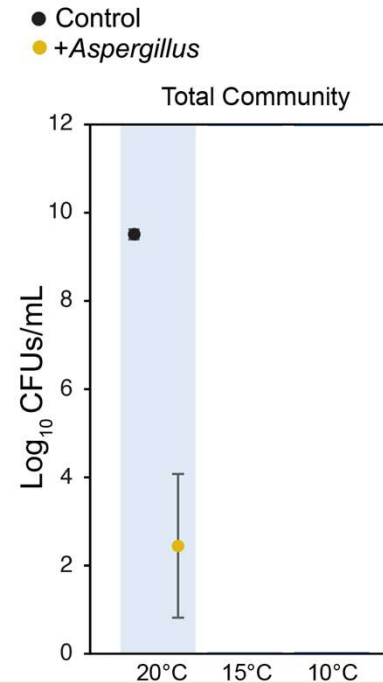
An emerging fungal problem in New England cheese caves



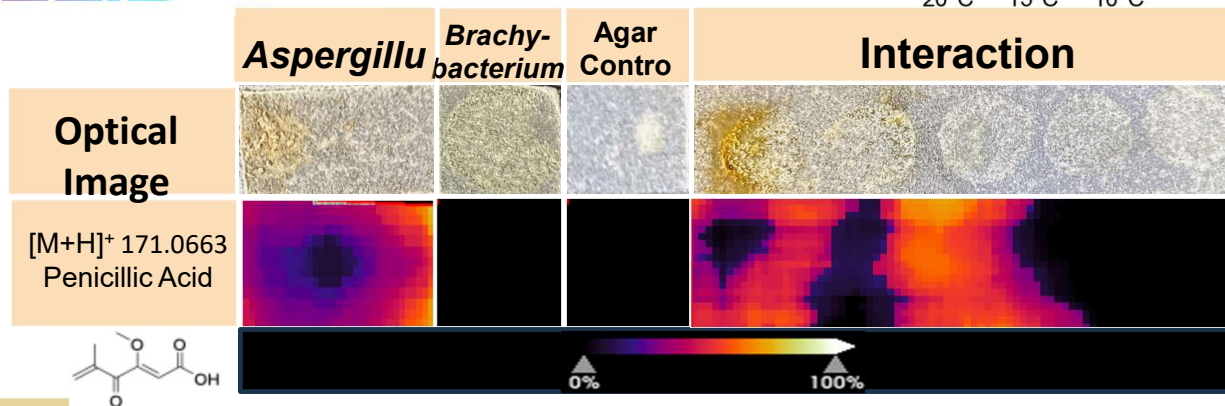
Whole-genome phylogeny
based on 6885 single copy
orthologous genes



