STUDY OF PH LEVEL OF VARIOUS SUBSTANCE USING NATURAL HOMEMADE PH INDICATOR

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Abstract

This is an experiment in which we create a homemade pH level indicator using red Cabbage and test pH and the colour of the solutions which are available at home. This is a fun experiment which can be done by anyone who has the basic knowledge of chemistry.

We all know examples of everyday substances that can be classified as acids or alkalis: lemon juice is acidic, bleach is alkaline and so on. Another substance that can be found in our kitchen can be used to test other substances to determine whether they are acidic or alkaline in nature. The chemicals that give red cabbage its colour also allow it to be used as a pH indicator.

Introduction

A **solution** is a mixture of a soluble chemical dissolved in water. Think about the difference between salt and tap water. The salt in the salt water is dissolved and the solution seems transparent, but the salt is still present. Because solutions are made with water, which is made of hydrogen and water, the hydrogen in the water can make a solution into an **acid** or a **base**. Some very common household solutions are acidic in nature. Acids are solutions are one which will donate hydrogen ions to a solution and they are usually sour in taste. Some commonly found acids are citrus fruit juices and household vinegar. Bases are solutions that accept hydrogen ions in solution and usually feel slippery in texture.Other bases make useful household cleaning products. Antacids(for example TUMS or Rolaids) are used to reduce the **acidity** in our stomach. A **pH indicator** is

a halochromic chemical compound added in small amounts to a solution so that the pH (acidity or **basicity**) of the solution can be determined visually. Hence, a pH indicator is a chemical detector for hydronium (H_3O^+) ions or hydrogen ions (H^+) in the Arrhenius model. The indicator causes the colour of the solution to change depending on the pH . Indicator can also show change in other physical properties for example, olfactory indicators show change in their odour. The pH value of a neutral solution is 7.0. Solutions with a pH value below 7.0 are considered acidic and solutions with pH value above 7.0 are basic (alkaline). As most naturally occurring organic compounds are carboxylic acids and amines, pH indicators find many applications in biology chemistry. pH indicators form one of the three main types of indicator compounds used in chemical analysis.

Keywords: acid, base, acidity, basicity. , pH indicator, Solution

Theory

pH indicators detect the presence of H+ and OH- . They do this by reacting with H+ and OH- : they themselves are weak acids and bases. If an indicator is a weak acid and is coloured and its conjugate base has a different colour, deprotonation causes the colour change. The ratio of the concentration of the indicator, HInd, and its conjugate base, Ind- , determines the colour we see. This ratio depends on the pKa of the indicator and the pH according to the Henderson-Hasselbalch equation.

Concentration (mol/L)		
$[H_3O^+]$	*$[OH^-]$*	
1	1×10^{-14}	
1×10^{-1}	1×10^{-13}	
1×10^{-2}	1×10^{-12}	
1×10^{-3}	1×10^{-11}	Acidic Solution
1×10^{-4}	1×10^{-10}	
1×10^{-5}	1×10^{-9}	
1×10^{-6}	1×10^{-8}	
1×10^{-7}	1×10^{-7}	Neutral Solution
1×10^{-8}	1×10^{-6}	
1×10^{-9}	1×10^{-5}	
1×10^{-10}	1×10^{-4}	
1×10^{-11}	1×10^{-3}	Basic Solution
1×10^{-12}	1×10^{-2}	
1×10^{-13}	1×10^{-1}	
1×10^{-14}	1	

Red cabbage contains a pigment molecule called flavin (an anthocyanin). This water-soluble pigment is also found in apple skin, plums, cornflowers and grapes. extremely acidic solutions will turn anthocyanin a red colour. Neutral solution result in a purplish colour. Basic solutions appear in greenish-yellow colour. So , It is possible to determine the pH of a solution based on the colour it turns the anthocyanin pigments in red cabbage juice. The colour of the juice changes in response to changes in its hydrogen ion concentration. pH is the -log[H+]. Acids will donate hydrogen ions in an aqueous solution and have a low pH (pH < 7). Bases accept hydrogen ions and have a high pH (pH > 7).

