

Lesson Plan for 2013 – 2014 NATURE Sunday Academy Program

The Three Sisters – Preservation and Safety.

Rotating Activity

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Cultural Activity

The Three Sisters – Preservation and Safety

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

What are the three sisters?

Traditional Native American Preservation

Relevance to Agriculture

North Dakota EPSCoR NATURE
Sunday Academy Culture Curriculum
2013-2014

The Three Sisters

(Name of Unit)

Sitting Bull College

(Name of Tribal College)

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Introduction (Tell how the cultural unit relates to the Sunday Academy Lesson)

In today's activities you'll learn about the three sisters. So far you've heard stories on Unsiiciyapi, wowacintanka, wawoohola, cantognake, woohitike, and canteyuke. Today you'll hear and learn about the value of Wisdom (woksape), which means to understand what is right and true or to use knowledge wisely.

Cultural Objective

Students will listen to "The Story of the Old Woman", from the book, The Lakota Way.

Students will learn what the meaning of wisdom is by the interpretation of the story.

Cultural Information

The Cultural Leader will explain the value of wisdom and how it was important to the Lakota/Dakota. The wisdom of the elders is always respected.

Hands-on Activity, Media, etc.(List materials needed, if any)

Powerpoint of the story, "The Story of the Old Woman".

Conclusion

A brief question and answer oral survey to check for understanding of the unit's content.

Activities
The Three Sisters – Preservation and Safety.

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 hardier 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. 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 FSIS recommends that the final product a_w of ≤ 0.85 be achieved during processing to inhibit the growth of pathogenic microorganisms (FSIS 2012). The recommendations also indicate that final product a_w of ≤ 0.70 is best because both pathogenic bacteria and molds can be inhibited at this a_w . 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.

Unlike a_w , 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.

References

Food Safety Inspection Service. 2012. FSIS Compliance Guideline for Meat and Poultry Jerky Produced by Small and Very Small Establishments. 2012 Updated Compliance Guideline http://www.fsis.usda.gov/PDF/Compliance_Guideline_Jerky_2012.pdf

Activities 1 & 2: Drying of squash

Overview: General information discussion regarding drying as a means to preserve foods. A hands-on activity involving drying squash will be completed.

- Examples of fresh, dried and spoiled products will be displayed to show how drying is a way to keep foods from spoiling. Examples may include actual foods (e.g. beans) and/or images.
- We will use a Powerpoint presentation to discuss drying.
- Students will slice some squash to place in a food dehydrator. The students will observe how their squash slices transform by the end of the Sunday Academy.

Computer Animation:

<http://flashmedia.sdstate.edu/vod/igrow/disposable equip/disposable equipment lab.swf>

Laboratory Exercise: Each group of students will dehydrate a squash provided. NDSU graduate students dehydrate the same squash variety. Student attending NATURE Sunday Academy will cut the squash into small slices (similar to potato chips) and place them in a dehydrator. The students will record water activity on the fresh product, the dry product provided, and their sample at the end of the activity. Students will also measure the b^* value of the fresh squash and dry squash prepared by the NDSU graduate students.

Materials



Colorimeter



Aw meter



Dehydrator



Squash

Other: Cutting board, knives

Methods

Step 1. Slice squash in half and slice the halves again. At this point you will have 4 pieces. Save 3 pieces for activities 2 and 3.

Step 2. With the one squash piece retained, cut thin slices (1 cm thick) and remove the husk or skin from the squash piece. Place sample on a tray, keep note of the number labeled on the tray. With the remaining sample, complete the color and aw analysis and given in step 4.

Step 3. Place dehydrator tray containing squash into the dehydrator.

Step 4. The color measurement will be completed using a Minolta colorimeter. Place sufficient squash 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 squash and then place the hand-held unit onto the covered squash. Complete the color

measurement as observed in the guide next to the colorimeter. **Record the b value.** These color readings will serve as the time zero reading. **Save squash sample for aw.**

Step 5. With the sample from the color analysis, place several pieces of squash into aw cup (make sure squash does not go over $\frac{3}{4}$ level of cup). Complete the water activity measurement as discussed in the lecture. Record the temperature and water activity reading. This water activity reading will serve as time zero.

Step 6. Repeat steps 4 and 5 with on the dried samples provided and on the squash sample removed from the dehydrator at the end of the activity.

