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Quality Evaluation of Glucose Syrup from Sweet Cassava Hydrolyzed by Rice Malt Crude Enzymes Extract

D. Ahure and C.C. Ariahu
Department of Food Science and Technology, University of Agriculture, Makurdi, Nigeria

Abstract: The quality of glucose syrup from cassava hydrolysis by rice malt crude enzymes extract was evaluated. Four syrups were produced using 5% rice malt 95% cassava flour, 10% rice malt 90% cassava flour, 15% rice malt 85% cassava flour and 20% rice malt 80% cassava flour, respectively. The viscosity, brix, refractive index, flavour, colour, taste and overall acceptability of the syrups were determined. The use of the crude enzyme extract for cassava starch hydrolysis resulted in significant ($p \leq 0.05$) decrease in viscosities which is advantageous in relation to flow and pumping requirements. The brix and refractive indices values were 65.5° and 1.454° (5% of rice malt 95% cassava flour), 61.0° and 1.445° (10% of rice malt 90% cassava flour), 58.5° and 1.439° (15% of rice malt 85% cassava flour) and 55.5° and 1.432° (20% of rice malt 80% cassava flour), respectively indicating that the substrate concentration was the limiting factor in enzyme hydrolysis of cassava starch. The mean sensory scores were 2.50-4.25 for 5% of rice malt 95% cassava flour, 2.75-3.58 for 10% of rice malt 90% cassava flour, 2.00-4.08 for 15% of rice malt 85% cassava flour and 3.08-4.08 for 20% of rice malt 80% cassava flour, respectively on a 5-point Hedonic scale.

Key words: Glucose syrup, viscosity, brix, flavour, Hedonic scale

INTRODUCTION

The Nigerian restriction on the importation of sugar has resulted in increase in price of the commodity. There is therefore the need to source fornatural sweeteners such as glucose syrup from other plant products other than sugar cane since sugar cane is been used for the planned bio-fuel productionin Nigeria.

Natural sweeteners are those sweetening substances derived from plant materials. The most important commercially available natural sweetener is sucrose, generally referred to as sugar. Commercially sucrose is processed from two sources cane (60%) and beet (40%). Since the 14th century A, D when sugar was first refined sucrose has been used both at home and at the industry as sweetening agent. Until recently, it is the only natural sweetener so used. The phenomenal increase in the price of this commodity coupled with advances in starch technology has led to the production of natural sweeteners from unconventional sources other than the sugar cane and beet root.

A review of recent developments in this area of research indicates that starch, the normal form of stored carbohydrate in plants is the most promising source of sweeteners (Inglet, 1981; Wardrip, 1971; Van Wyk *et al*., 1978; Francis, 1976). The principal sources of starch for industry are corn, cassava, wheat, potato, sorghum and similar plants. The contribution from these sources will depend on their availability and cost.

Glucose syrup is the hydrolysis product of starch and consists of glucose monomer and varying quantities of dimer, oligosaccharides and polysaccharides, dependent on the glucose syrupin question and its process of manufacture (Dziedzic and Kearsley, 1984). According to Ihekoronye and Ngoddy (1985), cassava contains 20-30% starch, 2-3% protein, 75-80% water, 0.1% fat, 1-0% fiber and 1.5% ash. Due to its high moisture content, cassava root is highly perishable with post-harvest shelf life o f <72 h. The estimated post-harvest loss of fresh cassava is about 23%. Therefore, there is the need to process cassava in order to reduce post-harvest losses and broaden its application (Dorosh, 1988). According to Ihekoronye and Ngoddy (1985), rice contains 80% starch, 6.8-8.0% protein, 11% moisture, 2% moisture, 2% fat, 0.2% fiber and 0.5% ash. The starch in most cereals is a mixture of amylose and amylopectin. The proportion of these two starches has much to do with the cooking and eating qualities of rice.

