COMPARATIVE ANALYSIS OF THE pH OF SOME RIPE, UNRIPE FRUITS AND SOIL IN BORI METROPOLIS, RIVERS STATE, NIGERIA

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Abstract

The pH of some ripe and unripe fruits and soil on which they were grown has been analysed in Bori and its metropolis. Pawpaw (Carica papaya), Pineapple (Ananas cosmosus), Guava (Psiduim guajava), Mango (Mangifera indica), Tomato (Solanum lycoperscium), Orange (Citrus x sinensis), Lemon (Citrus x lemon), Grape (Citrus x paradisi), Lime (Citrus x aurantifolia), Tangerine (Citrus x tangerine) and the soils on which they were grown was evaluated for pH levels. 25ml of fruit juice was extracted from both ripe and unripe fruit. E.I Digital pH meter model -112 was standardized using a buffer solution of pH 7 at 25oC. pH was measured in triplicates for the 20 fruits (10 unripe and 10 ripe). The soil sample was oven dried at 1200 for 2 hours. The soil solution was prepared and filtrate was evaluated for pH. Results showed that all the unripe fruits were acidic between the ranges of 2.30 to 4.00 while all the ripe fruits were also acidity between the ranges of 2.50 to 4.52. Lime had the least mean pH value of 2.30 and 2.50 both in unripe and ripe stages respectively. Mango and Guava had the highest mean pH of 4.00 in their unripe stage while only mango had the highest mean pH value of 4.52 in its ripe stage. The pH values obtained in the soil on which the fruits were grown ranged from 6.81 to 11.60. Station B (Zaakpon) had the least mean pH of 6.81 (Grape soil) while station D (Wiiyaakara) had the highest mean pH of 11.60 (Lime soil). This showed that among the four stations, the soils were slightly acidic - neutral – alkaline and all three pH levels yielded acidic fruits. Direct correlation analysis between soil and unripe fruit showed a negative value of -0.268 while the one between soil and ripe fruit showed a negative value of -0.362. This implies that if pH of soil increases, unripe and ripe fruit pH will decrease and vice versa. This work has therefore established that the pH of fruit can be controlled using the pH of soil.

Keywords: pH, soil, ripe and unripe fruits.

Introduction

Fruits are generally accepted as part of our dietary. They are fleshy product of trees and other plants that contain seeds that can be eaten whether ripe or unripe. Fruits are nutritious; they contain carbohydrates (sugar), proteins, vitamins and minerals (Adou et al., 2012) for the general health of the body system. Fruits contain acid as a result of natural organic acid such as citric acid, malic acid, ascorbic acid, tartaric acid, etc, present in them (Brandy and Holum, 1990).

At the unripe stage, fruits are premature and contain more of the organic acids. As they get matured, they form polymers that contain sugars. For the sugar in the fruits to be released, the fruit produces enzymes such as hydrolase, pectinase, amylase that breakdown the sugar and neutralizes the acid content which then display ripeness. Invariably, unripe fruits are low in sugar and so they are bitter and contain high concentration of organic acids which makes them to be astringent to the mouth (Bamise and Oziegbe, 2013), while ripe fruits are high in sugar, sweet and contains low amount of organic acids.

Fruits are grown on soil. The soil is the source of nutrients to the trees bearing these fruits so it plays a major role in the absorption of nutrients and the growth of the plants or trees. Therefore, a suitable pH level of the soil is required to enable the plants grow well. According to Sheridan (2014), soil pH of 6.00 to 6.50 encourages plant growth. Soil pH is a function of the balance between cation exchange and other processes that raise or lower the concentration of H^+ ion in soil. Soil anchors plant roots and is the main source of the organic nutrients plant require and it is also for respiration in root cells (Russell et al., 2008). Soil acidity is as a result of coal burning power plants, smelters, factories emitting sulfur dioxides, vehicles, power plants that burn gas and oil, nitrogen rich fertilizers that emit nitrogen oxides.