Data Collection

The focus of the data collection is on drying time as it relates to color and available water of the product. Students will:

- Compare the yellowness value (b^* obtained from colorimeter) before and after drying
- Compare the water activity value (obtained from water activity meter) before and after drying and at end of drying time. You will have a total of three (3) readings for each activity.

Squash Sample	Color analysis (b^* value = yellowness)	Water Activity (aw)
Fresh		
Dried (NDSU)		
Dried (end of experiment)		

Discussion of results

- How has the squash changed during the time spent in the dehydrator?
- Why do you think that might be?
- What is the impact of drying on the squash quality and safety?
- How might you change the experiment to get even more information?

Activity 3: Microbial Analysis of Fresh and Dried Squash

Overview: The Discussion regarding drying as a method to preserve foods will be related to microbiology of food. Focus of discussion will be on microorganisms as a major cause of food loss due to spoilage. Some microbes can also cause illness if not controlled. Food preservation techniques like drying allow foods to be stored for long periods of time.

Laboratory Exercise: The hands-on activity will involve estimating microbial numbers. We will examine the Petrifilm of squash samples to allow students the opportunity to estimate the number of bacteria present. We will test fresh squash and pre-dried samples of squash. We will compare the results to determine the effect of drying on the number of bacteria. These results will be from petri film completed at NDSU. Students will gain experience in determining the bacteria counts of fresh and dried squash using Petrifilm. However, due to an incubation needed, they will only be able to complete the plating aspect.

Materials

Squash: Fresh sample from 1 above and dried sample from NDSU.
Petrifilm
Dilution blanks

Methods

For Fresh Sample

1. Place the 10 gram sample into the dilution bottle containing 90 ml of sterile diluents (in this case sterile water). This is a 1:10 dilution.
2. Put the lid on tightly and shake the sample vigorously for two minutes.
3. Using a pipette, transfer one ml of the mixture to a Petrifilm and press as instructed to distribute the sample on the film. **(Recall video and see handout)**
4. The Petrifilm's will be incubated at 30°C for 48 hours.
5. Observe the pre-incubated (at NDSU) Petrifilms to count the colonies that have grown from the sample.
6. Record the number of colonies observed for each sample.

For Dried Sample

1. Place 1 gram of dried squash into the dilution tube containing 9 ml of sterile diluents (in this case sterile water). This is a 1:10 dilution.
2. Put the lid on tightly on the tube and shake the sample vigorously for two minutes.
3. Using a pipette, transfer one ml of the mixture to a Petrifilm and press as instructed to distribute the sample on the film. **(Recall video and see handout)**
6. The Petrifilm's will be incubated at 30°C for 48 hours
7. Observe the pre-incubated (at NDSU) Petrifilms to count the colonies that have grown from the sample.
8. Record the number of colonies observed for each sample.

Number of colonies from fresh squash	Number of colonies from dried squash	Change in numbers due to drying (subtract dried squash number from fresh squash number)

Discussion of results

- What are we looking for on the plates?
- Are the numbers different for the fresh versus the dried sample?
- Why do you think that might be?
- What would be the outcome of drying relative to spoilage?
- How might you change the experiment to get even more information?

Activity 4: Color Analysis of Fresh and Dried Squash and Beans

Overview: Many colored chemicals, or pigments, in foods have antioxidant characteristics. These are important nutrients and contribute to a healthy diet, which can prevent chronic diseases like diabetes. Food preservation techniques like drying may affect the nutrients in foods. We will see if drying affects the concentration of the pigments observed. Discussion regarding pigments in the Three Sisters crops will be present at the beginning of the lesson (activity 1). Information from the lecture includes:

- Carotenoids (orange and yellow pigments in squash, corn) and anthocyanins (blue, purple, red in beans and corn).
- Paper chromatography

Laboratory Exercise: We will examine food samples to estimate the impact of drying on pigments. We will test samples from a fresh sample of squash and a dried sample of squash. We will compare the results to determine what the effect of drying on the concentration of pigments in squash. We will also evaluate a different class of pigment in the bean. The method of paper chromatography will also be a valuable means to illustrate the difference in pigments and analytical techniques.

