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EFFECT OF VARIATIONS IN HYDROLYSIS TIME ON CARBOHYDRATE LEVELS OF WHITE RICE FLOUR (Oryza sativa L.) USE OF THE SCHOORL LUFF METHOD

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ABSTRACT

For humans, carbohydrates are a crucial nutrient that the body uses to produce energy. Additionally, carbohydrates aid in the body's digestion of extra protein. White rice flour (Oryza sativa L.) is a common energy source in the community with a high carbohydrate content. This research was done to find out how different hydrolysis times affected the amount of carbohydrates in white rice flour (Oryza sativa L.). The Schoorl Luff method is used to determine the carbohydrate content of commercial white rice flour. HCl 1 N was used as a catalyst to hydrolyze white rice flour, with different hydrolysis periods of 60 minutes, 90 minutes, 120 minutes, 150 minutes, and 180 minutes. A schoorl luff, a source of Cu2+, was used to assess the hydrolysis results and titrated iodometrically. With a time of 180 minutes and a weight-to-water ratio of 63.99%, the findings of determining the ideal carbohydrate content in commercial white rice flour were obtained.

Keywords: Time variation, hydrolysis, White Rice Flour, Luff Schoorl, Carbohydrates

ABSTRAK

Karbohidrat merupakan zat gizi yang sangat penting bagi manusia yang berfungsi untuk menghasilkan energi bagi tubuh. Karbohidrat juga membantu pemecahan protein yang berlebihan dalam tubuh. Tepung beras putih (Oryza sativa L.) adalah sumber energi yang memiliki karbohidrat tinggi dan banyak dimanfaatkan oleh masyarakat. Penelitian ini dilakukan untuk mengetahui pengaruh variasi waktu hidrolisis terhadap kadar karbohidrat tepung beras putih (Oryza sativa L.). Untuk penentuan kadar karbohidrat pada tepung beras putih komersial dilakukan dengan menggunakan metode luff schoorl. Tepung beras putih dihidrolisis menggunakan HCl 1 N sebagai katalisator dengan variasi waktu hidrolisis 60 menit, 90 menit, 120 menit, 150 menit, dan 180 menit. Hasil hidrolisis dianalisis dengan luff schoorl yang merupakan sumber Cu^{2+} dan dititrasi secara iodometri. Hasil penentuan kadar karbohidrat yang optimum pada tepung beras putih komersial diperoleh dengan waktu 180 menit sebesar 63,99 % b/b.

Kata Kunci: *Tepung Beras Putih., Karbohidrat, Luff Schoorl, Variasi Waktu, Hidrolisis*

INTRODUCTION

One kind of plant that is simple to locate is the rice plant (Oryza sativa L.). Most Indonesians consider rice to be a staple diet. The plant genus Oryza L., which contains about 25

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species and is found in tropical and subtropical areas including Asia, Africa, America, and Australia, is where rice is found. Rice plants are a type of transient crop. It only generates once and typically lasts for less than a year[1,2]. Rice is a high-carbohydrate food that provides energy. There are different types of rice, including white rice (Oryza sativa L.), that are grown in Indonesia. brown rice, and (Oryza nivara). The majority of Indonesians eat white rice (Oryza sativa L.) on a regular basis[3]. In addition to being a common item in the diets of the majority of Indonesians, processed flour made from rice is frequently used as a raw material in industrial products like vermicelli and noodles, a variety of pastries, biscuits, baby food, and so forth. The Republic of Indonesia's Ministry of Health's Directorate of Public Nutrition estimates that rice flour has 80 grams of carbohydrates for every 100 grams[4].

By using the iodometric approach, carbohydrate levels can be determined. The iodometric method is a widely used technique that makes use of reagents that will react with monosaccharide compounds and reducing sugars in accordance with the iodometric principle. When white rice flour was hydrolyzed, the levels were determined iodometrically using a Schoorl luff reagent with changes in the hydrolysis time. Utilizing HCl 1 N, the hydrolysis times are 60 minutes, 90 minutes, 120 minutes, 150 minutes, and 180 minutes.