Equations

1. $pH = - \log [H_3O^+]$
2. $pOH = - \log [OH^-]$
3. $pH + pOH = 14$

Materials and Equipment

The following are the materials required:-

- A small red cabbage
- Boiling pot of water
- Strainer
- Transparent glasses (one for each household item you want to test the pH of)
- Medicine dropper
- Large bowls or pots (2)
- Lab notebook
- A series of household items to test the pH of:
    - soap
    - Fruit juice: lemon
    - Soda pop(dark sodas might be tricky to see)
    - Vinegar
    - Baking soda solution
    - turmeric

Experimental Procedure

1. Grate a small red cabbage and place the pieces into a large bowl or pot, as shown in Figure 3, below.

2. Pour boiling water into the bowl to just cover the cabbage. Use caution when handling the boiling water.

3. Leave the cabbage mixture steeping, stirring occasionally, until the liquid is room temperature. This may take at least half an hour. The liquid should be reddish purple in colour.

4. Place a strainer over a second large bowl or pot and pour the mixture through the strainer to remove the cabbage pulp. Press down on the pulp in the strainer, such as by using a large spoon, to squeeze more liquid out of the pulp.

5. In the bowl, you should now have a clear liquid that will either be purple or blue in colour. (It should look darker after the pulp is removed.) This will be your indicator solution.

6. The colour of the liquid will change depending upon the pH. Use Table 1, below, to figure out the pH of the liquid by observing the colour.

pH	Colour
2	Red
4	Purple
6	Violet
8	Blue
10	Blue-green
12	Greenish-yellow

7. Set aside your indicator solution. You will use it as your "stock" solution for your experiments.

8. Next you will test various household solutions with your indicator. Use a separate Dixie cup for each solution you want to test because you do not want to mix chemicals that do not go well together or contaminate your results.

9. Fill about half of the glasses with your cabbage indicator solution. You can use less indicator solution for each cup if you do not have a lot of indicator solution.

10. Add drops of a liquid you want to test until you see the solution change in colour. Gently swirl the glass as you add the drops, being careful not to spill the solution.

11. Record the pH and a description of the each solution.

12. Analyse your results.

Result

Item	Colour	pH
Soap	green	9
Baking soda	blue	8.8
Vinegar	pink	2.4
Sprite	purple	3.3
Lemon juice	red	2.0


2018.11.28 19:56


SOAP
BAKING SODA
VINEGAR
SPRITE
TURMERIC
LEMON
2018.11.28 20:06

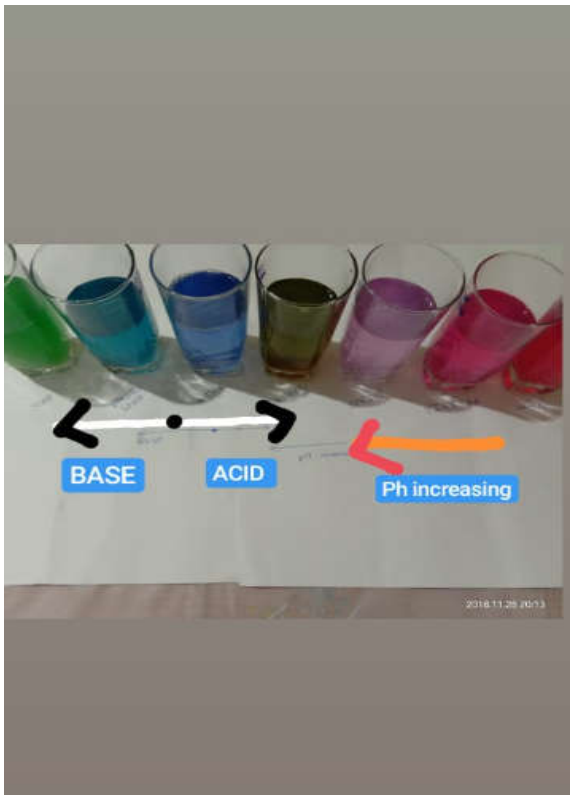

2018.11.28 20:11


2018.11.28 19:36


SOAP
WATER
TURMERIC
SPRITE
Base
Acid
pH increasing
2018.11.28 20:13


2018.11.28 19:32


2018.11.28 19:46


BASE
ACID
Ph increasing


SOAP
BAKING SODA
VINEGAR
SPRITE
TURMERIC
LEMON

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Credits

Sara Agee, Ph.D., Science Buddies

MLA Style

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