



RESEARCH ARTICLE

APPLICATION OF POLARIMETRY TO THE DETERMINATION OF THE PURITY OF A SUGAR.

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Abstract

The purpose of the present research work was the application of polarimetry in a sugar sample in order to determine the purity, when submitting the sample to an analytical analysis it was necessary to perform a dilution of the sample in water, which was treated and filter to avoid turbidity and thus guarantee polarimetric measurement, the result of the SAC-i-ATAGO equipment reading was $+ 6.351^\circ$ at a temperature of 20.6°C and a λ of 589 nm this determination is analytical for determination of the amounts of purity before the inversion of the sugar, after the measurement carried out, the sample was treated with HCl with the intention of determining the angle of rotation in the absolute configuration of the sugar after the inversion of the same, with this a measured from -0.056° at a temperature of 21.9°C and a λ of 589 nm, from these data an analytical calculation was carried out to determine the concentration of sucrose and glucose in relevance to Data tabulated at temperatures of 20°C , analytical calculations suggest that the inversion of the rotation angle is in relation to the treatment in acid medium of the sample, in addition that the concentrations expressed were analyzed in a solution expressed in grams per 100 ml, estimated concentration for the determination of the angle before and after the inversion. For this reason it is possible to determine the concentration or purity of a sugar thanks to the absolute configuration that it presents in the polarized light deviation since that estimates the concentration of the solution within the variations of the turn rotation.

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Introduction:-

The analysis methods for the determination of the purity of a sugar are pertinent to the spatial structure and the absolute configuration that saccharide molecules can present, since although a refractory analysis would show how light changes or diffracts in a medium, (Kvittingen & Sjursnes, 2020)(Kovarik et al., 2020)The results will be relevant according to light absorption, on the other hand, the BRIX measurement of saccharides or sugars identifies concentration percentages but does not show their purity, since it would be useful to understand that the concentration suggests the estimation of a solvent and solute, and that purity is defined as the most stable amount of structure within a mixture.(Zaki Dizaji et al., 2020)(Gambelli, 2017) Under this concept, when subjecting a saccharide to a polarimetry analysis, the deviation of the polarized light in the walls of the tube through which the light passes generates an optical activity within the compound, which is evident according to the deviation turn that it takes.(Sadeghi-Shoae et al., 2017) After your passage, at the same time it is inherent to establish that the rotation

of the light deflected in its path identifies the structure of the saccharide according to its absolute spatial configuration, however the measurement of the deviation of the light according to the rotation that it is take may be influenced by some factors, which are not necessarily those of light, since if there is a concentration of sugars in a solution in an unstable way, (Tran et al., 2020) that is, if a sugar solution presents inconsistencies in the dissolution, since the band of radiation through which light passes will be affected by a disturbance of the concentration of the solution, the temperature can generate interferences in the p case of polarized light, finally it is necessary to mention how in relation to the increase in optical rotation a decrease in the wavelength is seen until it stabilizes, for this reason it can be considered that the length of the polarized light path it is inversely proportional. (Janassek et al., 2018) (Kaufmann, Krüger, et al., 2018) (Wall et al., 2003) (Tang et al., 2019)

Under this context it is possible to define a specific rotation based on the following relationship $[\alpha]_{\lambda}^t = \frac{\alpha}{c \cdot l}$ (Ec.1.1). (Majidi et al., 2017) However, the rotation presented in the previous equation is able to identify an angular rotation related to molecular rotation as shown in the following equation $[M] = \frac{M[\alpha]}{100}$ (Ec. 1.2) (Fernández, 2014) In this equation it is estimated that the measurement conditions of the specific rotation occur under normal conditions. (Kaufmann, Mügge, et al., 2018) To measure the sugar content from a sample in solution subjected to polarimetry, it is necessary to consider the angle of rotation before and after immersion as shown in the following equation $Cs\left(\frac{g}{100\text{ ml}}\right) = (\alpha v - 2\alpha n) \times 0,567$ (Ec. 1.3) (Dymerski et al., 2014) To conclude, based on all the above, the following equation will serve to determine the glucose concentration, as is evident, the information obtained in the previous equations is needed. $\alpha v = \frac{[\alpha]G \cdot l \cdot CG}{100} + \frac{[\alpha]S \cdot l \cdot Cs}{100}$ (Ec. 1.4) (Sanjuan et al., 2021) (Wade, 2011) For the analytical resolution of this equation, it is essential to use tabulated data under normal conditions of sucrose and glucose since these parameters will serve to obtain the purity of a sugar. (Barlóg et al., 2018) (McGrath & Fugate, 2013) (Solomon, 2009) (Haneklaus et al., 1998)

