Philippine Science High School Western Visayas
Doña Lawaan H. Lopez Campus
Iloilo City

BLACKBERRY (*Rubus sp.*) EXTRACTS AS pH LEVEL INDICATOR

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In Partial Fulfillment
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Technology Research II

by

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March 2001

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APPROVAL SHEET

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Abstract

This study aimed to determine the feasibility of blackberry (*Rubus sp.*) as a pH level indicator (0-14). It also determined the significant differences in the different color wavelengths of the blackberry extract exposed to pH levels ranging from 0 to 14. The independent variable in this study was pH levels of 15 solutions, while the dependent variable was the color wavelength of the blackberry extract exposed to a certain pH level. The blackberry extract was added with NaOH to make the pH of the solution 7. Solution of different known pH levels from 0 to 14 were prepared and added with the extract. The color of the blackberry extract in each was determined using a spectrophotometer that measured the color wavelength in nanometers (nm).

In pH 0, the color wavelength was 575 nm. In pH 1, the color wavelength was 555 nm. In pH 2, the color wavelength was 525 nm. In pH 3, the color wavelength was 530 nm. In pH 4, the color wavelength was 526 nm. In pH 5, the color wavelength was 520 nm. In pH 6, the color wavelength was 527 nm. In pH 7, the color wavelength was 533 nm. In pH 8, the color wavelength was 525 nm. In pH 9, the color wavelength was 533 nm. In pH 10, the color wavelength was 525 nm. In pH 11, the color wavelength was 527. In pH 12, the color wavelength was 529 nm. In pH 13, the color wavelength was 535 nm. In pH 14, the color wavelength was 530 nm.

The results showed that there was no significant difference in some parts of the spectrum. There are, however significant differences between pH levels 0 to 3 and 5 to 7.

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BLACKBERRY (*Rubus sp.*) EXTRACTS AS pH LEVEL INDICATOR

Chapter 1

Introduction to the study

Background of the study

The Philippines as a whole is an agricultural land. The abundance of flora is due to the country's location. Different species of plants have lived, have nourished, and have adapted to the climate.

Blackberry, as a fruit, is juicy. Blackberry is not only a delicious fruit but also a good source of dye. These are not the only advantages that the blackberry could give us. Since we found out that the extracts of the blackberry change in color when reacting to an acidic and basic substance, we used this fruit to indicate the pH level of certain substances. And because we have resources of these fruits, we may replace the traditional pH level indicators with blackberry extracts. This would be much cheaper compared to other indicators.

In this study, the dependent variable was the wavelength of treated blackberry extract, and the independent variable was the

pH of the extract when subjected to substances with different pH levels.

The research paradigm in Figure 1 will show these relationships among variables.

Statement of the Problem and the Hypothesis

This study aimed to determine the capability of the blackberry extract in detecting pH level of a substance.

It specifically aimed to:

1. determine the change in color wavelength of the blackberry extract after being exposed to pH levels from 0 to 14.
2. study if there is a significant difference in the color wavelengths of the blackberry extract after being exposed to varying pH levels from 0 to 14.

It was hypothesized that there are no significant differences in the color wavelengths of the blackberry extract after being exposed to pH levels from 0 to 14.

DEPENDENT VARIABLE

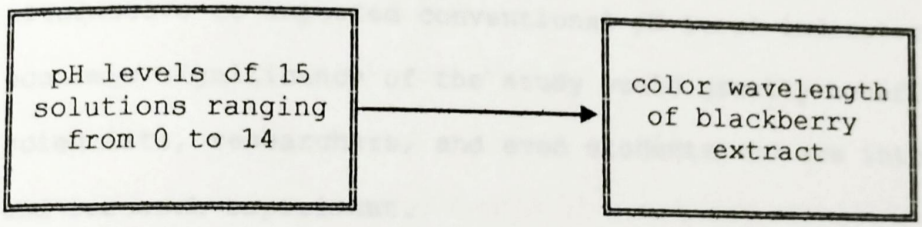

Figure 1. Change in color wavelength of blackberry extract after being exposed to solutions of different pH levels.

Significance of the Study

Our country today is experiencing economic crisis. Prices of goods are constantly increasing. People prefer imported goods rather than local ones. This results to an increase in the price of imported products and lower the prices of local products. Faced with this reality, the researchers conducted this study to determine the pH indicating capability of the locally available blackberry extract that will be used as a costwise, cheaper alternative to imported conventional pH level indicators. This economic significance of the study would greatly benefit scientists, researchers, and even students who are into science and research experiment.

