Lesson Plan Overview for 2012 – 2013 NATURE Sunday Academy Program

Project Title
Science and Tradition of Meat Safety and Preservation.

Summary
The project will focus on meat products similar to beef jerky, which is the counterpart to traditional Native American dry meats. We intend to have 4 parts. Part one will be the traditional meat preservation methods. Discussions regarding Native American tradition will be presented by cultural leaders. Other cultural practices from other countries will also be included in the cultural discussions. Part two will involve a discussion regarding ingredients and how they preserve foods. Part two will involve the drying time as it relates to water activity and the color stability of the product. The hands-on activity will involve preparing jerky from beef, bison, deer, and elk. The products will then be placed in a food dehydrator and samples collected at intervals to monitor the changes in water activity. Students will then plot changes in water activity over time. Part three is a hands-on activity involving the evaluation of samples with different levels of salt in jerky formulas. This will include tasting samples (outside of the lab), measuring water activity, and observing samples for mold growth. Part four will involve the sensory testing of jerky (to be done outside of the lab) prepared by various meats and methods. Students will be asked to rate the different products. After students have had the chance to evaluate the products, we will have a discussion about how they rated the sample and we will reveal the meat source. During this part, we will encourage the evaluation of samples prepared by hunter/processors from the reservations.

Project Objectives
To understand the cultural aspect of preserving meat using traditional Native American preservation methods.
To understand the scientific basis for preserving meat using modern preservation methods such as salting and drying.
To make jerkies using various animals and methods.
To explore how food is kept safe through preservation and the importance of water activity.
To increase student knowledge of how to conduct research in the food safety field.
To practice critical reflective thinking through the use of a journal log.

North Dakota Science Content and Achievement Standards Met

9-10.1.1 Explain how models can be used to illustrate scientific principles
9-10.2.2. Use appropriate safety equipment and precautions during investigations
9-10.2.3 Identify questions and concepts that guide scientific investigations
9-10.2.6. Design and conduct a guided investigation
9-10.2.8. Analyze data found in tables, charts, and graphs to formulate conclusions
9.10.7.2 Identify factors that affect populations (e.g., food webs, carrying capacity, overpopulation, disease, food supply, algal blooms, resources, conservation practices)
9-10.8.5. Explain how views and attitudes have influenced the development of science (e.g., religion, previous knowledge, cultural tradition, superstition, folklore, legends)
**Introduction**

Preservation is done during periods of abundance with the intent that the product will be available at a later date. Preservation is any method that converts useable commodity or product into a finished product. The raw material must be of high quality because preservation does not improve the quality of poor quality raw materials. The preserved food remains safe because harmful organisms are usually killed during processing or cannot grow in the preserved food. Modern day preservation methods are based on conditions identified through scientific exploration.

**Session Organization**

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>11:00-11:30</td>
<td>General organization/Cultural connection</td>
</tr>
<tr>
<td>11:30-12:00</td>
<td>Background about preservation methods and jerky/dried meat production</td>
</tr>
<tr>
<td>12:00-1:00</td>
<td>Activity 1 – Preparation of jerky, place in dehydrator</td>
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<tr>
<td>1:00-1:30</td>
<td>Lunch</td>
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<tr>
<td>1:30-2:00</td>
<td>Activity 2 – Impact of salt on meat preservation</td>
</tr>
<tr>
<td>2:00-2:30</td>
<td>Activity 3 – Sensory Evaluation of dried meats</td>
</tr>
<tr>
<td>2:30-3:00</td>
<td>Wrap-up and Evaluation</td>
</tr>
</tbody>
</table>

**Cultural Piece**

**Activity 1: Preparation of jerky:** Role of Ingredient and drying as preservation methods. Preparation of jerky from beef, bison, deer, and elk.

• Discussion regarding ingredients, drying, etc. used to preserve foods.
  

• The hands-on activity will involve preparing jerky.  
  – Beef, bison, deer, and elk  
  – Collect samples at intervals to monitor the changes in water activity and color  

• The focus of the sample collection is on drying time as it relates to water activity and food safety of the product. Student will  
  – Plot water activity over time  
  – Determine if meat and ingredients impacted water activity and color

**Activity 2: Evaluate the impact of salt on meat preservation:** Evaluation of samples with different levels of salt in jerky formulas.