Materials

Samples: fresh squash, dried squash, beans

Supplies for extraction: beakers (3); solvent (for squash = acetone, for beans = 1% HCl: 99% methanol); aluminum foil, stir bars / rods (3)

Supplies for chromatography: beaker with watch glass, Whatman chromatography paper, capillary tubes, solvents (for squash = isopropyl alcohol, for beans = 44.5% butanol: 44.5% water: 11% acetic acid)

Methods

For Squash Samples

1. Collect 5 grams (g) of the dried samples and 20 g of fresh sample (from sample in activity 1).
2. Place (A) 5 grams of dried sample in a beaker and add 10 ml of solvent (acetone) and (B) Place 20 g of fresh sample in a second beaker, smash /break apart sample and add 10 ml of solvent (acetone).
3. Carefully mix the plant material in the solvent using a glass rod. Replace the aluminum foil over beaker.
4. Stir the sample with the stir rod every 5 minutes until 30 minutes has elapsed. Allow the sample to settle.

5. Using a capillary tube, collect some of the clear solvent portion of the sample. Place one drop on the spot indicated on the paper (~1 inch from the bottom edge). Allow the drop to dry completely. Repeat this step three times on the same spot and allow to dry thoroughly between spotting.
6. In the beaker provided, place 25 ml of solvent labeled squash (i.e., isopropyl alcohol). Place the glass rod over the container.
7. Suspend the paper (sample end down) into the jar so that the end of the paper just barely touches the solvent, and then attach with a paper clip to the glass rod. Make sure that the paper does not touch the sides or the bottom of the beaker.
8. Cover the beaker with aluminum foil and let it develop. The solvent will wick up the paper and as it moves it will separate different chemical fractions of the spotted sample.
9. Once the solvent has traveled about two inches, take the strip out of the beaker and let it dry.
10. Do you see distinct green and/or yellow bands? These are the pigments. Green is usually due to chlorophyll in the plant; while yellow are the carotenoids (an important group of antioxidants).

For Bean Samples

1. Place 5 grams of bean flour into a beaker and add 10 ml of solvent (1% HCl: 99% methanol).
2. Carefully mix the plant material in the solvent using a glass rod. Replace the aluminum foil over beaker.
3. Stir the sample with the stir rod every 5 minutes until 30 minutes has elapsed. Allow the sample to settle.
4. Using a capillary tube, collect some of the clear solvent portion of the sample. Place one drop on the spot indicated on the paper (~1 inch from the bottom edge). Allow the drop to dry completely. Repeat this step three times on the same spot and allow to dry thoroughly between spotting.
5. In the beaker provided, place 25 ml of solvent labeled bean (44.5% butanol: 44.5% water: 11% acetic acid). Place the glass rod over the container.
6. Suspend the paper (sample end down) into the jar so that the end of the paper just barely touches the solvent, and then attach with a paper clip to the glass rod. Make sure that the towel does not touch the sides or the bottom of the beaker.
7. Cover the beaker with aluminum foil and let it develop. The solvent will wick up the paper and as it moves it will separate different chemical fractions of the spotted sample.
9. Once the solvent has traveled about two inches, take the strip out of the beaker and let it dry.
10. Do you see distinct red band? These are the pigments. Red is usually due to anthocyanins in the plants (an important group of antioxidants).

Results

	Fresh Squash	Dried Squash	Beans
Number of Bands			
Intensity of green band observed (-, +, ++, +++)			
Intensity of yellow band observed (-, +, ++, +++)			
Intensity of Red band observed (-, +, ++, +++)			
Other observations			

Discussion of results

- What do the spots on the paper represent?
- Are the intensities of the colored spots different for the two samples tested?
- Why do you think that might be?
- How might you change the experiment to get even more information?

Alternative to computer animation

Activity 5: Sensory Evaluation of Dried Squash

Overview: Complete sensory evaluation on previously prepared squash samples. Dehydration can affect cell structure and thus causing the product to have altered textural attributes. This activity will provide students an experience that relates processing with final product quality.

Laboratory Exercise: Hands-on activity involves sensory evaluation of samples (outside of the lab). A Just-About-Right scale will be used during the evaluation. We will discuss the outcomes of the activity and reveal the product. The focus of the data collection is the texture and color intensity of the squash.

Materials

Squash samples will be prepared at NDSU. Three samples will be tested.

Sensory forms and pencils

Scoresheet

Just About Right Test: Squash Evaluation

Sample Code _____

Date _____

Please taste the squash 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. Comments are welcome.

Color:

Too Brown Just About Right Too Yellow/Orange

Texture:

Too Soft Just About Right Too stringy/fibrous

Methods

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 your 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 listed on the sheet. Between samples drink a sip of water.
4. Select the product in the cup that has the 3-digit code in order presented on the sensory sheet.
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. Once completed with one product, repeat with the other two samples.

