

Effects of Variations of Sorghum malt/ Sweet Potato flour ratio on the Quality of Glucose Syrup produced through Enzyme Conversion activity of Sorghum Malt.

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Abstract

The chemical parameters of glucose syrup produced from five different weight ratios of sorghum malt and sweet potato flour using sorghum malt as a source of enzyme conversion were studied. There were variations in the chemical parameters of the samples as a result of the different weight ratios of sorghum malt and sweet potato flour used. The moisture content ranged from (5.3 – 8.26)%, ash content between (0.01 – 0.04)%, the dextrose equivalent between (37.00 – 39.33)%, the acid content between (0.02 – 0.09)%, the pH between (5.4 – 5.8) and the brix value range of (82 – 86)%. Significant differences were observed between the parameters (except the brix value) of the samples. All the samples had chemical parameters (except acid content) whose values were within the glucose syrup specifications set by the Standard Organisation of Nigeria (SON) as 18% maximum for moisture content, 0.3% maximum for ash content, (38 – 42)% for dextrose equivalent, (4.0 – 6.0) for pH and 82% minimum for brix value. Only the sample with the lowest ratio of sorghum malt to sweet potato flour (Glucose Syrup E) had an acid content which was within the glucose syrup specification for acid content which is 0.03% maximum.

Keywords: brix, enzyme conversion, glucose syrup, sorghum malt, sweet potato

1. INTRODUCTION

Glucose syrup is a concentrated aqueous solution of glucose, maltose and other nutritive value saccharide obtained from edible starch; it is therefore, the most viable substitute for sugar. Glucose or dextrose sugar is found in nature in honey and fruits such as grapes. It is less sweet than sucrose (cane or beet sugar) (Woolfe, 1997) and also less soluble in water, however, when used in combination with sucrose, the resulting sweetness is often greater than expected. It can be used along with a variety of dry solid substance without in any way, affecting other parameters like sweetness, ash content and acidity (Ahn, 1993). This advantage has earned its widespread usage in a wide range of industries for products like confectionery, jams, jellies and canned fruit, bakery products, pharmaceuticals, leather products, liquors and brewery product (Aisen and Muts 1997).

Glucose syrup is obtained commercially by hydrolyzing starch derived from cereals, roots and tuber crops such as wheat, barley, maize, rice, sorghum, white or sweet potatoes, cassava, sago palm and waxy maize (Chaplin, 2004). The three methods for starch hydrolysis which are used for commercial production of glucose are; acid hydrolysis developed by Kirchoff in 1811, partial acid hydrolysis followed by an enzyme conversion and a complete enzymes hydrolysis (Macgregor and Ballance 1990). Acidification which involves the conversion of starch into glucose syrup by acid hydrolysis is being

utilized by many factories (especially, the sugar confectionery industry) because of some advantages of this process which include; short hydrolysis time, installation simplicity and low raw material cost (Adeyemi, 1993). Acid hydrolysis has had widespread use in the past and is now widely replaced by enzymatic process as it required the use of corrosion resistant materials, gave rise to high colour and salt ash content (i.e. after neutralization), needed more energy for heating and was relatively difficult to control (Chaplin, 2004). Enzymes hydrolysis involves the use of various types of enzymes such as alpha-amylase, glucoamylase and pullulanase. In the acid-enzyme process, the starch slurry is treated by acidification, neutralization and filtration as in acid hydrolysis process and then is fed into the enzyme converter (FAO, 2008). However, glucose syrup is not abundantly used in Nigeria, but most of Nigerian industries make use of it in their manufacturing operations (Hug, *et al.*, 1993). The bulk of the syrup used is however being imported. The high cost of importing it into the country has led to the adoption of locally available raw materials for its production, and in an attempt to expand existing market for cassava, and existing Vietnamese technology for the production of glucose syrup was adopted and modified to enable its production from cassava flour and rice malt (Dziedzoave, *et al.*, 2003). The main aim is to provide a supply of locally produced glucose syrup to substitute for the imported ones.