• Samples will be prepared at NDSU with varying season/salt levels and drying times. We will focus only on beef jerky in this activity.

• Hands-on Activity  
  – taste testing of samples (outside of the lab)  
  – measuring water activity and color
– observing samples for mold growth

• At the end of the activity student will
  – Understand the impact of partial drying and ingredients on the jerky quality and safety

**Activity 3: Sensory Evaluation of Dried Meats:** Complete sensory evaluation on previously prepared jerky samples.

• Samples will be prepared at NDSU with different meats used in activity 1. One formula will be used in the preparation.

• Hands-on activity involves sensory evaluation of samples
  – taste testing of samples (outside of the lab)
  – we will have a discussion about how students rated the sample and we will reveal the meat source
  - if available, samples from the reservations will also be evaluated
  – measuring water activity and color (if time permits)

• The focus of the sensory evaluation is to illustrate the impact meat source has on final jerky quality. A the end of this activity students will
  – Understand the influence of meat source on the jerky quality
Science and Tradition of Meat Safety and Preservation.

Rotating Activity

Deland Myers Sr. and Clifford Hall (NDSU)
Mafany Mongoh (Sitting Bull College)
Charles Morin (Four Winds Community Schools)

Cultural Activity

Traditional Native American Meat Preservation

Note: This activity will be completed by the Cultural Leader at Each Academy Location

• Traditional Native American Meat Preservation

• Meat Preservation from other cultures (e.g., Africa)

http://www.fao.org/docrep/003/x6932e/X6932E02.htm
Activities

Science and Tradition of Meat Safety and Preservation.

Introduction

Food preservation is any process that reduces or prevents the deterioration of a food. Food deterioration is caused by a number of factors but can generally be grouped into several categories. These categories include microbial, biological, biochemical, chemical and physical. From a microbial perspective, the elimination of spoilage organisms is the major target for preserving a food. Pathogenic microorganisms are also targeted in many food processing operations because these organisms cause foodborne illness. However, eliminating pathogenic microorganisms does not necessarily guarantee that the food will be preserved. Typically, spoilage microorganisms are harder than the pathogens; thus, treatments that inhibit spoilage microorganisms will preserve the food. Enzymes are the most important biochemical means of spoilage. Enzymes can affect sensory quality such as color and texture, but also can increase the susceptibility of a food to other deteriorative processes. Physical parameters such as water activity \((a_w)\) and \(pH\) of the product and oxygen content of the environment also influence the rate of deterioration. Slowing the deteriorative processes will enhance the shelf life of a product or simply put, preserve the food.

In order to preserve foods, the nature of the food must be determined to best select a process that will eliminate possible deteriorative processes. A food manufacturer will use various unit operations and chemical additives to preserve foods. Unit operations used by food manufactures include:

- **Thermal Processes**
  - Blanching
  - Pasteurization
  - Commercial sterilization
- **Cold Temperatures**
  - Refrigeration
  - Freezing
- **Concentration / Dehydration**
- **Fermentation**
- **Irradiation**
- **Ultra High Pressure Processing**
- **Modified Atmospheric Packaging**

The unit operation is designed to eliminate as many of the deteriorative processes as possible. For example, thermal treatment can destroy microorganisms and enzymes do not necessarily prevent chemical deterioration (e.g. oxidation). Furthermore, some processes such as dehydration can significantly affect \(a_w\) whereas refrigeration has minimal effect on \(a_w\) changes. The combination of chemical preservatives and the unit operation provide the best preservation.