Discussion of results

- Which product was rated best for color? Texture?
- Did drying affect the intensity of the sensory characteristics?
- Why do you think that might be?

Evaluation and Wrap-up

Please answer the following questions:

1. What is the effect of drying on color of the squash?
2. Was there a reduction in water activity as the products dried during lab?
3. Give an example of another product that is dried.
4. Which of the three sisters is/are dried? How is it similar and different from the activity completed in lab?

Just About Right Test: Squash Evaluation

Please taste the squash sample provided in cups. You should taste the samples in the order given in the sheet below (i.e. 107, 359, 283). 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 scale and there are a total of three (3) samples. Comments are welcome.

Sample Code 107

Color:

<input type="checkbox"/>						
Too Brown		Just About Right				Too Yellow/Orange

Texture:

<input type="checkbox"/>						
Too Soft		Just About Right				Too stringy/fibrous

Sample Code 359

Color:

Too Brown Just About Right Too Yellow/Orange

Texture:

Too Soft Just About Right Too stringy/fibrous

Sample Code 283

Color:

Too Brown Just About Right Too Yellow/Orange

Texture:

Too Soft Just About Right Too stringy/fibrous

APPENDIX

a_w	Microorganism			Typical Products
	Bacteria	Molds	Yeast	
0.97	<i>Clostridium botulinum</i> E <i>Pseudomonas fluorescens</i>	—	—	Fresh meat, fruit, vegetables, canned fruit, canned vegetable, low-salt bacon, cooked sausages, nasal spray, eye drops
0.95	<i>Escherichia coli</i> <i>Clostridium perfringens</i> <i>Salmonella</i> spp. <i>Vibrio cholerae</i>	—	—	
0.94	<i>Clostridium botulinum</i> A, B <i>Vibrio parahaemolyticus</i>	<i>Stachybotrys atra</i>	—	Some cheeses, cured meat (ham), bakery goods, evaporated milk, Oral liquid suspensions, topical lotions
0.93	<i>Bacillus cereus</i>	<i>Rhizopus nigricans</i>	—	
0.92	<i>Listeria monocytogenes</i>	—	—	
0.91	<i>Bacillus subtilis</i>	—	—	
0.90	<i>Staphylococcus aureus</i> (anaerobic)	<i>Trichothecium roseum</i>	<i>Saccharomyces cerevisiae</i>	Sweetened condensed milk, aged cheeses (cheddar), fermented sausage (salami), dried meats (jerky), bacon, most fruit juice concentrates, chocolate syrup, fruit cake, fondants, Cough syrup, oral analgesic suspensions
0.88	—	—	<i>Candida</i>	
0.87	<i>Staphylococcus aureus</i> (aerobic)	—	—	
0.85	—	<i>Aspergillus clavatus</i>	—	
0.84	—	<i>Byssosclamyces nivea</i>	—	
0.83	—	<i>Penicillium expansum</i> <i>Penicillium islandicum</i> <i>Penicillium viridicatum</i>	<i>Debaryomyces hansenii</i>	
0.82	—	<i>Aspergillus fumigatus</i> <i>Aspergillus parasiticus</i>	—	
0.81	—	<i>Penicillium cyclopium</i> <i>Penicillium patulum</i>	—	
0.80	—	—	<i>Saccharomyces bailii</i>	
0.79	—	<i>Penicillium martensii</i>	—	
0.78	—	<i>Aspergillus flavus</i>	—	Jam, marmalade, marzipan, glace fruits, molasses, dried figs, heavily salted fish
0.77	—	<i>Aspergillus niger</i> <i>Aspergillus ochraceous</i>	—	
0.75	—	<i>Aspergillus restrictus</i> <i>Aspergillus candidus</i>	—	
0.71	—	<i>Eurotium chevalieri</i>	—	
0.70	—	<i>Eurotium amstelodami</i>	—	Dried fruit, corn syrup, licorice, marshmallow, chewing gums, dried pet foods
0.62	—	—	<i>Saccharomyces rouxii</i>	
0.61	—	<i>Monascus bisporus</i>	—	
0.60	No microbial proliferation			Caramels, toffees, honey, noodles, topical ointment
0.50	No microbial proliferation			
0.40	No microbial proliferation			Whole egg powder, cocoa, liquid center cough drop
0.30	No microbial proliferation			Crackers, starch based snack foods, cake mixes, vitamin tablets, suppositories
<0.20	No microbial proliferation			Boiled sweets, milk powder, infant formula