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Development of a Rapid and Cost-Effective Method for Estimating Plant Glucose Levels with a Glucometer

Akshya Kumar Mishra[1*], Jagdish Chandra Panda[2]

[1]Dept. of Microbiology, Batakrushna College of Pharmacy, Nuapada, Odisha, India
[2]Dept. of Pharma Chemistry, Batakrushna College of Pharmacy, Nuapada, Odisha, India
*Corresponding Author

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Abstract— *This work offers a unique glucometer procedure for quick and economical plant glucose determination. The effectiveness of the devised method was demonstrated by its successful application to a variety of plant samples. Tagetes erecta showed the greatest glucose content among the plants studied, while Aegle marmelos showed the lowest. This novel method of measuring plant glucose levels is quicker and less expensive than existing approaches, which gives it a major advantage over others. This approach has the potential to be an effective tool in a number of disciplines, such as agricultural science, ecological research, and plant physiology.*

Keywords— ***Glucometer, glucose estimation, plant glucose, fast and economic method***

I. INTRODUCTION

A basic component of plant life is glucose, a simple sugar. It is the principal energy source and a fundamental constituent of many cellular parts. The widely known process of photosynthesis, in which plants absorb sunlight and transform water and carbon dioxide into carbohydrates, is how they make glucose. Plants use glucose as their main energy source and as a key component of many physiological functions. In plants, glucose plays a pivotal role as a master regulator, impacting several physiological processes during their entire life cycle. These include the ferocious growth phases, the complex dance of nitrogen and carbon metabolism, the germination and development of seeds, and finally, senescence.[1] Understanding plant health, stress responses, and metabolic processes requires monitoring plant glucose levels regularly. Plant glucose is currently estimated using various techniques, such as the enzyme-based test, which makes use of enzymes unique to glucose metabolism. The hexokinase/glucose-6-phosphate dehydrogenase (HK/G6PDH) technique is a typical illustration. After ATP is used by hexokinase to phosphorylate glucose, glucose-6-phosphate is oxidised by G6PDH, which produces NADH. The amount of NADH generated can be determined by measuring its absorbance at 340 nm, which is proportional to the glucose content.[2] In a colorimetric assay, coloured products are produced by interactions between glucose and certain reagents. The glucose oxidase (GOD) technique is a widely used illustration. The oxidation of glucose to gluconic acid and hydrogen peroxide (H2O2) is catalysed by GOD. Then, a chromogenic substrate and H2O2 combine to form a chromogenic horseradish peroxidase (HRP), which produces a coloured product whose intensity correlates with glucose concentration.[3]. Chromatographic procedures can be used to separate and measure the components based on how a mixture's constituents interact with a stationary phase. High-performance liquid chromatography (HPLC) is one method that can be used to quantify and extract glucose from other sugars in a sample.[4].

We suggest a new, less expensive, and more straightforward approach of estimating glucose using a glucometer instead of these time-consuming, expensive, and skill-required methods. Glucometers are compact instruments for determining blood glucose levels. They work based on two well-established principles: electrochemical detection and enzymatic reaction.

II. METHODOLOGY

This methodology combines blood glucose meter calibration with estimating glucose content in a plant leaf extract but with some important modifications.

1. Glucometer Calibration

1.1. Follow the manufacturer's instructions for your specific glucometer model to perform calibration.

1.2. Use the commercially available 100 mg/dL glucose solution for calibration.

1.3. Record the displayed blood glucose reading from the glucometer.

1.4. Calculate the difference between the expected value (100 mg/dL) and the displayed reading. This value represents the calibration error of your glucometer for this specific test.

2. Plant Extract Preparation

2.1. Grind 1 gram of fresh leaves thoroughly using a mortar and pestle.

2.2. Mix 3 mL of 0.9% NaCl solution to the ground plant material.

2.3. Transfer the mixture to a centrifuge tube and centrifuge for 5 minutes at moderate speed (around 3000 rpm) to separate the liquid extract from the solid plant debris.