Several industries in West Africa (especially Ghana and Nigeria) use glucose syrup in their manufacturing operations and the bulk of the syrup are made from cassava and rice malt. The aim is to provide local supply sources for glucose syrup to substitute for the imported

Corresponding Author: D. Ahure, Department of Food Science and Technology, University of Agriculture, Makurdi, Nigeria

product (Dziedzoave *et al*., 2003). The objectives of this study were to produce glucose syrup from sweet cassava using crude enzyme from malted paddy rice and to evaluate the physicochemical and sensory properties of the glucose syrup produced.

MATERIALS AND METHODS

About 6 kg of paddy rice seeds (Farrow 44, Oryza sativa) and 20 kg of fresh cassava roots (TMS 30572, Manihot esculenta) were purchased from Benue ADP in Makurdi, Nigeria. Four products consisting of 5% of rice malt 95% cassava flour, 10% of rice malt 90% cassava flour, 15% of rice malt 85% cassava flour and 20% of rice malt 80% cassava flour were produced from the rice malt and cassava flour. After sorting and removing stones, debris and defective seeds, the paddy rice was steeped in clean tap water at room temperature (30±2°C) for 24 h which was changed every 8 h. Water was drained and steeped grains were left in container for 48 h (water grains 2 times every day). The seeds were spread to thickness of about 2-3 cm in malting tray with perforated bottom and placed on a slope. The seeds were covered with dark polyethylene sheet to avoid excessive light during germination. The sprouted seeds were watered two times a day up till the 7-9th day after steeping and once a day thereafter until the 10-12th day of steeping. Seedlings were pounded in a mortar with pestle and dried for use.

Processing of cassava flour: The technology for processing of fresh sweet cassava roots into flour involved cleaning, peeling, washing, grating, dewatering of mash, cake breaking, drying on raised platform, the granules were milled into flour and packaged. The critical factor to attain the standard is that the whole processing takes place in 24 h beyond which fermentation sets in.

Conversion of cassava flour or starch into glucose syrup: The concentrations of 5, 10 and 20 g of rice malt were added to the corresponding 95, 90, 85 and 80 g of cassava flour/starch, respectively. A 125, 120, 115, 110 and 105 mL of water were added to rice malt/cassava flour blends to form slurries and the pH adjusted to 7 with calcium salt.

About 250 mL of boiling water was added to each of the blends to gelatinize the starch. The slurries were stirred until no sign of whiteness was seen (5-10 min). The gelatinized slurries nt were covered and left to cool to temperature of 60-65°C and pH adjusted to 5.0-5.5 with addition of 2 g of rice malt, respectively.

It was stirred and left for 4-8 h in an insulated container (food flask) at constant temperature (60-65°C). The mixture was boiled briefly and filtered after 8 h. The filtrate was evaporated to about half the original volume and 2 g of sodium metabisulphite was added and mixed thoroughly. Evaporation of the filtrate continued until liquid became thick and syrupy. The syrup was removed from heat and poured into dry container to cool and packaged into plastic bottles according to Dziedzoave *et al.* (2003).

Evaluation of physicochemical and sensory properties of glucose syrup

Viscosity: The viscosities of the four samples of glucose syrups were measured using a Brook Field viscometer (LV-8, Viscometers, UK). Brook Field evaluations were performed using spindle 2, speed 12 rpm at 20°C (Table 1).

Brix and sugar content: Measurement was made using a refractometer calibrated with indices from 1.3-1.6 and accurate to 0.0001 units. The prism was maintained with circulating water, in order to prevent crystallization of high dextrose syrups and ease the handling of viscous, high solids syrups.

A small amount of the sample was introduced onto the prism face of the refractometer which is then immediately closed to prevent evaporation. On achieving temperature equilibrium the reading was taken according to Cocks and van Rede (1966).

Sensory evaluation: A 12 member panelist was used to evaluate the glucose syrups. The panelist was untrained but consisted of honey consumers. The serving order for each treatment for randomized. The panelist in an open area, fluorescent-lighted skill Development Centre (BNADA Headquarters) rated the glucose syrups colour, taste, flavour and general acceptability on a 5-point Hedonic scale where 5 was like extremely, 1-dislike extremely, 2-dislike moderately, 3-Neither like nor dislike and 4-like moderately.

