Fermenting Humanity

From Evolution to Edible

Presented by
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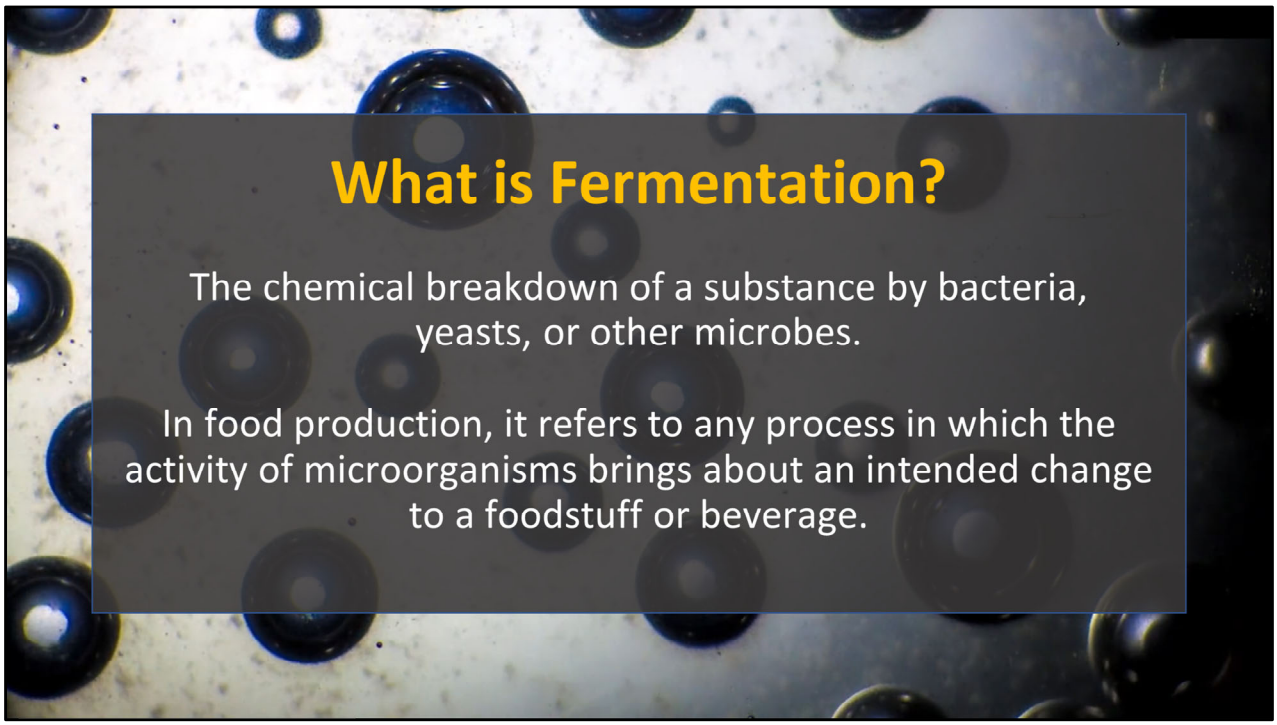
What we will explore:
1. The history of fermentation as a food preservation method
2. Fermentation use in cultures around the world
3. Benefits, risk and methods for home fermentation


What is Fermentation?
The chemical breakdown of a substance by bacteria, yeasts, or other microbes.
In food production, it refers to any process in which the activity of microorganisms brings about an intended change to a foodstuff or beverage.

A Key to Human Evolution

- ADH - Alcohol Dehydrogenase enzymes
- Increases/Extends:
  - Digestibility of fresh, raw foods
  - Shelf-life, edibility window
  - Seasonality of raw foods
  - Range of living environments
- Research Ongoing - nutrition; gut biome; effects on anti-nutrients

Every Culture has Fermented Foods and Beverages

Foods of the East

Every Culture has Fermented Foods and Beverages

Beverages of the East

Every Culture has Fermented Foods and Beverages

Foods of the West

Every Culture has Fermented Foods and Beverages

Beverages of the West

Through the Ages

Brewing Up Civilization

- Fruits Fermented Naturally, easily
- Grain Brewing Requires Human Interaction
- Early Religion & Mysticism
- First Recipes, Domestic Skills

