Case studies in food risk assessments

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Food Safety Specialist

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What you’re going to learn today...

1. Quick review of risk analysis theory
2. Practical application, where to start
3. Case studies
   a) FM: Shelf-life of refrigerated partially dried pasta
   b) FM: Raw cocoa/carob chocolate
      o Commercial or Natural/Organic
   c) Bakery couche
   d) Sous vide eggs
   e) FM: Flax/sunflower oil
Risk management activities

- Seize or detain product
- Suspend or cancel licence
- Order product destruction
- Recall notice or public advisory
- Increase/conduct product testing
- Issue prohibition notice
- On-site inspections
- Review all documentation
Risk communication activities

- Inform stakeholders about outcome
- Attend a Conference
- Write a peer reviewed paper
- Develop website messaging
- Suggest Policy
- Give a lecture
- Inform Media
- Consumers
- Industry
- Regulator
- Calls & meetings
- Emails
- Tweets
- Notices
- Educate your operator
- Write an IN or PSA
- Educate your operator

- Calls & meetings
- Emails
- Tweets
- Notices
- Educate your operator

- Educate your operator
RISK ASSESSMENT / COMMUNICATION / MANAGEMENT OVERVIEW FOR RECALLS/PSAs

Overview of Process for Provincially Initiated Public Advisory and Recalls

Health Risk Events (HRE):
- consumer complaint
- inspection finding
- suspect or confirmed foodborne illness

Communication of HRE
("Heads up" messaging)

Risk Assessment Phase

See Communications
- Director, EH, FPS (internal)
- Communications (internal)
- Ministry of Health
- Regional Health Authority, Directors

See supporting documentation for procedures

High Priority

Immediate product recall and public advisory is necessary to protect public health

Communicate* outcome to stakeholders, advise of actions that will be taken

Follow-up may include for example:
1. public health advisory
2. recall announcements
3. request for MA assistance
4. follow-up inspections
5. further product testing
6. illness trace-back
7. further assessment of product distribution networks
8. recall effectiveness checks

Communicate* summary to stakeholders, declare over

Medium Priority

Product recall is recommended to retail, but no public health advisory is indicated

Communicate* outcome to stakeholders, advise of actions that will be taken

Follow-up may include for example:
1. recall to retail
2. follow-up inspections

Low Priority

Low risk to public health

Communicate* outcome to stakeholders, no further public health actions needed

Routine follow-up with consumer (about complaint), operator (about inspection) or public health partners regarding unconfirmed illness

* see COMMUNICATIONS
Victorian risk assessment

This may be perilous

Excellent
Risk Assessment Considerations

<table>
<thead>
<tr>
<th>Collect background information</th>
<th>Examine food properties</th>
<th>Examine food preparation</th>
<th>Evaluate the evidence/make recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Any history of FBI with this food in the past?</td>
<td>• Are food ingredients safe for consumption and from an approved source?</td>
<td>• Identify and assess food handling practices that contribute to risk</td>
<td>• Are there enough hurdles?</td>
</tr>
<tr>
<td>• Review literature &amp; research available on product or food processing methods</td>
<td>• Review the 3 categories of hazards</td>
<td>• Are hazards controlled (i.e., CCP in the process)?</td>
<td>• Lab evidence: do counts meet guidelines? What additional tests are recommended?</td>
</tr>
<tr>
<td>• Identify standards for preparation of this food (if it exists) e.g., legislation, guidelines, laboratory testing, etc.</td>
<td>• Are any ingredients in the food potentially hazardous?</td>
<td>• Is the food adequately processed to destroy &amp;/or prevent growth of pathogens?</td>
<td>• Do you have enough information about the food, food process to make an informed recommendation?</td>
</tr>
<tr>
<td>• Is this a novel or common food? Have we given advice on this in the past?</td>
<td>• Intrinsic factors (pH, Aw, antimicrobials, e.g. nitrite)</td>
<td>• Are preservatives used?</td>
<td></td>
</tr>
<tr>
<td>• What do your colleagues know?</td>
<td>• Extrinsic factors (packaging, O2, storage temp and time)</td>
<td>• What are the critical limits?</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• shelf-life, use in other foods</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
POTENTIAL HURDLES for DANGEROUS MICROBES

Botulimum
Perfringens
Staphylococcus
Salmonella
Shigella
Listeria
Campylobacter
Vibrio
E. Coli
Yersinia
Parasites
Other recognized pathogens
Other unrecognized pathogens
start by collecting some data

