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GLUCOSE LEVELS ANALYSIS OF SEVERAL RICE TYPES (Oryza sativa L.) IN MAKASSAR

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ABSTRACT

The analysis of glucose content in several types of rice, which are marketed in Makassar by visible spectroscopy for sugar totally and reducing sugar by Luff Schoorl method, has been researched as a means to determine and compare glucose content in red rice, black rice, and herbal ponni rice. This research covered glucose extraction by blundering rice with 80% ethanol as a solvent by adding calcium carbonate and heating it to lose the ethanol content. The qualitative analysis was conducted by adding Mollisch reagent, a purple ring, and Benedict's reagent, which added a precipitate with a red colour. The results indicated a positive reaction to the analysis. The quantitative study was conducted by adding Anthrone's reagents, then analyzed by visible spectroscopy at 540 nm. The research showed that the sugar content in several black rice is 2,860 mg/g, red rice is 5,483 mg/g, and herbal ponni rice is 8,405 mg/g. The research results of the Luff Schrool method showed reduced sugar in several black rice 41.4006, red rice 36.539%, and herbal ponni rice 21.0707%.

Keywords: Rice; glucose; diabetes mellitus

1. INTRODUCTION

Food ingredients generally contain three main groups of chemical compounds: carbohydrates, proteins and fats. These foods come from plants, and their compounds are primarily carbohydrates. Carbohydrates are components in food that are the primary energy source for living organisms. Carbohydrates are classified into three groups, namely Monosaccharides, oligosaccharides, and polysaccharides. In food digestion, carbohydrates undergo hydrolysis in the mouth, stomach and intestines. This carbohydrate digestion process results in glucose, fructose, and galactose.

Normal human blood contains glucose in a fixed amount or concentration, between 70 - 100 mg per 100 ml of blood. This blood glucose can increase after we eat carbohydrate sources; if the carbohydrate source contains more glucose, then people tend to get diabetes mellitus,

where the amount of glucose is more significant than 130 mg per 100 ml of blood. In our diet, rice is mainly a source of carbohydrates; red rice, black rice, and herbal ponni rice are types of rice that diabetes mellitus sufferers specifically consume. International organizations such as WHO and the International Diabetes Federation (IDF) have made diabetes a global priority to achieve the Sustainable Development Goals (SDGs), especially in preventing non-communicable diseases, reducing poverty, and increasing access to health.

Diabetes mellitus is a global health issue that demands immediate attention. As one of the non-communicable diseases (NCDs), its impact is not only on individuals but also on society, the economy, and world development. This necessitates a cross-sectoral approach and global collaboration for its control and prevention. Based on the above, the problem arises whether some types of rice have different glucose levels, which can affect blood glucose levels. Therefore, glucose levels in several types of rice circulating in Makassar must be analyzed. This research is significant as it can provide valuable insights into the dietary choices of individuals with diabetes and contribute to the ongoing efforts to manage and prevent this global health issue.

This study was conducted to determine the glucose levels in several types of rice, namely red rice, black rice and herbal ponni rice. The research methods involved visible light spectrophotometry for total sugar and the Luff Schrool method for reducing sugar. These methods were chosen for their accuracy and reliability in determining the glucose content in food items. This research provides scientific data and information to the public, especially for diabetic diets. The findings suggest that consuming red rice, black rice, and Ponni herbal rice can significantly affect blood glucose levels. Therefore, individuals with diabetes should consider these findings when planning their meals.

2. METHODS

Sampling and Sample Preparation

Samples of several types of rice obtained at traditional markets in Makassar. For sample preparation, Red rice, Black rice and Ponni herbal rice (an imported brand) obtained from traditional markets are ground and ready to be extracted.

Sample Extraction

1. The sample was blended until crushed, weighed carefully as much as 25 grams, then added 25 ml of 80% ethanol, then blended again for 10 minutes.
2. All sample liquids were transferred quantitatively into a beaker and then filtered with cotton. The remaining solids were washed with 80% ethanol until all sugars were extracted.
3. The pH of the filtrate was measured, and then CaCO3 was added and heated in a water bath for 30 minutes. Then, it was filtered again using Whatman filter paper.
4. The filtrate was heated in a water bath to evaporate the ethanol at 85°C and then cooled.

