



Food Safety Scientist

A Dynamic STEM Educational Adventure

Manipulating pH
level in Food

ACKNOWLEDGEMENTS:

Curriculum:

Food Safety Scientist: A Dynamic STEM Educational Adventure

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South Dakota State University (SDSU) and New Mexico State University (NMSU) produced this project as part of a Higher Education Challenge Grant "Innovative STEM instruction techniques to increase the number and diversity of students in food safety related majors". SDSU served as the lead institution for the overall project developing the content and curriculum with NMSU leading the digital creation of classroom media, animations and interactive educational technologies. North Dakota State University serves as the outside evaluator of the project. This project was supported by Agriculture and Food Research Initiative Competitive Grant no. 2011-38411-30625 from the USDA National Institute of Food and Agriculture. This project was supported in part by the USDA NIFA grant numbers 2008-38411-19055, NDSU serving as the lead institution with SDSU and NMSU as sub-awardees. Virtual Lab creative presentation © 2010 The NMSU Board of Regents

FOOD SAFETY SCIENTIST

A Dynamic STEM Educational Adventure

Real-life situations provide some of the greatest opportunities for students to learn how science impacts their life. Explore the common science and technological concepts in the development of a safe food supply within the classroom through the Food Safety Scientist Curriculum.

ENGAGING

The Food Safety Scientist Curriculum is intended to enhance the regular classroom curriculum. Educators are encouraged to pick and choose from the various educational tools to engage students in the STEM related field of food safety.

SCIENTISTS NEEDED

Food safety requires the need for scientists in the research laboratory, production practices, regulatory agencies, veterinarians, food product development and processing, meeting the demands of feeding the world, as well as preparing and serving food within the home. Educators in Science, Agriculture, and Family and Consumer Sciences utilize the components of the curriculum to help students explore STEM careers that keep food healthy and safe.

FREE CURRICULUM

The curriculum is entirely free. Educators can access the website, download materials they want to use in their educational setting and change them to meet their needs. Components of the curriculum have been used in formal and informal educational settings as well as with various age levels. For example, the virtual labs of gram staining and using a microscope have been used with middle school students as well as introductory microbiology courses at colleges and universities across the United States.

CURRICULUM COMPONENTS

The curriculum enhancement tool Food Safety Scientist includes the following components:

1. Unit Guide to assist teachers in identifying the goals, objectives and standards (Next Generation Science Standards, and Career and Technical Education Classes) for each unit and individual learning experiences.
2. Interactive Virtual Labs that include real-life situations that bring science, technology, engineering and math into the delivery of a safe food supply.
3. Hands-on laboratory experiences that compliment the virtual labs. Providing the opportunity for students to gain real-life experiences and a greater understanding of the applications of STEM for food safety scientists.
4. Exposure to careers related to the agricultural and food safety sciences.
5. Discussion Guides for teachers to empower students to explore the various scientific concepts that are utilized to develop a safe food system.

LAB SUPPLIES

Supplies needed for the virtual labs may be obtained from Educational Science Supply Companies. The creators of the curriculum, SDSU Extension, have kits available on a limited basis. Shipping and handling will be charged. To obtain supplies contact: joan.hegerfeld-baker@sdstate.edu.

Contents of Unit

MANIPULATING pH LEVEL IN FOOD

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*Virtual Labs Series: pH of Foods

This unit was created to expose students to a career that has a connection to food safety (inspector and food scientist in research and development). All the units are developed for the teacher to pick and choose what they want to use. The enrichment activities are developed with a format that allows for educators to adapt for their purposes.

