EDUCATUM JSMT Vol. 10 No.2 (2023)
ISSN 2289-7070 / e-ISSN 2462-2451 (70-73)
https://ejournal.upsi.edu.my/index.php/EJSMT/index

Effect of pH On Xylitol Composition- Preliminary Study

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Published: 30 December 2023

To cite this article (APA): Shamsudin, N. N. I., & Othman, S. A. (2023). Effect of pH On Xylitol Composition-Preliminary Study. *EDUCATUM Journal of Science, Mathematics and Technology*, *10*(2), 70–73. https://doi.org/10.37134/ejsmt.vol10.2.8.2023

To link to this article: https://doi.org/10.37134/ejsmt.vol10.2.8.2023

Abstract

Xylitol is a sugar alcohol, its molecular structure is hybrids between the molecule of sugar and the moleculeof alcohol. Xylitol can be used as a sugar substitute in human uptake especially diabetes because it does a minimal effect on the blood sugar level. The properties of xylitol can be modified to be suit to replace sugar.Therefore, the main purpose for this research studies was to find what modification can be made on xylitol properties so that it is suitable to substitute sugar for sugar uptake in human and to prove that not all the commercial xylitol can be used to substitute sugar. In this research the pH of the xylitol were changed to thesuitable pH value. Then they were observed using UV-vis and FTIR to determine the changes on the composition of the modified xylitol.

Keywords Xylitol, pH, Sugar, UV-Vis., FTIR

INTRODUCTION

Xylitol often used as sweetener. Sweetener is a substances that transmit the sweet taste to a food for few kilojoules than sugar. The sweetness of the xylitol can be considered as sweet as tablesugar and it can be used as a sugar substitute. It does not involve a glucose 6 phosphate dehydrogenase in its metabolism and can metabolize without insulin, so it is suitable to be used asa sugar substitute to treat the diabetic patients [1]. Its glycemic load (GL) is low compare to other polyols sugar as its glycemic index is very low [2]. Glycemic load is used to ranks foods on a scalebased on their effect on blood sugar levels. The scale start from 1 to 100, the lower the scale of glycemic load of the food the less it affect the blood sugar.

Some of the properties in xylitol can be modified so that it is suitable to replace sugar as a sweetener. The power of its sweetening is depends on concentration, pH, temperature and also thecombination with other sweetener. Some modification can be made on xylitol properties either on its concentration, pH or on its temperature. Optimum performance of xylitol usually at pH above 5[3]. According to previous study, xylitol is said to be suitable to substitute sugar because of its lowcaloric value. But, there is not much studies were conduct on how the modified xylitol performs [2].

As we can see, there are abundance of sweetener that can be found in the market and groceriesstore. Most of them are claimed to have low calorie and can be used as healthy sugar alternative. Although there are many xylitol can be found in the supermarket and groceries store all over the world. Some of them were not suitable for some people especially the diabetic patient, this is because they are sometimes were combined with other sweetener. Xylitol is used exclusively or incombination with other sugar substitutes [4]. Most were arise in the production of sugar-free chocolate, chewing gum, hard candies, wafer fillings, chocolate, pastilles and other sweets for diabetes. The objective of this study are to study the properties of xylitol as a sugar substitute.

MATERIALS AND METHODS

The material and chemical used in this experiment are xylitol, sodium hydroxide (NaOH) and hydrochloric acid (HCl). The solvent used are distilled water. All samples are mixed in a test tube.Ultraviolet-Visible Spectroscopy (UV-vis) and Fourier Transform Infrared Spectrum (FTIR) wereused in this study to obtain spectral data of the sample.

For this experiment only the pH of xylitol were vary. Stock solution for xylitol with different pH were prepared. Xylitol were dilute in distilled water with the concentration fixed to 0.2 M. The pH of the xylitol, were set to pH 5, 6, 7, 8, and 9. To change the pH value of the xylitol solution sodium hydroxide (NaOH) and hydrochloric acid (HCl) solutions were used. By using titration method, the HCl were added drop by drop to make the xylitol solution become acidic. The NaOH were used to change the pH value to higher than the origin value. The temperature of the distilled water were fixed to room temperature 27 ^{o}C. The sample were observe using UV-vis and FTIR to observe the change in xylitol composition. Besides the bonding of the element in xylitol also can be determine using UV-vis and FTIR.

RESULTS AND DISCUSSION

The result obtained from the analysis and the characterization were discussed in further. Thegraphical results were analyzed and interpreted in detail. Analysis and explanation are done thoroughly on the result obtained after observed using UV-vis and FTIR.