This research therefore focuses on the production of glucose syrup using different weight ratios of sorghum malt and sweet potato flour and evaluating the quality parameters of the syrups produced.

2. MATERIALS AND METHODS

The major raw materials used were sweet potato roots and white sorghum grains. The sweet potato roots and sorghum grains used for the production of sweet potato flour and sorghum malt were obtained from Kuto market in Abeokuta, Ogun State and identified by a botanist in U.I. Ibadan, Oyo state Nigeria.

2.1 Preparation of Sorghum Malt

Sorghum grains were sorted, cleaned and soaked in clean water for 24 hours; during this period, the water is being changed every 8 hours approximately. The water was drained and the soaked grains were left in the container for 48 hours (grains were watered two times each day). The sorghum malt preparation was done according to the methods described by Dziedzoave *et al.*, (2003).

2.2 Production of Sweet Potato Flour

Freshly harvested sweet potato roots were selected, washed, peeled, dried and milled. The flour production was done according to the methods described by CTA, (2007).

2.3 Production of Glucose Syrup from Sweet Potato Flour using Sorghum Malt as a source of Enzyme Conversion

The procedure for glucose syrup production as explained by the methods of Dziedzoave *et al.*, (2003) was followed. Five (5) different samples of produced glucose syrup were produced by varying the weight ratios of sorghum malt, sweet potato flour, water, and sodium meta-bisulphite used. The five samples, Glucose syrup A – E, were represented as GA, GB, GC, GD and GE respectively. Table 1 shows the

proportion of sorghum malt, sweet potato flour, water and sodium meta-bisulphite used for the five different samples. 

Table 1: Proportions of Sorghum malt, Sweet Potato flour, water and sodium meta-bisulphite used for the five samples

Samples	Sorghum malt (g)	Sweet Potato flour (Kg)	Clean (litres)	Water	Sodium meta-bisulphite (g)	Ratio of SM to SPF
Glucose Syrup A	100	0.75	0.625		6.25	1:7.5
Glucose Syrup B	95	0.625	0.594		5.94	1:6.6
Glucose Syrup C	80	0.5	0.5		5	1:6.25
Glucose Syrup D	75	0.375	0.47		4.7	1:5
Glucose Syrup E	62.5	0.25	0.391		3.91	1:4

SM: Sorghum malt

SPF: Sweet Potato Flour

2.4 Moisture Content Determination

The moisture contents of the five samples ~~GA, GB, GC, GD and GE~~ were determined according to the moisture content determination method described by Onwuka (2005).

2.5 Ash Content Determination

The ash contents of the five samples ~~GA, GB, GC, GD and GE~~ were determined according to the ash content determination method described by Onwuka (2005).

2.6 Dextrose Equivalent Determination

The dextrose equivalent of the five samples ~~GA, GB, GC, GD and GE~~ were determined according to the dextrose equivalent determination method described by Onwuka (2005).

2.7 Acid content Determination

The acid contents of the five samples ~~GA, GB, GC, GD and GE~~ were determined according to the acid content determination method described by Onwuka (2005).

2.8 pH Determination

The pH of the five samples ~~GA, GB, GC, GD and GE~~ were determined according to the pH determination method described by Onwuka (2005).

2.9 Brix Value (Sugar concentration) Determination

The brix value of the five samples ~~GA, GB, GC, GD and GE~~ were determined according to the brix value determination method described by Onwuka (2005).

Table 2: Glucose Syrup Specification

Parameters	Units	Values
Brix	%	82 min.
Dextrose Equivalent	%	38 – 42
pH		4.0 – 6.0
Ash Content	%	0.3 max.
Acid Content	%	0.03 max.
Moisture content	%	18 max.

Source: SON (2004)

3. RESULTS AND DISCUSSION

The result showed significant differences between moisture content, ash content, dextrose equivalent, pH and acid content; except only in the brix value of the samples were no significant differences. All the analyses were conducted in triplicate and mean $\pm$ standard deviations ($p < 0.05$) of the three values were reported.