OVERALL GOAL:

Increase the number of students that consider food safety and related fields as a career path

Enrichment Activity	Time Allowed	Objectives Applied*	Standards*
Virtual Lab-Sensational Salsa	15 minutes	1,2,3,4,5,6,7	FCS 8, FCS 9, AgP 1.2, AgP 1.3, AgP 3.4, FS 1.2, FS 2.2, MS-ETS1-1, MS-ETS1-2, MS-LS1-5
Mixing it up with Sensational Salsa	50 minutes	1,2,3,4,5,6,7	FCS 8, FCS 9.2, AgP 3.4, FS 2.2, MS-ETS1-1, MS-ETS1-2, MS-LS1-5
Isoelectric Point of Milk: Making Curds & Whey	50 minutes	1,2,3,4,5,6,7	FCS 9.5.7, HS-PS1-3
Measuring pH	30 minutes	1,2,3,4	FCS 9.2.1, FCS 9.5.7, MS-LS1-5
Discussion Guide/Worksheet	45-50 minutes	1,2,3,4	MS-LS1-5

*See charts below to identify standards & objectives

Performance Objectives of Students

- Express an understanding of the monitoring of the food supply for safety and quality.
- Increase knowledge regarding food microbiology.
- Students will make inferences and interpretations from knowledge gained regarding the science related to monitoring the safety of the food supply.
- Students will examine the overall safety of the food supply from the farm to table.
- Students will describe the various types of safe food handling practices and monitoring of the food supply.
- Students will identify and give examples of various careers that support the safety of the food supply.
- Students will evaluate their competency in food safety and related fields.

Standards:

Family and Consumer Sciences

Standard 8: Integrate knowledge, skills, and practices required for careers in food production and services

8.2.1: Determine pathogens found in food and their roles in causing illness

Standard 9: Integrate knowledge, skills, and practices required for careers in food science, dietetics, and nutrition

9.2: Apply risk management procedures for food safety, food testing, and sanitation.

9.2.1: Determine factors that contribute to foodborne illness

9.5: Demonstrate use of current technology in food product development and marketing

9.5.7: Conducting testing for safety of food products, utilizing available technology.

Agriculture

ITA7.1 Illustrate how raw commodities become table-ready food products

AgP 1.2 Discuss how food safety is addressed in the food processing industry

AgP 1.3 Explain how regulatory agencies in the food industry work to protect consumers

AgP 2.1 Translate regulatory procedures as they apply to food processing

AgP 3.4 Process food safely

FS 1.2 Identify industry organizations and their impact on the food industry

FS 2.2 Apply safety and sanitation practices used in the food industry

Science (Next Generation Science Standards)

MS-ETS1-1- Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions

MS-ETS1-2 – Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem

MS-LS1-5 – Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms

HS-PS1-3- Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles



Lab Safety Protocol

- Lab coat is advised
- Wash hands before and after handling raw vegetables – Gloves are advised
- Keep long hair tied back away from face
- Wear closed toe shoes

Salsa & Food Preservation

- What is pH?
 - The measure of the acidity of food. It is measured on a scale of 0-14. The lower the pH the higher the acidity.
- The importance of pH
 - The pH level of homemade salsa is important when preserving the salsa over extended periods of time to prevent the growth of unwanted microorganisms.

What are the Safety Concerns of Heat Processed Salsa?

- The pH of food determines the type of heat processing used
- Less than 4.6: High Acid Food - processed using a boiling water bath.
 - Greater than 4.6: Low Acid Food - must be processed using a pressure canner
- The pH of the combined vegetables in salsa can often greater than 4.6
- Therefore extra acid added to it. It is therefore considered an acidified food - processed in a boiling water bath.
 - Acetic acid (vinegar) or lemon juice are often added to lower the pH well below 4.6
 - If recommended heat processing is not used, the jar of salsa stored on the grocery store shelf, or in your home cupboard, can support the growth of potentially harmful bacteria, Clostridium botulinum

Ingredients

- 2 Green Bell Peppers, sliced
- 1 Jalapeno Pepper*, sliced
- 2 Ripe Tomatoes, sliced
- 2 Cloves Garlic, minced
- 1 White Onion, sliced
- 1/2 bunch Cilantro, chopped
- One Can Corn or Black Beans



*If you have a sensitive reaction to jalapeno peppers or other items in this recipe, all you have to do is substitute any of the ingredients that give you that burning jalapeno pepper.