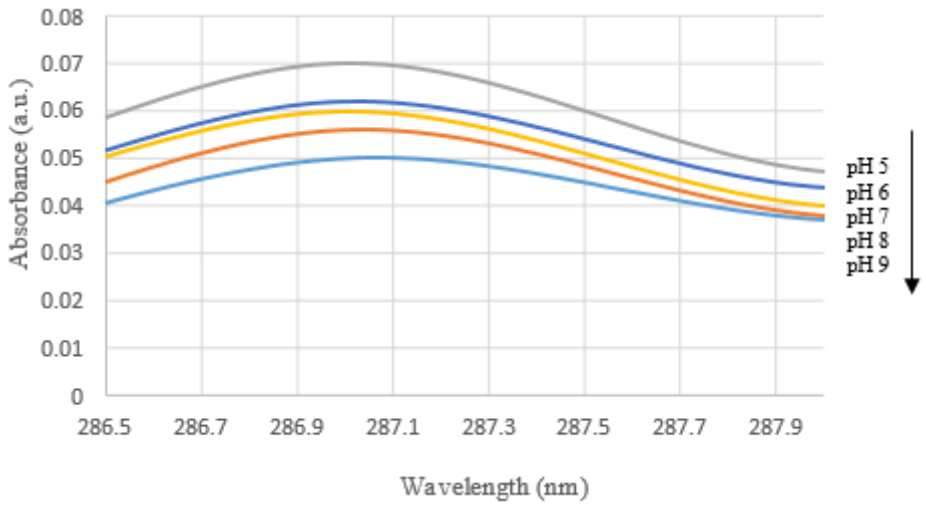

Figure 1: UV-vis analysis for different pH of xylitol.

Figure 1 show the result of UV-vis when 0.1M of xylitol were added by HCl or NaOH. The 0.1M of xylitol were chose from the previous result. As in the result it was found that 0.1M of xylitol had the least value of absorbance. HCl were added to the xylitol solution to lower its pH value, the value obtained were 5. To change the pH to 6, 7, 8 and 9 the NaOH were added into thesample.

As shown in the graph, it can be seen the present of the peak was at the wave length between 285 nm to 288 nm. Where it can be found that pH 5 has the highest value of absorbance. This was dueto the free hydronium ion that gives when acid react with aqueous solution of xylitol. The processof reaction called dehydration [5]. From the graph, pH 7 it showed the lowest absorption among other pH because of the hydration.The xylitol were added with NaOH in order to make it alkaline. NaOH contain a hydroxyl group substances which give a free hydroxyl ions when react with aqueous sugar. This explain why pH7 has the lowest value of absorption.

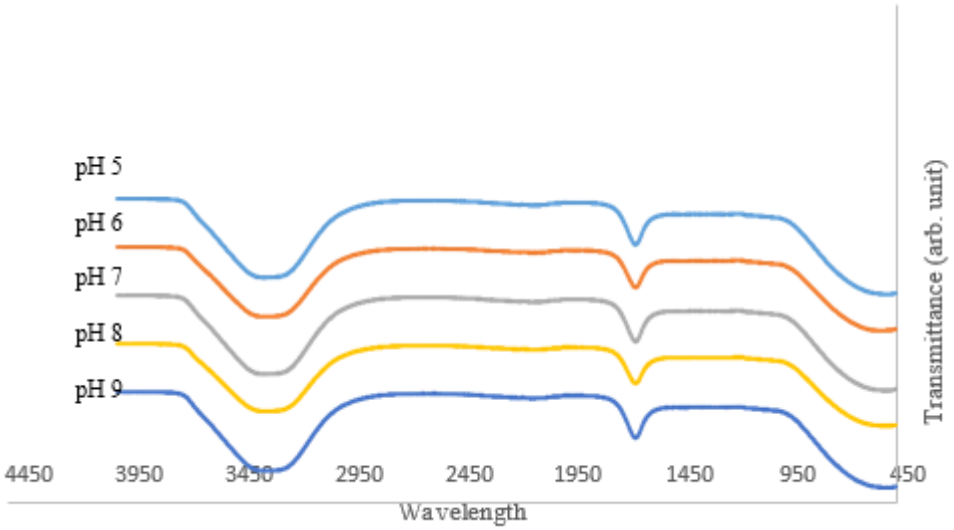

Figure 2: FTIR analysis for different pH of xylitol.

The graph 2 shows FTIR analysis for the effect of pH on xylitol. The sample were analyzed after the pH were modified from pH 5.7 to pH 5, 6, 7, 8, and 9. The sample were added with NaOH solution to make it become alkali and HCl to make the solutions become acidic. From the graph, itcan be seen that all the peaks were not much different from each other.

From the above graph, the peaks point were observed to be present between the wave number 3500 cm^{-1} to 3000 cm^{-1}. At this peak point there were present of water in the sample of analysis [5]. It was also shown that, the O-H stretching bond were strong between this regions. For the region from 1650 cm^{-1} to 1500 cm^{-1}, the C-C=C symmetric stretch bond can befound. This was due to the added of other solutions into the sample in order to change its pH. It also indicate that a medium intensity of absorption bands on this region. The solvation effect of different ions in a mixed solution could be treated additively [6]

CONCLUSION

In this study, the pH of xylitol can be changed by adding the desired amount of NaOH or HCl intothe solution of xylitol. Some calculation have been done to calculate the weight of the xylitol and volume of distilled water needed. The molarity were fixed to 0.2M. Based on UV-vis result, the absorptivity of xylitol shown that the xylitol with acidic pH which is pH 7 has the highest absorbance value while pH 5 shown the lowest. FTIR analysis of thesample shown a slightly different in the peak value of the graph of xylitol with the pH vary. To conclude, the xylitol with pH more than 5 were the most suitable to substitute sugar in human need.

The main purpose of this research is to find what modification can be made on xylitol properties so that it is suitable to replace sugar. After through several analysis, the objective of this research is succeeded by using two instrument. The characteristics of each sample are studiedby using UV-Vis and FTIR. Generally, studies on the xylitol were conducted in order to prove that xylitol can be used to substitute sugar for the sugar uptake in human

ACKNOWLEDGEMENTS

The authors would like to thank the Faculty of Applied Sciences and Technology for facilities provided that make the research possible.

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