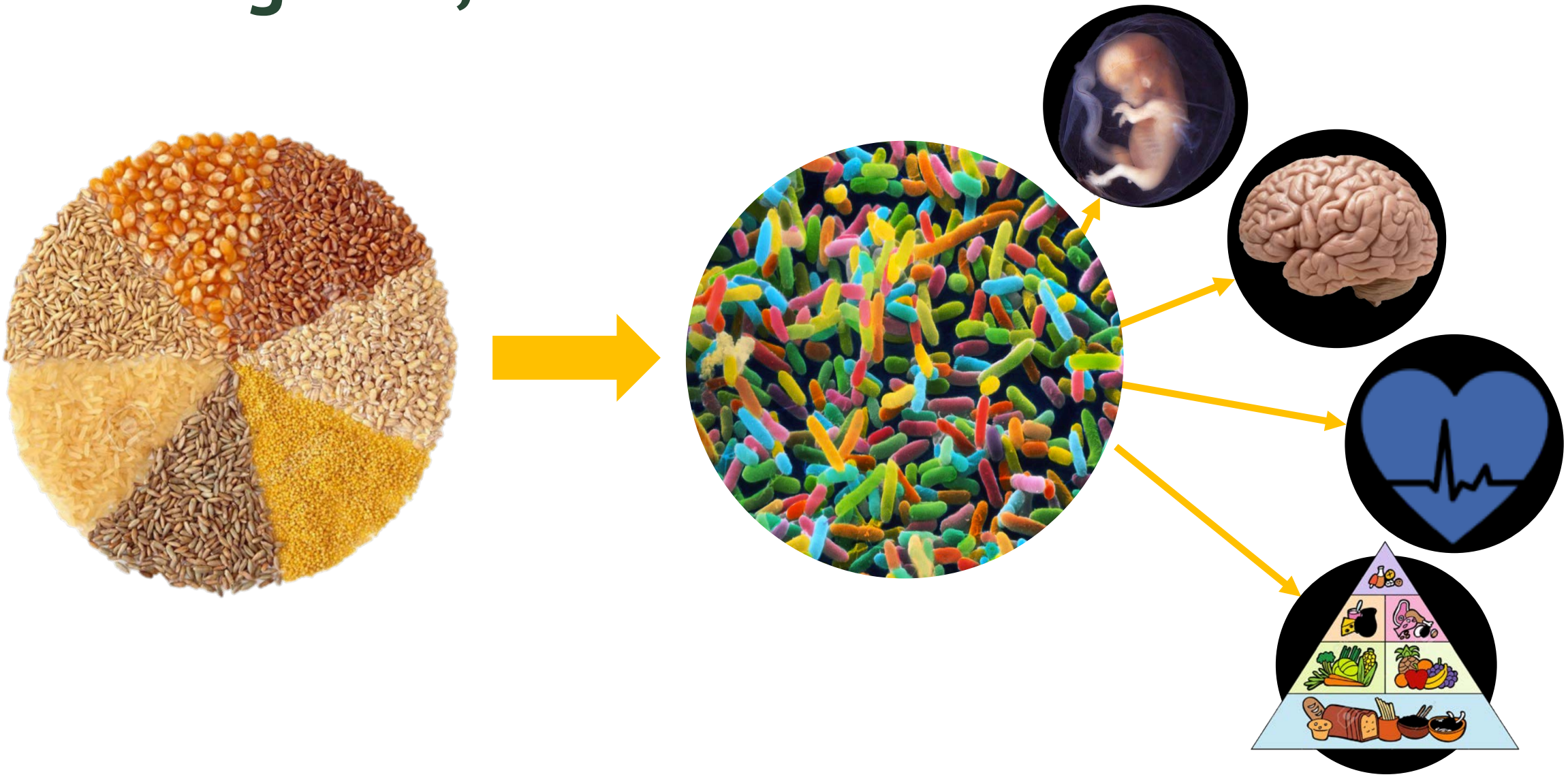
Sourdough

Erin McKenney, MS, PhD
Department of Applied Ecology
North Carolina State University

rediscover goodness
OLDWAYS

Whole grains, holistic health.



Overview

- HOW to grow a starter
- WHY sourdough is so popular
- WHAT is happening in that jar

photo credit: Lauren Nichols

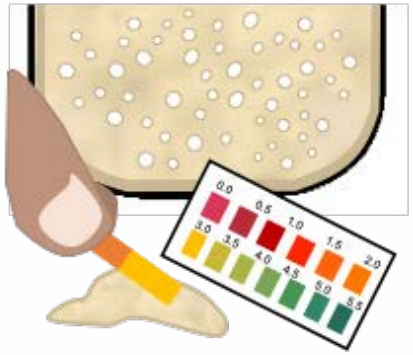
OLDWAYS WHOLE GRAINS COUNCIL

rediscover goodness OLDWAYS

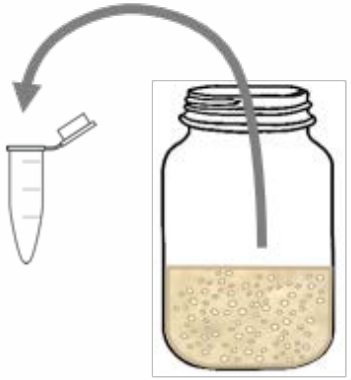
1 – How to make a starter

1. Mix flour and water.

2. Measure height.



3. Measure pH.



4. Sample for sequencing.

5. Backslop.

6. Add fresh flour and water. Mix.

7. Repeat steps 2-6 daily for two weeks.

OLDWAYS WHOLE GRAINS COUNCIL

rediscover goodness OLDWAYS

Smelling your starter

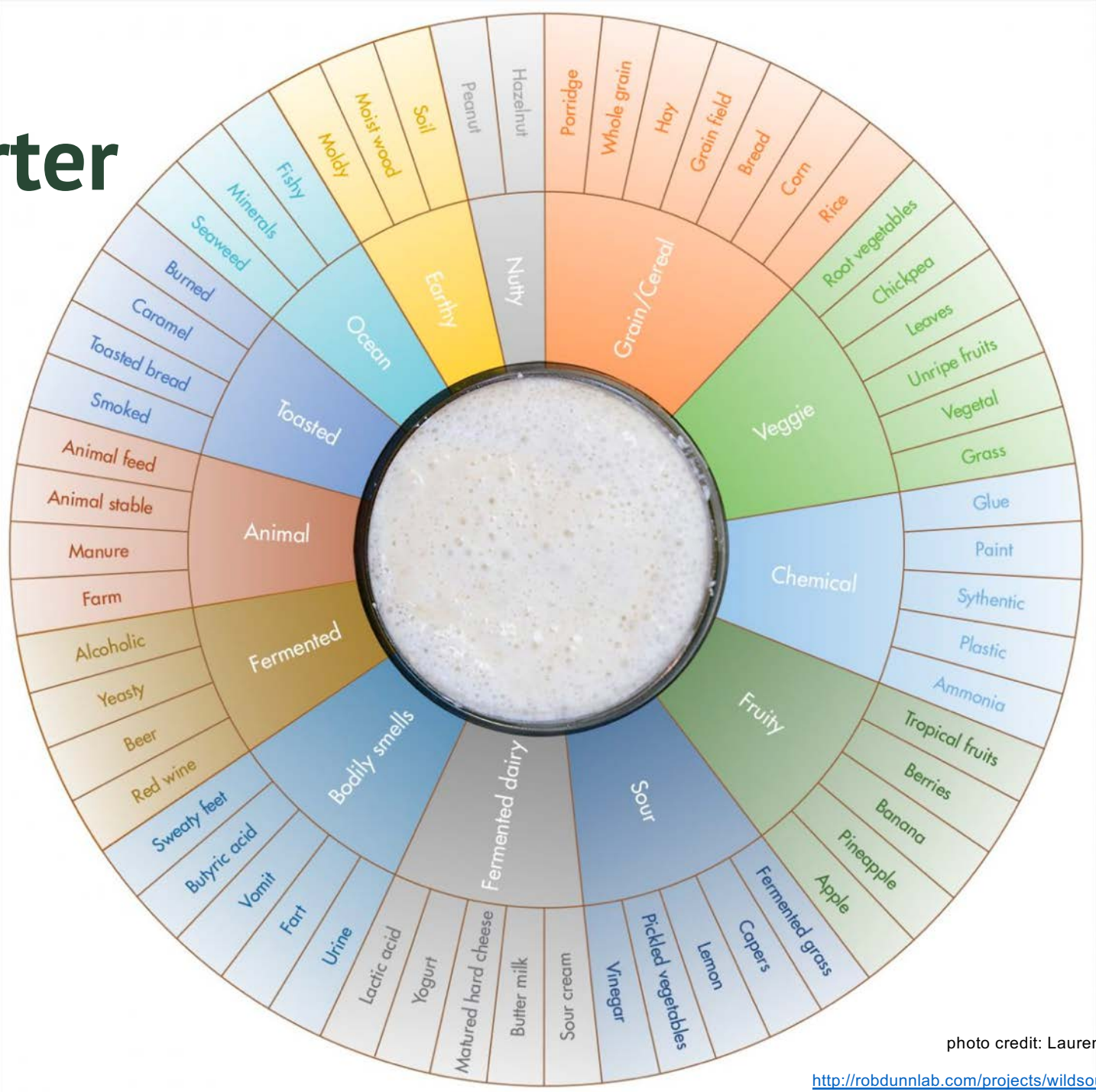


photo credit: Lauren Nichols

http://robdunnlab.com/projects/wildsourdough/

2 – Why is sourdough so popular?

photo credit: Lauren Nichols

OLDWAYS WHOLE GRAINS COUNCIL

rediscover goodness OLDWAYS

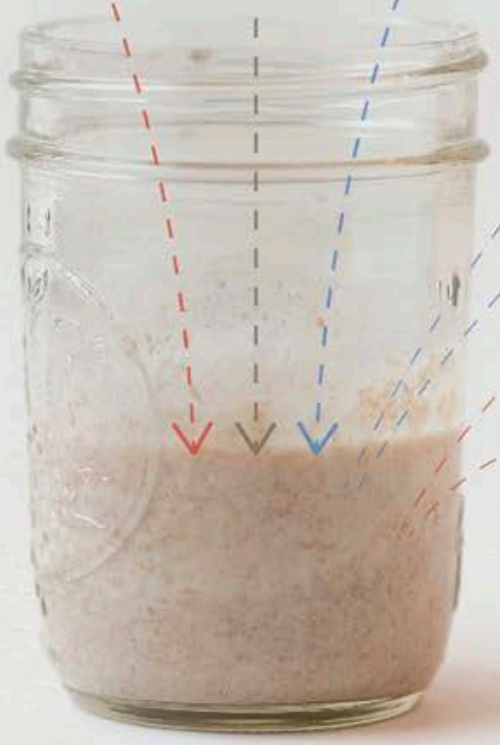

CORNBREAD
MIX
SCONE
MIX
SCONE
MIX
save $1.80
save 30¢
save 30¢
local
local
local
$3.99
ORGANIC
ORGANIC
local
save 70¢
BREAD FLOUR
ORGANIC
BREAD FLOUR
ORGANIC
local
local
save 70¢
save 60¢
$2.99

Science of Sourdough

BACTERIA
from the environment

YEAST
from the environment (only the acid-tolerant yeasts survive!)