A. westerdijkiae is antimicrobial and produces penicillic acid



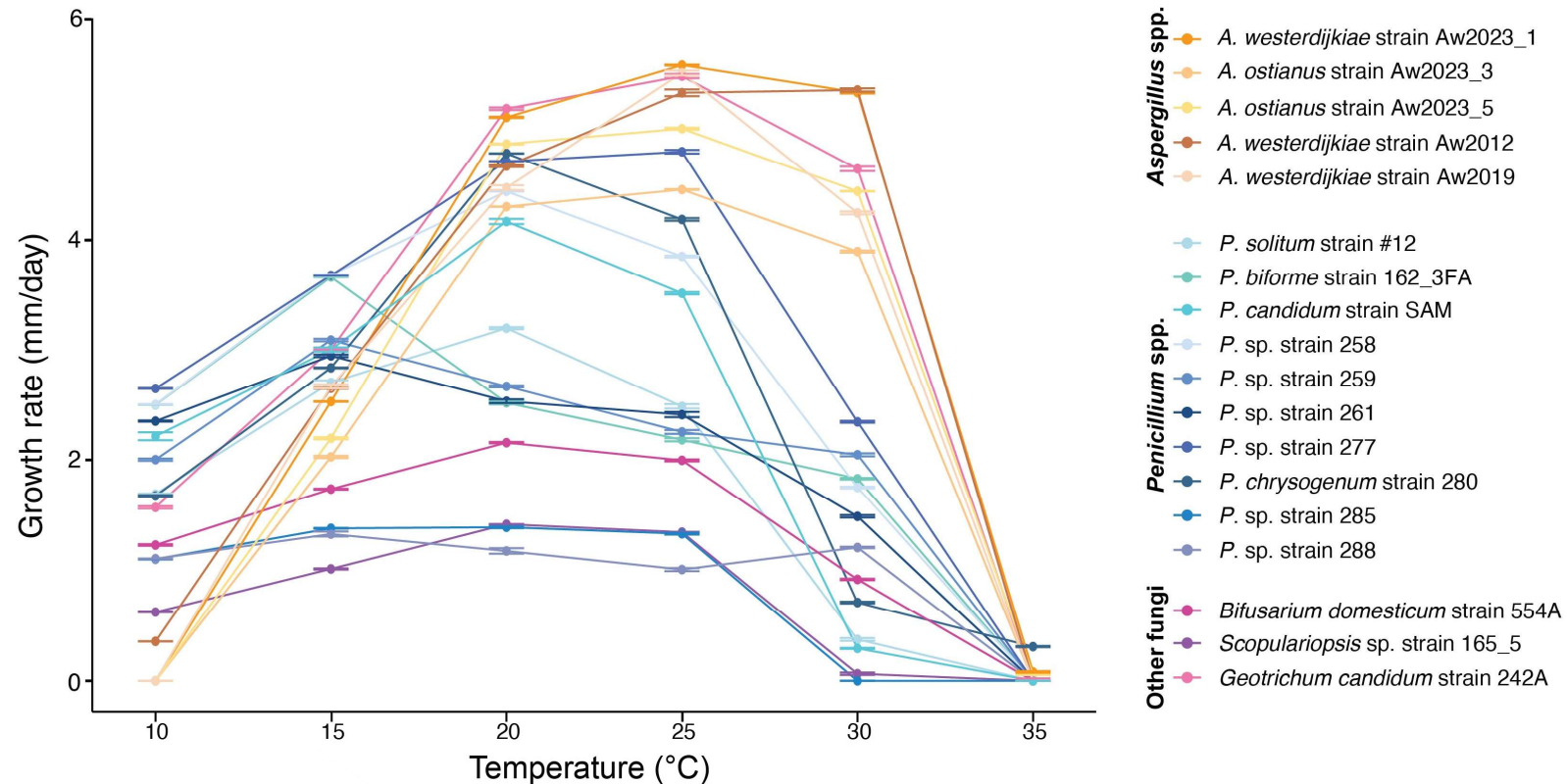
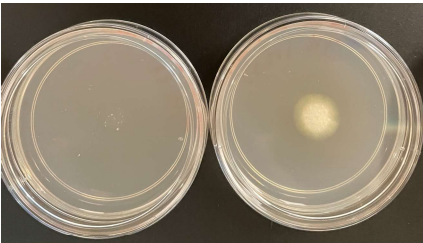
SANCHEZ
LAB



A. westerdijkiae can be easily controlled with colder temperatures

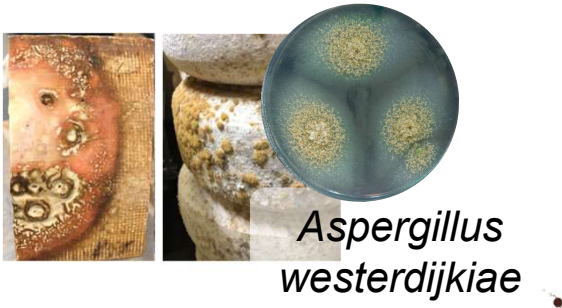
Maintaining low temperatures
(below 12°C/54°F)
can help reduce
the impacts of
Aspergillus in
cheese caves