- **EASY**: google search and google scholar
- **HARDER**: OVID / PubMed [define search criteria & hits]
- Search books; specific journals; government/organizational authorities
- Talk to colleagues, e-mail authors in the field
The question:

Is there any information on shelf stability for typical fresh and partially dried pasta products?

http://betterwithbutter.com/pasta-procrastination/
Ingredients in pasta\textsuperscript{1,2}

• Flour (semolina, farina, wheat flour)
• Water
• Eggs (sometimes)

Hazards in these ingredients\textsuperscript{3}

• \textit{Salmonella}
• \textit{Staphylococcus aureus}
• Spoilage moulds

\textsuperscript{2} Pasta. 2013 [cited 2013 Sep 20]; Available from: \url{http://www.madehow.com/Volume-2/Pasta.html}
What else do you need to know?

- $A_w$ – water activity $^{3,4}$

<table>
<thead>
<tr>
<th>Fully Dried Pasta</th>
<th>Partly Dried Pasta</th>
<th>Fresh Pasta</th>
</tr>
</thead>
<tbody>
<tr>
<td>$A_w = 0.4$ to $0.6$ $^6$</td>
<td>...in between...</td>
<td>$A_w = 0.92$ to $0.99$ $^{3,4}$</td>
</tr>
<tr>
<td>Shelf-stable room temperature</td>
<td>?</td>
<td>Refrigerated 2 to 3 days</td>
</tr>
<tr>
<td></td>
<td>...check blog sites...</td>
<td>Longer if preservatives added $^5$</td>
</tr>
</tbody>
</table>


What else was found?

- Very little documentation on best practices for partially dried pasta;

- Room temperature drying a risk for growth of *Salmonella* and heat stable *S. aureus* enterotoxin;\(^3\)

- Commercial pasta dried ≥55°C;\(^2\)

- Moisture resorption an issue; spoilage from mould/bacteria; pH drops from spoilage; coliforms increase after 3-4 days\(^3,5\)

- Water activity more important than temperature for controlling moulds.\(^7\)

- CFIA says the manufacturer must establish the shelf-life\(^8\)

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(evaluate evidence) → Recommendations

- Measure the $A_w$
  - $< 0.6$, store RT for several months
  - $> 0.6$, store refrigerated for one week (7 days)
    - Refrigeration prohibits growth of moulds, spoilage bacteria
    - Test coliforms of pasta, at 0, 7 and 14 days to establish shelf-life if hold longer than one week

- Dry above 55°C to prohibit growth of bacteria
- Use pasteurized eggs to control for *Salmonella*
- Proper hygiene (& past. eggs) to control for *S. aureus*
The question:

Can raw food desserts be made with raw cocoa/carob for sale in farmers’ markets?

http://michaelarthurfood.com/category/sweet-dishes/raw-brownie/
Chocolate desserts
-commercial chocolate
(TFM guideline)

Raw chocolate desserts
-homemade carob
(TFM guideline)

Raw chocolate desserts
-commercial carob
(TFM guideline)

<table>
<thead>
<tr>
<th>Guidelines prior to 2014</th>
<th>Guidelines in 2014</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Appendix 1 listing:</strong></td>
<td><strong>Appendix 1 listing:</strong></td>
</tr>
<tr>
<td>chocolate (provided it is used as an ingredient in a food that has undergone cooking to at least 71°C (160°F))</td>
<td>chocolate (provided it is used for re-melted or re-molded products only and: (1) not purchased from bulk bins; (2) sourced from a chocolate manufacturer that can provide a certificate of assurance that chocolate is free from <em>Salmonella</em>).</td>
</tr>
</tbody>
</table>
HACCP and process overview for milk chocolate manufacture

Chocolate manufacturing facts:

- Water activity low, between 0.37 to 0.5 (low moisture food) \(^3,5\)

- D-value during conching, 1292 min (approx one day) at 60°C to 584 min at 50°C \(^3\)

- In the majority of outbreaks, contaminated cocoa seeds, and a failure to control *Salmonella* during roasting occurred. \(^4-6\)

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Recommendations for commercial chocolate:

• Chocolate sourced from reputable suppliers with certificates stated product tested and found free of *Salmonella*

• Chocolate not purchased from bulk-food bins

• Hygienic control in the process, education of operators

• Melted and re-molded chocolate CANNOT be re-molded again, but could be used in baked products

• Reword the TFM guidelines
Back to the original question:

Can raw food desserts be made with raw cocoa/carob for sale in farmers’ markets?

http://michaelarthurfood.com/category/sweet-dishes/raw-brownie/
Carob - *Ceratonia siliqua*¹

- Chocolate substitute
  - Low caffeine
  - Low theobromine
- Made from beans²
  - “locust” beans, also used to make a food gum

**Food process**²,⁴

What else was found?