FLOUR
sugar & starch is food for the microbes



Acid
produced by bacteria
also produces sour flavor

Acid
produced by bacteria
keeps other microbes from growing

Aromas
produced by yeast
contribute to complex
flavors and smells

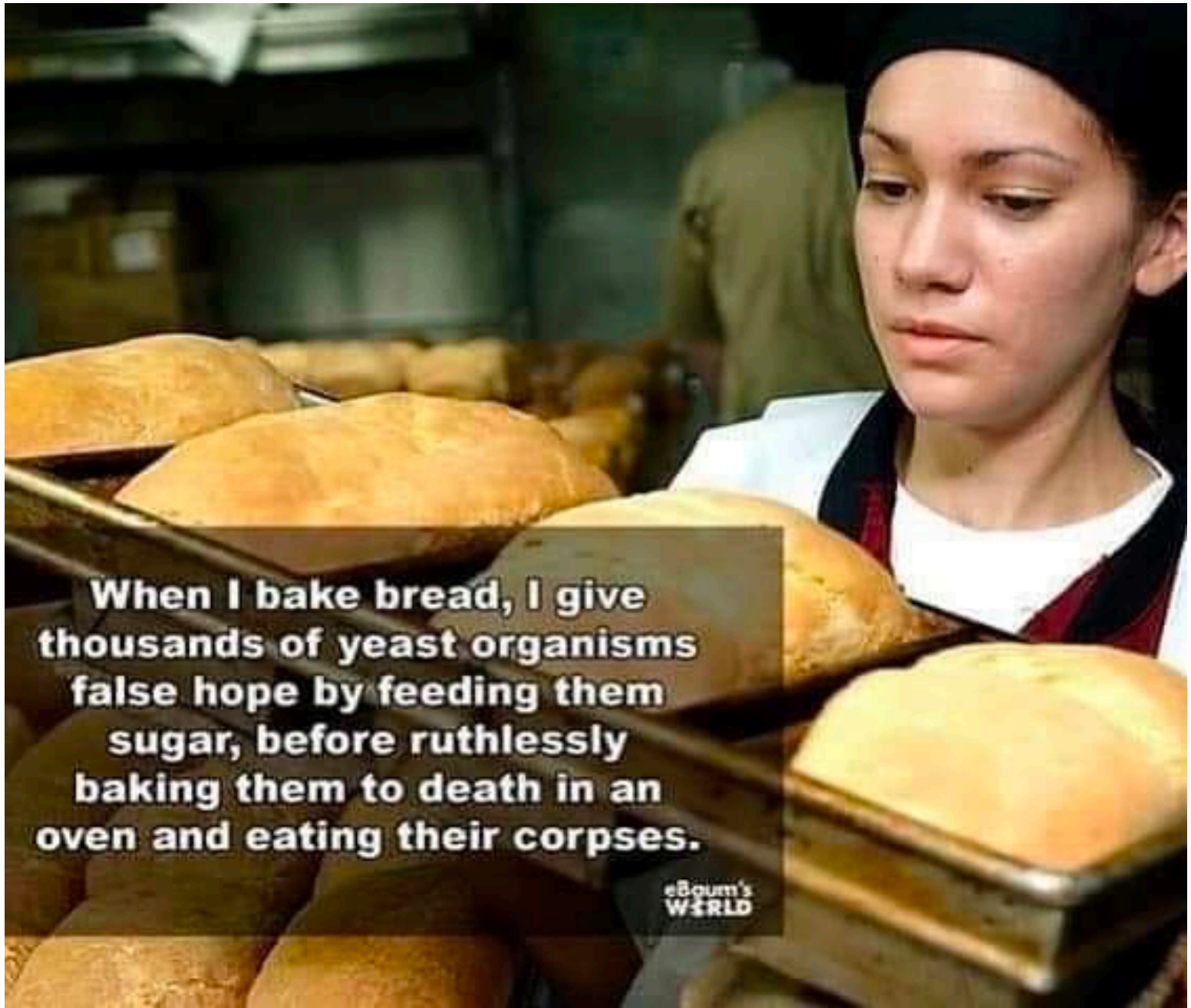
CO^2
produced by yeast
makes bread rise
and affects
texture

PHOTOS BY LAUREN NICHOLS

Sourdough is a PRE-biotic.

OLDWAYS WHOLE GRAINS COUNCIL

rediscover goodness OLDWAYS



OLDWAYS WHOLE GRAINS COUNCIL

rediscover goodness
OLDWAYS

Health benefits of sourdough

- vitamins B and K

- reduced glycemic index

- reduced gluten sensitivity

OLDWAYS WHOLE GRAINS COUNCIL

rediscover goodness OLDWAYS

photo credit: Lauren Nichols

rediscover goodness
OLDWAYS

3 – What is happening in that jar??

photo credit: Lauren Nichols

NOTE: The following slides contain unpublished results.
Please do not share any of the images or figures.

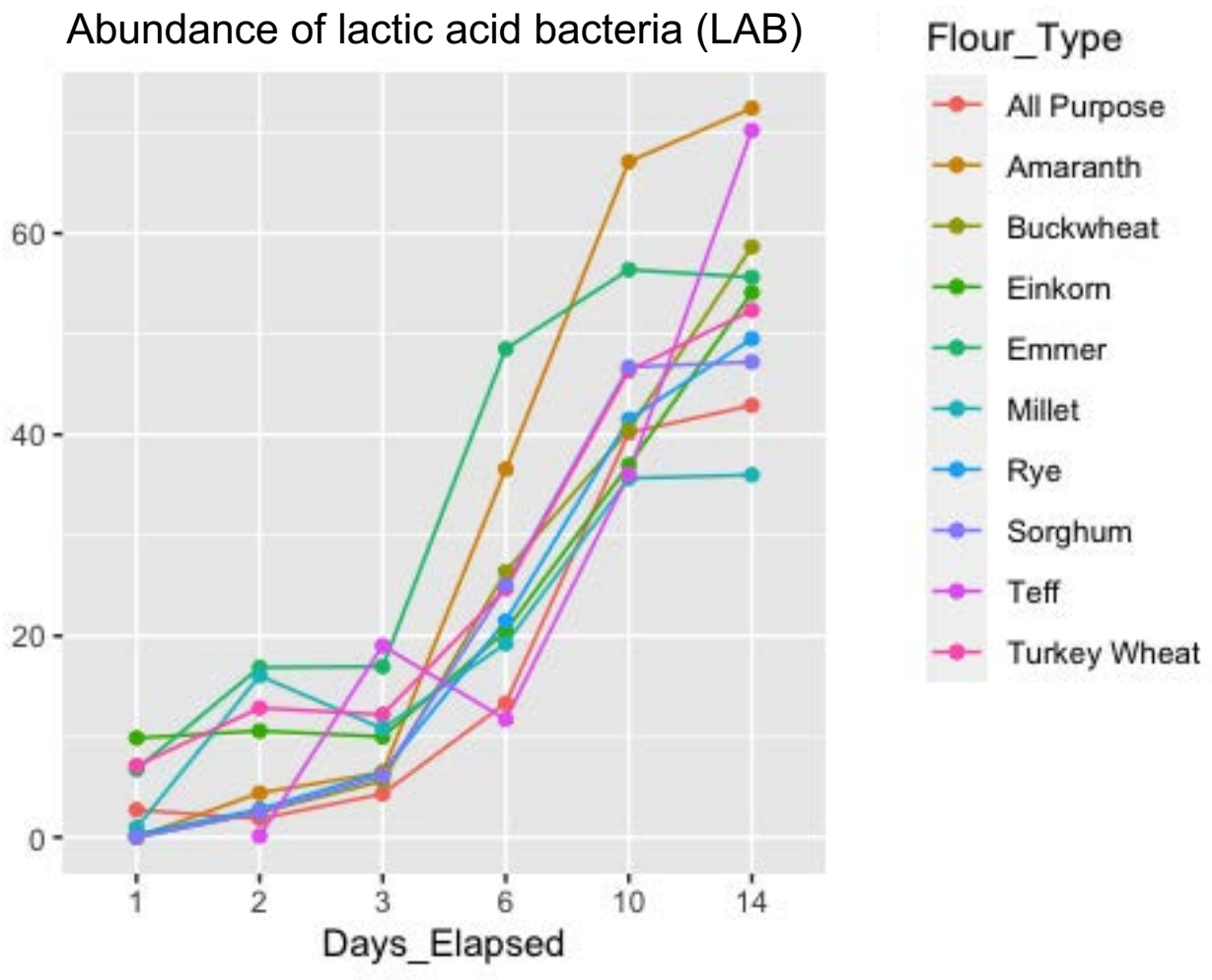
OLDWAYS WHOLE GRAINS COUNCIL

rediscover goodness
OLDWAYS

http://studentsdiscover.org/lesson/sourdough-for-science/
http://robdunnlab.com/projects/wildsourdough/