10°C (~50 °F) 11 °C (~52 °F)

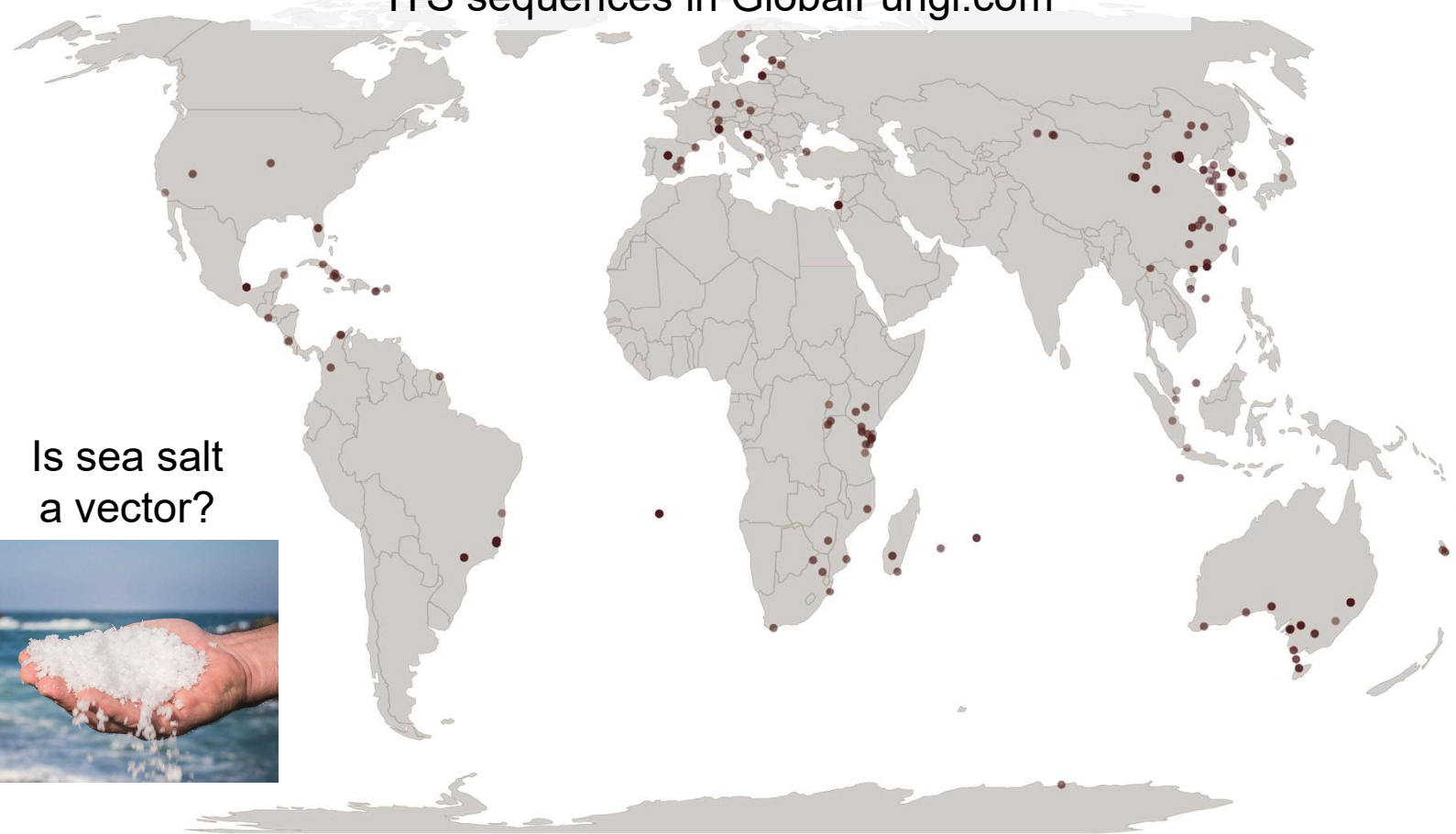


A. westerdijkiae is not naturally found in New England

Global distribution of *A. westerdijkiae* based on ITS sequences in GlobalFungi.com



Is sea salt
a vector?



