Nutrition Information NIRC Resource Center

Fact Sheet

pH and Titratable Acidity

The acidity or alkalinity of a food is usually expressed as pH. pH is on a scale of 1 to 14, with 1 being highly acidic and 14 being highly alkaline. The pH of a food can dramatically alter the growth of microbes in food and is a major determinant of the type of food preservation process used for that food. Yeasts and molds usually grow best between pH 4 and 6 and bacteria usually grow best at pH near 7. In selecting a food preservation process that makes a food shelf stable, the initial pH of that food must be considered to minimize the likelihood of bacterial growth in that food. Foods that are highly acidic may be preserved with minimal heat treatments, e.g., water bath processing of tomatoes. Foods that are alkaline must be preserved with higher heat treatments to kill any bacteria, e.g., pressure canning for green beans and other vegetables. Foods may also be preserved by fermentation or by adding acidulants to lower the pH. Most fermentation processes involve adding a bacterial culture which produces an acid, e.g., lactic acid. The acid produced by the bacteria lowers the pH of that food. Examples of fermented foods include saurkraut, yogurt, and summer sausages. Foods may also be directly acidified, such as the use of vinegar in making pickles.

In this exercise, the pH of a range of foods will be measured. This exercise includes foods that are naturally acidic (orange juice), those that are naturally neutral in pH (cucumber and cabbage), those that are directly acidified (Reese red cabbage and Claussen's Kosher Dill Pickle), and those that are acidified by fermentation (saurkraut, Mt. Olive Genuine Dill Pickle and Oscar Mayer Hard Salami).

Equipment

- Blender with blender blade attachments
- ½pint jars
- magnetic stirrer
- stirring bar
- buret
- buret stand
- food grinder
- top loading balance
- graduated cylinder, 100 ml
- spatulas
- knife or food processor
- pH meter with electrode

Reagents

- 0.1 N NaOH, standardized
- distilled water

Samples

- orange juice
- raw cabbage
- Reese red cabbage
- sauerkraut
- raw cucumber
- Claussen's kosher dill pickle
- Mt. Olive genuine dill pickle
- Oscar Mayer hard salami

Procedure

1. Sample Preparation

   Vegetables: coarsely chop the vegetables with a knife or food processor. Using the top loading balance and a spatula, weigh 10 grams of the sample into a ½pint jar.

   Meat: grind the meat sample twice a food grinder. Using the top loading balance and a spatula, weigh 10 grams into a ½pint jar.

2. Measure 100 ml distilled water into a graduated cylinder. Pour distilled water into the ½pint jar containing the sample.
3. Firmly attach the blender blades to the ½pint jar containing the sample and water.
4. Place the jar containing the sample and water on the blender base. Cover jar with a heavy cloth or glove to provide protection in case of breakage during blending.
5. Blend the sample for 10-15 seconds on low speed.
6. Remove the blender blades and, using a spatula, carefully scrape any food residue left on the blades into the homogenized sample.
7. Place a stirring bar into the ½ pint jar containing the homogenized sample.
8. Place the homogenized sample with the stirring bar on the stir plate. Turn the stir plate on low, so that the sample is stirring slowly.
9. While the sample is stirring, carefully insert the pH electrode into the sample. Turn the pH meter on and record the pH of the sample.

10. While the sample is stirring, titrate using small increments of the standardized 0.1 N NaOH until a pH of 8.3 is reached.
11. Record the volume of NaOH used for the titration.
12. Calculate the acid content (%) of the sample based on the following formula.

% acid = {(N NaOH)(ml NaOH) /g sample x molecular weight of acid in food} / 1000 x 100

Product	pH	N NaOH	NaOH (ml)	Acid (%)
Orange juice				
Raw cabbage				
Reese red cabbage				
Sauerkraut				
Raw cucumber				
Claussen's kosher Dill pickle				
Mt. Olive Genuine Dill pickle				
Oscar Mayer Hard Salami				

Some typical pH values for common foods are**:**

Food	pH	Food	pH
Fruit juices	2.0 – 3.0	grapes	3.3 – 4.5
Tomatoes	3.7 – 4.9	jams	3.5 – 4.0
Fresh beef	5.3 – 6.2	mayonnaise	3.8 – 4.0
Pork	5.3 – 6.4	carrots	4.9 – 6.3
Wine	3.0 – 4.0	beets	4.9 – 5.8
Most cheeses	5.0 – 6.0	mushrooms	6.0 – 6.5
Milk	6.5 – 6.8	shrimp	6.8 – 8.2
Turkey	5.6 – 6.0	fish	6.5 – 7.0
Chicken	5.5 – 6.4	bread	5.0 – 6.0
Egg white	7.5 – 9.5	rhubarb	3.1 – 3.3
Egg yolk	6.0 – 6.4	peaches	3.1 – 4.2

Notes:

1. The acid content is calculated on the basis of the known or "expected" predominant acid present in the food.
2. Molecular weights: Acetic acid = 60.05; Lactic Acid = 90.08; Citric Acid = 192.13

The Nutrition Information Resource Center is a collaborative effort of the Department of Food Science and Human Nutrition in the College of Agriculture, Forestry, and Life Sciences at Clemson University and the South Carolina Nutrition Council, South Carolina State University and Tri-County Technical College. For more downloadable fact sheets, go to *http://virtual.clemson.edu/groups/NIRC/*.