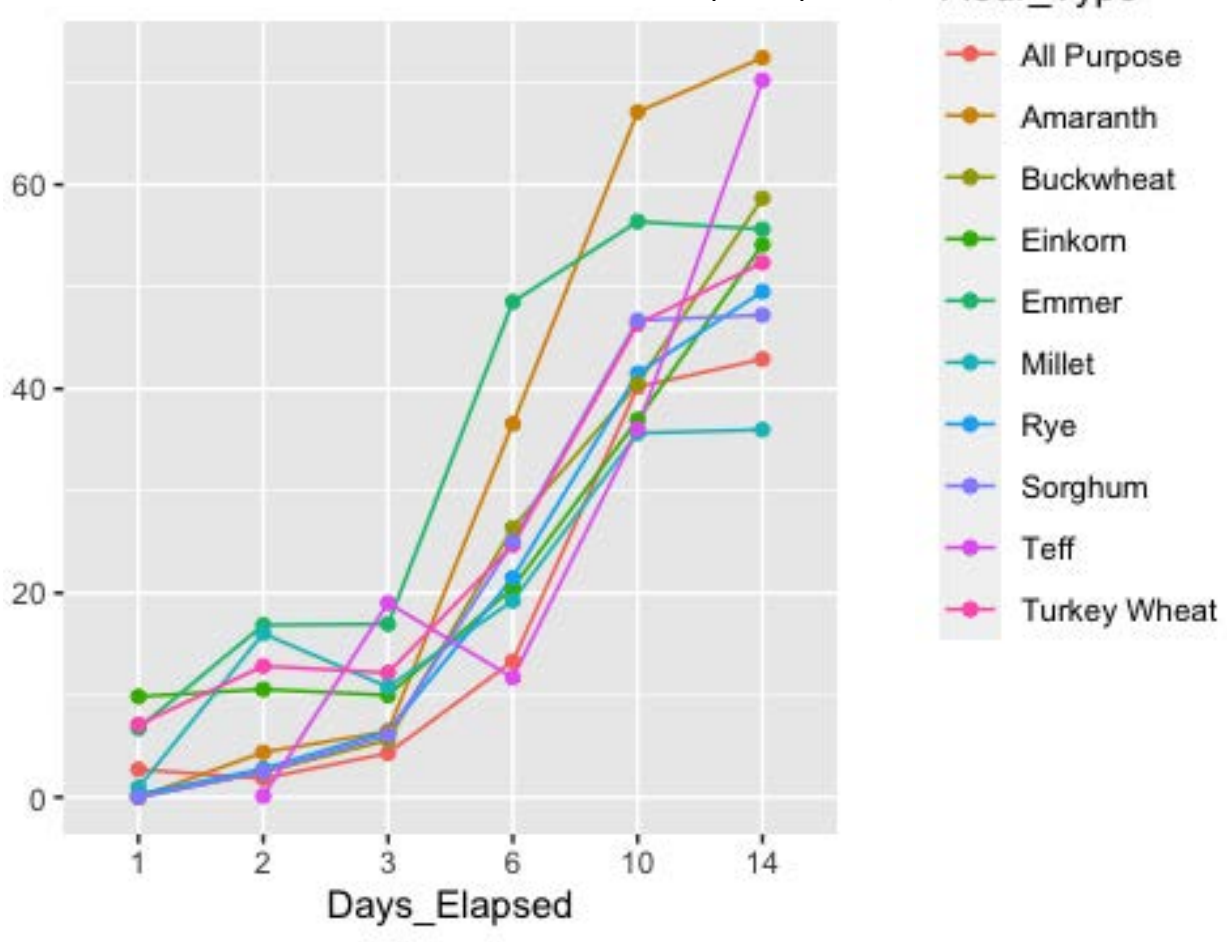
WILD SOURDOUGH

Lactic Acid Bacteria (LAB) increase over time.

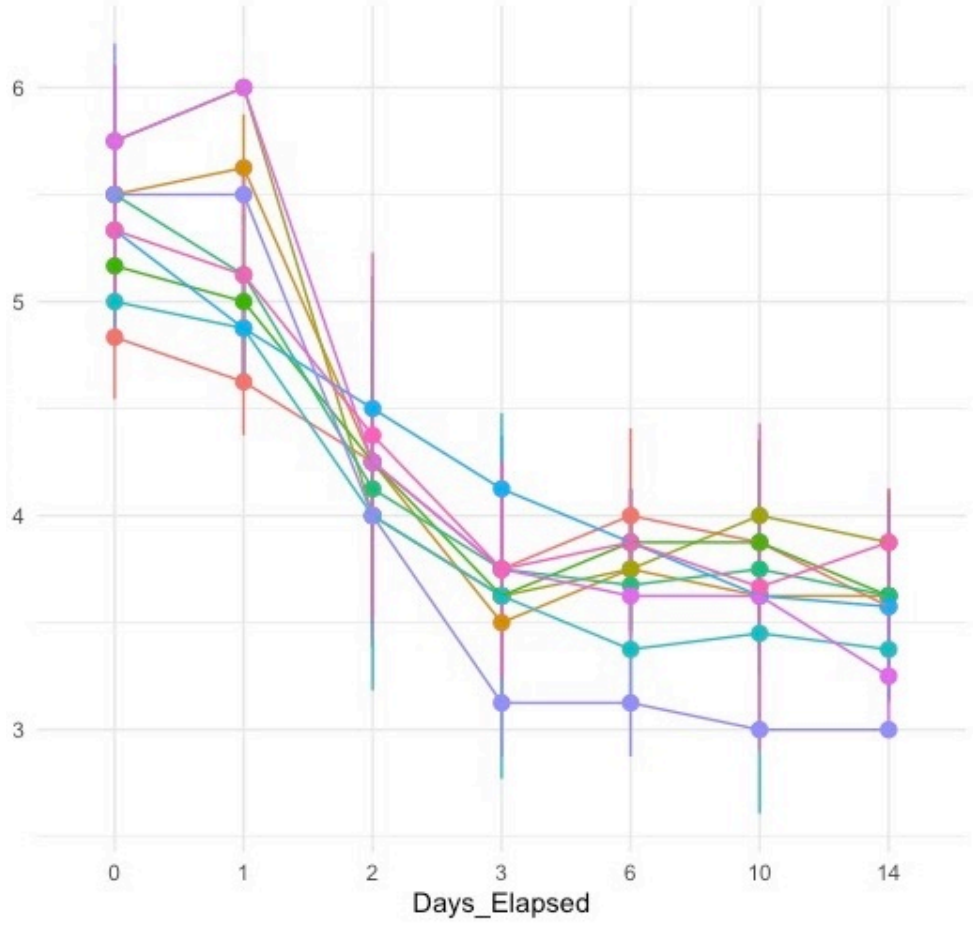


Lactic Acid Bacteria (LAB) produce acid.

Abundance of lactic acid bacteria (LAB)

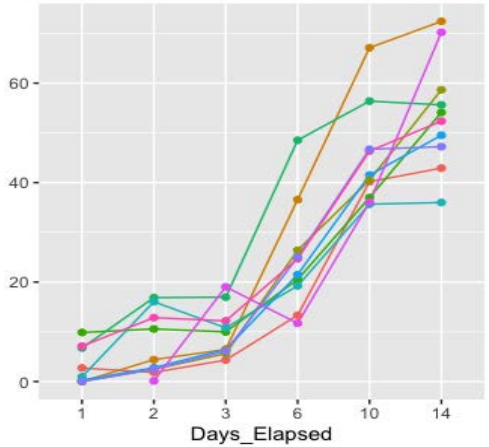


pH of the starter after mixing

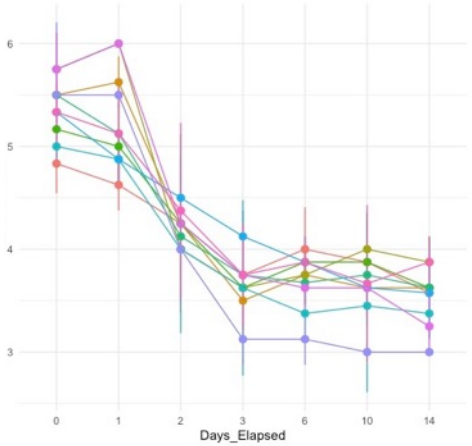


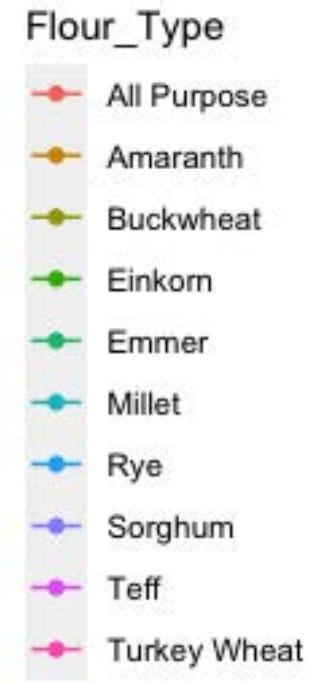
Acidity limits bacterial diversity.