In dry weather, air borne oxides fall as dry acid deposits. In moist air, they form nitric acid vapour, sulphuric acid droplets and sulphate nitrate salts. Wind typically disperses them far from their sources, they fall to earth in rain and snow and this wet acid deposition is called acid rain. When this acid rain falls on the soil, it causes soil acidification because of high acid precipitation. In soil of low acid precipitation, the soil is alkaline. An experiment carried out by Thomas (1995), on the effect of low soil pH from different fertilizers on performance of apple and pear trees, showed that on a soil of pH 4.1 to 6.9 at the end of the fifth year of fertilizer applications, there was an increased fruit size and improved red colouration of red apple. The apple skin was related to a higher soil pH, that is, higher soil pH (alkaline) enhances fruit ripening and increases fruit pH as well.

A study carried out by Bamise and Oziegbe (2013) on the laboratory analysis of pH and neutralizable acidity of commercial citrus fruits in Nigeria showed that all the citrus fruits evaluated were acidic with pH range of 2.4 to 4.1. Lime produced the lowest mean pH of 2.4 and tangerine yielded the highest of 4.1. Another study carried out by Kumara and Sarmah (2013) on the pH of ripe and unripe Lemon of Assam, India, showed that pH of ripe lemon was 2.60 and unripe was 2.38. This explains that as fruits get ripened, their pH reduces. In a related study carried out by Atsue and Joseph (2015), on the determination of the pH of ripe and unripe fruits (Mango and Orange) grown in Makurdi, Benue State, showed that sweet orange for 2, 4 and 7 months maturity stages were 2.92, 3.18 and 3.51 respectively and Mango for 2, 4 and 7 months maturity stages were 4.98, 5.19 and 5.40 respectively. This also agrees with the findings from Kumara and Sarmah (2013). Asare (2012) carried out a study on the pH and

conductivity of moisture content of half ripe and fully ripe pineapple and reported that half ripe pineapple had a pH of 3.96 and the fully ripe pineapple had a pH of 4.11.

Due to the daily consumption of fruits, most people consume them in their ripe and unripe stages. A study of the acidity and alkalinity of fruits and the effect of soil pH on the acidic and alkaline properties of certain fruits grown in Nigeria and other countries of the world are very necessary, hence, the need for this research.

Materials and Methods

Materials

Some of the materials used for this study include ripe and unripe fruits such as pawpaw, pineapple, guava, tomato, orange, lemon, grape, lime, tangerine and mango. Other materials used include soil samples, E.I. digital pH meter model 112, oven, blender, sieve, measuring cylinders and deionised water.

Methods

Sample collection

The ripe and unripe fruits and the soils on which the tree bearing them are grown were obtained from Bori and neighbouring towns such as Zaakpon, Wiiyaakara and Yeghe in Khana and Gokana Local Government Areas of Rivers State. Bori is situated on latitude 4^{o} 42^{l} North of the equator and longitude 7^{o} 21^{l} East of Greenwich meridian. Figure 1 below shows the location of Bori town and its environs in Ogoni land of Nigeria.

Figure 1: Map of Ogoni showing study areas (Courtesy, July, 2011 UNEP Report)

Sample Preparation

Each fruit sample (ripe and unripe) were peeled, cut into pieces and manually squeezed to extract juice. Juice was filtered through a sieve and transferred into clean beakers. Soil samples were oven dried at 120^{o}C for 2 hours and allowed to pass through a sieve. 10g of sample was transferred into glass beakers. 10ml of distilled water was added and stirred

thoroughly. The mixture was allowed to stand for 1 hour, followed by filtration and proper labeling. The filtrate was then analysed for pH.

Measurement of pH

The pH of each fruit sample (ripe and unripe) and soil samples were measured using E. I Digital pH meter model -112 and was standardized using a buffer solution of pH 7 at 25^{o}C. 25ml of each fruit extract was transferred into small glass beakers. Electrode was immersed into each fruit extract for 1 minute until a stable reading was obtained. Each fruit was tested in triplicate (after every 20 seconds readings were taken) and their averages were obtained. Between readings, the electrode was rinsed in distilled water to ensure no contamination. The procedure was repeated for soil filtrates.