The preservation of foods is due to many factors. In fact, the food industry uses hurdle technology (Figure 1) as a means to preserve foods. The hurdle effect was characterized as “hurdles” in which microorganisms must overcome to survive and cause food spoilage or foodborne illness (Leistner, 1995). Hurdle technology is the application of the hurdle effect and is simply combining several factors to preserve foods. Several factors include \(a_w\), \(pH\), and temperature. Thus, incorporating multiple factors in the processing of a food will increase the likelihood that the food will not spoil or contain microorganisms that cause foodborne illness.
Beef jerky is defined as ready-to-eat meat product that can be whole or meat strips or ground and molded into a shape (USDA, 2004). The Food Safety Inspection Service or FSIS (2011) of the USDA further defines jerky as having a moisture-to-protein ratio of 0.75 (or less) to 1. This means that for every gram of protein in the product there must be no more than 0.75 g of water in the product. However, this definition is only indicative of moisture level in the product and not necessarily the safety of the product. In recent years the use of water activity (aw), as an indicator of jerky safety, has been incorporated into FSIS guidelines. The FSIS recommends that the final product aw of $\leq 0.85$ be achieved during processing to inhibit the growth of pathogenic microorganisms (FSIS 2012). However, final product aw of $\leq 0.91$ is allowable provided that the additional steps that include vacuum packaging are utilized. The recommendations also indicate that final product aw of $\leq 0.70$ is best because both pathogenic bacteria and molds can be inhibited at this aw. Other conditions such as internal meat temperatures of 71.1°C (160°F) must also be achieved during processing. The combination of aw and internal meat temperature are hurdles that a microorganisms must overcome to survive. In addition, preservatives such as salt and sodium nitrites can also inhibit microorganisms further adding a hurdle to the process. If a microorganism can survive all of these hurdles (i.e. treatments) it is possible that the organisms could promote spoilage of the jerky or cause a foodborne illness.

Critically monitoring the conditions during processing and in the final product allows processors to assure the governmental agencies that product was manufactured in accordance with guidelines. It also minimizes the risk to consumers of being exposed to a pathogenic microorganism. Water activity and color analysis are two simple methods to evaluate safety and quality characteristics, respectively.

Water activity is “the ratio of the vapor pressure of water in a material(p) to the vapor pressure of pure water (po) at the same temperature” Decagon Devices (2012). In other words, aw is the ease to which water can migrate within and out of the samples. The more water migration, the more likely the product will support microorganism growth, chemical reactions, etc resulting in unsafe food and poor product quality. Table 1 of the appendix provides a listing of food products and their associated aw. In general, the higher the water activity, the more likely the food can support pathogenic microorganism growth and
toxin production. Both situations could lead to a foodborne illness if product is consumed.

The water activity instrument works on a principle of relative humidity and equilibrium relative humidity (ERH). “Relative humidity of air is the ratio of the vapor pressure of air to its saturation vapor pressure” (Decagon Devices, 2012). In a closed system such as that used in the water activity meter, water migration out of the samples will balance with that of the air surrounding the product inside the chamber resulting in an equilibrium between sample aw and relative humidity in the air in the chamber. Mathematically, aw is a ratio of vapor pressures and can be expressed as \( aw = \frac{p}{p_0} = \frac{ERH}{100} \), resulting in a number without units. The values range from 0.0 (extremely dry) to 1.0 (pure water).

Unlike aw, color analysis is a quality measure only. Color does not indicate safety; however, it is a basis for sensory evaluation. The meter measures different wavelengths of light and through algorithms converts it into three values called L, a* and b*. The lightness (L) of the color is indicated with value of 0 to 100 where 0 = black and 100 = white. The a* values represents red and green where positive values indicate red and negative a* values indicate green. Yellow and blue are represented as b* values where positive values indicate yellow and negative values indicate blue. The perceived color is therefore dependent on several factors. In jerky the presents of nitrites typically yields red color because nitrite interacts with meat pigment (i.e. myoglobin) to produce a pink to pink-red color. Products that do not contain nitrites appear browner in color, similar to a cooked meat color.

References


**Activity 1: Preparation of jerkies:** Role of Ingredient and drying as preservation methods. Preparation of jerky from beef, bison, deer, and elk.