Abundance of lactic acid bacteria (LAB)

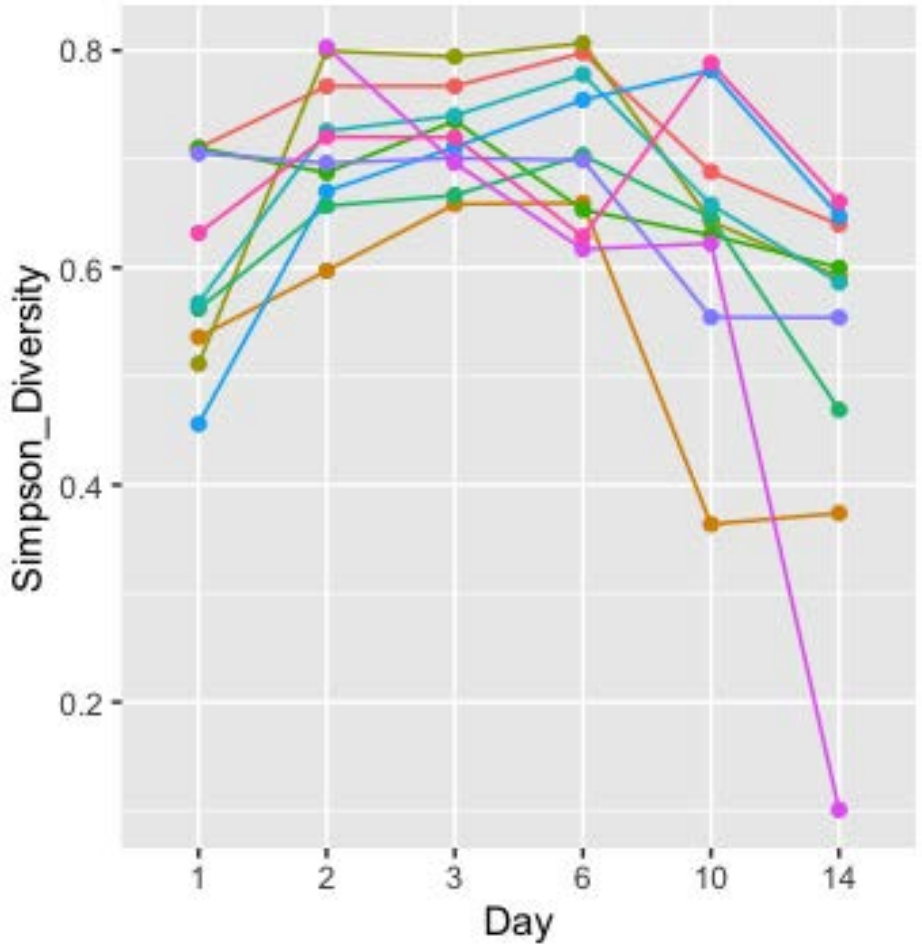


pH of the starter after mixing



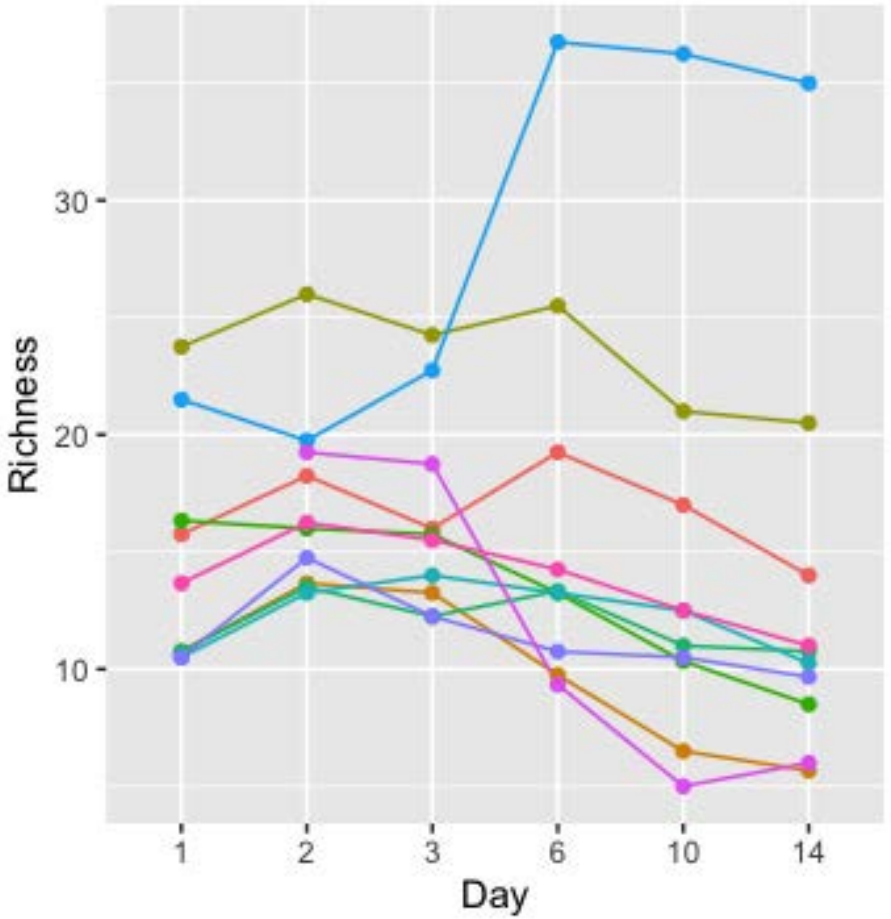


Bacterial diversity

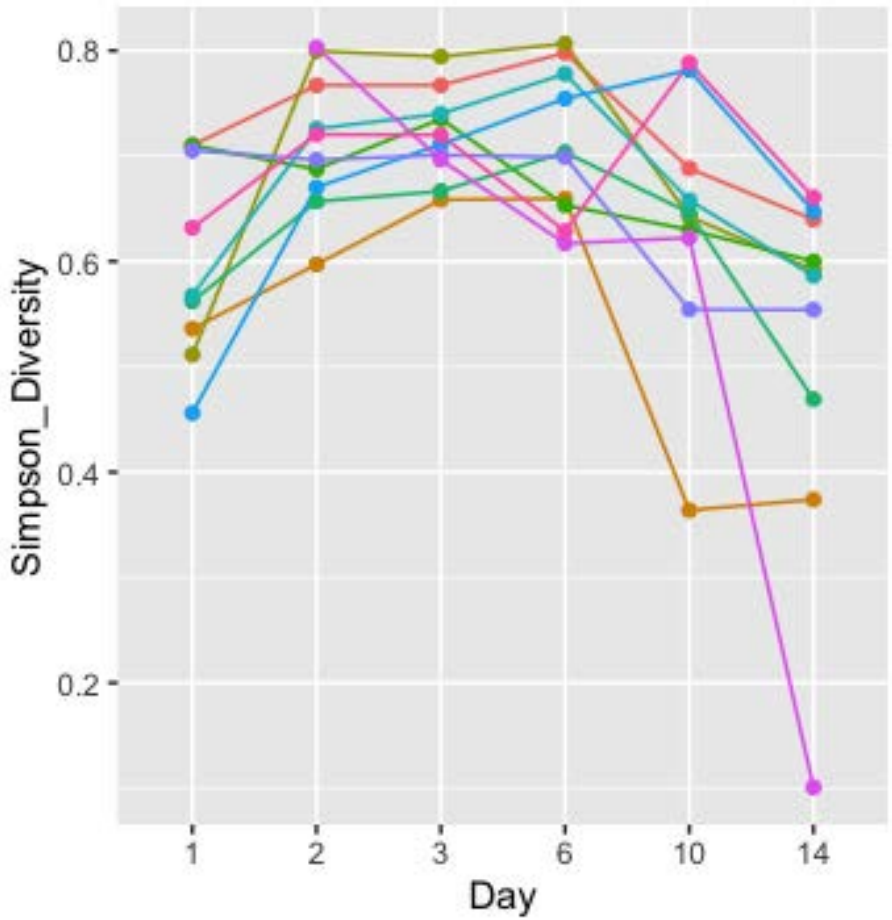


...although Rye is an outlier.

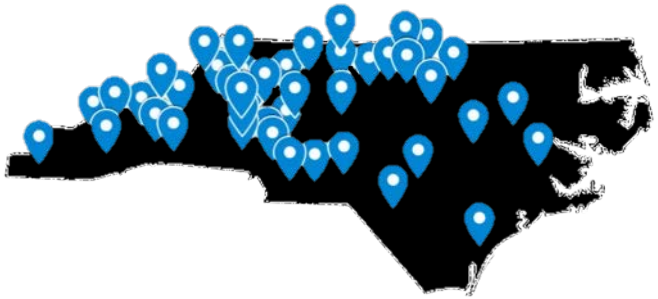
Number of types of bacteria



Bacterial diversity



GSW 2017



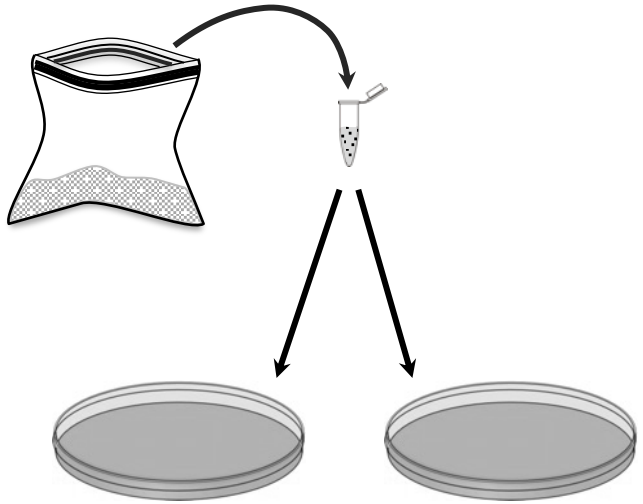
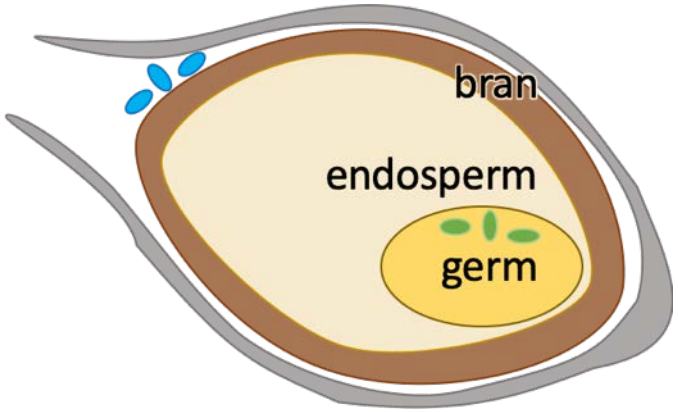