Statistical Package for the Social Sciences (SPSS) Version 14 was the statistical software used to analysed the results obtained from the correlation between the ripe and unripe fruits, their pH values and their soil pH.

Results and Discussion

Results of pH of unripe and ripe fruits, soil sample and locations

Table 1: **pH of the Tested Unripe Fruits and their Location**

Location	Fruits	1st Reading	2nd Reading	3rd Reading	Mean Value
Bori	Pawpaw	3.50	3.52	3.52	3.52
Zaakpon	Mango	4.00	4.00	4.00	4.00
Zaakpon	Tangerine	2.80	2.80	2.81	2.80
Zaakpon	Grape	2.60	2.60	2.60	2.60
Zaakpon	Lemon	2.40	2.40	2.42	2.40
Yeghe	Tomato	3.80	3.80	3.82	3.80
Yeghe	Guava	4.00	4.00	4.00	4.00
Wiiyaakara	Orange	2.80	2.80	2.80	2.80
Wiiyaakara	Pineapple	2.51	2.51	2.50	2.51
Wiiyaakara	Lime	2.30	2.30	2.30	2.30

Table 2: pH of the Tested Ripe Fruits and their Locations

Location	Fruits	1st Reading	2nd Reading	3rd Reading	Mean Value
Bori	Pawpaw	4.30	4.30	4.30	4.30
Zaakpon	Mango	4.50	4.52	4.52	4.52
Zaakpon	Tangerine	3.10	3.10	3.10	3.10
Zaakpon	Grape	3.00	3.00	3.00	3.00
Zaakpon	Lemon	2.60	2.61	2.60	2.60
Yeghe	Tomato	4.20	4.20	4.20	4.20
Yeghe	Guava	4.10	4.10	4.10	4.10
Yeghe	Orange	3.20	3.20	3.20	3.20
Wiiyaakara	Pineapple	3.70	3.70	3.70	3.70
Wiiyaakara	Lime	2.50	2.50	2.50	2.50

Table 3: pH of the tested soil on which fruits bearing trees were grown and their locations

Location	Fruits	1st Reading	2nd Reading	3rd Reading	Mean pH on soil
Station A					
Bori	Pawpaw	7.50	7.50	7.51	7.50
Station B					
Zaakpon	Mango	7.20	7.20	7.20	7.20
Zaakpon	Tangerine	7.50	7.50	7.50	7.50
Zaakpon	Grape	6.80	6.81	6.81	6.81
Zaakpon	Lemon	7.20	7.20	7.20	7. 20
Station C					
Yeghe	Tomato	7.90	7.90	7.90	7.90
Yeghe	Guava	8.00	8.00	8.00	8.00
Station D					
Wiiyaakara	Orange	7.40	7.42	7.42	7.42
Wiiyaakara	Pineapple	7.80	7.82	7.80	7.80
Wiiyaakara	Lime	11.60	11.60	11.60	11.60

Table 4: Summary of the pH mean values

Location	Fruits	Mean values of unripe fruits	Mean values of ripe fruits	Mean values of soil
Bori	Pawpaw	3.52	4.30	7.50
Zaakpon	Mango	4.00	4.52	7.20
Zaakpon	Tangerine	2.80	3.10	7.50
Zaakpon	Grape	2.60	3.00	6.81
Zaakpon	Lemon	2.40	2.60	7.20
Yeghe	Tomato	3.80	4.20	7.90
Yeghe	Guava	4.00	4.10	8.00
Wiiyaakara	Orange	2.80	3.20	7.42
Wiiyaakara	Pineapple	2.51	3.70	7.80
Wiiyaakara	Lime	2.30	2.50	11.60