**Laboratory Exercise:** Each group of students will make jerky using one of the meats provided. We will make two types of jerky. The first type of jerky will be made using marinade and sliced meat. In this product, NDSU graduate students will slice the meat and then marinade it for the designated time. Student attending NATURE Sunday academy will remove the meat slices from the storage container and place them in the dehydrator as indicated below. The second jerky product will be of the molded type involving the use of ground meats. Students will mix meats with the dry ingredients, mold into shape, and place in the dehydrator. The students will then monitor water activity and color initially and then every 30 minutes thereafter. The students will then plot the water activity over time.
**Materials**
Marinated beef, bison, deer and elk strips
Ground beef (90% lean), bison, deer and elk
Spice Mix
Sodium Nitrite (cure mix)
Bowls and utensils for mixing ground meat with dry ingredients
Dehydrators
Colorimeter
Water activity meter
Balances
Kitchen scissors
Lab Gloves

**Methods**

- **Product 1. Jerky product made from ground meats without nitrite addition**

**Step 1.** Weigh, into the bowl provided, 1/2 pound (226.8 g) of the meat assigned to you. Weight 7.7 g of the spice mix into the weigh boat provided. **(DO NOT add the cure packet)**

**Step 2.** Spread the dry mix over the ground meat in the bowl and then mix using a spatula or hands (make sure you are wearing lab gloves) until the dry mix in thoroughly mixed into the meat.

**Step 3.** The color measurement will be completed using a Minolta colorimeter. Place sufficient mix into a petri dish provided. Make sure that the cover of the petri dish is 1/2 full. Place the bottom of the petri dish over meat and then place the hand-held unit onto the covered meat. Complete the color measurement as observed in the video and by the guide next to the colorimeter. **Record the L, a, and b values. These color readings will serve as the time zero reading.** Please see introduction regarding the color analysis. **(Please note: the meat sample used for color analysis should be returned to the bowl)**

**Step 4.** The water activity will be measure by placing a sample of the ground meat and mix into a water activity cup (**fill the cup only halfway**). Complete the water activity measurement as observed in the video. Record the temperature and water activity reading. **This water activity reading will serve as the time zero reading.** Return the meat from the water activity cup into the bowl containing ground meat and mix.

**Step 5.** To make meat strips, place the meat mixture into the jerky gun and squeeze the trigger to make thin strips of meat. The meat strips should be placed directly onto the dehydrator tray.

**Step 6.** Using tape and a Sharpie, label the tape and attach to the edge of the tray to identify the treatment.

**Step 7.** Place the tray containing product into the dehydrator. Please note that the dehydrator will be running and up to temperature before the product is placed in the dehydrator. **To prevent a significant drop in temperature place tray in the dehydrator as quickly as possible.**

**Step 8.** At 30 minute intervals, collect sufficient samples to run water activity and color analysis. The samples should be allowed to cool 3-5 minutes at room temperature before completing the water activity and color (i.e. L, a, and b values) measurements.
• Product 2. Jerky product made from ground meats with sodium nitrite (cure) addition

Step 1. Weigh, into the bowl provided, 1/2 pound (226.8 g) of the meat assigned to you. Weight 7.7 g of the spice mix and 7.7 g of curing into the weigh boat provided.

Repeat steps 2-8 of the procedures used to make product 1 above.

• Product 3. Jerky product made from ground meats with ½ of the sodium nitrite (cure) addition

Step 1. Weigh, into the bowl provided, 1/2 pound (226.8 g) of the meat assigned to you. Weight 7.7 g of the spice mix and 3.85 g of curing into the weigh boat provided.

Repeat steps 2-8 of the procedures used to make product 1 above.

• Product 4. Marinated strip jerky product

Step 1. The marinated meat strips will be provided in ziplock baggies. Drain the meat to remove excess marinade by placing meat on a mesh rack placed over a plastic container.

Step 2. After 3 minutes of draining, pat dry the surfaces of the meat trying not of squeeze marinade from the meat.

Step 3. The color measurement will be completed using a Minolta colorimeter. Place two of the strips next to each other in the cover of the petri dish so that the width is large enough to cover the opening of the colorimeter. Record the L, a, and b values. These color readings will serve as the time zero reading. Please see introduction regarding the color analysis. (Please note: the meat strips used for color analysis should be saved for drying)

Step 4. Cut a piece of the meat strip to fit into the water activity cup. Complete the water activity measurement as observed in the video. Record the temperature and water activity reading. This water activity reading will serve as the time zero reading.