photo credit: Erin McKenney


BACTERIA
YEAST

photo credit: Erin McKenney

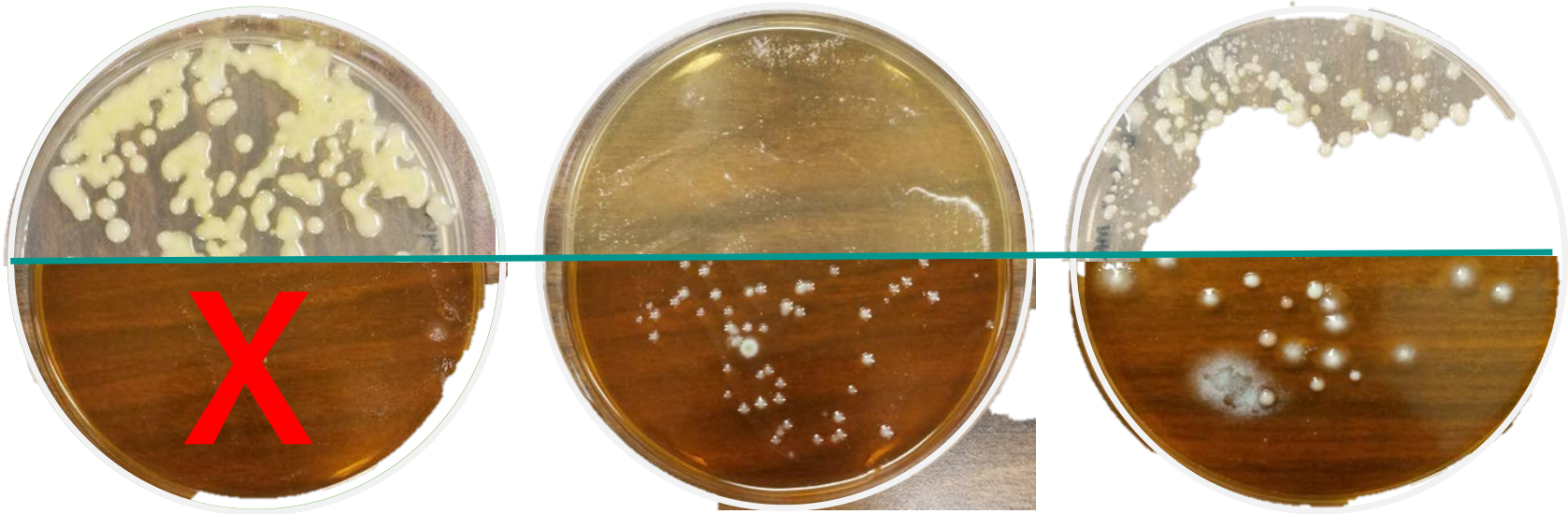
photo credit: Erin McKenney



all-purpose

whole wheat

rye



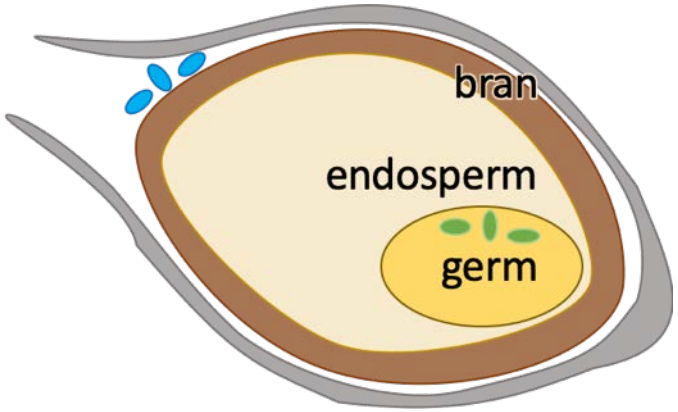
teff

sorghum

buckwheat

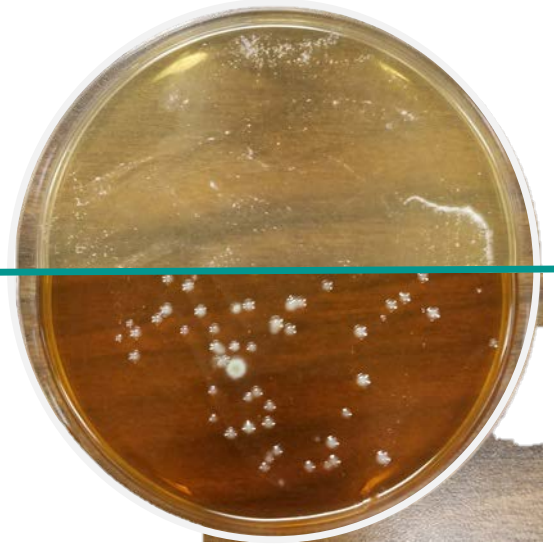
amaranth

photo credit: Erin McKenney

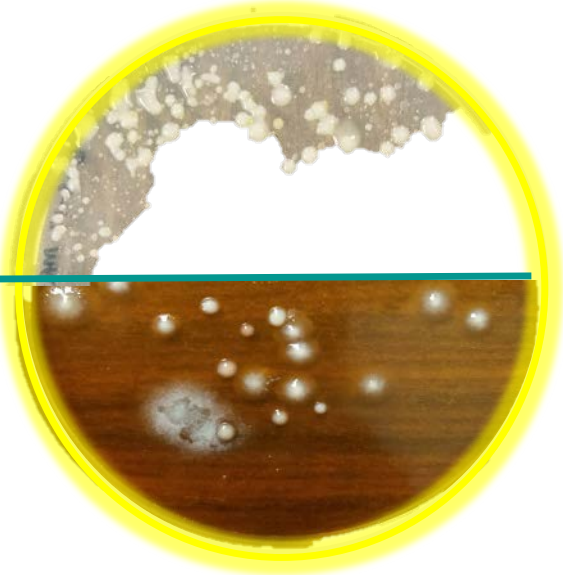


all-purpose

whole wheat

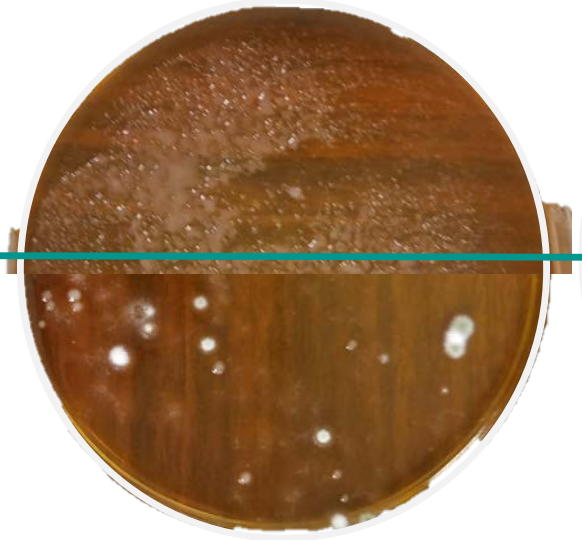


rye



teff

sorghum



buckwheat

amaranth

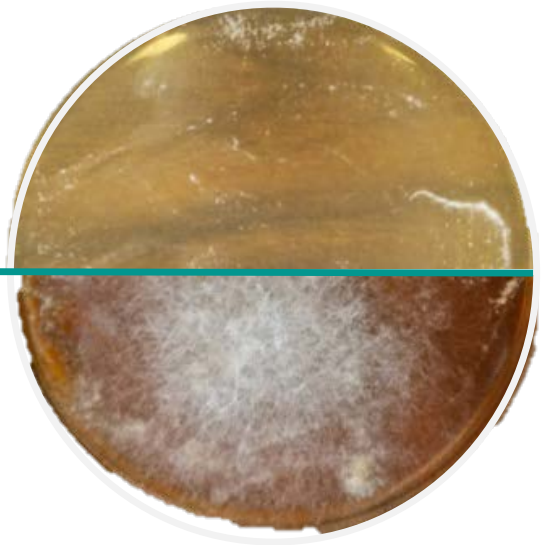
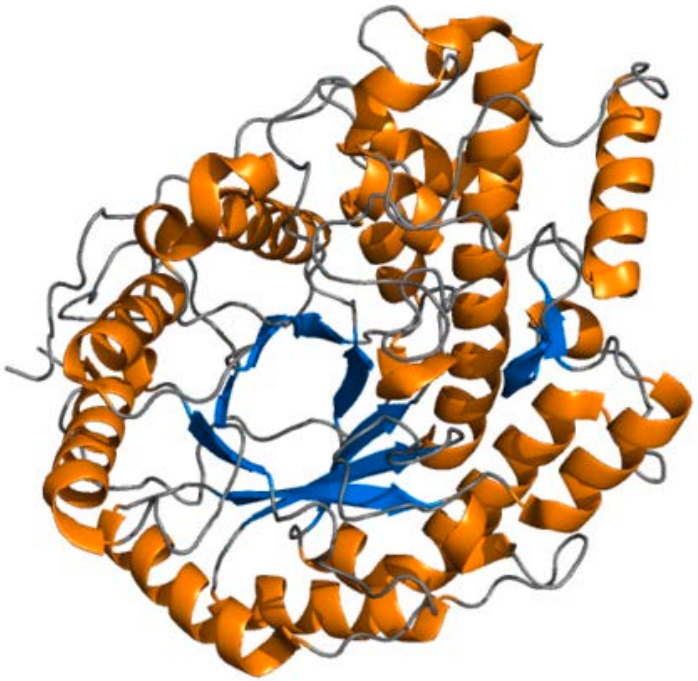
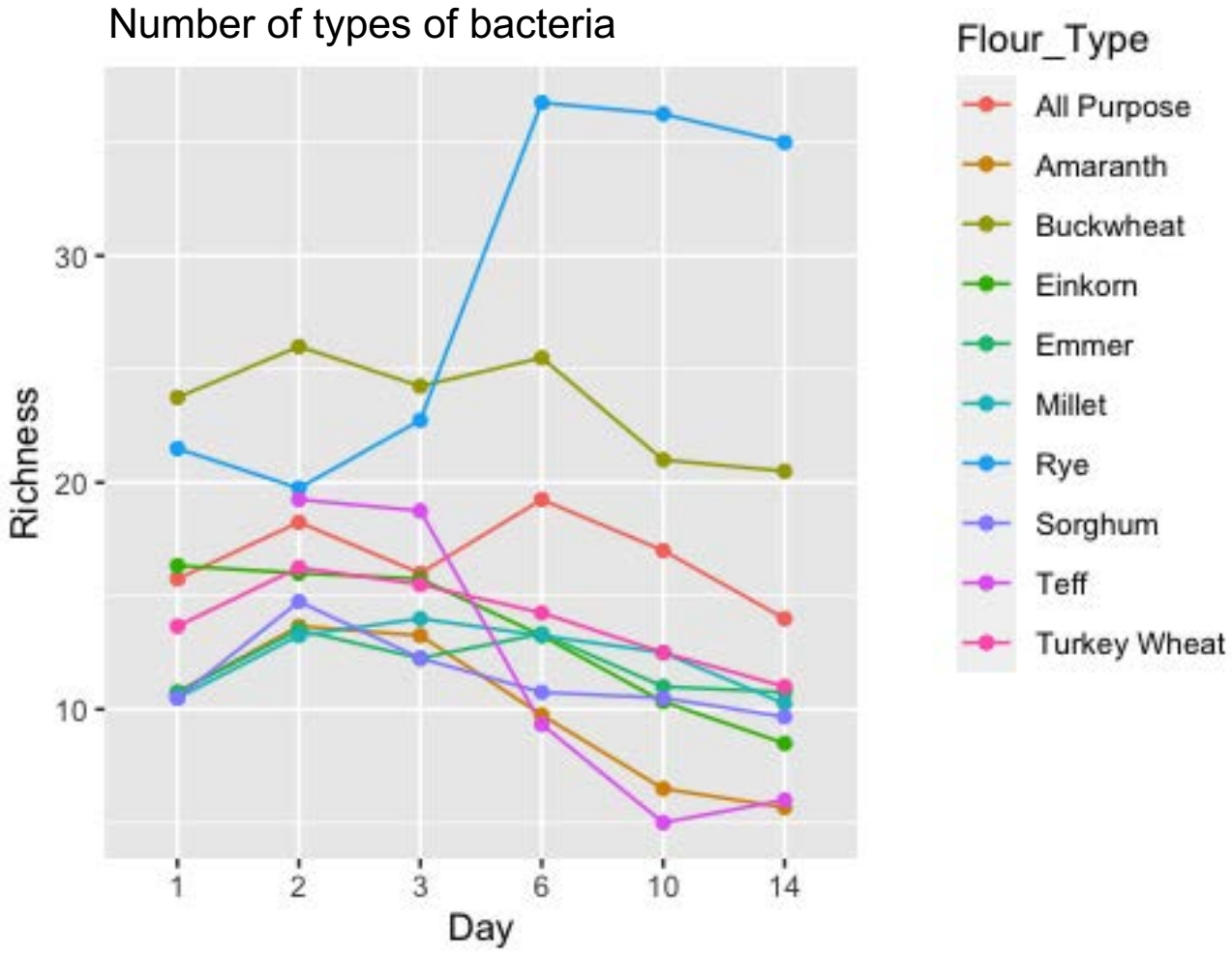