A Medieval Shift

- Towns and Specializations, Trades
- Travelers, Inns, Alewives and Brewsters
- Taxes and Tithes, Church and Property Rights
- Guilds and Trade Organizations
- Witches and Ergotism

- Top image: “Egyptian cooks grinding, baking, and brewing grains (c. 21st – 19th century BC)” https://healthandfitnesshistory.com/ancient-nutrition/ancient-egyptian-nutrition/
- Early bread-making (Bappir) intermediary step in beer brewing, Ancient Egyptian methods created Tetracycline
- Requires harvest, sprouting (malting), mashing, kettling Vs. wines, ciders are mainly controlling wild fermentation Spawned Agriculture, Writing, Mathematics, Medicine
- Rites and Celebrations, Transformation, Enlightenment
- Many sects sought to control product, process, ‘Al Kohl’ is ‘The Essence’, the ‘Spirit’, Distillation is ‘Al Kemy’
- Bottom image: “Alehouse with Alestake”, by Angus McDonnell, in “Chaucer’s Canterbury Pilgrims”, 1909, p 185
- Hanseatic league, trading and export, Reinheitsgebot 1489, fight for water rights
- Guild propaganda to eliminate cottage competitors, replaced with tied houses

Through the Ages

Progress & Industrialization
- Opportunities
- Challenges

Social Resurgence
- Fermenting is hip!

Modern Research
- Medical; health; scientific interest

Bottom right image, fermenting research at the University of Wageningen, Netherlands

Fermenting: Getting Started at Home

Additional Terms

Brining - Wet methods, pickling, steeping

Curing - Dry methods, salts, sugars, spices, smoke, air

Substrate - Base material for main fermentation

Enzymes - Non-living proteins, catalysts, biochemicals

Culture (n) - Single or mixed fermenters, often repitched

Strain - Specific fermenter, isolated via lab, time

Sanitize - Microbiologically clean, not sterilized

Step 1: Choose a Substrate

- Plants - Fruits, Vegetables, Legumes
- Meats, Eggs, and Dairy

Step 2: Determine Desired Changes

- Proteins
- Acids
- Sugars/Starches
- Lignin, Fiber, or Connective tissue

Step 3: Select Methods

- Wet Brine
- Dry Cure
- Inoculation (Various Methods)

What to make?

Brine Fermenting

- Veg, fruit, beans, fermented in salt water
- Usually at 2-10% brine range
  - Salt and water determined by ratio
- Ferments by allowing more desirable laco-bacteria to grow
- Ex. Lacto-fermented Carrots, Green Beans, Beets, Peppers, etc.
- Most ferments in 2-3% brine; some 5%
  - 2-3%: Firm veg like carrot, squash, asp, etc.
  - 3-5%: Peppers
  - 5%: Cucumbers (watery)
  - 10% (rare) for feta cheese, fish sauce, etc.

Examples of Firm veg:

Cure ("dry brine") Fermenting

- Moisture comes from the product itself, pulled by salt
- Usually at a 2% salinity by weight
- Weigh after cutting up
- Items like *Sauerkraut*, *Hot Sauce*, *Relish*

Salt Matters

Weaker brines/cures :

- Do not suppress microbial action as much
- Allows faster fermentation
- Greater chance of spoilage
- Less salt = softer vegetables because salt preserves cell wall integrity/vacuole pressure

Stronger brines/cures:

- Minimizes risks
- Slows fermentation, creates more complex flavors
- Too strong and it can kill the ferment entirely
- More salt = stronger, crunchier vegetables

Tips

- Work in weights and metric to measure out brines and cures
  - Volume measured salt is very imprecise
  - Math is easier working in base 10 units:

ie. 5% brine in 1 liter (1000 milliliters) water is
1000 x .05 = 50 grams salt

- Fermentation is quite forgiving; being off on the salt a bit is okay
- Often 10 days for veg is recommended, but you should ferment to taste
- Consider surface ratio when cutting (spears are crisper than chips)
- *Strike a Balance* [non-desirable microbes/desirable microbes/desired texture/desired flavor]