Recipe makes 8 cups of salsa

Making Salsa: Procedure

Preparing Fresh Salsa

- Blanch the tomatoes by placing them in boiling water for 2 minutes
- After 2 minutes place the tomatoes in ice water to easily peel the skin off the tomatoes



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Making Salsa: Procedure

1. Combine diced peppers, tomatoes, garlic, onion & cilantro in a bowl
2. Obtain a sample by transferring 1 cup of the sample to a food processor. Pulse or liquify the sample until it is uniform in texture.



* Why is it important to homogenize the sample before testing the pH?

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Homogenize means to make the entire sample the same. With salsa there are different ingredients added with different pH levels thus it is important for the entire sample to have the same pH and ensure it the pH reading is accurate for the entire sample.

Step #2 is optional – heating will help to create a pH that is similar throughout the entire product.

Making Salsa: Procedure

3. After the mixture is pureed, place 1/2 cup into a sample dish and test the pH using a calibrated pH meter
4. If the pH meter reads above 4.6, the salsa will not meet the standard that keeps *Clostridium botulinum* from growing when heat processed (canned) in a jar.



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*Notice in the image the pH reading is above 4.6

What can be added to change the pH of salsa?

To reduce the pH of salsa an ingredient with a low pH (highly acidic) liquid must be added.

Two common ingredients are:



pH: 2.6-3.4

pH: 1.8-2.3

What are other ways to alter the pH of a homemade salsa recipe?

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The ingredients! Consider the pH of each ingredient. Do some ingredients have a higher pH level than other? Consider altering the recipe and doing some trial and error testing to further adjust the pH. The acid may still need to be added but in different ratios.

Acidifying Salsa

- Add the lemon juice or acetic acid, 2 mL at a time, to the 1/2 cups sample
- Record the resulting pH after each addition (refer to the next slide)
- Continue until a reading of 4.6 or below is reached. Use the chart on the following slide to assist in keeping track of amount of acid added and the resulting pH.

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Chart to record data

Salsa sample - 1/2 cup pulsed by food processor

Acid Added (mL)	pH Meter Reading
3 mL	
3 mL	
4 mL	
3 mL	
3 mL	

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Conversions

• If the beakers or graduated cylinders are unavailable, household items such as measuring spoons can be used. The following conversions include:

Sample (mL)	Conversion to Tablespoons/ Teaspoons
3 mL	1/8 tsp.
10 mL	2 tsp.
15 mL	1 TBS.
25 mL	2 tsp. + 1 TBS.

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Why is acid important in food preservation?

• Microorganisms grow within a certain pH range. If the pH remains below 4.6, the deadly microorganism *Clostridium botulinum* will not be able to grow.

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LAB REPORT: ACIDIFYING SALSA

Name: _____ Date: _____

Introduction:

What is the purpose of this lab?

What do you hypothesize the results will indicate (or conclude)?

Results:

Acid Added (mL)	pH reading
0	
2 ml	
4 ml	
6 ml	
8 ml	

Continue adding acid until the pH falls below 4.6

From your results, construct a linear graph that shows the relationship between the acid added and the pH readings and draw a trend line showing the results.

Discussion:

1. Which is the dependent variable and which is the independent variable in this lab exercise?

2. What observations can be made from the graph?

3. If this experiment were repeated, what could be done differently? Why?

Interpretation/Conclusion:

Were the results as expected? What can be concluded from this experiment?

LAB REPORT: ACIDIFYING SALSA (TEACHER'S VERSION – ANSWER KEY)

Name: _____ Date: _____

Introduction:

What is the purpose of this lab?

The purpose of the lab is to demonstrate the importance of pH in food products to maintain a safe product and how to manipulate the pH of a salsa recipe.