5. If there is still sediment, the solution is added with saturated lead acetate and 1 gram of potassium oxalate, then stirred until smooth and filtered.
6. The filtrate is put into a 100 ml beaker, then distilled water is added to the limit, then 1 ml is pipetted and put into a 100 ml volumetric flask, then distilled water is added to the limit mark.

Analysis Methods

Qualitative analysis (Preparation of solution)

a. Making Mollisch Solution

Consists of 10% a - naphthol and H_2SO_4 p

Weigh 10 g of a-naphthol and put it into a 100 ml volumetric flask, then add 95% ethanol to the limit mark.

b. Making Benedict's Solution

Consisting of cupric sulfate, sodium carbonate, and sodium citrate. Dissolve 173 g of sodium citrate and 10 g of sodium carbonate in a 100 ml volumetric flask, then add 17.3 g of cupric sulfate and make up the volume to the mark.

Analysis with Mollisch reagent

1 ml of sample solution in a reaction tube is added with two drops of 10% a-naphthol reagent (freshly made). Carefully add 2 ml of $H2SO_4$, concentrated through the tube wall, forming a purple ring that positively contains carbohydrates.

Analysis with Benedict's reagent

1 ml of the sample solution in a test tube is added with 5 ml of Benedict's reagent, then heated in a water bath for 1 minute; a red precipitate occurs, which means it is positive for glucose.

Quantitative Analysis (Determination of total sugar using the anthrone method)

Making Solution

a. Preparation of standard glucose solution

1. Anhydrous glucose is weighed accurately at 100 mg, put into a 100 ml volumetric flask, and then dissolved with sufficient distilled water, and the volume is made up to the boundary mark. A total of 10 ml is pipetted, put into a 100 ml volumetric flask, and then diluted with distilled water to the boundary mark; this solution has a concentration of 100 ppm (stock solution).
2. To make concentrations of 10, 20, 30, 40, and 50 ppm, pipette 1, 2, 3, 4, and 5 ml of stock solution, put into a 10 ml volumetric flask and dilute with distilled water to the mark.

b. Making 0.1% Anthrone solution

Anthrone was weighed accurately at 100 mg, then 100 ml of concentrated H_2SO_4 was added in an Erlenmeyer flask and shaken until dissolved.

Determination of maximum wavelength

1. A standard glucose solution (stock solution) with a concentration of 30 ppm was prepared, 1 ml was pipetted into a test tube, and 5 ml of anthrone reagent was quickly added until a blue-green colour was formed.
2. It was heated in a water bath at 100 °C for 12 minutes, then cooled, and the absorbance was measured using visible light spectrophotometry at a wavelength of 400-800 nm.

Measurement of standard glucose solution

1. Prepare standard glucose solutions with 10, 20, 30, 40, and 50 ppm concentrations. Pipette 1 ml and put it into a test tube.
2. Quickly add 5 ml of Anthrone reagent into the test tube. Stir until a blue-green color forms.
3. Heated in a water bath at 100 °C for 12 minutes, then cooled.
4. Transferred into a cuvette, the absorbance was measured using visible light spectrophotometry at 540 nm.

Measurement of total sugar content in a sample

1. Pipette 1 ml of the sample solution made, then put it into a test tube.
2. Add 5 ml of anthrone reagent into each test tube and stir until a blue-green colour is formed. Parse in a water bath at 100 °C for 15 minutes, then cool.
3. Transferred into a cuvette, the absorbance was measured using visible light spectrophotometry at a maximum wavelength of 540 nm.
4. Determine the total sugar concentration in the sample

Data analysis

From the results of measuring the absorption of the standard solution with the maximum wavelength, a graph is made between the absorption and concentration for the sample, with the absorption values on the Y axis and the concentration on the X axis. A line is drawn between the points to obtain a straight-line equation.