Step 5. The remaining meat strips can then be placed onto the dehydrator shelves. Using tape and a Sharpie label the tape and attach to the edge of the tray to identify the treatment.

Step 6. Place the tray containing product into the dehydrator. Please note that the dehydrator will be running and up to temperature before the product is placed in the dehydrator. To prevent a significant drop in temperature place tray in the dehydrator as quickly as possible.

Step 7. At 30 minute intervals, collect sufficient samples to run water activity and color analysis. The samples should be allowed to cool 3-5 minutes at room temperature before completing the water activity and color (i.e. L, a, and b values) measurements.
**Activity 2: Evaluate the impact of salt and drying time on meat preservation:** Evaluation of samples with different levels of salt in jerky formulas and different drying times.

**Laboratory Exercise:** The jerky samples used in this exercise will be prepared at NDSU. The products have varying levels of salt will be evaluated. The students will be asked to taste beef jerky and rate their responses using the Just-About-Right scale. In total, there will be three samples to evaluate. This part of the activity will involve evaluating the non-edible samples for mold.

**Materials**
- Beef jerky (both edible and nonedible samples) with varying levels of salt and from different drying times
- Sensory forms and pencils
- Water activity meters

- **Part I. Sensory evaluation of beef jerky (outside of lab)**
  
  The samples will be provided in sample cups labeled with three digit codes. You will be asked to evaluate each product using the Just-About-Right scale.

  1. Try not to look at you neighbor when doing this activity.

  2. There are three (3) samples to be evaluated. In front of you are the sample cups with three digit codes.

  3. Taste the samples in the order provided (from left to right – do not mix up the order). Between samples drink a sip of water.

  4. On the sensory sheet provided, write the sample code on the line provided in the upper left corner.

  5. For each sensory characteristic check the box that indicates how you feel about the product. You are free to check any of the boxes.

  6. On separate sheets continue the evaluation for other products remembering to take a sip of water between samples and to use a new sheet for each sample.

  7. When you have rated all products return sheets to instructors and return to lab for the next activity. We will discuss the results before activity 3.

- **Part II. Determination of mold on products (in lab)**

  Beef jerky with or without mold present are in the lab in petri dishes or plastic bags. You will view the Petri dishes and determine if the ingredient (i.e. salt) and drying time had an impact on shelf stability of the prepared jerkies.

  1. Please DO NOT open the Petri dishes.

  2. Please observe the level of mold growth on the samples in the Petri dishes provided.

  3. Spoilage is indicated by the presence of mold (i.e. green, black, or white fuzzy looking material) or small white circular colonies (yeast).
4. Record your observations in the data collection sheet provided and assign a number indicating the level of spoilage. The number 0 indicates no spoilage, 1 indicates minimal or little spoilage, and 2 indicates a high level of spoilage (fuzzy mass of microorganisms).

- **Part III. Determination of water activity of products (in lab)**

Beef jerky without mold will be in plastic bags near the water activity meter. You will determine if the ingredient (i.e. salt) and drying time had an impact on water activity of the prepared jerkies.

**Data for Activity 2.**

![Figure 1. The effects of ingredients and preparation temperature on the log colony forming units (cfu) of E. coli on beef jerky.](image)

**Activity 3: Sensory Evaluation of Dried Meats:** Complete sensory evaluation on previously prepared jerky samples.

**Laboratory Exercise:** The jerky samples used in this exercise will be prepared at NDSU from meat used in activity 1. The students will be asked to taste jerkies and rate their responses using the acceptance scale. In total, there will be four samples to evaluate.

**Materials**

Beef jerky samples will be prepared at NDSU with different meats used in activity 1. One formula will be used in the preparation.

Sensory forms and pencils
part I. sensory evaluation of beef jerky (outside of lab)

Complete sensory evaluation on previously prepared jerky samples. The samples will be provided in sample cups labeled with three digit codes. You will be asked to evaluate each product using the acceptance or Hedonic scale.