What do you hypothesize the results will indicate (or conclude)?

Answers Vary. A hypothesis can be made that adding vinegar to the salsa will significantly lower the pH of the salsa as a whole. Another hypothesis may be, the pH of the salsa is below 4.6 without the addition of an acid because of the natural low pH level of the ingredients.

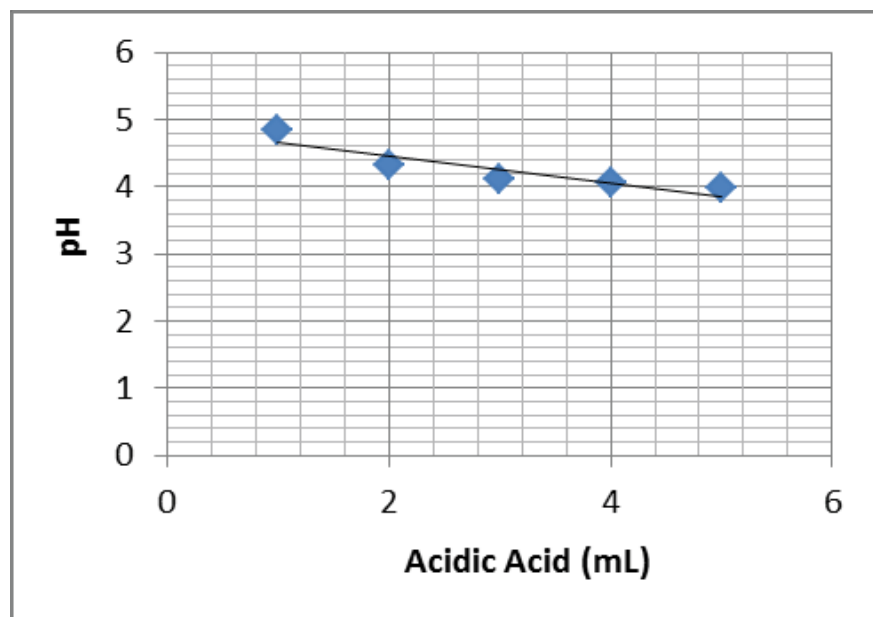
Results:

Acid Added (mL)	pH reading
0	4.83
2 ml	4.31
4 ml	4.10
6 ml	4.05
8 ml	3.97

Continue adding acid until the pH falls below 4.6

Answers may vary depending on pH readings

From your results, construct a linear graph that shows the relationship between the acid added and the pH readings and draw a trend line showing the results.



Discussion:

1. Which is the dependent variable and which is the independent variable in this lab exercise?

In an experiment, the independent variable is the variable that is varied or manipulated by the researcher, and the dependent variable is the response that is measured

Dependent: pH (effect)

Independent: Amount of Acid Added (cause)

2. What observations can be made from the graph?

The graph shows the more acid added to the salsa the lower the pH level. A conclusion can be drawn: as long as the acid is increased the pH of the salsa will continue to decrease.

3. If this experiment were repeated, what could be done differently? Why?

Answers vary depending on how the procedure was done. Additional changes could include: make sure the pH meter was calibrated correctly, changing the type of acid that was used, using a different recipe for the salsa, where the sample was taken from, was the sample completely homogenized, and was the salsa completely mixed with the acid prior to taking the pH reading?

Interpretation/Conclusion:

Were the results as expected? What can be concluded from this experiment?

Answers vary depending on hypothesis. A conclusion could be something along the lines of the more acid added to the salsa the lower the pH and the decreased growth of microorganisms thus preventing the growth of harmful toxins.



pH: Food & Microorganisms

- Pathogenic Bacteria grow well at a pH of 6.5-7.5
- Meat & Milk have a pH of 5.5-6.8 making them an excellent growth media for foodborne pathogens
- Fruits: 3.5-4.5
- Vegetables: 3.5-6.0
- Pathogens grow slowly with a pH BELOW 4.5 & can be inactivated even more with a pH of 4.5
- Interesting acidity has been used for centuries to preserve foods and is still used today.