2.4. Carefully transfer the clear supernatant (liquid extract) to a clean centrifuge tube using a micropipette or by pouring slowly.

3. Glucose Conversion and Measurement (Estimation)

Important Note: This step aims to convert some of the starch present in the leaves to glucose using hydrochloric acid (HCl). However, the efficiency of this conversion and the presence of other sugars in the extract can significantly impact the accuracy of the glucose estimation.

3.1. Add 1 mL of N/10 HCl solution to the collected plant extract in the centrifuge tube.

3.2. **Safety Precaution:** Wear gloves and eye protection while handling hydrochloric acid.

3.3. Mix the solution gently and incubate it at room temperature for 10 minutes (or as recommended in plant starch hydrolysis protocols for your specific plant type). This step converts some of the starch to glucose.

3.4. **Neutralization:** After incubation, carefully neutralize the solution using a weak base like sodium bicarbonate (baking soda) until a neutral pH is reached (around pH 7). This step is crucial to avoid damaging the glucometer.

3.5. Dilute the neutralized extract with distilled water if necessary, following the recommendations in your glucometer's user manual for minimum sample volume.

3.6. Use the glucometer to measure the glucose concentration of the diluted plant extract according to the manufacturer's instructions.

4. Calculation and Interpretation

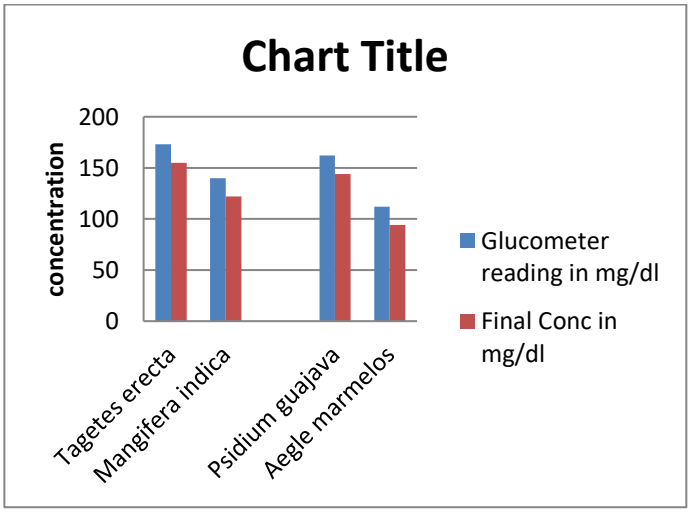
4.1. Since a glucometer is not designed for plant extracts, the displayed reading might not directly represent the leaf glucose concentration.

4.2. Consider the following points for interpretation: Subtract the calibration error (calculated in step 1.4) from the glucometer reading for the plant extract to get a potentially more accurate value. Remember that this method only estimates glucose content by converting some starch and might not account for other sugars present.

III. RESULTS

In this present work, we analyzed four plant leaf samples, which are reflected in the following table.(calibration error = -18)

No	Plant name	Glucometer reading in mg/dl (GR)	Final Conc (GR+CE)
1	*Tagetes erecta*	173	155
2	*Mangifera indica*	140	122
3	*Psidium guajava*	162	144
4	*Aegle marmelos*	112	94



Graph showing a concentration of the different sample

Estimating glucose content of *Tagetes erecta*

IV. CONCLUSION

In conclusion, this study established a new protocol for estimating plant glucose using a glucometer. The findings demonstrated that *Tagetes erecta* exhibited the highest glucose content among the tested plants, while *Aegle marmelos* displayed the lowest. This novel method offers a rapid and cost-effective approach for plant glucose estimation, potentially proving valuable in various fields, including plant physiology, agriculture, and ecological research. This study explored the feasibility of using a glucometer for rapid and economic estimation of plant glucose. The results confirmed that the developed protocol successfully measured glucose levels in various plant samples.

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