1. Try not to look at your neighbor when doing this activity.
2. There are four (4) samples to be evaluated. In front of you are the sample cups with three digit codes.
3. Taste the samples in the order provided (from left to right – do not mix up the order). Between samples drink a sip of water.
4. On the sensory sheet provided, write the sample code on the line provided in the upper left corner.
5. For each sensory characteristic check the box that indicates how you feel about the product. You are free to check any of the boxes.
6. On separate sheets continue the evaluation for other products remembering to take a sip of water between samples and to use a new sheet for each sample.

part II. sensory evaluation discussion

We will discuss product ratings by the students rated and we will reveal the meat source. If available, samples from the reservations will also be evaluated. Water activity and color of the products evaluated will be tested if sufficient time is available.

evaluation and wrap-up

Please answer the following questions:
1. What is the hurdle effect as it relates to dried meats/jerkies?
2. Was there a reduction in water activity as the products dried during lab?
3. Did additives and drying time affect sensory quality of the jerkies?
4. Was there any mold growth on the products in the Petri dishes? If so, which products contained mold? Why do you think that some had mold?
5. In the video on jerky preparation, the meat was dried using furnace filters and a fan. Do you think that this method is acceptable from a food safety perspective? Explain.
Sensory Evaluation of Beef Jerky

SAMPLE NUMBER: _________________________

Please evaluate the bread sample for the following qualities: Flavor, Texture, Appearance and Overall Acceptability (i.e. liking). Make an X on the appropriate line. Please give comments in the space provided below each quality if desired.

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<thead>
<tr>
<th>APPEARANCE</th>
<th>FLAVOR</th>
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<tbody>
<tr>
<td>like extremely</td>
<td>like extremely</td>
</tr>
<tr>
<td>like very much</td>
<td>like very much</td>
</tr>
<tr>
<td>like moderately</td>
<td>like moderately</td>
</tr>
<tr>
<td>like slightly</td>
<td>like slightly</td>
</tr>
<tr>
<td>neither like nor dislike</td>
<td>neither like nor dislike</td>
</tr>
<tr>
<td>dislike slightly</td>
<td>dislike slightly</td>
</tr>
<tr>
<td>dislike moderately</td>
<td>dislike moderately</td>
</tr>
<tr>
<td>dislike very much</td>
<td>dislike very much</td>
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<tr>
<td>dislike extremely</td>
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COMMENTS:  

<table>
<thead>
<tr>
<th>TEXTURE</th>
<th>OVERALL ACCEPTABILITY</th>
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<tr>
<td>like extremely</td>
<td>like extremely</td>
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<tr>
<td>like very much</td>
<td>like very much</td>
</tr>
<tr>
<td>like moderately</td>
<td>like moderately</td>
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<tr>
<td>like slightly</td>
<td>like slightly</td>
</tr>
<tr>
<td>neither like nor dislike</td>
<td>neither like nor dislike</td>
</tr>
<tr>
<td>dislike slightly</td>
<td>dislike slightly</td>
</tr>
<tr>
<td>dislike moderately</td>
<td>dislike moderately</td>
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<tr>
<td>dislike very much</td>
<td>dislike very much</td>
</tr>
<tr>
<td>dislike extremely</td>
<td>dislike extremely</td>
</tr>
</tbody>
</table>

COMMENTS:  

Just About Right Test: Jerky Evaluation

Sample Code ___________________    Date __________________

Please taste the jerky sample provided in cups. Make a check mark in the box that indicates how you feel about the product. You are free to check any of the boxes. Each sample will be evaluated on a separate sheet and there are a total of six (6) samples. Comments are welcome.

**Color:**

□ □ □ □ □ □ □
Too Brown          Just About Right          Too Red/Pink

**Texture:**

□ □ □ □ □ □ □
Too Soft          Just About Right          Too Tough

□ □ □ □ □ □ □
Too Moist         Just About Right             Too Dry

**Flavor:**

□ □ □ □ □ □ □
Not enough smoked flavor Just About Right            Too Much smoke flavor