Lab Safety Protocol

- Lab coat is advised
- Keep long hair tied back away from face
- Wear closed toe shoes

Properties of Milk




- Milk is a Colloid
- Colloid is a mixture of liquid and tiny particles that do not settle (white orange juice). Examples of Colloids: Chex, Cream, & Fat
- When Milk is heated, the proteins denature and with the addition of the acid the milk will begin to separate (coagulate) into solid particles (curds) and the remaining liquid is known as whey
- Cheese is made from the curds (milk protein & casein) of milk either left uncooked or through cooking, another food preservation method.
 - Examples of uncooked cheese: cottage, ricotta, cream, cheese
 - Examples of cooked cheese: Cheddar, parmesan, jack, mozzarella, pizza

Properties of Milk Continued

- Milk has a pH between 6.5-6.7
- The pH is controlled by a buffer system of three components:
 - Phosphate, Citrate, & Carbonate
- When vinegar is added to lower the pH of the milk it inactivates the buffer system
 - pH can decrease - reach isoelectric point
 - Formation of curds

Isoelectric Point in Milk

- Isoelectric Point:** When a molecule carries neither a positive or negative charge
- In milk, the isoelectric point indicates when the protein, casein, no longer has a positive or negative charge
- The isoelectric point for casein is pH value of 4.6. Once 4.6 is reached, the casein protein will separate from the liquid and clump together.

<p>Procedure: Making Curds & Whey</p> <ul style="list-style-type: none"> • Supplies & Equipment per team: <ul style="list-style-type: none"> • (Calibrated) pH Meter • 400 mL (2 cups) Milk • 10 mL (2 tsp.) White Distilled Vinegar • 500 mL Beaker (or larger) • Bunsen Burner • Thermometer • Colander or Cheese Cloth 	
<p>Isoelectric Point: Making Curds & Whey</p> <ul style="list-style-type: none"> • Make sure the pH meter is calibrated to ensure precision & accuracy when taking readings • Measure 400 mL of milk into a 500+ mL beaker- Take 2 pH readings of the milk and record the average • Take 2 pH readings of the vinegar and record the average 	
<p>Isoelectric Point: Making Curds & Whey</p> <ul style="list-style-type: none"> • Place the beaker on a Bunsen Burner and heat milk until it reaches 180°F • Continuously check the temperature with a thermometer and stir the milk to prevent burning 	
<p>Isoelectric Point: Making Curds & Whey</p> <ul style="list-style-type: none"> • Once 180°F is reached, remove the milk carefully from the Bunsen burner • Slowly pour 10 mL of white distilled vinegar into the milk, stir continuously • Once cooled, take a pH reading after stirring the acid and record.  <p>* Notice the change of consistency in the milk.</p>	
<p>Isoelectric Point: Making Curds & Whey</p> <ul style="list-style-type: none"> • Once the milk has cooled down, pour the beaker into a colander or sieve through cheese cloth. • Filtering the milk separates the curds from the whey  <p>* Why does the liquid (whey) now have a more opaque appearance?</p>	<p>Caseins give the milk its white appearance as it absorbs all the color except white. Another contributor to the white color of milk is the cream or fat in the milk.</p>

LAB REPORT: ISOELECTRIC POINT OF MILK – MAKING CURDS & WHEY

Name: _____ Date: _____

Introduction:

What is the purpose of this lab?

What do you hypothesize the results will indicate (or conclude)?

Results:

pH of Milk:

pH of Vinegar:

pH of Milk & Vinegar combined (whey):

Discussion:

1. Was there a significant change in the pH of the milk after to adding the vinegar? Why?

2. What physical properties changed after the acid was added? Please describe.

3. Why did the color of the milk change when the casein was removed?

4. If this experiment were repeated, what could be done differently? Why?

Interpretation/Conclusion:

Were the results as expected? What can be concluded from this experiment?