Table 3: Physicochemical Parameters of Five Different Glucose Syrups Produced by Varying the Weight Ratios of Sorghum malt and Sweet Potato flour

Samples	Moisture Content (%)	Ash Content (%)	DE (%)	Acid Content (%)	pH	Brix (%)
GA	8.26 $\pm$ 0.04 ^a	0.04 $\pm$ 0.02 ^c	38 $\pm$ 0 ^{bc}	0.09 $\pm$ 0 ^{cd}	5.6 $\pm$ 0 ^c	86
GB	7.57 $\pm$ 0.01 ^b	0.03 $\pm$ 0.03 ^{bc}	37 $\pm$ 0 ^a	0.08 $\pm$ 0 ^d	5.4 $\pm$ 0 ^a	84
GC	7.46 $\pm$ 0.01 ^c	0.025 $\pm$ 0 ^b	39.33 $\pm$ 0 ^d	0.07 $\pm$ 0.03 ^{bc}	5.5 $\pm$ 0 ^b	84
GD	6.28 $\pm$ 0.01 ^d	0.02 $\pm$ 0 ^{ab}	37.67 $\pm$ 0 ^{ab}	0.04 $\pm$ 0 ^b	5.8 $\pm$ 0 ^d	82
GE	5.33 $\pm$ 0.01 ^e	0.01 $\pm$ 0.01 ^a	38.67 $\pm$ 0 ^{cd}	0.02 $\pm$ 0 ^a	5.7 $\pm$ 0 ^e	82

Mean values showing different alphabets which are significantly different ($p < 0.05$)

GA, GB, GC, GD and GE represent Glucose syrup A, Glucose syrup B, Glucose syrup C, Glucose syrup D and Glucose syrup E respectively.

GE had the lowest moisture content of 5.33% while GA had the highest moisture content of 8.26%. The moisture contents of the five samples decreased from GA – GE as a result of decrease in weights of sorghum malt and sweet potato flour used (Hug, *et al.*, 1993). However, the moisture contents of all the samples were within the limits of SON glucose syrup specification for moisture content which is 18% maximum. Also, the ash content of the samples decreased from GA – GE as a result of decrease in weights of sorghum malt and sweet potato flour used (Chinaka, 1997). GE had the lowest ash content of 0.01%, while GA was the highest with 0.04%. All the values were within the '0.3% maximum' SON ash content specification for glucose syrup. The dextrose equivalent from GA – GE were (38, 37, 39.33, 37.67 and 38.67)% respectively. All the values were within the dextrose equivalent specification for glucose syrup which is 38 – 42%. Moreover, the acid contents of the samples decreased from GA – GE respectively due to decrease in weight of sorghum malt and sweet potato flour used for their production (Walter, *et al.*, 2000). However, only GE had an acid content value that is within the 0.03% maximum

value specification of SON. The high acid contents of GA, GB, GC and GD could have resulted from the weight ratio of the sorghum malt and sweet potato flour used for their production (Dziedzoave, *et al.*, 2003). Therefore, a suitable weight ratio for sorghum malt/ sweet potato flour would slightly less than 1:4 (Aba, *et al.*, 2004). The pH values of all the weight ratios also fall within the SON specification (4.0 – 6.0). There were no significant differences between the brix values of all the weight ratios used for the production of the five glucose syrup GA – GE. All the samples displayed brix values that are within the acceptable limits (Oduro, *et al.*, 2000 and Vuilleumier, 1993).

4. CONCLUSION

The weight ratios of sorghum malt/ sweet potato flour used in production of the five sample glucose syrups exhibited acceptable parameters except for acid contents. The only weight ratio of sorghum malt/ sweet potato flour acceptable for all the parameters is 1:4. Therefore, a weight ratio of sorghum malt/ sweet potato flour that will be suitable to produce acceptable glucose syrup within the specification of SON should not be more than 1:4.

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