

## The Relative Glucose Yields of Some Carbohydrate Foods: Need for Caution

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**Abstract:** The glucose yield of some carbohydrate foods- maize, rice, yam and cassava was determined through the titrimetric analysis of the ethanol yield of the samples using standard  $\text{KMnO}_4$  solution. Cassava (*Manihot esculenta*) gave the highest glucose yield of 64mg/g dry weight, followed in this order by yam (*Dioscorea rotunda*): 54 mg/g, maize (*Zea mays*): 42mg/g and then rice (*Oryza sativa*) which gave the least value of 40mg/g. This result in essence shows that the level of carbohydrates in the listed foods is in the order: cassava > yam > maize > rice. Since most of the B vitamins and other essential nutrients are washed off during cassava processing, it is advisable that people eat whole grain foods. They contain lesser carbohydrates, rich in fiber, and their nutrients are retained. This is to reduce the tendency of suffering from diseases that are related to carbohydrates not being split into glucose but fat and fighting against diseases like heart disease and cancer.

### Key words:

### INTRODUCTION

Plants store energy in the form of carbohydrates-sugars and starches, which are the products of photosynthesis. Carbohydrates are broken down into glucose (a simple sugar) molecules when eaten. Double, triple and higher sugars must, in fact, be split into glucose before they can be absorbed, as only simple sugars can pass through the intestine into the bloodstream. About 12 hours worth of sugar is stored in the liver and bloodstream; any excess is stored as fat, which can be broken back down into sugar for later use.<sup>[1]</sup> Glucose is also stored as glycogen in animal tissue, a compound which readily breaks down to glucose as the body needs it. Principally glucose is needed for the production of energy by oxidation.<sup>[2]</sup>

As living standards improve, there is a pursuit of high quality in all aspects of our lives including the food we eat. Hence most of the foods we eat have become more refined. It is advised that one should avoid grains that have had the wheat germ removed, which is what white bread is. The germ contains most of the nutrients. Refined and processed grains are acid-forming (high in phosphorus) and when consumed as flour, tend to cause problems in the gut, the brain and the joint capsules.<sup>[3]</sup> Refined grains are also said to be very high in phytates, which latch onto water-soluble nutrients including vitamins B and C and minerals such as calcium, chromium and magnesium.<sup>[3]</sup> Carbohydrate sugars in manufactured foods are refined sugars. They are dangerous to health. They contain far less fiber, nutrition and water than natural carbohydrate

sugars in fruits and vegetables.<sup>[4]</sup>

Naturally, sugars and starches are always paired with vitamins, minerals, phytochemicals and fiber in plants.<sup>1</sup> Most of the vitamins, minerals and other nutrients are stripped away during processing thereby turning them into all kinds of nutritionally empty products. For example, the protein content of wheat is reduced by one sixth during processing; vitamin B1, B2, calcium and cellulose are lost completely.<sup>5</sup> Where any of the B vitamins are not available, the conversion of carbohydrates to energy is prevented. Instead, the carbohydrates are converted into fat which:

- raises blood levels of triglycerides;
- uses up the good HDL cholesterol, which lowers blood levels of HDL and increases risk for heart attacks;
- is stored in fat cells primarily in the abdomen;
- helps form plaques in arteries, which makes them stiff and raises blood pressure; and
- blocks insulin receptors on cells so that adequate response to insulin is not possible.

This causes the production of more insulin making one to get hungrier thereby storing more fat and eventually leads to diabetes in susceptible people.<sup>[1]</sup>

Therefore, persistent eating of carbohydrates separated from the vitamins, minerals and other essential nutrients opens the eater to high risk for diabetes, obesity, heart attacks and high blood pressure.

Some of the unhealthy carbohydrates include the refined sugars found in foods like cookies, sweets,

cakes, carbonated soft drinks, ice cream and syrups. The most refined of all sugars is table or icing sugar.<sup>[4]</sup> Since they are harmful to the body it is advisable not to eat them.

This research study was undertaken to determine the carbohydrate levels of some carbohydrate foods commonly eaten in this part of the continent so as to recommend those to be preferred for health reasons.