LAB REPORT: ISOELECTRIC POINT OF MILK – MAKING CURDS & WHEY (TEACHER'S VERSION – ANSWER KEY)

Name: _____ Date: _____

Introduction:

What is the purpose of this lab?

The purpose of the making curds and whey lab is to understand how lowering the pH of acid affects the physical and chemical properties of milk. The lab also identifies the isoelectric point of the protein, casein, in milk.

What do you hypothesize the results will indicate (or conclude)?

Adding acid to the milk will lower the pH of the milk and cause the protein to separate and form curds

Results:

pH of Milk: 6.4 - 6.8

pH of Vinegar: 2.4 - 3.4

pH of Milk & Vinegar combined (whey): Varies; typically falls between 3 - 5

Discussion:

1. Was there a significant change in the pH of the milk after to adding the vinegar? Why?

After adding the vinegar to the milk, the pH will drop well below 6. Vinegar has a low pH and when combined with a low acid substance such as milk it will overall lower the pH of the milk.

2. What physical properties changed after the acid was added? Please describe.

Milk is made up of a several components including water, fat, and protein. When vinegar is added to milk it substantially lowers the pH, sours the milk, and the negative charge of the casein proteins in the milk will become neutralized and instead of pushing each other apart they will clump together into white clusters, the liquid (whey) will take on a greenish opaque color.

3. Why did the color of the milk change when the casein was removed?

Casein plays a role in the white color of milk. The fat globules and the casein micelles are large enough to reflect light and produce a white color when the light enters the milk. When the casein is removed from the milk, the liquid portion of the milk (whey) loses its white color.

4. If this experiment were repeated, what could be done differently? Why?

Trying different temperatures to determine if it will affect how much of the casein is removed from the milk. Different types of milk (1%, 2%, whole milk, skim, goat milk) will have an effect on the appearance of the curds and the whey as the casein is removed.

Interpretation/Conclusion:

Were the results as expected? What can be concluded from this experiment?

Answers vary depending on hypothesis. The conclusion should be something along the lines of pH being able to manipulate the physical and chemical properties of milk. Changing the pH of milk causes milk to curdle and the casein protein to reach its isoelectric point and separate from the liquid component. Changing the pH of milk is also a contributor in making cheese, a milk bi-product.



Equipment

- 1 Dozen Hard Boiled Eggs
- 7 Sampling Cups
- Water
- Quick Test pH Strips
- Mixing Bowl
- Whisk
- Measuring Cups
- Writing Utensil

Preparing Samples

1. Remove the egg yolks from the hard boiled eggs and break down using a mortar & pestle or a whisk.
2. Add 1 cup of water to yolks and whisk together until a slurry is formed.



Procedure

Sample	Egg Yolk (Many yolk)	Water (ml)	Water (ml)
Standard	25	25	25
#1	25	25	25
#2	25	25	25
#3	25	25	25
#4	25	25	25
#5	25	25	25
#6	25	25	25

Prepare the samples as shown above and label each one



Conversions


If beakers or funnels are unavailable, household items such as measuring spoons can be used. The following conversions include:

Metric Units	Conversion to Tablespoons/ Teaspoons
5 mL	1 tsp.
10 mL	2 tsp.
15 mL	1 TBS.
25 mL	2 tsp. + 1 TBS.

Using pH Test Strips

1. Cut 1-pH test strips 5 cm long for each sample including the standard
2. Dip each strip in the sample and remove immediately
3. Compare the color of the strip to the standard included with the strip dispenser.