The syrups were served to the panelists in colourless transparent plastic cups coded with 3-digit random numbers. Colourless transparent plastic spoons were provided for testing the samples. Fresh tap water was provided to rinse mouth between evaluatios.

Statistics: Significance ($p \leq 0.05$) differences in sensory attributes were determined by analysis of variance

Table 1: Viscosity of glucose syrup samples

	Blends				
Ingredients	A	B	C	D	E
Rice malt	0	5	10	15	20
Cassava flour	100	95	90	85	80
Viscosity (Cp)	Very high	2480	2475	2310	2300

A = 0% rice malt:100% cassava flour; B = 5% rice malt:95% cassava flour cassava flour; C = 10% rice malt:90% cassava cassava flour; D = 15% rice malt:85% cassava flour; E = 20% rice malt:80% cassava flour according to Kramer and Twigg (1970) while Duncans multiple range and Tukey's (Ihekoronye and Ngoddy, 1985) were used for separating the means.

RESULTS AND DISCUSSION

The brix and refractive index of a specific glucose syrups B, C, D and E are shown in Table 2. The Refractive Index (RI) of a specific glucose syrup as determined using a refractometer is directly related to its dry solids content and is directly related to its dry solids content and is used as such for this purpose industrially to control evaporative process. It is important to note that RI is dependent on certain parameters of the syrup. Refractive index increases with increase in total solids. Also, RI decreases as the temperature of the syrup increases at the same solid content (Kearley *et al*., 1980).

Table 3 shows the sensory scores of glucose syrups of rice malt/cassava flour products. Flavour scores ranged from 2.5 (odourless) for B (5% rice malt 95% cassava flour) to 3.8 (Good) for E (20% rice malt 80% cassava flour). Colour scores ranged from 2 (brown) for D (15% rice malt 85% cassava flour) to 4.25 (cream) for B (5% rice malt 95% cassava flour).

Taste scores ranged from 2.67 (moderately sweet) for B, 2.83 for C, 3.25 for D and 3.05 for E. These scores show that there is no significance difference between the four samples on taste. Scores for general acceptability were 4.08 for D and E, respectively (like moderately) 3.5 and 3.58 for B and C (neither like nor dislike).

Table 2: Brix and refractive index of glucose syrups from rice malt and cassava flour at 20°C

	Blends				
Parameters	A	B	C	D	E
Refractive index	-	1.454	1.445	1.439	1.432
Brix (°brix)	-	65.500	61.000	58.500	55.500

A = 0% rice malt:100% cassava flour; B = 5% rice malt:95% cassava flour cassava flour; C = 10% rice malt:90% cassava flour; D = 15% rice malt: 85% cassava flour; E = 20% rice malt:80% cassava flour

Table 3: Sensory evaluation of glucose syrups from rice malt and cassava flour

	Blends				
Parameters	A	B	C	D	E
Colour	-	4.25^{a}	3.00^{b}	2.00^{c}	3.17^{d}
Flavour	-	2.50^{b}	2.75^{b}	3.42^{ab}	3.80^{a}
Taste	-	2.67^{a}	2.85^{a}	3.25^{a}	3.08^{a}
General acceptability	-	3.60^{b}	3.58^{ab}	4.08^{a}	4.08^{a}

Values in the same column with different superscripts are significantly ($p \le 0.05$) different A = 0% rice malt:100% cassava flour; B = 5% rice malt:95% cassava flour cassava flour; C = 10% rice malt:90% cassava flour D = 15% rice malt:85% cassava flour; E = 20% rice malt:80% cassava flour

CONCLUSION

Acceptable and improved quality glucose syrup which could be used as sweeteners in brewing, baking, dairy and confectionery industries can be produced from rice malt and cassava flour using germination process. Addition of malted rice at 5-20% levels to cassava flour blends resulted in viscosity reduction. Due to limitations of equipment, this exposed the products to unduly longer periods of sun drying which could have affected the organoleptic properties. The use of flash dryer with its attendant advantage of a High Temperature and Short Time (HTST) process would further improve the sensory properties of the glucose syrups.

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