Definition of Terms

pH level- is a measure of acidity and alkalinity of a solution- that is a number on a scale on which a value of seven represents neutrality, the lower numbers indicate increasing acidity, and the higher numbers indicate increasing alkalinity, and on which each unit of change represents a tenfold change in acidity or alkalinity, that is the negative logarithm of the

effective hydrogen ion activity in gram equivalents per liter of the solution (Merriam Webster's Collegiate Dictionary, 1994).

In this study, the term referred to the acidity or alkalinity levels that the blackberry extract had indicated through its color.

Blackberry- is a black or dark purple juicy but seedy edible aggravate fruit of various brambles of the rose family (Merriam Webster's Collegiate Dictionary).

In this study, the term referred to the fruit in which the pH indicating extract was taken.

Indicator- is any of the various substance used to indicate acidity or alkalinity of a solution, the beginning or end of a chemical reaction, the presence of a certain substance, etc., by change in color (Webster's New World Dictionary, 1994).

In this study, the term referred to is the blackberry extract, indicating the acidity or alkalinity of a substance through its color.

Color- a phenomenon of light (as red, brown, pink, gray) or visual perception that enables one to differentiate otherwise identical objects (Webster's New Encyclopedic Dictionary, 1994).

In this study, the term meant as defined.

Scope and Delimitation of the Study

This study aimed to determine the capability of the blackberry extract in detecting pH level of a substance. It specifically determined if there is significant difference in the color wavelengths of the blackberry extract exposed to pH levels ranging from 0 to 14.

The independent variable in this study was the pH levels of 15 solutions, while the dependent variable is the color wavelength of the blackberry extract after being exposed to a certain pH level.

Temperature, ripeness of the used blackberry, length of time the blackberry extract solution was kept standing, and exposure to sunlight, were not considered to be variables of the study. Control groups, such as blackberry extract placed on distilled water, were also not included for possible comparison.

The experiment was conducted at the Philippine Science High School Western Visayas Science Research Laboratory located at Barangay Bito-on, Jaro, Iloilo City.

Chapter 2

Review of Related Literature

Chapter 2 was divided into 3 parts. These parts were (1) Blackberry, (2) Indicators, and (3) pH.

Blackberry

Blackberry, common name for several of the fruits and plants of a genus of the rose family. The ripe fruit is an aggregate of small, purplish-black drupes attached to a cone-shaped receptacle, which readily separates from the plant when the berries are picked. In other members of the genus, the receptacle separates from the drupes and remains on the plant. More than 24 species of blackberry are known, including several called dewberry and albino varieties called white blackberry. Although the blackberry was highly developed as a wild fruit, it was rarely grown as a garden fruit until 1850. Since then, it has been widely cultivated and has become a major commercial crop (Microsoft Encarta 98 Encyclopedia, 1998).

Blackberries belong to the genus *Rubus* of the family Rosaceae (Microsoft Encarta 98 Encyclopedia).

The blackberry is a trailing-to-erect bramble, usually spiny, in the genus Rubus of the Rosaceae (rose) family. Blackberries occur throughout the world, with the exception of dry desert regions, but the greatest numbers are ,in the Northern Hemisphere. Commercial production is largely limited to the United States, where the principal producers are Oregon, Texas, Oklahoma, and Arkansas. Important types are Thornless Evergreen, Marion, Boysen, Olallie, Cherokee, Comanche, Cheyenne, Humble and Darrow. Loganberry is a trailing type with a purplish fruit that is different in many aspects from other blackberries; most taxonomists consider it a true and separate species (Grolier Multimedia Encyclopedia, 1996).

Indicator

Indicator are used mainly to signal the completion of titrations, usually by changing color at the endpoint, which is when sufficient titrant has been added to react with all the substance being analyzed in the sample solution. Ordinarily, the tiny amount of intensely colored indicator needed to impart a distinct color consumes a negligibly small volume of titrant when

the color changes at the endpoint (Grolier Multimedia Encyclopedia).

Most indicators can be classified according to their color change mechanisms or kinds of titrations for which they are applicable. Acid-base indicators respond to changes in hydrogen ion concentration, oxidation-reduction indicators to changes in oxidizing strength (potential), and metallochromic indicators (for complexion titrations) to changes in free metal ion concentration. Indicators for precipitation titrations function by absorbing on a precipitate surface or by forming a (colored) precipitate or colored metal complex. Occasionally, a titrant or analyte such as potassium permanganate is highly colored and serves as its own indicator. Fluorescent indicators are highly useful in titrating turbid or highly colored solutions (Grolier Multimedia Encyclopedia).