Inoculation Fermenting

Usually single strain

- Tempeh
- Mead
- Beer
- Wines
- Ciders

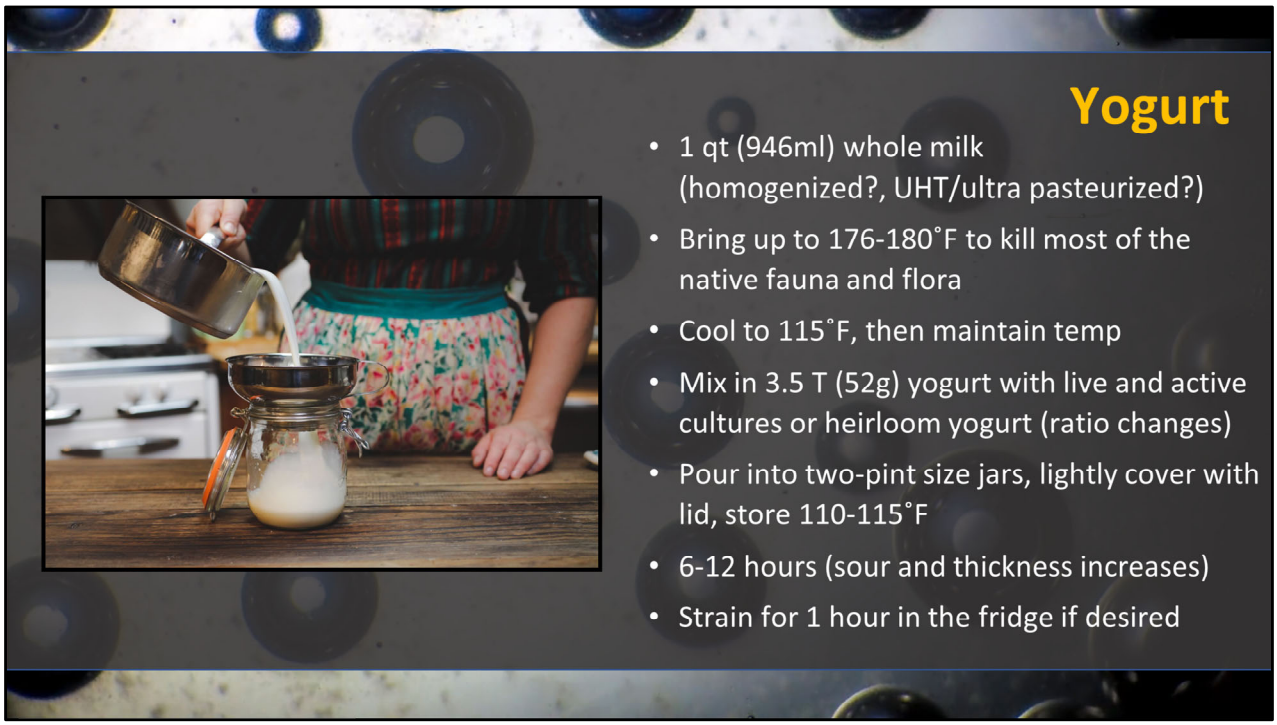
Usually mixed culture

- Sour Dough
- Kombucha
- Kefir
- Yogurt

Too many styles to say

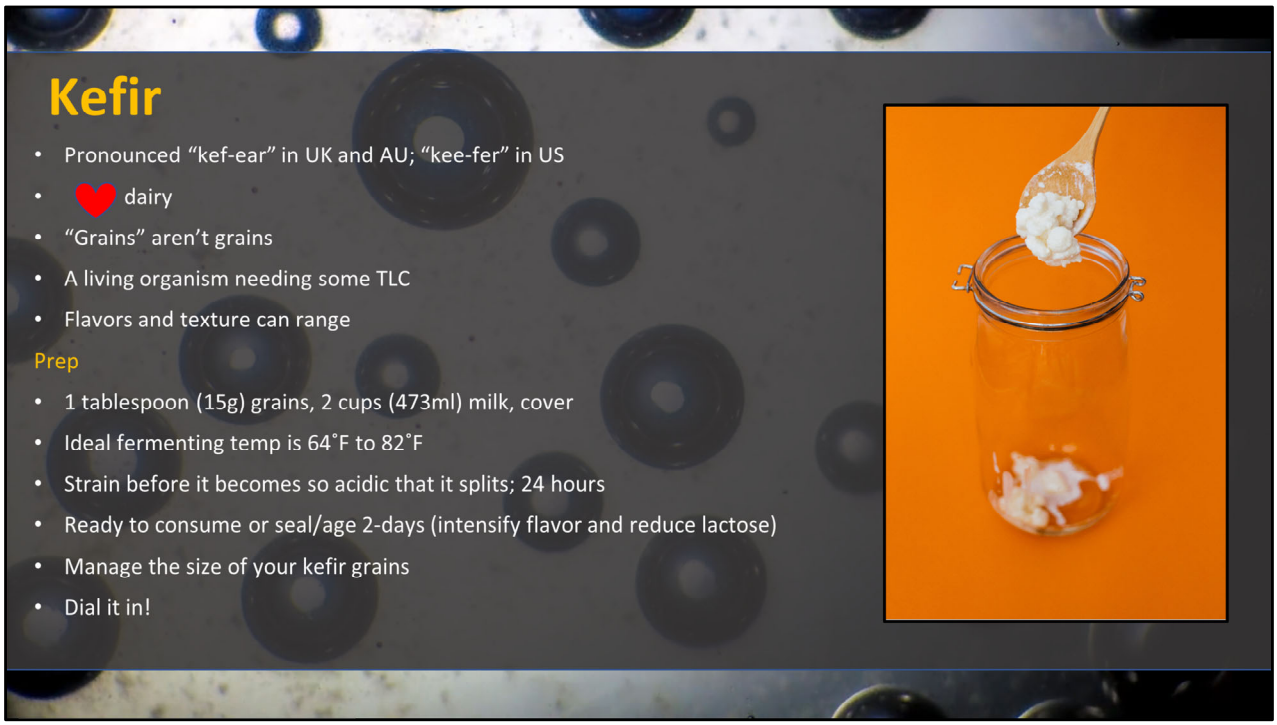
- Cheese

Mother, starter, SCOBY (symbiotic community of bacteria and yeasts). No matter the form, these starters all began wild and free.



Remember longer ferments at lower temperatures = more complex acids and flavors


More on YEAST
Yeast makes the product, you just provide substrate
Species and strains are NOT always interchangeable
Use those specified for your final product
Temperature Ranges
Attenuation, Metabolic abilities
Nutritional needs
Alcohol tolerance
Acidity, pH
Pressure
FLAVORS!



gelatinous polysaccharide structures made of hundreds of microbes The microbes create the structures and live on them.

Fortifies through thickening and acidifying

Can be stored for short term to thousands of years

Remember longer ferments at lower temperatures = more complex acids and flavors

Prep
2 cups whole, un-homogenized milk (Davis), 1 T kefir