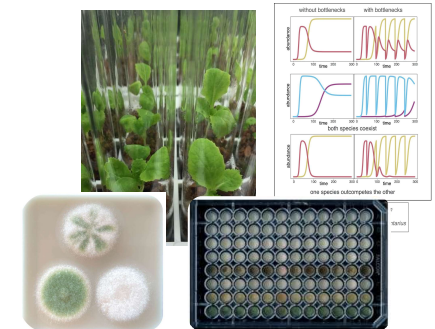
• = *A. westerdijkiae* detected

Basic science

Humans (& their microbiomes) ↔ Fermented food microbiomes

What **ecological/evolutionary** processes
control microbiome assembly and function?

How do fermented food microbiomes
interact with **human microbiomes**?



Practicing/ Crafting

How do **practitioners/practices** affect the
ecology and evolution of food microbes?

Why do some food microbiomes **fail**, and how
can broken food microbiomes be **fixed**?

Can we use microbial ecology/evolution
to develop **novel ferments**?



Education

How can we use fermented foods
to promote **microbial literacy**?

Can we create novel fermented foods using rational design and ecological principles?

CellPress

Current Biology

Review

Novel fermentations integrate traditional practice and rational design of fermented-food microbiomes

Dillon Arrigan¹, Caroline Isabel Kothe², Angela Oliverio³, Joshua D. Evans², and Benjamin E. Wolfe^{1,*}

¹Department of Biology, Tufts University, Medford, MA 02150, USA

²Novo Nordisk Foundation Center for Biosustainability, Sustainable Food Innovation Group, Technical University of Denmark, 2800 Kgs. Lyngby, Denmark

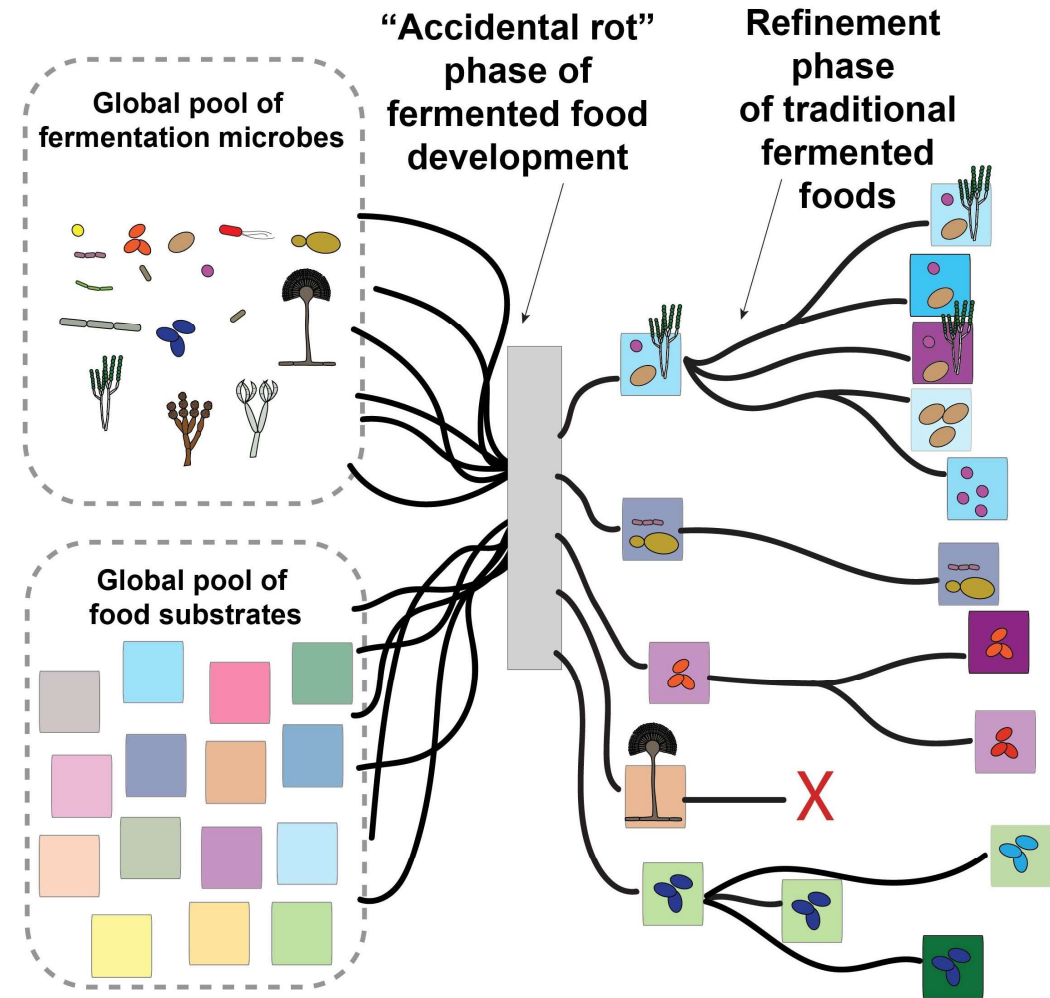
³Department of Biology, Syracuse University, Syracuse, NY 13210, USA