Therefore, in the present work, the Inverting a sucrose solution by acid hydrolysis was proposed, in order to apply polarimetry to determine the sucrose and glucose content of a sugary solution and therefore determine its purity. And finally, calculate the concentration of sucrose and glucose from the angle of rotation obtained with the polarimeter.

Methodology:-

Determination of the angle of rotation before inversión

Weigh ten grams sample, these are taken to a 100 ml volumetric flask and must be dissolved in 50 ml using hot distilled water. Create a mixture, said mixture must be leveled and then filtered, it is necessary to discard in the first instance an amount of ten ml. When using the polarimeter in the determinations, it is required that the solution is complete and does not present turbidity. Enter the sample in solution into the polarimeter tube considering a temperature of 20 ° C. The reading obtained in the SAC-i-ATAGO saccharimeter was + 6.351 ° at a temperature of 20.6 ° C and a λ of 589 nm

Determination of the angle of rotation after inversión

A residual quantity of 50 ml of the sample in solution is placed in a 100 ml Erlenmeyer flask, in which 25 ml of distilled water must be added, for the inversion of the sugar to take place it is necessary to shake the sample thus giving a homogeneous mixture. and with this add 5 ml of HCl with a purity of 37%, to control the temperature of the solution when heating a thermometer is entered into the material and heating is carried out in a water bath with water at a temperature of 70 ° C. When observing the reading of the thermometer in the stable hot solution in a range that goes from 67 to 70 ° C in an estimated time of five minutes, it is necessary to stir the solution. Then, after five more minutes, the material was cooled with the solution in cold water and made up to a volume of 100 ml, considering a temperature of the final solution of 20 ° C. To finish the treatment of the sample, it must be homogeneous before entering the reading of the polarimeter, thus the reading obtained in the SAC-i ATAGO saccharimeter was -0.056 ° at a temperature of 21.9 ° C and a λ of 589 nm

Results and Discussion:-

When applying the polarimetry measurements obtained in the laboratory for the determination of the sucrose concentration, we have:

$$Cs\left(\frac{g}{100\text{ ml}}\right) = (\alpha v - 2\alpha n) \times 0,567$$

$$Cs\left(\frac{g}{100\text{ ml}}\right) = (+63,51^\circ - 2(-0,56)) \times 0,567$$

$$Cs\left(\frac{g}{100\text{ ml}}\right) = 36,6$$

To determine the concentration of glucose in the solution we have:

$$\alpha v = \frac{[\alpha]G * l * CG}{100} + \frac{[\alpha]s * l * Cs}{100}$$

$$\alpha v = \frac{52,7 * 1 * CG}{100} + \frac{66,5 * 1 * 36,6}{100}$$

$$CG = 96,18 \left(\frac{g}{100\text{ ml}}\right)$$

The results reveal an estimated concentration in 100 milliliters of solution, whether of sucrose or glucose, but a radical difference between the 2 is evidenced that could be considered as twice the concentration of glucose than that of sucrose, these data can be interpreted as an estimate. variable in relation to the concentration from which the polarimetry measurements were taken, since although the concentration can be considered stable in the solution, the dissolution of the sugar from which we start suggests changes in the concentration that are reflected in the analytical calculations. , because the sugar underwent an acid hydrolysis that estimates to change the absolute spatial configuration of the simple(Huidobro & Simal, n.d.)(Perez & Borges, 2010)(Férrandez et al., 2011)

Conclusions:-

After applying the experimental polarimetry methodology, it was possible to determine a concentration of 36.6 and 96.18 (g / 100ml) for sucrose and glucose respectively from a diluted sugar sample.

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