For non-dairy Kefir ferments, alternate between dairy and non-dairy because the grains will not thrive in non-dairy, **or** use a non-diary kefir culture

Inoculated Alcoholic Beverages:

TYPE	RECIPE	EQUIPMENT	EXPERTISE	PREP TIME	FERMENTATION
MEAD	3 ingredients - Honey, Water, Yeast	Fermentor, Bung, Airlock, small pot, long spoon	Super Easy! Any size batch	10 minutes, plus cleaning	A few weeks to 6 months
CIDER	2 ingredients - Apple must, yeast (Water if from concentrate)	Fermentor, Bung, Airlock, long spoon	Very Easy - concentrate kits available in local HBS, too.	10 minutes, plus cleaning, unless picking, scratting and pressing your own must	2-6 weeks
WINE	2 ingredients - Grape must, yeast (Water if from concentrate)	Fermentor, Bung, Airlock, long spoon	Moderately easy, all kinds of concentrate kits available	Same as above, using raw grapes requires more care, time, additives	4 weeks to 2 years
BEER	4 ingredients - Water, Malt, Hops, Yeast	Unless extract kit, mash tun, kettle, fermentor, airlock, likely more	Extract = Easy, All-Grain = varies with beer style	1 hour extract, or 6 hours all-grain	1- 6 weeks, depending on style

Lead with Mead!