*Correspondence: Benjamin.Wolfe@tufts.edu

<https://doi.org/10.1016/j.cub.2024.09.047>

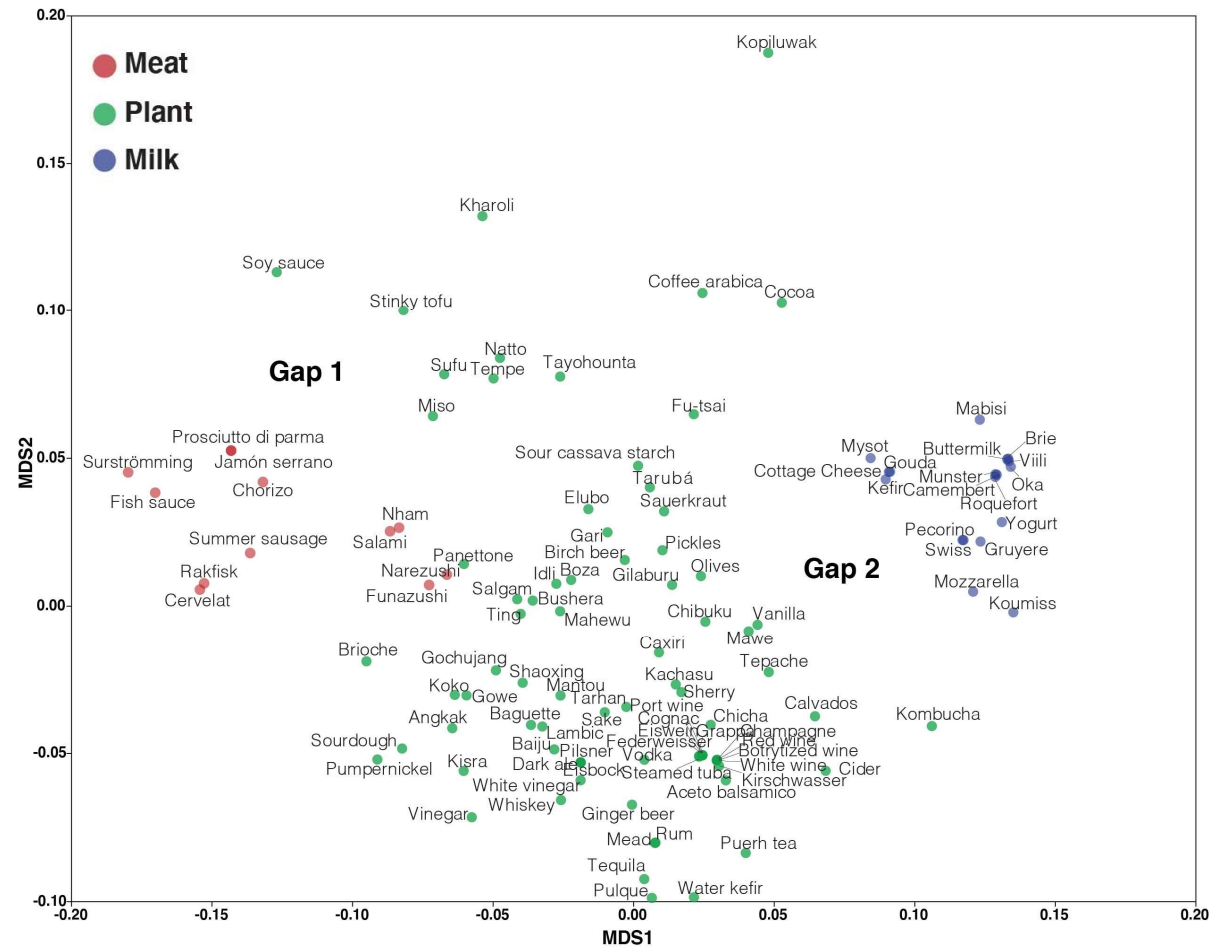
SUMMARY

Fermented foods and beverages have been produced around the world for millennia, providing humans with a range of gastronomic, cultural, health, and scientific benefits. Building on these traditional forms, a convergence of factors, including culinary innovation, globalization, shifts in consumer preferences, and advances in microbiome sciences, has led to the emergence of so-called ‘novel fermentations’. In this review, we define novel fermentation as the confluence of traditional food practices and rational microbiome design. Using principles of microbial ecology and evolution, we develop a microbiological framework that outlines several strategies for producing and characterizing novel fermentations, including switching substrates, engrafting target species, assembling whole-community chimeras, and generating novel phenotypes. A subsequent analysis of existing traditional ferments points to gaps in ‘fermentation space’ where novel ferments could potentially be produced using new combinations of microbes and food substrates. We highlight some important safety and sociocultural issues presented by the repurposing and modification of microbes from traditional ferments that fermented-food producers and microbiologists need to address.



Practicing/Crafting

Gaps in “fermentation space” suggest potential for new combinations of substrates and communities



Novel fermentations integrate ecological principles, synthetic biology, and traditional practice