Method

Material

Chemical Research Methods

Commercial White Rice Flour (Oryza sativa L.) in Bukittinggi City, West Sumatra Province, with the following ingredients: $CuSO_4.5H_2O$, Na_2CO_3, HCl, NaOH, $K_2Cr_2O_7$, H_2SO_4, $NaHCO_3$, $Na_2S_2O_3$, KI, $C_6H_8O_7.H_2O$ water, alcohol, and amylum.

Equipment

Reflux (Condesor, flask, water bath), standard and burette clamps, erlenmeyer, measuring flask, becker glass, funnel, measuring cup, universal pH, stirring rod, evaporating saucer, volume pipette, analytical scales, digital scales, and scales with a digital readout.

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Method Of Research

Manufacture Of Reagents

Luff Schoorl Solution

25 grams were dissolved in 10 milliliters of aqua dest for solution A, 12.5 grams in 25 milliliters of aqua dest for solution B, and 71.9 grams in 200 milliliters of aqua dest boiling for solution C. A 500 ml measuring flask is used to combine the cooled solutions A and B. Solution C is then gradually added, along with enough water to fill the flask to the 500 ml mark, and the mixture is allowed to stand overnight before being filtered[5].

HCl 1 N

A little amount of aqua dest is poured to a 1000 ml beaker glass, followed by 54 ml of HCl p supplied through the beaker glass wall, and then aqua dest is gradually added until 650 ml is reached[6].

NaOH 40%

40 g of NaOH are dissolved in 100 ml of water[5].

KI 15%

300 cc of aqua dest was used to dissolve 45 g of KI[5].

H_2SO_4 *25%*

A little amount of aqua dest is added to the 500 ml Erlenmeyer, followed by the addition of 132 ml of H_2SO_4 through the wall. The aqua dest is then added gradually up to the limit mark[6].

$Na_2S_2O_3$*0,1 N*

Dissolved up to 500 ml of CO2-free water with 13 g of p and 100 mg of sodium carbonate [6].

Amylum indication

One gram of weighed amylum manihot is gradually added to 100 ml of aqua dest, boiled for a short time, and then cooled[5].

non-CO_2 water

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Then, secure the cover after adding 500 ml of aqua dest to the Erlenmeyer. Once boiling, remove the top and continue heating until the CO2 is gone. Then, shut the erlenmeyer once more[5].

Sulfating Sodium Thiosulfate

700 mg of $K_2Cr_2O_7$ P were carefully weighed and then dispersed in 100 ml of water in a measuring flask. After shaking until the P was completely dissolved, the flask was filled with 10 ml of the solution $K_2Cr_2O_7$, which was then swiftly filled with 1 g of KI P, 0.7 g of $NaHCO_3$ P, and 5 ml of HCl P. Close the erlenmeyer, shake to combine, and then set in a dim area for 10 minutes. Titrate with a 0.1 N solution until the color turns pale yellow, then add 3 drops of Amylum indicator. Titrate slowly to prevent the blue color from vanishing and the green solution color from developing. Perform 3 times. Note the $Na_2S_2O_3$ 0.1 N solution that was used[5].

4.904 mg $K_2Cr_2O_7$are contained in 1 ml of sodium thiosulfate at 0.1 N [6]

Titration Of A Blank

Put 25 ml of water into the Erlenmeyer, then thoroughly added 25 ml of Luff-Schoorl solution, H_2SO_4 25% 25 ml of 25 ml, and 15 ml of KI 15% while the Erlenmeyer was gently shaken. Titrated with $Na_2S_2O_3$ 0.1 N until a pale yellow color, then added 2 ml of Amylum indicators, and the titration was continued slowly stop until the dark blue color was blackish and the solution changed color to The operation is carried out three times[5].

Determination of carbohydrate levels

5 pieces of weighed samples of 3 grams each were put into erlenmeyer added with 120 ml of HCl 1 N refluxed for 60 minutes, 90 minutes, 120 minutes, 150 minutes, and 180 minutes. Then it is cooled, after which it is neutralized to a pH of 7 with 40% NaOH then diluted into a measuring flask of 1000 ml. Take 25 ml of diluted sample put in erlemeyer and add 25 ml of luff schoorl, heat for 10 minutes. Cooled, then addH_2SO_4 25% by 25 ml. Added again KI 15% as much as 15 ml. Titration with a solution of$Na_2S_2O_3$ 0.1 N until a pale yellow color, then add 2 ml of amylum indicator and the titration is continued slowly stop until it is blackish blue and until the titration solution is colored milky white solution, record the $Na_2S_2O_3$ 0.1 N solution used. Do 3 repetitions[5].