Discussion

The experimental results obtained in this study as presented from the above tables show that the pH of all the unripe fruits evaluated in the study ranged from 2.30 to 4.00. This showed that they were acidic, while the pH of ripe fruits evaluated ranged from 2.50 to 4.52, though acidic but higher than the pH values obtained from the unripe fruits. This finding agrees with the report from Atsue and Joseph (2015) on the investigation of the electrical conductivity and the pH values of some fruits grown in Makurdi. Considering the citrus fruits (Orange, Grape, Tangerine, Lemon and Lime), they had the lowest pH values both in their ripe and unripe stages. In their unripe stage, lime had the lowest pH of 2.30, Orange and Tangerine had the highest pH of 2.50 while in their ripe stage, lime still had the lowest pH of 2.50 and orange had the highest pH of 3.50. This is because, citric fruits are high in citric acid but lime seems to be very rich in citric acid (Bamise and Oziegbe, 2013). This finding agrees with the report from (Bamise and Oziegbe , 2013) on the analysis of pH and neutralizable acidity of commercial citric fruits in Nigeria. The trend of acidity among the ripe

fruits analyzed was Lime < Lemon < Grape < Tangerine < Orange < Pineapple < Guava < Tomato < Pawpaw < Mango.

The pH values of the analyzed soils on which the fruit bearing trees were grown ranged from 6.81 to 11.60. The lowest soil pH was 6.81 (grape soil) obtained from station B (Zaakpon) and the highest soil pH was 11.60 (Lime soil) obtained from station D (Wiiyaakara).

The output result of SPSS Version 14 showed that the correlation between the unripe fruit (URF) pH value and soil pH is negative (-0.268) and the correlation between ripe fruits (RF) pH value and the same soil pH value is also negative (-0.362). The above results suggested that the unripe and ripe fruits have a negative correlation with the soil. Statistically, it means that an increase in the pH of the soil will lead to a reduction in the pH of the fruit (whether ripe or unripe). This agrees with the results in the Tables 1, 2 and 3. The highest soil pH (11.60) yielded the lowest fruit pH for both unripe (2.30) and ripe (2.50) (Lime fruit). Furthermore, the pH of the soil samples which are high (alkaline) also yielded acidic fruit (reduced pH).

Conclusion

The fruits under study obtained from different stations showed that unripe fruits are more acidic than ripe fruits. Though, all the pH values were acidic between the ranges of 2.30 – 4.52, the pH of the soil on which the fruits were grown had pH values between the ranges of 6.81 – 11.60. This shows that the pH of the soils is tending to alkaline and therefore, produces acidic fruits. Further studies should be carried out on how sugar affects the pH of different fruits.

References

Adou, M., Tetchi, F. A, Gbane, M., Kouassi, K. N., Amani, N. G. G. (2012). physico- chemical characteristics of cashew, apple, juice *(anacardium occident*om*ale)* from Yamoussoukro (cote d 'Ivoire). *Innovative Romanian food Biotechnology.* 11:32 -43.

Asare, R.. (2012). pH and Conductivity Moisture of Pineapple. *Journal of the Science of Food and Agriculture*. 53(6):945.

Atsue. T. & Joseph. E. (2015). Investigation of the Electrical Conductivity and pH values of some fruits grown in Makurdi, Benue state, Nigeria. National Institute of Physics, 36th Annual Conference University of Uyo. P 10 – 12.

Bamise, T. C. & Oziegbe, O. E. (2013). Laboratory Analysis of pH and neutralizable Acidicity of Commercical Citrus Fruits in Nigeria. *Advances in Biological Research.* 7 (2): 72-76.

Brandy, J. & Holum, M. (1990). Fundamentals of Chemistry. 2nd Edition. Wiley publishers. New York.

Kumara, S. & Sarmah, N. (2013). Antioxidant Activities of unripe and ripe Citrus Lemon of Assan. *International Journal of Innovative Research in Science, Engineering and Technology*. Pp 5.

Russell, P. J., Wolfe, L. S., Hertz, P. E., Starr, C. & Mcmillan, B. (2008). Biology the Dynamic Science. Student Edition, Yolanda Cossio, China. 762.

Sheridan, P. (2014). Testing the Effect Ripening has on the pH of Apples, Lemons and Oranges. *Sheridan page Cary Academy*. pp 4-6.

Thomas, J. R. (1995). Effect of low Soil pH from different Fertilizers on Performance of Apple and Pear trees. *Tree fruit research laboratory*. USDA – ARS. Wenatchee, Wa 98801. USA.