Novel substrates for oncom fungus



Maini Rekdal et al,
Nat. Microbiol., 2024

White blue cheese



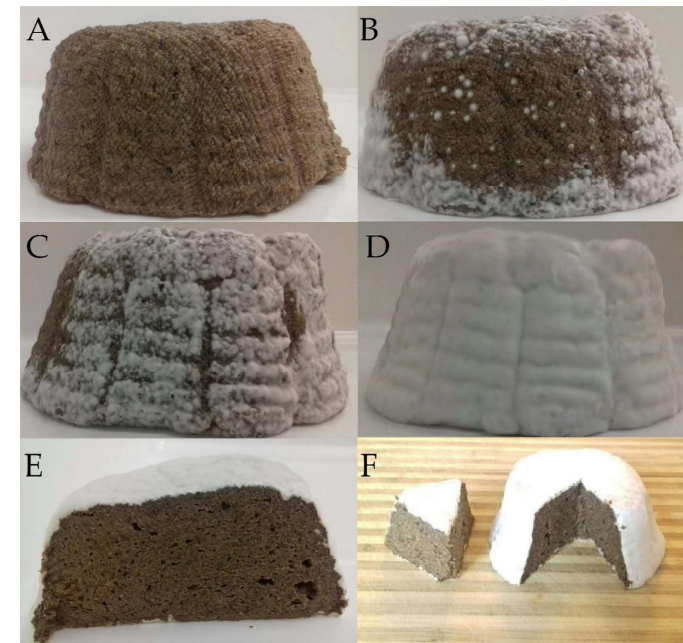
Cleere et al,
npj Sci. Food, 2024

Koji Camembert



Hayashida et al,
J. Dairy Sci., 2023

Flaxseed Camembert



Lopusiewicz et al.,
Microorganisms, 2020

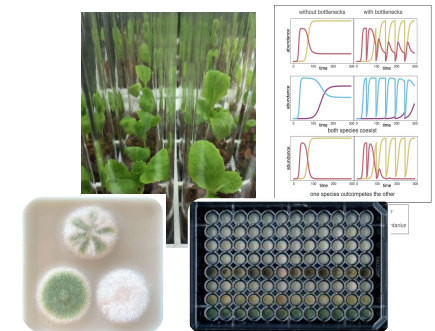
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My lab is now offering food microbiome testing services

The Wolfe Lab @ Tufts University

RESEARCH TEACHING AND OUTREACH PEOPLE PUBLICATIONS OPEN LAB
FOOD MICROBIOME TESTING SERVICES

Food Microbiome Testing Services

We are excited to begin offering **food microbiome testing services** to both professional and home fermenters. We provide a range of services to help food producers **identify** the microbes in their food products, **diagnose** microbial defects, and understand how to **control** microbes that determine food quality.

This work will provide actionable knowledge for food producers and enthusiasts while also providing training opportunities for students at Tufts. By working with our lab, you can get critical data to support your food production and can also support the microbial ecology research in our lab.

Please see [our services page](#) for more details on the range of tests.



3. Fermented food microbiome profile (culture)

Are you working with a complex community of microbes in **fermented vegetables, kombucha, cheese, salami** or other products? Or are you developing a product where your cultures you are adding are developing a proper community? Our fermented food microbiome profile builds on **over 10 years** of experience to isolate and identify the dominant molds, yeasts, and bacteria in your ferment.



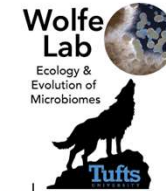
What foods to test: This service works on any fermented food. For sourdough starter profiling, see our Sourdough Starter Profiling page.