$Y = a+bx$

where :

A = Constant

B = Slope

The values of a and b can be calculated using the formula

$$a = \frac{\Sigma Y - b(\Sigma)}{n} \qquad b = \frac{\eta(\Sigma XY) - (\Sigma X)(\Sigma Y)}{\eta(\Sigma X^2) - (\Sigma X^2)}$$

The sample concentration is calculated from the linear regression line equation by plotting the absorption results against the regression line equation.

Determination of reducing sugar using the Luff Schoorl method

Preparation of H_2SO_4 Solution, 25%

Measured H_2SO_4, 26 ml concentration, put into a 100 ml volumetric flask. The volume is carefully filled with distilled water through the wall of the flask to the boundary mark.

Preparation of Potassium Iodide Solution

Dissolve 20 grams of potassium iodide in a 100 ml volumetric flask with distilled water.

Making Luff Schoorl Solution

1. Anhydrous sodium carbonate was weighed accurately at 143.8 g, put into an Erlenmeyer flask and dissolved in 300 ml of distilled water while stirring.
2. Add 50 grams of citric acid dissolved in 50 ml of distilled water.
3. Add 25 grams of copper sulfate dissolved in 100 ml of distilled water.
4. The solution is transferred into a 1-litre volumetric flask, and the volume is shaken and made up to the mark with distilled water.
5. Leave overnight and strain if necessary.

Preparation of 0.1 N Sodium Thiosulfate Standard Solution

1. Sodium thiosulfate was weighed accurately at 26 grams and 200 mg of sodium carbonate.
2. Dissolved with carbon dioxide-free distilled water in a 1000 ml volumetric flask.

Standardization of 0.1 N Sodium Thiosulfate Standard Solution

1. Weigh 210 mg of potassium bichromate p accurately and dissolve it in 100 ml of water in a 500 ml glass-stoppered volumetric flask. Shake until dissolved.
2. Quickly add 3 grams of potassium iodide p, 2 grams of sodium bicarbonate p and 5 ml of hydrochloric acid p. Stopper the flask, shake to mix, and leave in a dark place for 10 minutes.
3. Titration with sodium thiosulfate solution using starch solution indicator p. The normality of the solution is calculated.

Making 0.5% Amylum Solution

1. Weigh 500 mg of starch, then suspend with 5 ml of distilled water.
2. Put it into boiling water little by little while stirring, then ensure the volume is up to 100 ml.

Determination of Reducing sugar in samples

1. Pipette 10 ml of sample solution into a 250 ml Erlenmeyer flask, add 15 ml of distilled water, 25 ml of Luff Schoorl solution and several boiling stones.
2. Heat continuously for 10 minutes, then remove and immediately cool in a tub of ice.
3. After cooling, add 10 ml of 20% KI solution and 25 ml of 25% sulfuric acid solution.
4. Titrated with 0.1 N sodium thiosulfate solution with 0.5% starch solution as an indicator.
5. A blank determination was made with 15 ml of distilled water and 25 ml of Luff Schoorl solution.

Determination of Reducing Sugar Content in Samples

The reduced sugar content in several materials can be found using the Luff Schoorl table by knowing the difference between the blank titration and the sample titration.

3. RESULTS AND DISCUSSION

The results of the analysis of glucose levels in black rice, red rice, and Ponni herbal rice are as follows:

1. Qualitative analysis using Mollisch and Benedict's reagents produced positive results because a purple ring and brick-red precipitate were formed.
2. Quantitative analysis using visible light spectrophotometry method using Anthrone reagent at a wavelength of 540 nm obtained the average total sugar content at:

   a. Black rice is 2,860 mg/g.

   b. Brown rice is 5,483 mg/g.

   c. Ponni herbal rice is 8.405 mg/g.

3. Quantitative analysis using the Luff Schoorl method obtained the average reducing sugar content in:

   a Black rice is 41.4006%

   b. Brown rice is 36.539%

   c Ponni herbal rice is 21.0707%

Polysaccharides undergo a hydrolysis process into disaccharides to produce monosaccharides. This hydrolysis process can occur with heating or with the addition of reagents. After the qualitative analysis is carried out, namely the Mollisch test, where carbohydrates will undergo hydrolysis into monosaccharides by concentrated sulfuric acid and then undergo dehydration into furfural or hydroxy methyl furfural, which will condense with alpha naphthol to form a purple complex compound. While in the Benedict test, reducing sugar with Benedict solution will undergo oxidation-reduction. The presence of aldehyde groups in carbohydrate molecules can reduce copper (II) ions (cupric) into copper (1) ions (cuprous), which then precipitate as cuprous oxide.