photo credit: Erin McKenney

Beta amylase unlocks sugars, fueling diversity.



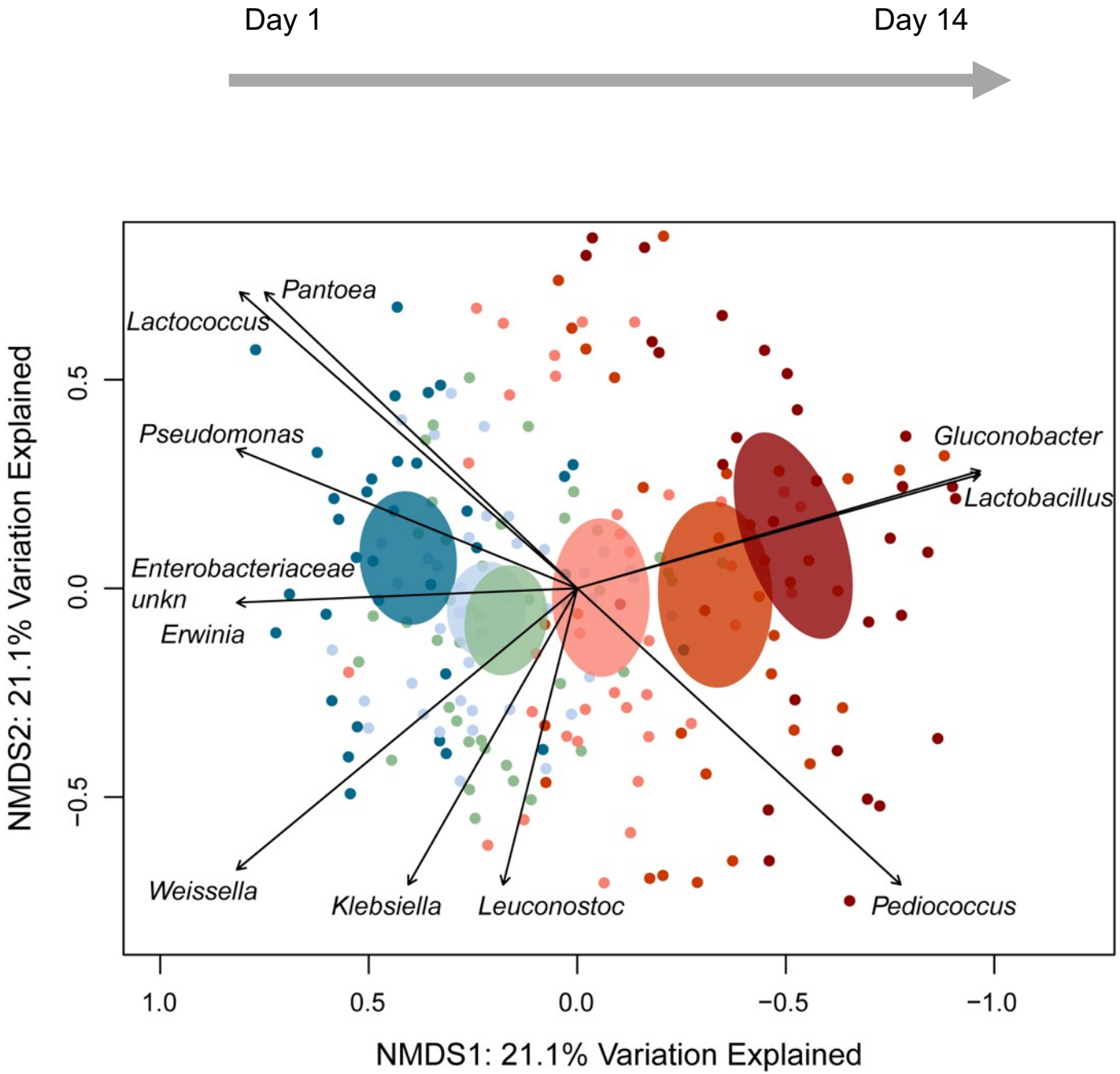


I digress.

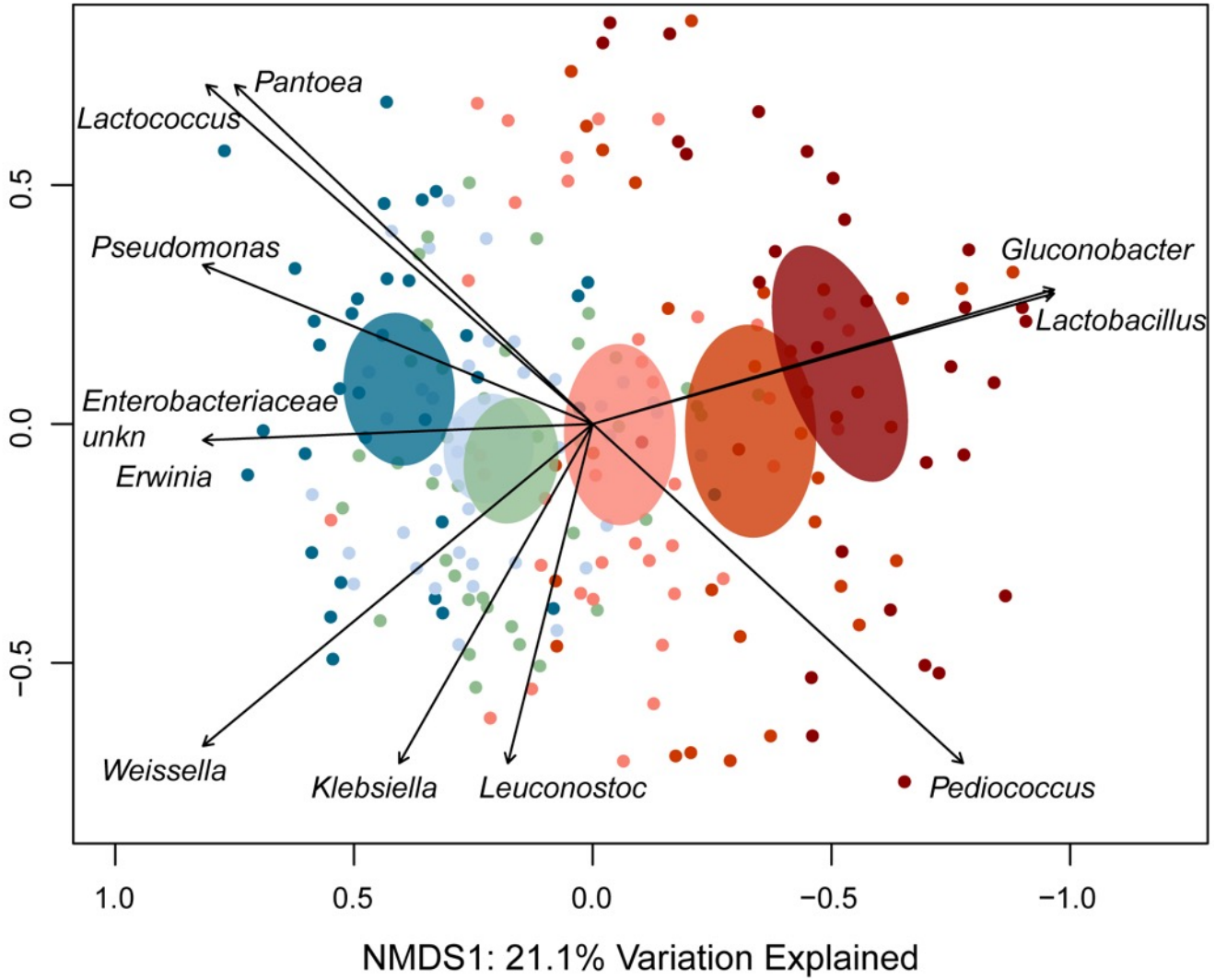
Back to the colonization story!