- no outbreaks/illnesses / no Cdn recalls
- Roasting reduces the pH of the pods from pH=6.0 to pH=4.8

HAZARDS (infer from cocoa processing)

<table>
<thead>
<tr>
<th>Physical</th>
<th>Chemical</th>
<th>Biological</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stones</td>
<td>Mycotoxins</td>
<td><em>Salmonella</em>&lt;sup&gt;5-9&lt;/sup&gt;</td>
</tr>
<tr>
<td>Metals / woods</td>
<td>Aflatoxins</td>
<td>VTEC&lt;sup&gt;10-11&lt;/sup&gt;</td>
</tr>
<tr>
<td>Allergen? Tree-nut</td>
<td><em>B. cereus cereulide</em>&lt;sup&gt;12&lt;/sup&gt;</td>
<td></td>
</tr>
</tbody>
</table>
Roasted Carob Powder Food Flow Process

Recommendations for home prepared raw carob

• Do not recommend using home-prepared raw carob powder without any roasting or heating step in the process

• Hygienic process (equipment and personnel), including washing & disinfecting pods before use

• Sift powder for physical hazards

• Caution for chemical hazards, inspect for moulds (mycotoxin/aflatoxin) / allergen issues
RAW FOOD
What if the raw carob powder was purchased commercially?

SunFoods stated that “the carob pod is air dried for no more than a few seconds, dependent upon the humidity, and the air temperature is between 122/140 F. The carob itself remains at a lower temperature than the air, it is not roasted or toasted”.

Raw carob or cocoa purchased from a commercial supplier may still be higher risk than traditionally manufactured carob/cocoa

- …acceptable for use in products if vendors provide a COA from their suppliers. As with lower risk foods, all items must have pH <4.6 or \(A_w <0.85\).

- Preparation of foods with raw carob and cocoa must be done with processes that minimize any amplification of existing hazards (e.g., *Salmonella*), …. sanitary and hygienic …no CCP downstream to …eliminate bacterial hazards

- We would further recommend consumer disclosure …and that market managers are aware of the labelling requirements for these products.
RAW FOODIE ISSUES
Each **raw food application** must be evaluated individually and include the following:

- Raw ingredients must be sourced from suppliers that can provide a COA that demonstrates all ingredients are free from pathogens of concern for that ingredient.
- Raw ingredients must not be purchased from bulk bins.
- Recipes including quantities and process steps must be written out. We recommend all applicants chart out the food flow in a diagram and create a food safety plan for food safety assessment.
- All process steps must be designed to limit amplification of potential bacterial hazards. Examples of process steps that increase likelihood of bacterial hazards multiplying in raw foods:
  - Soaking dry ingredients in water at temperatures above 4°C.
  - Dehydrating raw food mixtures in the temperature danger zone: specifically between 4°C and 55°C.
  - Not providing anaerobic conditions for lactic acid fermentation to occur properly.
The question:

Is it an unsanitary practice when bakeries do not wash their proofing linens?
Bakery linen, or bakers couche$^{1,2,3}$

- A product used for allowing bread dough to rise (forms a surface crust)

  - FLAX LINEN – shouldn’t be washed  
    - Changes structure and performance
  - COTTON CANVAS – should be washed  
    - Flour and iron before re-use

Hazards with this “ingredient”/utensil$^{2,3}$

- moulds

1. https://www.youtube.com/watch?v=hZAwSV1VakA
Top: couche, used for proofing shaped breads, 50 years old

Right: couche hanging up to dry at end of day

https://foodstartuhelp.blogspot.com
What else was found?