**MATERIALS AND METHODS**

Two 10.0 g portions of each grated yam and cassava and ground dry rice and maize were weighed accurately. A 10.0g portion of each of the carbohydrate food was placed in the oven, first at 60<sup>o</sup> C for 1 hour and then at 110<sup>o</sup> C for 3 hours 20 minutes when a constant weight was obtained for each sample. The other 10.0g portion of each carbohydrate sample was hydrolysed to glucose by boiling with 150ml of 0.2M solution of HCl for 1 hour. Anhydrous Na<sub>2</sub>CO<sub>3</sub> was added to the mixture on cooling until a small piece of litmus inserted into the mixture turned slightly blue.

Yeast was added, and the mixture was left to ferment for 24 hours in a closed vessel. The mixture was filtered and the residue rinsed with distilled water. The volume of ethanol solution obtained for each sample is recorded in Table 1. An aliquot of the ethanol solution (25ml) was acidified with 40ml of approximately 0.1M solution of H<sub>2</sub>SO<sub>4</sub> and titrated against standard 0.05M KMnO<sub>4</sub> solution to the first permanent pink end point.<sup>6</sup> The mean titre of three determinations for each sample, having subtracted values for blanks, and the calculated mole of ethanol yielded by 10.0g sample are reported in table 1.

**RESULTS AND DISCUSSIONS**

The pertinent equations for the determinations are as follows:

- $4MnO_4^- + 12H^+ + 5CH_3CH_2OH \rightarrow 4Mn^{2+} + 5CH_3COOH + 11H_2O$  (1)
- $MnO_4^- \equiv 1.25CH_3CH_2OH$   
Yeast
- $C_6H_{12}O_6 \rightarrow 2CH_3CH_2OH + 2CO_2$  (2)  
Zymase
- $CH_3CH_2OH \equiv 0.5C_6H_{12}O_6$

Equation (2) shows that 1 mole of ethanol is produced by 0.5 mole of glucose. The relative molecular masses of ethanol and glucose are 46.069 and 180.158 respectively. The dry weight of samples, the mass of glucose in 10.0g sample and the mass of glucose in mg/g dry sample are reported in Table 2. From the Table, cassava gave the highest glucose yield followed by yam. The glucose yields of maize and rice are very close but fairly lower than those of the root and tuber foods. Cassava is one carbohydrate food that involves a great deal of processing before it is suitable for consumption because of the high cyanide content. The root is processed into *garri*, *fufu* and cassava flour.<sup>[7]</sup> This practice cuts across tropical West Africa where it is popularly grown.

Perhaps all the B vitamins being water-soluble and other essential nutrients are washed off during processing. In most cases the vitamins and the other nutrients are not added back to the processed food before eating. So a non-nutritious food is eaten most of the time that could lead to a high risk for diabetes, obesity, heart attacks and high blood pressure. In poor

**Table 1:** Mole of ethanol obtained from 10.0g of carbohydrate sample

Sample	Total Vol. Of Ethanol (ml)	Mean titre of three determinations (ml)	Concentration of ethanol solution (M)	Mole of ethanol produced by 10.0g sample
Maize	246.0	3.93	0.0098	0.0024
Rice	299.5	3.37	0.0084	0.0025
Yam	255.0	2.30	0.0058	0.0015
Cassava	375.0	3.43	0.0086	0.0032

**Table 2:** Mass of glucose in dry sample in mg/g

Sample	Dry weight of sample in g	Mass of glucose in sample (mg)	Mass of glucose in in dry sample (mg/g)
Maize	5.197	216	42
Rice	5.692	225	40
Yam	2.496	135	54
Cassava	4.510	288	64

splitting carbohydrates to glucose are lacking.

There is not much expected danger in the eating of yam compared to cassava. This is because yam may be roasted for food without actually washing off the nutrients. However, some of the vitamins and other nutrients may be lost communities where cassava products are the only affordable foods (because cassava is cheaper to cultivate) diseases such as beriberi, pellagra and the ones mentioned earlier would be very rampant. This is because most of the carbohydrates eaten would be converted into fat since the B vitamins needed to initiate some of the reactions to the water used for cooking.

The consumption of whole grains such as maize and rice (containing less carbohydrates than cassava and yam) as nature intended should be encouraged so as to stay alive. In fact, people who are susceptible to diabetes should be advised to eat more grains than tuber or root carbohydrate foods.

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