Litmus, vegetable dye obtained from lichens, usually of genus *Variolaria*, and used in chemistry to determine the presence of acids and bases in a solution. Strips of paper impregnated with blue or red litmus solution, or small quantities of the solution itself, is used to indicate the presence of an acid or a base; acids turn blue litmus red, and bases turn red litmus blue (Microsoft Encarta 98 Encyclopedia).

pH

The pH of an aqueous solution is a value expressing the solution's acidity or alkalinity in terms of the relative amounts of hydrogen ions (H^+; protons) ad hydroxide ions (OH^-) present. A pH value may fall anywhere on a scale from 0 (strongly acidic) to 14 (strongly basic or alkaline), with a value of 7 representing neutrality.

The measurement and control of pH is important in the manufacture of foods, paper, and chemicals. In agriculture, testing and maintenance of soil pH is necessary for good yields of crops. Maintenance of water quality and the study of acid rain illustrate the application of pH measurement methods in environmental science.

According to its simplest definition, introduced by Soren Sorensen in 1909, pH is the negative logarithm of the molar concentration of H^+ ions: $pH = -\log [H^+]$ or $[H^+] = 10^{-pH}$.

Each pH unit downward represents, therefore, tenfold increase in the H^+ concentration. A pH of 3, for example, indicates a 10 to the negative 3 (10^{-3}) molar concentration of hydrogen ions.

Chapter 3

Research Design and Methodology

This study aimed to determine the capability of the blackberry extract in detecting pH level of a substance. It specifically aimed to determine the change in color wavelength of the blackberry extract after being exposed to pH levels from 0 to 14. This study also aimed to determine if there is a significant difference in the color wavelengths of the blackberry extract after being exposed to varying pH levels from 0 to 14. It was hypothesized that there are no significant differences in the color wavelengths of the blackberry extract after being exposed to pH levels from 0 to 14.

Research Design

The One Spot Case study was used as the research design for the study. The independent variable was the pH levels of 15 solutions while the dependent variable was the color wavelength of the blackberry extract after the treatment was applied. The experimental group was the blackberry extract exposed to substances with 15 different pH levels, which served as the treatment.

Methods

Materials and Equipment

These following materials and equipment were used in the study: spectrophotometer, beakers, pH meter, blackberry extract, test tubes, test tube racks, pipette, micropipette or dropper, stirring rod, buffers, and solutions with 15 different pH levels. HCl and NaOH were used as an acid and base, respectively.

Site of Experiment

The experiment was conducted at the Philippine Science High School Western Visayas Science Research Laboratory located at Barangay Bito-on, Jaro, Iloilo City.

Gathering of Materials

The beakers, buffers, basic and acidic solutions, spectrophotometer, and pH meter were taken from Philippine Science High School Western Visayas. The blackberries were taken from University of the Philippines in the Visayas Grounds and Talisay, Negros Occidental, Philippines.

Preparation of the Blackberry Extract

The juice of the blackberry was extracted by wringing. The juice was then filtered to assure that only the liquid component was used for the study. The juice, which is acidic, was neutralized with a base so that the pH level will be equal to 7 or neutral.

Preparation of Acidic and Basic Solutions

HCl and NaOH were used as an acid and base, respectively. The pH of pure HCl and NaOH (0 and 14, respectively) were changed to respective pH levels (1 to 13) by dilution of water.

Determining the Color Wavelength of the Treated Extract

2 mL of the pH-7 blackberry extract was placed to test tubes containing 10-mL solutions with pH levels from 0 to 14. This solution was then added with 20 mL of distilled water to make the change in transmittance more perceivable, and therefore, more accurate. The final solution was then placed in a spectrophotometer, which determined the wavelength in which the solution has the greatest transmittance. The wavelength in which there was the greatest transmittance was considered to be the color wavelength of the solution

Statistical Data Analysis

For the descriptive analysis, the mean was used to determine the average of the nanometer readings in all trials. The standard deviation determined the standard difference among the scores taken compared with their means. For the inferential testing, the One-Way ANOVA, with the level of significance set at 0.05, compared if there were any significant difference in the change in color wavelength of the blackberry extract. The SPSS computer software was used in the processing of research data.

