Potential Hazards Associated with Fermented Foods

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and

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Fermentation as a Food Trend

- What’s old is new again...
- Fermentation has long been a part of human history dating back at least 9000 years.
- This played a vital role in human survival before stoves and refrigeration.
Fermented Foods

- Cheese
- Sauerkraut
- Olives
- Salami
- Jerky
- Bread
- Beer
- Wine
- Hot Chocolate

Source: https://www.google.com/search?biw=1187&bih=663&tbm=isch&q=fermented+food
Food Poisoning

Scientific literature has never recorded a case of food poisoning involving raw vegetables that have been fermented properly.
PROPERLY!

Source: http://www.naturalnews.com/food_poisoning.html
How does it work?

- Fermentation happens when the natural bacteria in the vegetables breaks down the components into forms easier to digest and sometimes more nutritious than raw vegetables.

- Some consider fermented vegetables safer than raw products because of the lactic acid produced killing any pathogens.
Fermentation

- More specifically, chemical changes are brought about in an organic substrate through the action of enzymes elaborated by microorganisms.

- Fermentation is a metabolic process in which an organism converts a carbohydrate such as starch and sugar into alcohol and/or acid.
What is Fermentation?

Fermentation leading to excretion of Lactate

- Glucose
- 2ADP → 2ATP
- 2ADP → 2ATP
- 2ATP
- 2NADH + 2H+ → 2NAD+
- 2NADH + 2H+ → 2NAD+
- 2 x pyruvate → 2 x lactate
- NAD+ regeneration
Lactic Acid Bacteria

- Carnobacterium
- Enterococcus
- Lactococcus
- Lactobacillus
- Lactosphaera
- Leuconostoc
- Oenococcus
- Pediococcus
- Streptococcus
- Tetragenococcus
- Vagococcus
- Weissella
Pickling and Fermenting are Not the Same Thing

- “Overlapping” categories
- A cucumber can be pickled with vinegar or fermented without vinegar using a salty brine instead.
- During fermentation, vinegar and other acids are produced giving fermented sauerkraut and pickles a vinegary taste.
## Fermentation vs Pickling

<table>
<thead>
<tr>
<th>Feature</th>
<th>Fermentation</th>
<th>Canning/Pickling</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preserving Liquid</td>
<td>Brine → Lactic Acid</td>
<td>Vinegar</td>
</tr>
<tr>
<td>Environment</td>
<td>Clean</td>
<td>Sterile</td>
</tr>
<tr>
<td>Probiotic (alive)</td>
<td>Encourages Good Bacteria</td>
<td>Kills All Pathogens</td>
</tr>
<tr>
<td>Adds Nutrients</td>
<td>✓</td>
<td>×</td>
</tr>
<tr>
<td>Speed</td>
<td>Slow</td>
<td>Fast</td>
</tr>
<tr>
<td>Flavor</td>
<td>Complex</td>
<td>One-Note</td>
</tr>
<tr>
<td>Shelf Stable</td>
<td>×</td>
<td>✓</td>
</tr>
</tbody>
</table>

Source: [www.fermentersclub.com](http://www.fermentersclub.com)
Worldwide

- Kimchee – Korea
- Sauerkraut – Germany
- Turnips – Turkey
- Olives – Spanish, Greek, Sicilian
- Tempeh – Indonesia
- Miso – Japan
- Ogi – Nigeria
- Gari – Western Africa

http://www.fromscratchmag.com/fermenting-foods-joy-fermentation/
What About Food Safety?

- Basic food safety practices MUST be followed.
  - Vegetables grown using Good Agricultural Practices (GAP)
  - Washing produce
  - Hand washing
  - Cutting or preparation utensils
  - Food contact surfaces
  - Food containers

[https://producesafety.osu.edu/](https://producesafety.osu.edu/)
Food Safety

- The biggest concern with fermented vegetables is contamination AFTER the foods have been fermented.
- Handling them with unclean hands
- Letting them come into contact with contaminated proteins (meat or fish)
- Surfaces that have not been cleaned properly
The potential of lactic acid fermentation to control the harmful effects of food contamination depends on multiple factors which most kitchen employees are not able to quantify:

- Initial bacterial load of lactic acid bacteria
- Initial level of contamination
- Hygiene and sanitation
- Resulting degree of acidity
Fermentation

- On its own, fermentation cannot eliminate all food-related health risks.