- Simplest methods and ingredients (just water, honey and yeast)
- Any level of Sweetness, Alcohol, Carbonation, ANY SIZE BATCH
- Allows for greatest creativity, individuality, experimentation

- ***Hydromel -*** *Low Alcohol, often carbonated*
- ***Traditional Mead*** *-* ***Varietal*** *Honey, water, yeast*
- ***Melomel -*** *Honey with added fruits*
- ***Pyment*** *- Honey and wine grapes*
- ***Cyser*** *- Honey and Apple or Pear Cider*
- ***Metheglin*** *- Honey with Herbs and/or Spices*
- ***Braggot*** *- Honey with Beer, Malt*

Equipment

Food

Mason Jar airlock kits

Weights

Tamper

Large Ferment Pot

pH meter

Incubator?

Equipment Beverage

Fermentors:

Vessel = Batch Size, 1 qt to 50 gals
Glass or steel over plastic

Rubber Bungs:

Sizes are numbered, drilled or solid

Airlocks:

3-Pc for primary, S-shaped for secondary, Blow-Off tubes for vigorous Hi-Pro!

Stirring and Mixing:

Steel or PET, drill-mounted for wine

Measuring:

Refractometer, or Hydrometer, Thief, Cylinder

Thermometers

Dos and Don’ts

Do

Work clean; Package cleaner

Monitor ferments often

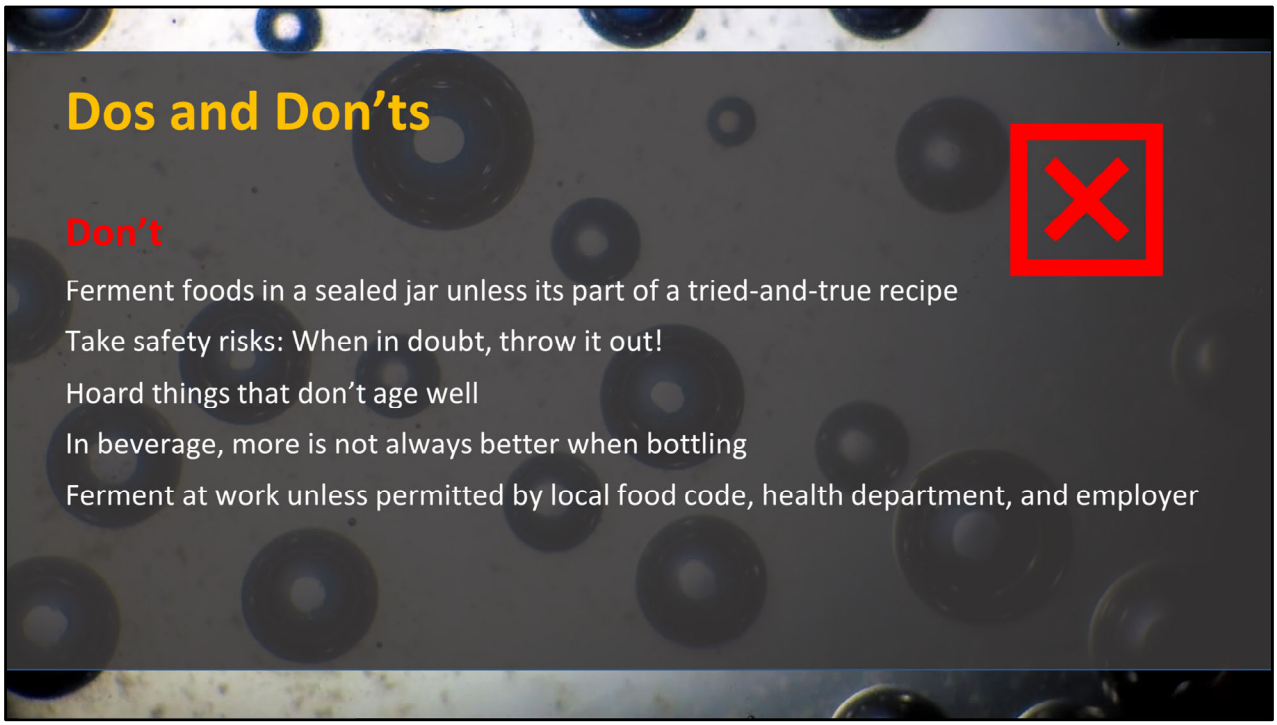
Keep record; Measure accurately (weights/ratios/metric)

Dial-in to your taste; Keep at it

Have fun being creative… but not too creative!

