Effects of Variations of the Ration of Sorghum Malt with Sweet Potato flour 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 hydrolysis 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 5.33, 6.28, 7.46, 7.57 to 8.26%, ash content were 0.040, 0.030, 0.025, 0.020 and 0.010%, the dextrose equivalent were 38.00, 37.00, 39.33, 37.67 and 38.67%, the acid content 0.09, 0.08, 0.07, 0.04 and 0.02%, the pH 5.6, 5.4, 5.5, 5.8, 5.7 and the brix value of 86, 84, 84, 82 and 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 (1:4) 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 hydrolysis, glucose syrup, sorghum malt, sweet potato

1. INTRODUCTION

Glucose syrup is a concentrated aqueous solution of glucose, maltose and other nutritive oligosaccharide obtained from edible starch; it is therefore, the most viable substitute for sugar. Glucose or dextrose sugar is found in nature in honey and a wide variety of fruits. 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 substances without affecting other parameters like sweetness, ash content and acidity (Ahn, 2005). This advantage has enabled its widespread use in a range of industries for products like confectionery, jams, jellies and canned fruit, bakery products, pharmaceuticals, leather products, liquors and brewery product (Aisen and Muts, 2004).

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 or a complete enzyme hydrolysis (Macgregor and Balance, 2004). 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, technical set-up simplicity and low raw material cost (Adeyemi, 2003). Acid hydrolysis had widespread use in the past and is now widely replaced by enzymatic process as the former required the use of corrosion resistant materials, gave rise to high colour and residual salt content (i.e. after neutralization), needed more energy for heating and was relatively difficult to control (Chaplin, 2004). Enzyme 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).

Table 1: 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)

Although, glucose syrup is not abundantly produced in Nigeria, but most of Nigerian industries make use of it in their manufacturing operations (Hug, *et al.*, 2003). The bulk of the syrup used is however 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 of the study was 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 (which are cheap food materials within the southwestern part of the country) 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 (*Ipomoea batatas*) 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 24hours; during this period, the water was changed every 8h. The water was drained and the soaked grains were left in the container for

48h (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, sliced, 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 different samples of glucose syrup were produced by varying the weight ratios of sorghum malt, sweet potato flour, water, and sodium meta-bisulphite. 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 2: Proportions of Sorghum malt, Sweet Potato flour, water and sodium meta-bisulphite used for the five samples

Samples	Sorghum malt (g)	Sweet Potato flour (g)	Water (litres)	Sodium meta-bisulphite (g)	Ratio of SM to SPF
Glucose Syrup A	100	750	0.625	6.25	1:7.50
Glucose Syrup B	95	625	0.594	5.94	1:6.58
Glucose Syrup C	80	500	0.500	5.00	1:6.25
Glucose Syrup D	75	375	0.470	4.70	1:5.00
Glucose Syrup E	62.5	250	0.391	3.91	1:4.00

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 HACH (2004) and 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).

3. RESULTS AND DISCUSSION

The result showed that significant differences existed between moisture content, ash content, dextrose equivalent, pH as well as acid content of the five samples; except in the brix values, where no significant difference was noticed. All the analyses were conducted in triplicate and mean ± 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 ± 0.04^{a}	0.04 ± 0.02^{C}	38 ± 0^{bc}	0.09 ± 0^{cd}	5.6 ± 0^{c}	86
GB	7.57 ± 0.01^{b}	0.03 ± 0.03^{bc}	37 ± 0^{a}	0.08 ± 0^{d}	5.4 ± 0^{a}	84
GC	7.46 ± 0.01^{c}	0.025 ± 0^{b}	39.33 ± 0^{d}	0.07 ± 0.03^{bc}	5.5 ± 0^{b}	84
GD	6.28 ± 0.01^{d}	0.02 ± 0^{ab}	37.67 ± 0^{ab}	0.04 ± 0^{b}	5.8 ± 0^{d}	82
GE	5.33 ± 0.01^{e}	0.01 ± 0.01^{a}	38.67 ± 0^{cd}	0.02 ± 0^{a}	5.7 ± 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.*, 2003). However, the moisture contents of all the samples were within the limits of SON glucose syrup specification (as shown in Table 1) 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, 2007). 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. 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.*, 2007). However, only GE had an acid content value that is

within the 0.03% maximum value specification of SON, as shown in table 1. 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 be 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 were within the acceptable limits (Oduro, *et al.*, 2004 and Vuilleumier, 2004).

4. CONCLUSION

The weight ratios of sorghum malt/ sweet potato flour used in production of the five samples of glucose syrup 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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