Chapter 4

Results and Discussions

The main aim of this study was to determine the pH indicating capability of blackberry (*Rubus sp.*) extract. It specifically aimed to determine the change in color wavelength of the blackberry extract after being exposed to pH levels from 0 to 14. This study also aimed to determine if there is a significant difference in the color wavelengths of the blackberry extract after being exposed to varying pH levels from 0 to 14.

Means of Color Wavelengths of Blackberry Extract at Different pH Levels

Results from the spectrophotometer showed that pH 0 has a maximum wavelength transmittance at 575 nm, while pH 1 has a wavelength of 555 nm; pH 2, 525 nm; pH 3, 530nm; pH 4, 526nm; pH 5, 520 nm; pH 6, 527 nm; pH 7, 533 nm; pH 8, 525 nm; pH 9, 533 nm; pH 10, 525 nm; pH 11, 527 nm; pH 12, 529 nm; pH 13, 535 nm; pH 14, 530 nm.

Table 1 shows the data.

One-way ANOVA of Color Wavelength Values of the Blackberry Extract at Different pH Levels.

The values taken from One-way ANOVA for color wavelength values at different pH levels showed that the sum of squares between groups is 8304.00, having a degree of freedom of 14, a mean square of 593.143, and a significance of 0.000.

The sum of squares taken within groups is 30.000, 30 is the degree of freedom, and the mean square is 1.

Table 2 shows the data.

Test for One-way ANOVA in Table 2

The SPSS have certain results comparing the values taken among different pH levels.

Table 3 shows the data.

Table 1

Means of the Color Wavelengths of Blackberry Extract at Different pH Levels

Category	N	Mean (in nm)	Standard Deviation
PH 0	3	575	1.00
PH 1	3	555	1.00
PH 2	3	525	1.00
PH 3	3	530	1.00
PH 4	3	526	1.00
PH 5	3	520	1.00
PH 6	3	527	1.00
PH 7	3	533	1.00
PH 8	3	525	1.00
PH 9	3	533	1.00
PH 10	3	525	1.00
PH 11	3	527	1.00
PH 12	3	529	1.00
PH 13	3	535	1.00
PH 14	3	530	1.00
Total	3	533	13.76

Table 2

One6-way ANOVA of Wavelength Values of the Blackberry Extract at Different pH Levels.

	Σx^2	Df	Mean square (in nm)	F	Sig.
Between groups	8304.00	14	593.143	593.143	0.000
Within groups	30.00	30	1.000		
Total	8334.00	44			

Table 3

Test for Oneway ANOVA in Table 2

Category		Mean difference	Standard error	Significance
pH 0	pH 1	20.00	.816	.000
	pH 2	50.00	.816	.000
	pH 3	45.00	.816	.000
	pH 4	49.00	.816	.000
	pH 5	55.00	.816	.000
	pH 6	48.00	.816	.000
	pH 7	42.00	.816	.000
	pH 8	50.00	.816	.000
	pH 9	42.00	.816	.000
	pH 10	50.00	.816	.000
	pH 11	48.00	.816	.000
	pH 12	46.00	.816	.000
	pH 13	40.00	.816	.000
	pH 14	45.00	.816	.000
pH 1	pH 2	30.00	.816	.000
	pH 3	25.00	.816	.000
	pH 4	29.00	.816	.000
	pH 5	35.00	.816	.000
	pH 6	28.00	.816	.000
	pH 7	22.00	.816	.000
	pH 8	30.00	.816	.000
	pH 9	22.00	.816	.000
	pH 10	30.00	.816	.000
	pH 11	28.00	.816	.000
	pH 12	26.00	.816	.000
	pH 13	20.00	.816	.000
	pH 14	25.00	.816	.000
pH 2	pH 3	-5.00	.816	.012
	pH 4	-1.00	.816	1.000
	pH 5	5.00	.816	.012
	pH 6	-2.00	.816	.952
	pH 7	-8.00	.816	.000
	pH 8	0.00	.816	1.000
	pH 9	-8.00	.816	.000
	pH 10	0.00	.816	1.000
	pH 11	-2.00	.816	.952
	pH 12	-4.00	.816	.105
	pH 13	-10.00	.816	.000
	pH 14	-5.00	.816	.012