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Data analysis

Levels of Glucose = $\frac{w1 \times fp}{w} \times 100\ \%$

Carbohydrate levels = 0,90 × Levels of Glucose

Information :

fp = dilution factor

w = sample weight (mg)

w1 = glucose contained for each ml

Volume $Na_2S_2O_3$ (Vol. $Na_2S_2O_3$blanko – Vol. $Na_2S_2O_3$ sample) x N. $Na_2S_2O_3$ X 10

Results

White rice flour contains polysaccharides as its source of carbohydrates. Since polysaccharides cannot be titrated with $Na_2S_2O_3$ directly, they must first be converted into monosaccharides, which are simpler molecules. A hydrolysis procedure is used to convert polysaccharides into monosaccharides. Compounds from polysaccharides are broken down into monosaccharides during the hydrolysis process. In a chemical reaction known as hydrolysis, water molecules (H_2O) are broken down into hydrogen cations (H^+) and hydroxide anions (OH^-)[7].

Table 1. White rice flour's quality test results

White rice flour	Iodine test reagents	Schoorl luff reagent
preceding hydrolysis	Blue-black	No discoloration occurs
After hydrolysis	Colorless	Red brick

Table 2. Titration of samples of white rice flour

Titration	bookkeeping	Blank Titration	Titration level determination
Preceding titration	Brownish-red	Brown	Brown
After titration	Greenish-blue	Milky white	Milky white

The best concentration for hydrolyzing, HCl 1 N, is used to hydrolyze white rice flour[5]. A reflux apparatus is used to hydrolyze white rice flour. Refluking is a distillation process that includes condensing reversed vapors from the condensate back into the original system[8]. There are five different hydrolysis times used when processing white rice flour: 60 minutes, 90 minutes, 120 minutes, 150 minutes, and 180 minutes. Finding the ideal hydrolysis time for the best carbohydrate content in white rice flour is the goal of the hydrolysis time variation. The ideal time to hydrolyze polysaccharide compounds into reducing sugar compounds and monosaccharides in order to achieve the maximum carbohydrate content in white rice flour is

180 minutes. The monosaccharides will become damaged if the time is longer than the recommended time[9]. The hydrolysis reaction is influenced by the presence of acid, temperature and content in the white rice flour itself. Acid solvents function to accelerate the course of a reaction (as a catalyst), the higher the concentration of acid, the faster the hydrolysis process so that the glucose obtained will be higher and the reaction is also accelerated with the help of heating during hydrolysis [9]. Monosaccharides from the results of hydrolysis are cooled, then neutralized with NaOH. Determination of carbohydrate levels is carried out at neutral pH conditions.

After the sample is hydrolyzed into a monosaccharide form, then it can be reacted with luff schoorl reagent with the principle of redox reaction. A 0.1 N solution is a secondary raw solution that is standardized as the primary standard. is a primary raw compound that does not need to be standardized again with other states, because it has the properties of pure, stable, non-hygroscopic, dry and easily soluble in water[6]. In the manufacture of $Na_2S_2O_3$ 0.1 N solution sodium carbonate is added with the aim of being a preservative[5]. In the process of making luff schoorl reagent sodium carbonate is inserted slowly so that it does not spill the reagent in the measuring flask because at the time of administration it will release CO_2 gas bubbles[5].

On the coupling $Na_2S_2O_3$ with a redox reaction occurs. $K_2Cr_2O_7$ added concentrated hydrochloric acid, sodium carbonate and potassium iodide. The KI added in the bookkeeping must be exaggerated in order to be fully formed. Then allowed to stand for 10 minutes in a dark place aims to perfect the reaction of free iodine formation, and then titrated with 0.1 N until a green color is formed.

Chemical Reactions of Baking

$Na_2S_2O_3$ with $K_2Cr_2O_7$:

$$K_2Cr_2O_7 + 6\ KI + 14\ HCl \longrightarrow 8\ KCl + 2\ CrCl_3 + 3\ I_2 + 7\ H_2O$$

$$I_{2(berlebih)} + 2\ Na_2S_2O_3 \longrightarrow Na_2S_4O_6 + 2\ NaI$$ [10].