□ □ □ □ □ □ □
Not Salty Enough Just About Right             Too Salty

Comments: ________________________________________________
__________________________________________________________________
<table>
<thead>
<tr>
<th>(a_w)</th>
<th><strong>Bacteria</strong></th>
<th><strong>Molds</strong></th>
<th><strong>Yeast</strong></th>
<th><strong>Typical Products</strong></th>
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<tbody>
<tr>
<td>0.97</td>
<td><em>Clostridium botulinum E</em> <em>Pseudomonas fluorescens</em></td>
<td>—</td>
<td>—</td>
<td>Fresh meat, fruit, vegetables, canned fruit, canned vegetable, low-salt bacon, cooked sausages, nasal spray, eye drops</td>
</tr>
<tr>
<td>0.95</td>
<td><em>Escherichia coli</em> <em>Clostridium perfringens</em> <em>Salmonella spp.</em> <em>Vibrio cholerae</em></td>
<td>—</td>
<td>—</td>
<td>Some cheeses, cured meat (ham), bakery goods, evaporated milk, Oral liquid suspensions, topical lotions</td>
</tr>
<tr>
<td>0.94</td>
<td><em>Clostridium botulinum A, B</em> <em>Vibrio parahaemolyticus</em></td>
<td><em>Stachybotrys atropurpurea</em></td>
<td>—</td>
<td>Sweetened condensed milk, aged cheeses (cheddar), fermented sausage (salsimi), dried meats (jerky), bacon, most fruit juice concentrates, chocolate syrup, fruit cake, fondants, Cough syrup, oral analgesic suspensions</td>
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<td>—</td>
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<tr>
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<td><em>Bacillus subtilis</em></td>
<td>—</td>
<td>—</td>
<td>—</td>
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<td><em>Staphylococcus aureus</em> (anaerobic)</td>
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<td><em>Saccharomyces cerevisiae</em></td>
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<td>—</td>
<td><em>Candida</em></td>
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<tr>
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<td><em>Staphylococcus aureus</em> (aerobic)</td>
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<td>—</td>
<td>—</td>
</tr>
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<td>—</td>
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<td>—</td>
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<tr>
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<td>—</td>
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<td>0.81</td>
<td>—</td>
<td><em>Penicillium cyclopium</em> <em>Penicillium patulum</em></td>
<td>—</td>
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</tr>
<tr>
<td>0.80</td>
<td>—</td>
<td>—</td>
<td><em>Saccharomyces bailii</em></td>
<td>—</td>
</tr>
<tr>
<td>0.79</td>
<td>—</td>
<td><em>Penicillium marneffei</em></td>
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<tr>
<td>0.78</td>
<td>—</td>
<td><em>Aspergillus flavus</em></td>
<td>—</td>
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<tr>
<td>0.77</td>
<td>—</td>
<td><em>Aspergillus niger</em> <em>Aspergillus ochraceus</em></td>
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</tr>
<tr>
<td>0.75</td>
<td>—</td>
<td><em>Aspergillus restrictus</em> <em>Aspergillus candidus</em></td>
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</tr>
<tr>
<td>0.71</td>
<td>—</td>
<td><em>Eurotium chevalieri</em></td>
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<tr>
<td>0.70</td>
<td>—</td>
<td><em>Eurotium anastomosum</em></td>
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<tr>
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<td>—</td>
<td>—</td>
<td><em>Saccharomyces rouxii</em></td>
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<tr>
<td>0.61</td>
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<td>—</td>
<td><em>Monascus bisporus</em></td>
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<tr>
<td>0.60</td>
<td>No microbial proliferation</td>
<td>—</td>
<td>—</td>
<td>Caramels, toffees, honey, noodles, topical ointment</td>
</tr>
<tr>
<td>0.50</td>
<td>No microbial proliferation</td>
<td>—</td>
<td>—</td>
<td>Whole egg powder, cocoa, liquid center cough drop</td>
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<tr>
<td>0.40</td>
<td>No microbial proliferation</td>
<td>—</td>
<td>—</td>
<td>Crackers, starch based snack foods, cake mixes, vitamin tablets, suppositories</td>
</tr>
<tr>
<td>0.30</td>
<td>No microbial proliferation</td>
<td>—</td>
<td>—</td>
<td>Boiled sweets, milk powder, infant formula</td>
</tr>
<tr>
<td>&lt;0.20</td>
<td>No microbial proliferation</td>
<td>—</td>
<td>—</td>
<td>—</td>
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