pH 3	pH 4	4.00	.816	.105
	pH 5	10.00	.816	.000
	pH 6	3.00	.816	.509
	pH 7	-3.00	.816	.509
	pH 8	5.00	.816	.012
	pH 9	-3.00	.816	.509
	pH 10	5.00	.816	.012
	pH 11	3.00	.816	.509
	pH 12	1.00	.816	1.000
	pH 13	-5.00	.816	.012
	pH 14	0.00	.816	1.000
pH 4	pH 5	6.00	.816	.001
	pH 6	-1.00	.816	1.000
	pH 7	-7.00	.816	.000
	pH 8	1.00	.816	1.000
	pH 9	-7.00	.816	.000
	pH 10	1.00	.816	1.000
	pH 11	-1.00	.816	1.000
	pH 12	-3.00	.816	.509
	pH 13	-9.00	.816	.000
	pH 14	-4.00	.816	.105
pH 5	pH 6	-7.00	.816	.000
	pH 7	-13.00	.816	.000
	pH 8	-5.00	.816	.012
	pH 9	-13.00	.816	.000
	pH 10	-5.00	.816	.012
	pH 11	-7.00	.816	.000
	pH 12	-9.00	.816	.000
	pH 13	-15.00	.816	.000
	pH 14	-10.00	.816	.000
pH 6	pH 7	-6.00	.816	.001
	pH 8	2.00	.816	.952
	pH 9	-6.00	.816	.001
	pH 10	2.00	.816	.952
	pH 11	0.00	.816	1.000
	pH 12	-2.00	.816	.952
	pH 13	-8.00	.816	.000
	pH 14	-3.00	.816	.509
pH 7	pH 8	8.00	.816	.000
	pH 9	0.00	.816	1.000
	pH 10	8.00	.816	.000
	pH 11	6.00	.816	.001
	pH 12	4.00	.816	.105
	pH 13	-2.00	.816	.952
	pH 14	3.00	.816	.509

pH 8	pH 9	-8.00	.816	.000
	pH 10	0.00	.816	1.000
	pH 11	-2.00	.816	.952
	pH 12	-4.00	.816	.105
	pH 13	-10.00	.816	.000
	pH 14	-5.00	.816	.012
pH 9	pH 10	8.00	.816	.000
	pH 11	6.00	.816	.001
	pH 12	4.00	.816	.105
	pH 13	-2.00	.816	.952
	pH 14	3.00	.816	.509
pH 10	pH 11	-2.00	.816	.952
	pH 12	-4.00	.816	.105
	pH 13	-10.00	.816	.000
	pH 14	-5.00	.816	.012
pH 11	pH 12	-2.00	.816	.952
	pH 13	-8.00	.816	.000
	pH 14	-3.00	.816	.509
pH 12	pH 13	-6.00	.816	.001
	pH 14	-1.00	.816	1.000
PH 13	pH 14	5.00	.816	.012

Chapter 5

Conclusion and Recommendation

Summary

This study aimed to determine the capability of the blackberry extract in detecting pH level of a substance. It specifically aimed to determine the change in color wavelength of the blackberry extract after being exposed to pH levels from 0 to 14. This study also aimed to determine if there is a significant difference in the color wavelengths of the blackberry extract after being exposed to varying pH levels from 0 to 14. It was hypothesized that there are no significant differences in the color wavelengths of the blackberry extract after being exposed to pH levels from 0 to 14.

Findings

There was no significant difference in most of the values achieved, which determines the change in color wavelength of the blackberry extract, through the spectrophotometer. There were, however, significant differences in the values taken among pH levels 0 to 3 and 5 to 7.

Conclusion

The data based on this study, which were presented and discussed, where evidences of the following conclusions:

The blackberry extract cannot be used as an indicator for pH levels from 0 to 14. It can, however, be used as a pH indicator from pH levels 0 to 3 and pH levels 5 to 7. For this matter, the blackberry extract can be used as a cheap pH level indicator at pH ranges from 0 to 3 and 5 to 7.

Recommendations

The researchers recommend the feasibility of the blackberry extract as a pH indicator for pH level 0 to 3 and 5 to 7, for there are significant differences in the color wavelengths of the indicator in these pH levels.

A further study on experimenting with the blackberry extract's indicating capability using variables such as temperature, ripeness of the used blackberry, length of time the blackberry extract solution was kept standing, and exposure to sunlight is recommended.

Finally, it is recommended to restudy this work using other methodologies on how to determine the significance on the changes in color wavelengths of the blackberry extract.

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