Use spices, herbs, garden harvest, different liquids, etc.

Use fresh, high quality products



Note:

Beverage Things to Avoid

Sanitation

Caustic Cleaners

Essential for devouring Organics, regular use

Acid Cleaners

Removing Scale, deposits, occasional use

Sanitizers

No-Rinse, Spray bottle and Baths, constantly

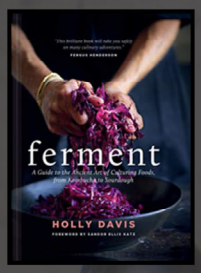
Packaging

Bottles, Swing-Tops, Caps, Corks, Siphons, Hoses

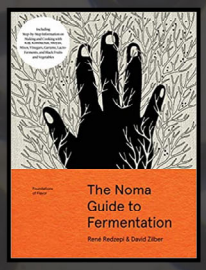
Additives

Clarifying Agents, Preservatives, Priming Sugars, Oak Chips, Flavorings, Acid Blends, Tannin Extract

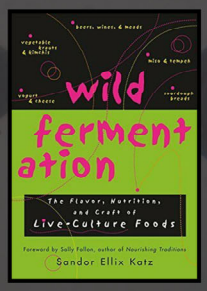
General Resources

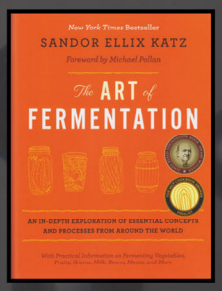


Holly Davis

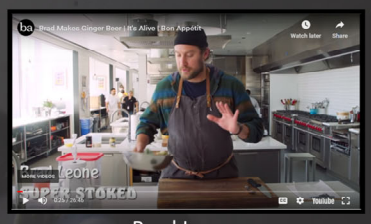


Rene Redzepi



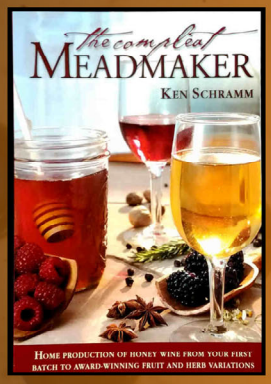


Sandor Katz

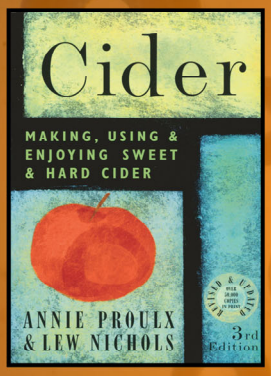


Brad Leone
Bon Appetite
(YouTube)

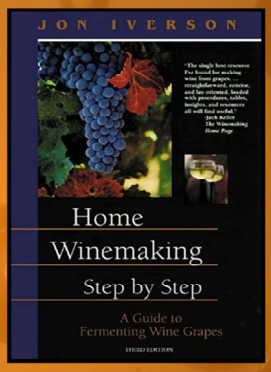
Beverage Resources



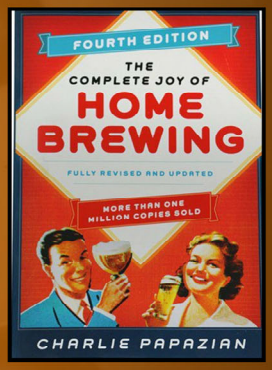
Ken Schramm



Annie Proulx & Lew Nichols



Jon Iverson



Charlie Papazian

American Homebrewers Association - https://www.homebrewersassociation.org
American Mead Makers Association - https://mead-makers.org
American Cider Association - https://ciderassociation.org/
American Wine Society - https://americanwinesociety.org/

New England Dairy

Questions?