What to send: Please see our [sample preparation and shipment page](#) for details.

How our testing works: We will isolate the dominant bacteria and fungi in your ferment. Specific isolation approaches will depend on your particular food. Within two weeks of receiving your sample at our lab, you will receive a report providing photos of your microbes, their identities, and basic information about what is known about their roles in fermentation.

Cost: \$325 per sample

Please email completed form to wolfelab@tufts.edu. Please also include a copy with your samples.



Food Microbiome Testing Services

Test options:

1. Targeted microbial isolation/identification
 2. Sourdough starter microbiome profile
 3. Fermented food microbiome profile (CULTURE)
 4. Fermented food microbiome profile (METAGENOMIC)
- (see <https://sites.tufts.edu/wolfelab/food-microbiome-testing-services/service-options/>)

Submitter information:

Submitter's name:	
Submitter's email*:	
Submitter's phone number:	
Submitter's address:	

* results/inquiries will be sent to this email address.

Ship samples to:

Wolfe Lab at Tufts University
200 College Ave., Room 103
Medford, MA 02155
wolfelab@tufts.edu
ph: 617-627-0694

Sample information:

Sample ID	Test Option 1-4 (see above)	Notes:

Sample submission:

See [our website](#) for more details on how to collect and ship samples. Samples must arrive by end of day on Thursday. We cannot receive samples on the weekend. Please ship samples to the address indicated above. Make sure samples have labels that match the "Sample IDs" noted above.

Notices and agreements:

By submitting this form, you acknowledge that you have read and agreed to the notices below.

Notice about data usage/claims: The data generated by the ordered tests are only to be used for informational purposes to understand your food/product/submission. The data cannot be used for food safety, health/nutrition claims, or for marketing purposes.

