

Glucose syrup from yam starch using rice malt as the source of enzymes

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Abstract

Studies were conducted on the enzymatic hydrolysis of yam starch by the use of enzymes from rice malt of high diastatic activity. Yam starch was isolated from *Dioscorea rotundata* ('Doko bayere') with a percentage starch content of 15.24%. The syrup produced had a dextrose equivalent (D.E.), Brix, total solids, and pH of 38.04%, 70.5, 78.58% and 4.1 respectively. The chemical characteristics of the yam glucose syrup compares favourably with those of commercial syrup. Yam starch can be processed into glucose syrup using enzymes from rice malt.

Keywords: Yam, starch, syrup, rice malt, enzymes.

Introduction

Glucose syrups are essentially industrial sugars used in the manufacture of food products, pharmaceuticals but are mainly consumed in the confectionery industry (Bello-Pérez *et al.*, 2002; Akinola and Ayanlele, 2004). Glucose syrup can be obtained by treating starch with hydrolytic enzymes during which glucosidic bonds are broken (Guzman-Maldonado and Paredes-Lopez, 1995).

According to Raemackers (2001), yam has a starch content of 15-23%. In many tropical countries, yam is produced in large quantities but has a narrow range of utilization and is plagued with high incidence of postharvest losses and limited market expansion (ICRA, 1996; Onwueme, 1987). Product diversification of yam tubers through efficient use will therefore help curtail many of these challenges.

Thus, this study attempts to produce glucose syrup from yam starch using enzymes from rice malt. Enzyme conversion of yam starch to glucose syrup can lead to efficient utilization of yam. The glucose syrup can therefore serve as a complete or partial substitute for sugar in the food and pharmaceutical industries.

Materials and methods

Raw materials

Paddy rice (*Jasmine 85 variety*) was obtained from the Crop Research Institute (CRI), Fumesua, Kumasi and fresh yam tubers (*Dioscorea rotundata*) were purchased from the Kumasi Central Market, Ghana.

Rice malt production

Five hundred grams of the rice seeds was steeped for 3 days at $30 \pm 1^\circ\text{C}$ in a micro malting chamber. Grains were air rested for 6 hours. Grains were then germinated for 8 days at a temperature of $30 \pm 1^\circ\text{C}$ in a micro malting chamber. Kilning of rice seedlings was done in the sun at $36 \pm 2^\circ\text{C}$ for 2 days. Dried malt was then milled using the plate attrition mill.

Glucose syrup production

Extraction of starch for the glucose syrup production was done using the wet method as described by Barimah and Mantey (2002). The starch obtained was dried with a solar drier tent for 3 days. The final weight of the starch was measured and used to calculate the percentage starch content of the yam used.

One hundred grams (100g) of the dried yam starch was mixed with 500 ml distilled water to form slurry. The slurry was gelatinized at a temperature of 80-85°C for 20 minutes and cooled to 60-65°C. Eight grams (8g) of the rice malt was added to the gelatinized starch and stirred for 10 min in the liquefaction phase. A second batch of 8g rice malt and 100g yam starch was prepared and added to the first batch. The mixture was stirred and allowed to stand for 3 hours. The temperature of the mixture was lowered to 55°C followed by the addition of 16g of the rice malt for the saccharification phase which proceeded for 4 hours. The liquid was then heated for about 20-30 minutes at 80-85°C to inactivate the enzymes from the malt, filtered and heated again to evaporate water and produce syrup. The syrup was packaged in a glass bottle.

Analyses conducted

Analyses conducted on the syrup included yield, dextrose equivalent, pH, moisture content and total solids and Brix at 25°C. The pH was measured with pH meter (BECKMAN 340, 5894, U.S.A).

The refractometer (Master Refractometer, ATAGO, 781-741-8778, Japan) reading was expressed in degree Brix at 25°C. The moisture content and total solids were determined according to AOAC (1990) methods.

Determination of dextrose equivalent (DE)

Ten (10) ml of the dextrose solution was taken and diluted to 100ml with distilled water. 10ml of the final solution was taken again and diluted to 50ml with distilled water. 100ml of 0.1M Iodide (I₂) solution and 10ml of the 0.47M Na₂CO₃ was added. The solution was then allowed to stand in the dark for 20 minutes. After 20 minutes, 15ml of the 1.02M H₂SO₄ was added. The excess iodide was then titrated with 0.5M Na₂S₂O₃. The average titre values were then used to calculate the dextrose equivalent.

Results and discussion

The starch yield of yam and moisture content of starch were 15.24% and 21.41% respectively. These values are within the range reported by Raemackers (2001) and Dziedzoave *et al.* (2003). The pH (4.1) of the yam glucose syrup was lower than that reported by Dziedzoave *et al.* (2003) which was between 5.5-5.6. This could be attributed to fermentation that might have occurred during cooling and filtration of the final syrup. The dextrose equivalent of the yam glucose syrup obtained was 38.04%, higher than the minimum recommended standard for glucose syrup (> 20%) (Pancoast and Junk, 1980).

Comparing the yam glucose syrup (YGS) to the commercial glucose syrup (CGG), all the parameters measured were lower in YGS than in CGS (Table 1). This may be attributed to the differences in the production processes (Grace, 1977) as well as the raw material - yam starch and corn starch (www.most.gov.mm) respectively. However, the YGS can be used in products that require low sugar such as canned fruit preserves, ice cream, bakery products, jam, soft drinks, candy and all kinds of confectionery. Large quantities are also used as a booster in the fermentation of alcohol (www.starch.dk).

Table 1. Comparison of Yam Glucose Syrup and Commercial Glucose Syrup

Properties	Yam glucose syrup	Commercial glucose syrup (Glaxo)*
pH	4.1	6.7
DE (%)	38.04	48
Total solids (%)	78.58	79
Brix (°)	70.5	78

*Akinola and Ayanleye (2004)

Conclusion

It can be concluded from this study that potential exists for the preparation of glucose syrup from yam starch using rice malt.