From the quantitative analysis that has been done by the visible light spectrophotometry method for total sugar, namely the anthrone test, in principle the same as the mollisch test, the furfural compound formed with the anthrone reagent will form a complex compound that is blue-green. So, from the analysis, the average total sugar content in black rice is 2.860 mg/g, red rice 5.483 mg/g, and Ponni herbal rice 8.405 mg/g. This shows that the highest content is Ponni herbal rice, and the lowest content is black rice.

The Luff Schrool method is used for reducing sugars, which in principle is the same as the Benedict test, where the amount of sediment... cuprous oxide is equivalent to the amount of reducing sugar present. Thus, black rice's average reduced sugar content is 41.4006%, red rice 36.539%, and Ponni herbal rice 21.0707%. This shows that the highest content is in black rice, and the lowest is in Ponni herbal rice.

From the results obtained, the average total sugar content shows that Ponni herbal rice has the highest content, where this rice is rice that is consumed explicitly by people with diabetes mellitus (DM); this is because this rice contains more fibre than starch so fibre can also be hydrolyzed, where this total sugar method, not only calculates monosaccharides but disaccharides can also be calculated So that the results obtained are pretty significant than the other two races, namely red rice and black rice.

Compared to when we use the Luff Schrool method, namely the determination of reducing sugar, the results obtained are that the lowest average reducing sugar content is Ponni herbal rice and the highest is black rice, the determination of this reducing sugar, in principle reducing sugar has aldehyde and ketone groups (glucose, fructose), where it can bind heavy metals (copper) in the reagent.

Diabetes Mellitus is considered a global health issue because of its widespread and multifaceted impact on individuals, communities, and health systems worldwide. Globally, the number of cases of Diabetes Mellitus in 2021, approximately 536.6 million people (10.5% of the adult population) worldwide had diabetes mellitus. This number is expected to increase to 783.2 million in 2045 (12.2% of global prevalence). Global diabetes-related health expenditure reached USD 966 billion in 2021 and is projected to increase to USD 1,054 billion in 2045.

Indonesia is ranked 7th in the country with the highest number of Diabetes Mellitus sufferers, with 19.5 million cases in 2021, or 10.8% of the adult population. Recent data shows an increase in Diabetes Mellitus cases in South Sulawesi. Makassar City reported 11,619 cases in 2022, making it the area with the highest number of cases in the province. Makassar City is most prevalent in South Sulawesi, driven by a high-sugar diet and lack of physical activity.

Diabetes mellitus has a major impact on global health, including significant cost burden, high morbidity, and chronic complications such as kidney failure, cardiovascular disease, and stroke. Global efforts in integrating diabetes issues include: 1) Prevention through promoting healthy eating patterns, obesity control, and physical activity; 2) Screening and Early Diagnosis to reduce complications through global programs such as those supported by WHO and the International Diabetes Federation; and 3) Disease management can be achieved by expanding access to essential medicines and patient education.

4. CONCLUSION

Glucose levels vary between types of rice circulating in the city of Makassar, for example, some of those used as samples: a) Black rice, red rice, and ponni herbal rice contain glucose; b) The highest total sugar content is found in Ponni herbal rice, 8.405 mg/g; c) Red rice is 5.483 mg/g, and the lowest in black rice is 2.860 mg/g; and d) The highest reducing sugar content is found in black rice 41.4006%, red rice 36.539%, and the lowest in Ponni herbal rice 21.0707%. Certain varieties have lower glucose levels, suitable for people with diabetes mellitus. This research provides important data for consumers. Global efforts in integrating diabetes issues include prevention, screening, early diagnosis, and disease management. These steps are designed to reduce the burden of diabetes mellitus nationally and globally.

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