Notice about sample/data privacy: Data generated from submitted samples will be stored in password-protected databases that will not be shared outside of the Wolfe Lab. Product names and info will not be associated with samples as they are processed or when data is stored. Samples will be destroyed through autoclaving and biohazardous waste disposal after data has been generated.

wolfelab@tufts.edu

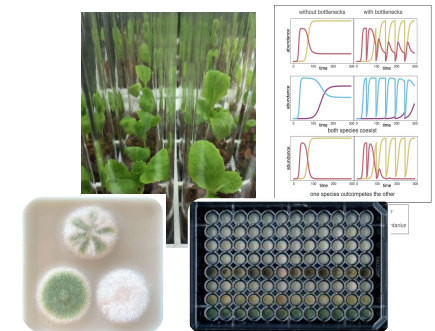
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Education

How can we use fermented foods to promote **microbial literacy**?



Microbial literacy should be a priority as microbiome science continues to develop as a field

The public has a limited understanding of microbes and microbiomes

As microbiologists and microbiology educators, we have not formerly assessed **public understanding of microbes/microbiomes**

What is a microbe?

Differences between bacteria, viruses, fungi, etc...

Difference between “good” and “bad” microbes

How do our lifestyles and actions affect our interactions with microbes?

Education

Hidden virus inside gut bacteria linked to doubled colorectal cancer risk, study finds

Researchers found colorectal cancer patients twice as likely to carry a virus within common intestinal bacterium

By Deirdre Barndt Fox News

Published February 21, 2026 1:54pm EST

Facebook Twitter YouTube Instagram LinkedIn

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A new study suggests a virus living inside common gut

Doctors have known for years that Bacter with colorectal cancer, which includes ca healthy people also carry the bacteria, it v cases and not others.

So researchers looked at subtle genetic something unexpected.

Scientists find a new clue to help them identify a healthy gut microbiome

FEBRUARY 27, 2026 - 4:44 AM ET

HEARD ON MORNING EDITION

By Will Stone

3-Minute Listen

PLAYLIST

TRANSCRIPT

Scientists are still trying to identify what a healthy gut microbiome looks but new research may offer a clue.

Considering a gut microbiome test? Read this first.

New research has found that at-home gut microbiome tests lack standardization, resulting in different results from the same stool sample.

February 27, 2026

7 min

Summary

8

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A common killer bug is endangering Americans: 'Pandemic in plain sight'

As Group A strep continues to rise, the Murdoch Children's Research Institute shares efforts toward a vaccine

By Dr. Marc Singal, Melissa Rudy Fox News

Published May 2, 2023 5:00am EDT



Invasive Group A strep poses significant threat, doctor warns

Dr. Joshua Ozowski, team leader and senior research fellow at the Murdoch Children's Research Institute in Melbourne, Australia, speaks about the risks of invasive Group A strep and the progress toward a vaccine.

CNN Health

HEALTH - 3 MIN READ

What to know about the Nipah virus

JAN 20, 2025

By Michael Thompson



Health Organization says

are viruses in an

people it infects, via where the first as measles, significantly more

Fermented foods provide delicious opportunities to promote microbial literacy

Food Producers



TuftsNow
‘These Cheeses Have a Life, They Have a Story’
After a microbiology workshop, cheesemakers and mongers have a new way to talk about their tasty, funky products



Cheesemakers and cheese mongers gathered for a workshop in microbiologist Ben Wolfe's laboratory to learn more about the ways in which their cheeses are impacted by microbes. Photo: Jenna Schell

“The workshop gave me more language, more specificity, and it reconfirmed what I already knew,” Norton explained. “These cheeses have a life. They have a story.”



The Public



Thank you!!

The Wolfe Pack



NORTHEAST DAIRY BUSINESS INNOVATION CENTER



Collaborators

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Cobus Visagie, Univ. Pretoria

Joanna Tannous, Oak Ridge National Lab

Laura Sanchez, UC Santa Cruz

Lawrence Uricchio, Tufts University

Angela Oliverio, Syracuse University