OLDWAYS WHOLE GRAINS COUNCIL

rediscover goodness OLDWAYS

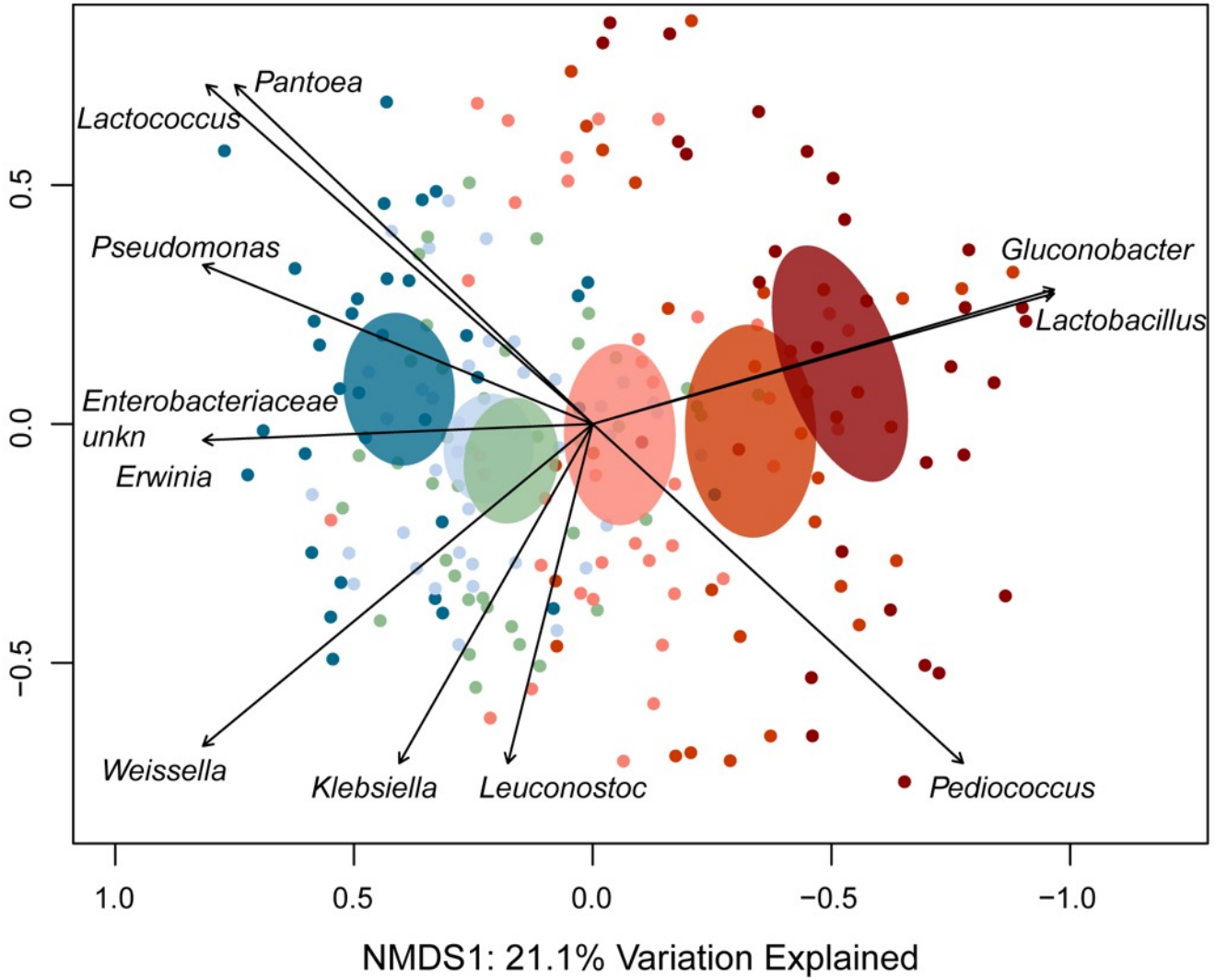

Day 1
Day 14
Pantoea
Lactococcus
Pseudomonas
Enterobacteriaceae
unkn
Erwinia
Gluconobacter
Lactobacillus
Weissella
Klebsiella
Leuconostoc
Pediococcus
NMDS2: 21.1% Variation Explained
0.5
0.0
−0.5
1.0
0.5
0.0
−0.5
−1.0
NMDS1: 21.1% Variation Explained

Day 1 Day 14

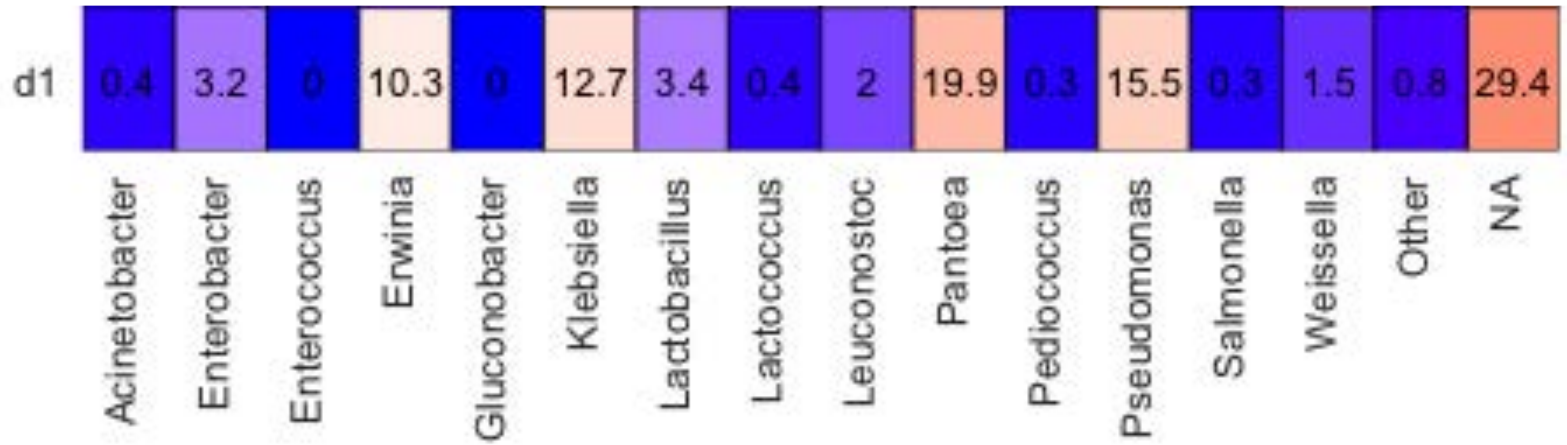

Pantoea
Lactococcus
Pseudomonas
Enterobacteriaceae
unkn
Erwinia
Gluconobacter
Lactobacillus
Weissella
Klebsiella
Leuconostoc
Pediococcus
0.5
0.0
−0.5
1.0
0.5
0.0
−0.5
−1.0
NMDS1: 21.1% Variation Explained

Day 1

Day 14


Pantoea
Lactococcus
Pseudomonas
Enterobacteriaceae
unkn
Erwinia
Gluconobacter
Lactobacillus
Weissella
Klebsiella
Leuconostoc
Pediococcus
0.5
0.0
−0.5
1.0
0.5
0.0
−0.5
−1.0
NMDS1: 21.1% Variation Explained