- It should not be seen as a replacement for observing food hygiene principles.
Temperature

- 70-75°F – kraut will ferment in 3-4 weeks
- 60-65°F – kraut will take 5-6 weeks
- Below 60°F, kraut may not ferment

Proper fermentation temperature may allow the destruction of potential pathogens as well as inhibit spoilage bacteria.
Salt

- Salt is an essential ingredient but most chefs do not have a method to measure salt content so recipes must be tested.

- Must use canning or pickling salt not just for clarity but for concentration.

- Salt with iodine should not be use since iodine can inhibit fermentation.
Storage Time

- Storage time affects the texture.
- The shorter the time, the firmer the vegetables.
Fermented foods need a pH level of 4.2 or lower indicating that it is acidic enough to be safe and non-TCS.
Pathogens Associated with Fermented Foods

- Harmful Pathogenic microorganisms may still survive
- Parasites, bacteria, fungi and some virus are components of fermented fruits/veggies
Botulism

- 263 cases from 1990 – 2000
  - Majority from Alaska associated with traditional Alaska native foods
  - 2002 beached beluga whale

- 2012 New York C. bot in fermented tofu
  - People who fell ill bought from the store’s bulk tofu which had been kept unrefrigerated, uncovered, and in water-filled bins
Staphylococcus aureus

- Similar to C. bot, the fermentation process can reduce or destroy live bacteria, however, if allowed to produce toxins, the toxins cannot be destroyed.

http://www.micronaut.ch/shop/staphylococcus-aureus/
Vegetable Size

- Grate, chop or shred vegetables because vegetables such as carrots or beets are dense and it is difficult for the lactic acid to penetrate.
- This is a quality issue because it is difficult for pathogens to enter the vascular system of the plant (leafy greens are different).
- Because cucumbers are about 90% water, the lactic acid can penetrate easily.
Kimchi

- Staple of Korean cuisine
- Usually served as a side dish
- Traditionally stored underground in clay pots to keep cool and unfrozen in the winter months
- Kimchi refrigerators are now used
Kimchi

- Individual ingredients were sampled to identify the source of Lactic acid bacteria in Kimchi
  - Radish
  - Ginger
  - Napa Cabbage
  - Peppers
  - Garlic*

Source: https://mykoreankitchen.com/fresh-napa-cabbage-kimchi-salad-baechu-geotjeori/
Tempeh

- Tempeh is a traditional soy product originating from Indonesia.

- Like tofu, tempeh is made from soybeans, but it is a whole soybean product with different nutritional characteristics and textural qualities.

- Tempeh's fermentation process and its retention of the whole bean give it a higher content of protein, dietary fiber, and vitamins.

- It has a firm texture and an earthy flavor, which becomes more pronounced as it ages.
2012, 89 cases of *Salmonella enterica* in North Carolina
- 10 food service workers
- 2 health care providers
- 39 university students

3 restaurants using *unpasteurized* tempeh

Multiple opportunities for cross contamination

Smiling Hara identified as producer which distributed to 36 restaurants
Kombucha

- Kombucha is a naturally carbonated, fermented tea.

- It's made by fermenting tea and sugar and a mother culture also known as a Symbiotic Culture of Bacteria and Yeast (aka SKOBY)
  - It's a biofilm

- Many claim health benefits, but its benefits or adverse effects have not been determined scientifically.
Kombucha

- If prepared correctly, it should have a pH between 2.5 and 3.5, but it takes 5-10 days to lower the pH
- Most recommend adding concentrated Kombucha or distilled white vinegar as the started liquid
Kombucha Risks

- Risks for mold compromise to the SKOBY
- Equipment issues
- Ingredient Risks
- Poor Sanitation
- Pest Risks – especially ants, fruit flies and vinegar nematodes
Vinegar Nematodes

- Enjoy the low pH
- Not harmful but most people do not like drinking tea with swimmy things in it.
- Colonize the SKOBY – everything must be thrown out.

http://kombuchahome.com/teli-kombucha-vinegar-eels/
Kombucha Risks

- Over consumption:
  - Fatigue
  - Diarrhea
  - Muscle Cramps
  - Headaches
  - Anxiety
  - Sinus Problems
  - Skin Rashes
THANK YOU!

- Questions?