New England Dairy

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Linked In
FB: JWUBrewing

Thank you

NewEnglandDairy.com
@NewEnglandDairy

References

Adeyemo, S. M., & Onilude, A. A. (2013). Enzymatic reduction of anti-nutritional factors in fermenting soybeans by lactobacillus plantarum Isolates from fermenting cereals. *Nigerian Food Journal, 31*(2), 84-90. doi:https://doi.org/10.1016/S0189-7241(15)30080-1

Bell, V., Ferrão, J., Pimentel, L., Pintado, M., & Fernandes, T. (2018). One health, fermented foods, and gut microbiota. *Foods, 7*(12), 195.

Gogineni, V. K., Morrow, L. E., Gregory, P. J., & Malesker, M. A. (2013). Probiotics: history and evolution. *J Anc Dis Prev Rem, 1*(107), 2.

Kok, C. R., & Hutkins, R. (2018). Yogurt and other fermented foods as sources of health-promoting bacteria. *Nutrition Reviews, 76*(Supplement_1), 4-15. doi:10.1093/nutrit/nuy056

Davis, Holly (2017). Ferment: A guide to the ancient art of culturing foods, from kombucha to sourdough. Chronicle, San Francisco.

Phengnuam, T., & Suntornsuk, W. (2013). Detoxification and anti-nutrients reduction of Jatropha curcas seed cake by Bacillus fermentation. *Journal of Bioscience and Bioengineering, 115*(2), 168-172. doi:https://doi.org/10.1016/j.jbiosc.2012.08.017

Sokrab, A. M., Mohamed Ahmed, I. A., & Babiker, E. E. (2014). Effect of fermentation on antinutrients, and total and extractable minerals of high and low phytate corn genotypes. *Journal of Food Science and Technology, 51*(10), 2608-2615. doi:10.1007/s13197-012-0787-8

Tamang, J. P., Cotter, P. D., Endo, A., Han, N. S., Kort, R., Liu, S. Q., . . . Hutkins, R. (2020). Fermented foods in a global age: East meets West. *Comprehensive Reviews in Food Science and Food Safety, 19*(1), 184-217.

van Hylckama Vlieg, J. E. T., Veiga, P., Zhang, C., Derrien, M., & Zhao, L. (2011). Impact of microbial transformation of food on health—from fermented foods to fermentation in the gastro-intestinal tract. *Current Opinion in Biotechnology, 22*(2), 211-219. doi:https://doi.org/10.1016/j.copbio.2010.12.004

Wolfe, Benjamin E., & Dutton, Rachel J. (2015). Fermented foods as experimentally tractable microbial ecosystems. *Cell, 161*(1), 49-55. doi:https://doi.org/10.1016/j.cell.2015.02.034

Yokoyama, S., & Yokoyama, R. (1987). Molecular evolution of mammalian class I alcohol dehydrogenase. *Molecular biology and evolution*, *4*(5), 504-513.

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Evolutionary man. Adapted from Alexas Fotos on 11/27/2020. https://www.needpix.com/photo/1831971/evolution-development-forward-monkey-human-changes-change

Kombucha Bottle. Adapted from remedydrinks.com on 11/27/2020. https://rem-admin.remedydrinks.com/media/catalog/product/cache/b525b5efbf62c7f316b911b2429b4b6c/k/o/kombucha-300-gl-pet.png

Beer fizzing. Adapted from Sustainable Nano on 11/27/2020. https://sustainablenano.files.wordpress.com/2018/09/giphy.gif?w=810

Miso. Adapted from Clearspring.com on 11/27/2020. https://www.clearspring.co.uk/blogs/news/what-is-miso-why-is-it-so-good-for-us

Koji. Adapted from Food Craft Lab on 11/27/2020. https://www.flickr.com/photos/134946786@N05/19857431680/

Dosa. Adapted on 11/27/2020. http://meinblogland.blogspot.com/2012/05/recipe-of-month-mysore-masala-dosa.html#.X8FWzeWSnIU

Sake Brewing. Adapted on 11/27/2020. https://ourworld.unu.edu/en/biodiversity-in-kanazawa-autumns-lesson

Open-Source Image List, cont.