<table>
<thead>
<tr>
<th>Lean Dough</th>
<th>Rich dough</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yeast</td>
<td>Yeast</td>
</tr>
<tr>
<td>Low fat</td>
<td>Eggs</td>
</tr>
<tr>
<td></td>
<td>Oils</td>
</tr>
<tr>
<td></td>
<td>Butter</td>
</tr>
</tbody>
</table>

• Linen couche used with lean dough only
• Bakeries traditionally do not use wet cleaning methods (wet flour=glue)
• No illnesses related to use of bakers couche were found

Summary of PubMed search information
PubMed: “foodborne illness” AND “bakery”=2 hits, not related to breads. “illness” AND “bread”=63 hits, 8 related to gastrointestinal illness and bread consumption, but none to baking equipment issues. [3 from food handlers (2 norovirus, 1 Salmonella Thompson); 3 from cross-contamination issues with eggs (all Salmonella Enterititis); 1 stuffed bread, agent not specified; 1 S. Typhimurium from cross contamination with chicken].
(evaluate evidence) → Recommendations

• Scrape down and dry both types of cloths between use
• Discard if visibly mouldy
• Flax linen couches should not be washed, but can be if required (blog sites differ)
  • Use only with lean dough (no eggs)
• Cotton canvas couches can be washed if needed, flour and iron before re-use
The question:

Is the sous vide cook process for shell eggs used by operator X acceptable?

http://vineelasiva.blogspot.ca/
Backgrounder to this question:

- 2 SE illnesses linked to premise
- Bakery items made with sous vide style cooked egg glaze
- Caesar salad made with raw shell eggs
Hazard assessment / what we know about SE:
• ~ 6.3 billion table eggs sold in Canada in 2005 (7 billion now?) 5
• 1.7 million SE contaminated table eggs sold in Canada annually 6
• estimation of annual SE illness reduction with egg pasteurization in the US 9

<table>
<thead>
<tr>
<th></th>
<th>None</th>
<th>3 log</th>
<th>5 log</th>
</tr>
</thead>
<tbody>
<tr>
<td>130,000</td>
<td>41,000</td>
<td>19,000</td>
<td></td>
</tr>
</tbody>
</table>

• Vertical transmission from hen (81%); environmental transmission (19%). 1
• Contamination in egg yolk interior as well as various layers of egg, cracks, condensation, and other factors allow pathogens in. 2,3

Sous vide style cooking

Sous vide – (fr.) under vacuum
- LTLT
- Low temperature
- Longer times

Foods are
1. Vacuum-packaged,
2. Cooked, using either
   - Water bath = Immersion circulator
     - Water immersion circulator
     - Heating coil
     - Controller
   - Convection steam oven
   - ❌ Bain maries, dishwashers or hot tub not recommended!
3. Finished before service

Photo courtesy of Karen Rehbein, VCH
How the eggs were made

- 60 eggs placed in bowl from refrigerator
- Placed in immersion circulator set to 62.5°C
- Left for 2 hours
- Cooled on cookie sheet at room temperature

→ Inspector tested internal temp of SV egg, 55°C egg yolk yellow and runny; egg white partly translucent

http://thesadpig.com/blog/2013/02/sous-vide/

One Hour Sous vide Eggs

http://www.pepper.ph
Was our guideline giving the correct advice?

Guidelines for restaurant sous vide cooking safety in British Columbia

September 2014

Prepared by the Sous Vide Working Group

Endorsed by Chef and Environmental Health Officers of the Sous Vide Working Group

http://www.bccdc.ca/foodhealth/foodguidelines/default.htm
Total cooking time = CUT + PR time

Table 3 – at 62°C, to achieve a 7-log PR of *Salmonella*, hold egg for 12.4 minutes.\(^{11}\)

Chef sous vide style egg cookery: between 62°C and 65°C, for ~ 45 min (~30 min to equilibrate). \(^{12}\)


What else was found?

- Penetration into intact egg is slow as eggs are not efficient heat conductors. 13
- Previous studies on shell eggs found CUTs of 24 to 35 min at temps of 57 – 58°C. 14,15

Issues with the process (evaluate evidence)

- Stainless steel bowl did not allow water to circulate around eggs
- FSP did not specify CUT or PR times at 62°C
- Cooling time on cookie sheet not specified

eggs likely temperature abused for 4+ hrs
Recommendations

• SV equipment must perform correctly – i.e. water MUST circulate around food item

• Operator MUST use a thermometer to verify temperatures

• Bowls holding eggs must be perforated and eggs must be fully immersed

• Quantity of eggs must not exceed heating capacity of circulator

• Operator must provide a FSP with CUT/PR times and temperatures – follow Table 3 of BC sous vide guidelines

• Operator must define cooling and warming processes
The question:

Can a flax and sunflower oil product be sold in farmers’ markets?

https://www.piteba.com/eng/index_eng.asp
The operators process:

- Soak sunflower seeds in water for 2 days (in refrigerator)
- Place sunflower and flax seeds into screw press extractor
- Bottle product and refrigerate
- Shelf-life of 6 days

*Add a little water to assist extraction*
What else was found?