Blank titration is titration using a solution that does not contain analytes. Blank solution is usually used as a comparison solution in the analysis. The process of working on the blank titration is the same as the carbohydrate analysis with the distinction not containing the results of carbohydrate hydrolysis[11]. The analysis of determining the level began using the results of hydrolysis of white rice flour that had been neutrally diluted with aquadest. The results of the hydrolysis were added with luff schoorl reagent and then heated for 10 minutes, 10 minutes of

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heating so that the reduction process runs perfectly so that a brick-red precipitate color is formed because luff schoorl reduces ions to indicate the presence of carbohydrates in white rice flour. As the reaction below :

$$\text{R-COH} + 2\ \text{CuO}_{\text{Excess}} \longrightarrow \text{R-COOH} + \text{Cu}_2\text{O}\ (\downarrow\text{brick red precipitate}) + \text{CuO}\ r_{\text{emnant}}\ [12].$$

Inside the brick-red deposit there is a residual CuO marked by the presence of blue luff schoorl to be titration. Then add and KI with the following reaction:

$$\text{Cuo} + \text{H}_2\text{SO}_4 \longrightarrow \text{CuSO}_4 + \text{H}_2\text{O}$$

$$\text{CuSO}_4 + \text{KI} \longrightarrow \text{CuI} + \text{K}_2\text{SO}_4$$

$$2\text{CuI}_2 \longrightarrow \text{Cu}_2\text{I}_2 + \text{I}_2$$

These free tri-iodide ions will then be titrated with a standard solution of Na2S2O3 with the reaction:

$$\text{I}_3^- + 2\text{S}_2\text{O}_3^- \longrightarrow \text{I}^- + 2\text{S}_4\text{O}_6^{-2}$$

By adding 0.1 N excess to the solution of tri-iodide ions is reduced to colorless iodide ions, so that the precipitate is milky white. The addition of the amylum inidicator is carried out at the moment of approaching the equivalence point until the blackish-blue color.

From the research conducted, the optimum time of hydrolysis for 180 minutes was 63.99% w/w using HCl solvent 1 N.

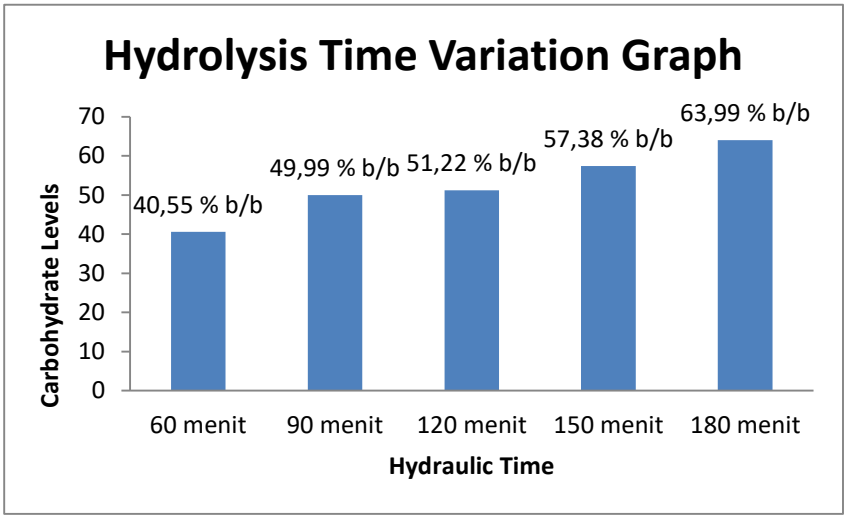

Figure 1. Hydrolysis Time Variation Graph

According to the image above, the amount of carbohydrates obtained increases with a longer hydrolysis time. The monosaccharides will develop improperly if it is less than the ideal time, though. The monosaccharides produced will be harmed if the time is longer than the ideal time. This is so that the produced monosaccharides can be changed by the process into other substances[10].

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Conclusion

The longer the hydrolysis time, the more carbohydrate content was achieved, according to a study on the impact of hydrolysis time changes on the carbohydrate content of white rice flour (Oryza sativa L.) produced commercially using the Schoorl luff process. Using an optimization time of, the amount of carbohydrates in commercial white rice flour (Oryza sativa L.)

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