Classification of dextrose equivalent analysis maltodextrin starch seeds through enzymatic hydrolysis reaction

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Abstract. Maltodextrin is produced by hydrolysis process using enzyme catalyst. This enzyme catalyst is used because it is able to catalyze the process of starch hydrolysis to produce simpler molecules such as glucose, maltose, and dextrin. Maltodextrin is an imperfect starch composed of a simple, low-calorie mixture of sugars. The hydrolysis process takes place by varying the enzyme concentrations of 10%, 15% and 20% and varying the time 60 minutes, 90 minutes, 120 minutes. The optimum condition obtained in the process of hydrolysis of starch to maltodextrin in this research is at hydrolysis time of 120 minutes with enzyme concentration 20% yield equivalent of 13.4% dextrose, water content 4.3% and pH 5.

1. Introduction

Diabetes is the sixth deadliest disease in the world, and it is called a deadly disease because it attacks all the organs of the body and causes complaints [1]. Therefore, to prevent the number of diabetics continue to increase, then sought alternative source of substitute raw materials of other sucrose sugar derived from the plant part of the jackfruit seeds that can produce sugar and will be processed so that become one of modified starch product that is maltodextrin [2]. Maltodextrin can be obtained through the process of starch hydrolysis, this process is the reaction of breaking the starch structure into simpler sugars [3].

Maltodextrin is an enzymatic degradation product of starch glucoside bonds characterized by a dextrose equivalent (DE) value of less than 20, thereby enhancing the quality of the dried product, reducing adhesiveness and enhancing product stability [4,5]. Maltodextrin with lower average molecular weights indicate a higher DE value [6].

The natural (unmodified) starch has some disadvantages to its characteristic that it takes a long time in cooking (requires high energy), the pasta is hard and not clear, besides it is too sticky and doesn’t tolerate the treatment with acid so limited its use in the industry [7]. Therefore, efforts to improve the quality of natural starch need to be done, one of them by natural starch is hydrolysis by enzyme α-amylase so it has the desired properties that are expected to can meet market needs (industry) both in national and international scale (export). Basically the process of starch hydrolysis using a catalyst is acidic catalyst and enzyme catalyst [8]. Amylase enzyme is an enzyme capable of catalyzing the process of starch hydrolysis to produce simpler molecule such as glucose, maltose, and dextrin. The use of amylase increases every year. The demand for amylase enzyme has reached at least 25% of the total enzyme requirement [8].
[7] Characteristics of maltodextrin of jackfruit seed with α-amylase enzyme hydrolysis characteristic testing of jackfruit seed starch produced by white jackfruit starch has a low yield, ie 12.9%, 2.04% water solubility and 5 moisture contents, 3%. Characteristics of jackfruit maltodextrin produced were brownish yellow, had a 64% rendment, water content of 3.07%, pH 6, dextrose equivalent (DE) 15.44 and water solubility increased to 95.5%. The resulting characteristics were not met the SNI standard7599: 2010.

2. Research Methodology
The process of manufacturing maltodextrin is divided into several stages, namely:

2.1 Tools and Materials
Equipment used is two-neck flask, erlenmeyer, stirring motor, stirring rod, beaker glass, 100 ml measuring cup, stirring motor adapter, bath, filter cloth / filter paper, grinding machine, oven, blender. While the equipment used for the analysis phase is a burette, reactor thermometer and dropper drops. The material used for the manufacture of maltodextrin is jackfruit seed, enzyme α-amylase, aquadest, CaCl2.H2O, fehling A and fehling B, glucose, HCl and NaOH solution.

2.2 Insulation of Jackfruit Seed Starch
Jackfruit seeds used for the manufacturing process of maltodextrin obtained after skin peeling, refinement, filtration, and drying which then made the process of hydrolysis of starch into maltodextrin.