<table>
<thead>
<tr>
<th>Sunflower oil&lt;sup&gt;2&lt;/sup&gt;</th>
<th>Flax seed oil (linseed oil)&lt;sup&gt;3&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Helianthus annuus</em> L.</td>
<td><em>Linum usitatissimum</em></td>
</tr>
</tbody>
</table>
| High linoleic fatty acids| Polyunsaturated fats:  
Linolenic fatty acids (57%)  
Linoleic acid (16%)         |

Very little information about hazards – most removed during processing.

<table>
<thead>
<tr>
<th></th>
<th>Physical</th>
<th>Chemical</th>
<th>Biological</th>
</tr>
</thead>
<tbody>
<tr>
<td>General hazards</td>
<td>Seed casings, stones, dirt, leaves&lt;sup&gt;1&lt;/sup&gt;</td>
<td></td>
<td><em>Clostridium botulinum</em>?</td>
</tr>
<tr>
<td>Sunflower Oil</td>
<td></td>
<td>Allergen</td>
<td></td>
</tr>
<tr>
<td>Flaxseed Oil</td>
<td></td>
<td>Cyanide&lt;sup&gt;3&lt;/sup&gt;</td>
<td>Linatine, Phytic acid&lt;sup&gt;3&lt;/sup&gt;</td>
</tr>
</tbody>
</table>
What else was found?

Crude oil extractions can contain:2,3

• Phosphatides, phosholipids
• Mucilaginous matter
• Waxes
• Tocopherols, sterols, resins, carbohydrates, pesticide, trace metals and pigments

Procedural gaps to control for food safety hazards

- No washing or disinfecting of seeds before grinding or use;
- No heating or cooking of seeds before grinding;
- No separation step to remove surface water from oil before bottling;
- No filtering of extracted oil to remove water through clay membrane; and,
- No filtering of extracted oil to remove physical particulates
(evaluate evidence) → Recommendations

Product is low risk, but not zero risk:

1. Seeds should be screened for dirt, sticks and other physical debris before using

2. Sunflower seeds could be hulled and seeds separated before using to reduce risk of seed hull splinters getting into the final product

3. Oil could be grossly refined by the following:
   - Pass through a fine metal mesh screen to remove particulate debris
   - Separate out water from oil components

4. Include the statement “keep refrigerated at all times” or something similar on the label.

5. Reduce the shelf-life to 4 days (from 6 days)
Assessment from Health Canada BMH

Our comments are focused only on the microbiological hazards associated with this product. Health Canada does not have specific guidelines on flax/sunflower oil production. Cold-pressed oils (such as some olive oils) are common in the marketplace and do not usually have an aqueous phase that would permit the growth of *C. botulinum*. Oils have very little to no available water to allow for bacterial growth.

As long as good manufacturing and proper sanitation/hygienic practices are satisfied along with an added separation step to remove any water, we do not foresee any microbiological issues with this sunflower-flax seed oil mixture. If these conditions were met, refrigeration is not necessary for this product from a safety perspective.
You Dropped Food on the Floor
Do You Eat It?

Was it sticky? — No. — Did anyone see you? — YES.

Yes.

Is it a
Megalosaurus?

No.

Are you a puma?

No.

Is it bacon?

No.

Is your cat healthy?

No.

YOUR CALL

EAT IT.

EAT IT.

EAT IT.

EAT IT.

EAT IT.

DON'T EAT IT

DON'T EAT IT
Nahhhh...I don't think it will work. Let's do something different...something smarter...something cooler!
lorraine.mcintyre@bccdc.ca  Ph: 604.707.2458
Docs will be  http://www.bccdc.ca/foodhealth/foodguidelines/default.htm
links to NCCEH  contact@ncceh.ca

http://www.happy-mothering.com/03/household/pros-and-cons-of-hang-drying-your-laundry/