<p>pH Meter (field unit)</p> <ul style="list-style-type: none"> Using a pH meter is also an effective instrument for testing the pH of foods It is important to calibrate the meter before use to ensure accuracy 															
<p>Microorganisms: survival and growth</p> <ul style="list-style-type: none"> Resilient to harsh, unorthodox and enrichment and ideal conditions to grow Intrinsic Factors: Inherent parts of food & animal hosts Extrinsic Factors: Properties of storage environment that affect both the food and the microorganism <table border="1" data-bbox="203 625 503 724"> <thead> <tr> <th>INTRINSIC FACTORS</th> <th>EXTRINSIC FACTORS</th> </tr> </thead> <tbody> <tr> <td>pH</td> <td>Temperature of Storage</td> </tr> <tr> <td>Moisture (a_w)</td> <td>Pressure/Concentration of Gases</td> </tr> <tr> <td>Carbon Source/Protein</td> <td>Presence & Activities of other microorganisms</td> </tr> <tr> <td>Water</td> <td>Salinity/Binding of water</td> </tr> <tr> <td>Antimicrobial Compounds</td> <td></td> </tr> <tr> <td>Biological Structures</td> <td></td> </tr> </tbody> </table>	INTRINSIC FACTORS	EXTRINSIC FACTORS	pH	Temperature of Storage	Moisture (a _w)	Pressure/Concentration of Gases	Carbon Source/Protein	Presence & Activities of other microorganisms	Water	Salinity/Binding of water	Antimicrobial Compounds		Biological Structures		
INTRINSIC FACTORS	EXTRINSIC FACTORS														
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Water	Salinity/Binding of water														
Antimicrobial Compounds															
Biological Structures															
<p>Discussion Questions</p> <ul style="list-style-type: none"> What solutions, other than changes, would increase the acidity? Why is it important to have a higher level of acidity when processing food? What controls the growth of microorganisms other than changing the pH? The pH range has an inverse relationship to acidity, what does this mean? Do you think there would be a significant change in taste after adding the vinegar? Why or Why not? If a company is developing a salsa that would be shelf stable in a jar, what pH range does it need to be and why? 	<ol style="list-style-type: none"> Lemon Juice, Lime Juice any liquid with a pH between 2-3 A low pH or high acidity slows and prevents the growth of microorganisms that could lead to spoilage or potential toxins that could cause illness water activity (moisture), temperature, nutrients, gases in the environment (i.e. oxygen) and time This means when the pH is low the acidity is high and when the pH is high the acidity is low Answers will vary. It depends upon the amount added, the ingredients in the food product, and personal taste preferences 4.6 or below, as that is the standard to prevent the growth of <i>C. botulinum</i> a primary concern for canning foods. 														

LAB REPORT: MEASURING AND MANIPULATING THE pH LEVEL OF EGG YOLKS

Name: _____ Date: _____

Introduction:

What is the purpose of this lab?

What do you hypothesize the results will indicate (or conclude)?

Results:

Sample	Water (mL)	Vinegar (mL)	pH strip color	pH reading	pH Meter reading
Yolk Slurry Standard	0	0	Orange		
1	2	0			
2	4	0			
3	6	0			
4	0	2			
5	0	4			
6	0	6			

Discussion:

1. Which substance, the water or vinegar, had an effect on the pH of the sample? Why is that?

2. If this experiment were repeated, what could be done differently? Why?

Interpretation/Conclusion:

Were the results as expected? What can be concluded from this experiment?

LAB REPORT: MEASURING AND MANIPULATING THE pH LEVEL OF EGG YOLKS (TEACHER'S VERSION – ANSWER KEY)

Name: _____ Date: _____

Introduction:

What is the purpose of this lab?

The purpose of the acidified egg lab is to examine the effects an acid and a neutral solvent have on a low acid food by using different laboratory techniques to test the pH. And, to become familiar with using a pH meter.

What do you hypothesize the results will indicate (or conclude)?

Answers may vary. The acid (vinegar) will significantly lower the pH as more acid is added, and the water will have little to no effect on the pH of the egg slurry.