Chinese Rice Wine Production. Adapted on 11/27/2020. https://helloteacup.com/2017/01/20/what-is-chinese-yellow-rice-wine-huang-jiu/

Kombucha. Quora. Adapted on 11/27/2020. https://www.quora.com/How-is-kombucha-tea-made

Brined Cheese. Adapted on 11/27/2020. https://en.wikipedia.org/wiki/Brined_cheese

Olives. Adapted on 11/27/2020. https://www.greekboston.com/cooking/curing-olives/

Fesikh. Adapted on 11/27/2020. https://www.egypttoday.com/Article/1/84888/Egypt%E2%80%99s-traditional-fesikh-dish-can-cause-botulism-poisoning-Health-Ministry

Injera. Adapted on 11/27/2020. https://chipabythedozen.com/en/injera-ethiopian-flatbread/

Tej. Adapted on 11/27/2020. https://en.wikipedia.org/wiki/Tej

Gari. Adapted on 11/27/2020. http://ghananews360.com/drinking-raw-gari-banned-nigeria-state/

Kafir. Adapted on 11/27/2020.https://foodhow.com/kefir-yogurt-soured-milk/

Ancient wines from the Middle East. Adapted on 11/27/2020. https://www.organicauthority.com/buzz-news/ancient-wine-cellar-uncovered-in-the-middle-east

Ancient wine vessels. Adapted on 11/27/2020. https://learn.winecoolerdirect.com/history-of-wine/

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Krauts. Adapted on 11/27/2020. https://everydayshortcuts.com/red-and-green-garlic-sauerkraut-recipe/

Crème Fraiche. Adapted on 11/27/2020. https://healthstartsinthekitchen.com/how-to-make-creme-fraiche/

Sausages. Adapted on 11/27/2020. https://www.jta.org/jewniverse/2017/how-portugals-jews-saved-themselves-with-a-sausage

Lutefisk. Adapted on 11/27/2020. https://unclestinky.wordpress.com/category/stinky-food/

British Beers. Adapted on 11/27/2020. https://blog.eckraus.com/english-british-beer-styles

Cider. Adapted on 11/27/2020.https://twitter.com/brsciderhouse

Mead. Adapted on 11/27/2020. https://grainfather.com/making-mead-recipes/

Pozol. Adapted on 11/27/2020. https://foodandtravel.mx/5-bebidas-fermentadas-de-todos-los-tiempos/

Corn Smut. Adapted on 11/27/2020. https://apps.extension.umn.edu/garden/diagnose/plant/vegetable/corn/leavesdeformeddistorted.html

Cocoa beans fermenting. Adapted on 11/27/2020. https://onthecocoatrail.com/2012/06/20/from-tree-to-bean-the-beginning-of-fermentation/

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Seal Flipper. Adapted on 11/27/2020. https://www.pinterest.com/pin/517421444660906078/

Chicha. Adapted on 11/27/2020. https://www.laylita.com/recipes/spiced-pineapple-drink-chicha/

Pulque. Adapted on 11/27/2020. https://sanmigueltimes.com/2019/02/festival-del-pulque-2019-took-place-in-hidalgo/

Pisco. Adapted on 11/27/2020. https://bubblyprofessor.com/2013/11/11/the-pisco-wars/

Chili paste. Adapted on 11/27/2020. https://fullofplants.com/my-favorite-chili-paste/

Blachan. Adapted on 11/27/2020. https://kwgls.wordpress.com/2013/05/04/interesting-cooking-ingredient-series/

Natto. Adapted on 11/27/2020. https://www.tsunagujapan.com/you-ll-get-addicted-in-one-bite-the-correct-way-to-eat-natto/

Tabasco. Adapted on 11/27/2020. https://www.southernliving.com/pasta/sauces/tabasco-hot-sauce

Salami. Adapted on 11/27/2020. https://www.nutritionadvance.com/salami-nutrition/

Apple Cider Press. Adapted on 11/27/2020. https://www.motherearthnews.com/real-food/fermenting/making-apple-cider-zmaz94djzraw