2.3 The Process of Starch Hydrolysis Into Maltodextrin
Consider starch with concentration according to process variable, then dissolve starch in aquadest. Then add 0.04 gram CaCl.H2O, the suspension is added 0.1 N NaOH to pH 6 (pH optimum enzyme α-amylase). Furthermore, the suspension plus enzyme amylase (according to ratio) in the form of liquid and stir at a speed of 200 rpm for a certain time (according to process variables), the hydrolysis process lasted for 90°C. The suspension has been hydrolyzed, then the enzyme is inactivated by cooling in the temperature range 30°C lowered its pH with added HCl 0.1 N in the range of 3, and silenced for 30 minutes. Maltodextrin added 0.1 N NaOH to its pH to 6, then maltodextrin filtered to separate the precipitate. Then the precipitate was dried at 50°C for 3 days. The drying result is crushed into amaltodextrin powder.

3. Results and Discussion
Carbohydrates are polysaccharide compounds prepared by saccharide monomers connected by 1.4 glycoside bonds. The formation of simple sugars in dextrin is actually not expected because it affects the higher DE values, which is very difficult to avoid.

Dextrose equivalent are a measure of the quality of the starch hydrolysis product which expresses the ratio of the amount of reducing sugar to its dry weight. Dextrose equivalent (DE) is a quantity stating the total value of a reducer of starch or a starch modified product in percent units. If the price of DE is high then the price of hygrokopsis, plasticity, sweetness and solubility is also high, besides starch will be easier to experience the process of browning.

The process of hydrolysis of starch can be done by using two methods: hydrolysis by using enzyme catalyst and acid catalyst. In the process of hydrolysis of jackfruit seed starch is used enzyme catalyst, enzyme used is enzyme α-amylase which can function in starch degradation process. Commercially, the use of modified starch is affected by the value of DE.
Based on the result of Dextrose equivalent (DE) value analysis showed that there is difference of hydrolysis time effect to dextrose equivalent value presented in figure 1. Figure 1 shows hydrolysis time gives effect to DE value of maltodextrin produced. The longer the hydrolysis time the value of DE maltodextrin will increase.

![Figure 1. Effect of hydrolysis time on DE Maltodextrin](image)

Increasing the value of DE is due to the longer reaction time, the more substrate is hydrolyzed so that the number of short polymers that are formed will be more. The more polymers to be formed, the value of dextrose equivalent (DE) maltodextrin will also increase. The results of this research obtained the best maltodextrin characteristic that is at 120 minutes resulted the highest DE value that is 13.4, water content 4.3%, pH 5.

The result of dextrose equivalent analysis can be seen in figure 2, with the marked change of color on the result of the analysis, the resulting maltodextrin contains sugar content. The result of the DE analysis is reddish brown. This proves that the resulting maltodextrin product contains value of dextrose equivalent (reducing sugar). Dextrose equivalent obtained states that the resulting maltodextrin belongs to the category of quality requirement maltodextrin according to SNI 7599:2010, namely the requirement I reducing sugar content of 11.0 s.d 15.0 which can be used in the food, beverage and pharmaceutical industries.
Figure 2. Color change process on the result of dextrose equivalent Analysis

4. Conclusion

Based on the results of research that had been done, the length of hydrolysis time in the process of making maltodextrin was effect on its characteristics, especially on its value of DE. Preparation of maltodextrin with jackfruit seed raw material carried out by enzymatic hydrolysis process has met the requirements of standard I, so it can be used as an additive in foods, beverages and pharmaceuticals. The best results obtained from this study at 120 minutes yielded maltodextrin characteristics with a brownish color of DE 13.4, moisture content of 4.3% and pH 5.

Acknowledgments

The author would like to thank for the Ministries of research and higher education (KEMENRISTEKDIKTI) who has funded this research in full, thanks also to the staff of the Lhokseumawe State Polytechnic laboratory who has facilitated the implementation of this research. And thanks to all those who have helped and supported us we would like to say thank you very much.

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