Results:

Sample	Water (mL)	Vinegar (mL)	pH strip color	pH reading	pH Meter reading
Yolk Slurry Standard	0	0	Orange		6-6.5
1	2	0			
2	4	0			
3	6	0			
4	0	2			
5	0	4			
6	0	6			

*The pH strips should go from an orange to a dark green color as more vinegar is added.

*The pH reading should continuously decrease with the addition of vinegar and may vary depending on the slurry solution.

*The water has no effect on the pH and it shouldn't change with the addition of more water. The strips will maintain the same color.

Discussion:

1. Which substance, the water or vinegar, had an effect on the pH of the sample? Why is that?

Vinegar has a much lower pH value (higher acidity) than egg yolks, therefore when added to the solution, it will bring the overall pH level down, closer to that of vinegar. Water, has a pH of 7, which is neutral. This could eventually lead to a very "slight" increase in pH of the egg yolk slurry.

2. If this experiment were repeated, what could be done differently? Why?

Answers will vary. Possible answers: Add different amounts of vinegar; use a different acid.

Interpretation/Conclusion:

Were the results as expected? What can be concluded from this experiment?

Answers vary depending on hypothesis. The interpretation/conclusion may include some of the following statements:

- The addition of vinegar lowered the pH of the egg slurry.
- The vinegar had a much greater affect on the pH than the water.
- Water has a neutral pH – therefore it does not change the pH of the egg yolk sample (if anything, it could cause a very slight increase in pH).
- The decrease in pH did not decrease in a direct ratio with the addition of the vinegar. The slope of the line was curved downward, instead of straight.



Procedure for Testing the pH of Various Foods
Hands-on activity
Food Safety Extension Curriculum

Purpose of the Lab

What is pH?

The acidity of food is measured on a scale of 0-14. The lower the pH the higher the acidity.

Why is pH important in food?

pH is a factor in food that contributes to the growth of microorganisms – yeast, mold, fungi and bacteria. Foods with a higher pH are more susceptible to microbial growth as opposed to highly acidic foods.

Materials

- pH paper
- Sample Caps
- pH meter (optional)
- Buffers
- Constituents with different pH levels



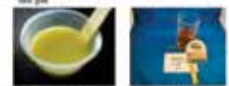
Constituents with Different pH Levels

pH can be tested with household items. If using pH test strips, consider examples that produce a noticeable color change.

Constituent	pH	Constituent	pH
Liquid Dish Cleaner	10	Flavlor Cit	3
Shampoo	10	Black Milk	3
Housecleaner	10	Beer/Brake	4
Window Cleaner	11	Beer/Boiling Hot	4
Ammonia Cleaner	10	Soybean Sauce	5
Baking Soda + Water	8	Apple Juice	3
Club Soda	3	Tomato Juice	4
Acid Tea	2		
Water	7		
Milk	6		

Procedure

1. Place different constituents into sample caps.
2. Cut 5 cm strips of the pH paper.
3. Dip the each strip into a sample.
4. The strip will immediately change color in accordance to the pH.
5. Compare the pH strip with the color guide to determine the pH.



Procedure

- If supplies are available, use a calibrated pH meter to test the constituents.
- Compare the pH strips with the pH meter reading.
 - Which method is more accurate? Why?
 - Which method is more likely used in a food safety laboratory? Why?

Recording Data

Condition	Replicate #	Color of pH Strip	pH Reading

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Discussion

1. Were any of the results surprising? Which ones and why?
2. What else are pH strips used for?
3. What other than food has a pH?
4. What other factors control the growth of microorganisms other than pH?
5. How can pH be changed?

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1. Answers will vary.
2. Swimming pools, food processing, drinking water, soil testing, formulation of medicines, medical tests, and others
3. Soil, blood, saliva, chemicals, medicine, and others
4. Food nutrients, gases in the air, temperature, time, moisture (water activity),
5. Adding other constituents or ingredients.