All Samples

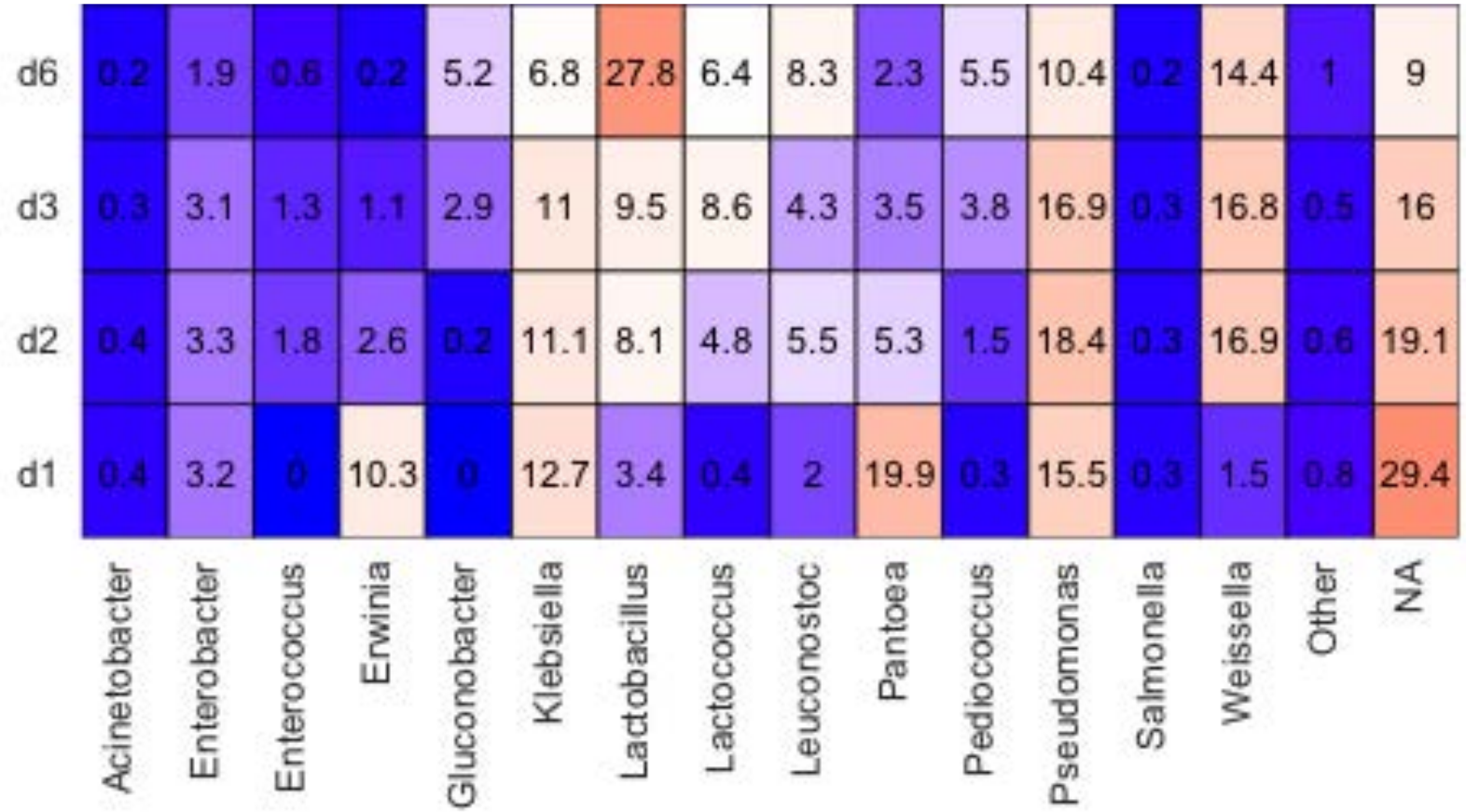


rotten, bodily odors

OLDWAYS WHOLE GRAINS COUNCIL

rediscover goodness OLDWAYS

All Samples

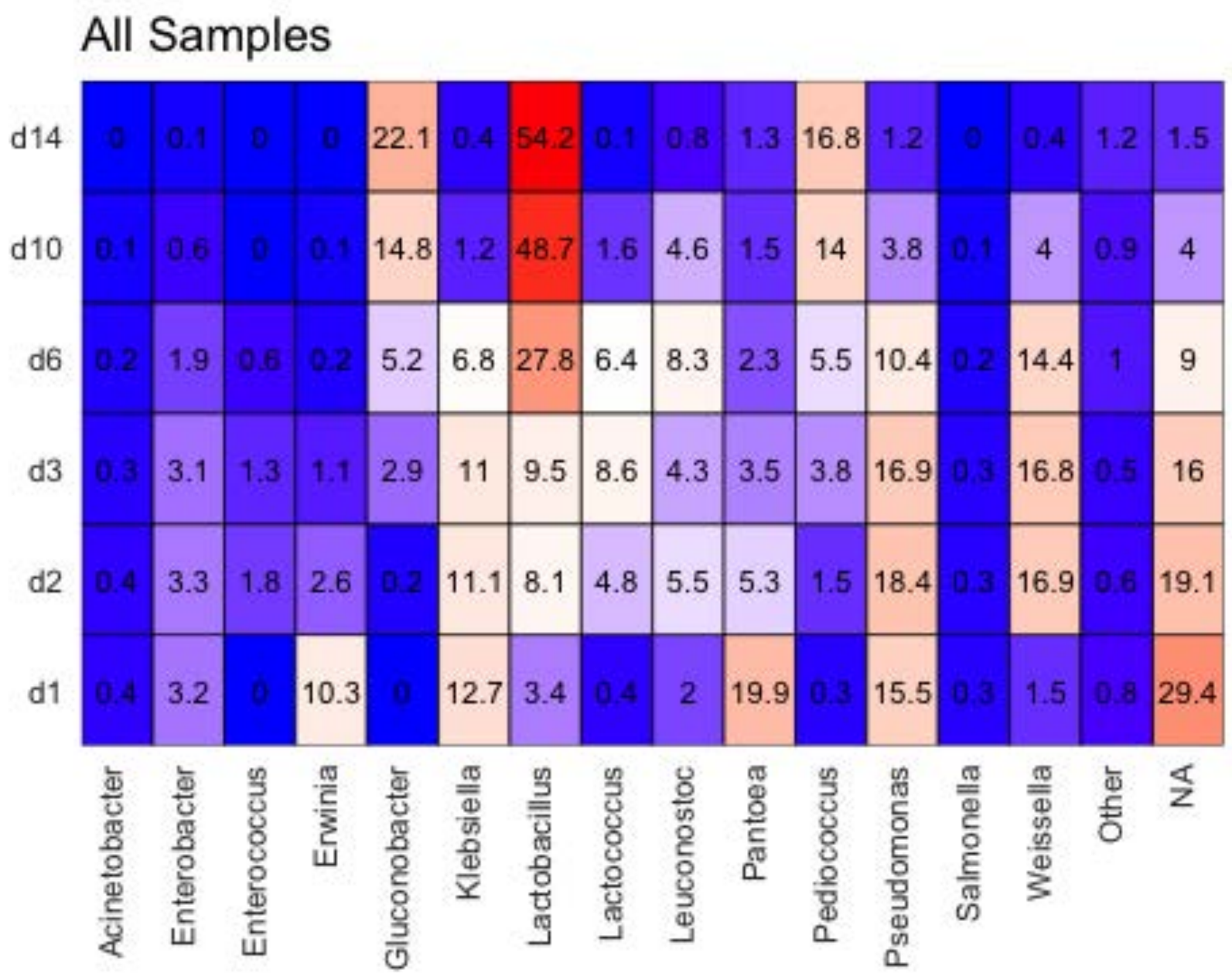


sour

rotten, bodily odors

OLDWAYS WHOLE GRAINS COUNCIL

rediscover goodness OLDWAYS



sour, bread

sour

rotten, bodily odors

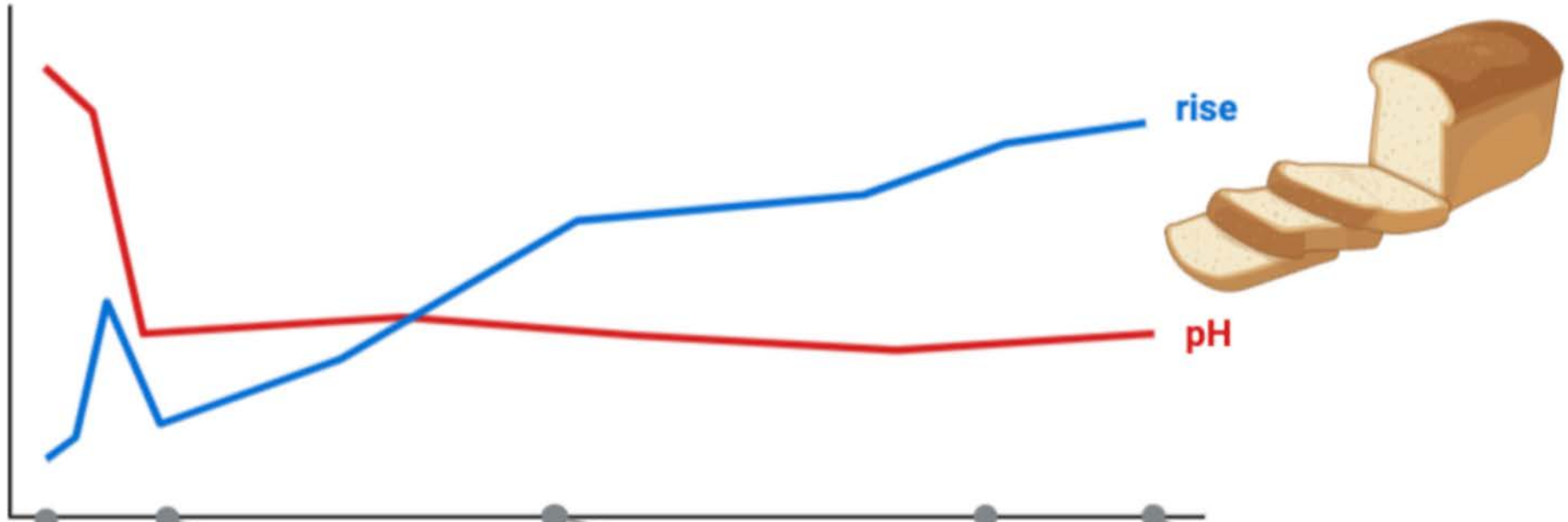
OLDWAYS WHOLE GRAINS COUNCIL

rediscover goodness OLDWAYS

Day 14

	Curtobacterium	Gluconobacter	Klebsiella	Lactobacillus	Leuconostoc	Massilia	Paenibacillus	Pantoea	Pediococcus	Pedobacter	Pseudomonas	Sphingomonas	Weissella	Other	NA
Turkey Wheat	0	25.1	0	66.5	0.5	0.1	0	0.7	4.7	0	1.2	0	1.1	0	0
Teff	0	0	0.2	0	1.6	0	0	0	95.5	0	0.1	0	2.4	0.2	0
Sorghum	0.1	33.3	0	18.6	0.6	0	0	0	45.6	0	0.2	0.1	0	0.1	1.4
Rye	0.9	12.3	0.1	64.9	0.6	0.7	0.4	3.3	2.4	1	2.1	1	0.4	3	6.9
Millet	0	46	0.9	26.3	0.4	0	0	0.5	22.7	0	1.5	0	0.2	0.3	1.2
Emmer	0	18.1	0	74.3	0	0	0.3	2.9	1.4	0	1.1	0	0.4	0.2	1.2
Einkorn	0	25.1	0	72.9	0.2	0	0	0	0.7	0	1	0	0	0	0
Buckwheat	0.5	5.8	0	79.5	0	0.5	0.2	5.6	0.3	0.1	3.5	0.9	0.1	2	1
Amaranth	0	0	0.2	95.7	0.9	0	0	0	2.8	0	0	0	0.4	0	0
All Purpose	0	35.4	1.6	43	2.5	0	0	0	15.4	0	0.8	0	0	0.5	0.7

photo credit: Erin McKenney



Day 1-3

Spoiled, rotten, puke

Klebsiella

Leuconostoc

Pseudomonas

Day 6

Sour, dairy, vinegar

Klebsiella

Leuconostoc

Lactobacillus

Gluconobacter

Day 10-14

Sour, bread

Lactobacillus

Gluconobacter

Pediococcus


photo credit: Lauren Nichols

Sourdough recipes!

- bread (whole wheat, rye, millet)
- crackers (whole wheat, amaranth, buckwheat)
- pancakes (whole wheat, buckwheat, oats)
- waffles (whole wheat, rye)
- pizza dough (whole wheat)

OLDWAYS WHOLE GRAINS COUNCIL

rediscover goodness OLDWAYS

OLDWAYS WHOLE GRAINS COUNCIL

rediscover goodness
OLDWAYS