

Evaluation of the Importance of Yam Cossettes Flour Couscous (*wassa-wassa tchigan*) in the Diabetics Diet in Benin

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Abstract The measurement of food glycemic index constitutes a considerable advance in medicine because it makes it possible to orient the choice of foods according to the health of a patient. This study aims to improve the diet of diabetics in Benin. It consisted in the determination of the total sugar content and the glycemic index of the yam chips flour couscous (*wassa-wassa tchigan*) and then the evaluation of the influence of this food on the glycemic index of the subjects. This cross-sectional study covered 7 apparently healthy subjects. In the first test each subject consumed a dish of *wassa-wassa tchigan* containing 50g of carbohydrate. Each subject was tested twice for a period of one week. A week later, in the second test, bread crumb containing 50 g of carbohydrate was ingested. Each glycemic test was measured at regular intervals of 30 minutes for 3 hours. The study on the determination of the total sugar content of *wassa-wassa tchigan* revealed that one gram (1 g) of *wassa-wassa tchigan* contained 483.55mg of carbohydrate. The peak of blood glucose increase in subjects was reached from the thirtieth minute postprandial. The area under the curve of the subjects varied from the reference food to the test food and from one subject to another. The glycemic index of the *wassa-wassa tchigan* determined was 36.83% which made this meal a meal with very low glycemic index.

Keywords: *yam cossettes flour couscous (wassa-wassa), soft bread, glycemic index*

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1. Introduction

Diabetes mellitus is a universal disease that spares no continent, even though the prevalence rates vary considerably from one country to another [1,2]. In Africa according to WHO, the real fact is its progression. Indeed prevalence varies from 6 to 15.2% [3]. According to the Ministry of Health, the prevalence rate in Benin is 2.6% of the general population in 2008.

There is no originality concerning the indications and conduct of drug therapy, but the need to adapt it to the limited resources of the individuals as the community which represents the major problem of diabetes in Sub-Saharan Africa [1,4]. The dual indication of an

uninterrupted treatment in both medicinal and dietetics is a heavy financial burden at all levels.

The diet is therefore essential for maintaining glycoregulation. To this end, several studies have been carried out in order to manufacture diets for diabetics [5]. Some of them carried out in West Africa which is based on yams. This tuber occupies an important place in the diet of the Beninese. National yam production in Benin's republic accounts for 6% of world production [6], in fact yam occupies an important place of the food crops which are produced in Benin's republic and almost half of the Beninese population use it as a staple food [7]. Its consumption is made on the one hand from the fresh tubers and on the other hand from the flour obtained from the cossettes which allows more elaborated cooking such as the 'amala' still called 'télîbô wô' and the 'wassa-wassa'.

Indeed 'wassa-wassa' is a form of couscous cooked from yam cossette flour [8]. It originates in the northern region of Benin's republic where it is first cooked and consumed at the household level.

The works which had realized on 'amala' in Nigeria had focused on the postprandial glycemic response in diabetic and non-diabetic Nigerians. Indeed reference [9] found in a very low glycemic index for the 'amala' which makes it therefore recommendable for diabetics.

As 'pre-cooked and dried *wassa-wassa* which is increasingly entering the diet of the Beninese, is obtained from the same flour as the *amala*, is its indication in the diabetics would be justified? What is its content in carbohydrate? And what is its hyperglycemic power?

These questions led to the initiation of this study, whose main objective was to study the importance of 'pre-cooked and dried *wassa-wassa*' in the diet of diabetics by determining its glycemic index..

2. Materiel and Methods

2.1. Studied Population

This study examined 11 apparently healthy adults, aged of 18-30 (23.45 ± 4.39 years), with a body mass index (BMI) ranging from 18.12 to 23.72 kg/m². All participants gave their informed consent. The protocol of the study was explained to the subjects before the collection of the consent. Blood glucose was performed in each subject before integrating in the study so as to not select diabetic subjects.

2.2. Food

For our study 3 types of food were used.

2.2.1. Test Food: 'pre-cooked and dried *wassa-wassa*'

Pre-cooked and dried *wassa-wassa* product and marketed by the company Fènou Foods constitutes the test food of our study.

103.4 grams of pre-cooked and dried *wassa-wassa* grains, containing in average 50 g of carbohydrates which are weighed on an analytical balance. This quantity was poured into 500 ml of previously boiled water and the whole was left to stand for 5 min and then cook with steam for 10 min (according to the reconstitution method marked on the product label). *Wassa-wassa* was thus reconstituted and served with a tablespoon of vegetable oil and a pinch of salt.

2.2.2. Reference Food: Soft Bread

Reference food used is soft bread made from pastry. This bread contains wheat flour, pure cane sugar, yeast,

salt, butter, bread improver and water in proportions defined by reference [10].

Table 1. Chemical composition of the reference food

Substances	Proportion (gram)
Wheat flour type 45	1000
Water	650
Pasteurized butter	50
Sea salt	20
Natural yeast	20
Pure sugar of cane	50
Bread improver	5

110.04 grams of this bread contains 50 g of carbohydrate [10].

2.2.3. Food for Validation: Full Corn Flour Porridge

Whole maize flour porridge was used for the validation of our method. The maize was bought at the Dantokpa market and ground to the mill to obtain the flour. 66.5 grams of corn's flour containing on the average 50 g of carbohydrates (DANA) are weighed on an analytical balance. This amount is cooked as a liquid porridge.

2.3. Biochemical Essays

The sugar content of 'wassa-wassa Tchigan' was determined by the method of reference [11]. The glycemic index has been evaluated according to the method described by reference [12]. Finally the blood sugar was evaluated according to the ELITECH Clinical Systems SAS.

2.4. Validation of the Study's Method of the Glycemic Index

In the literature, we were unable to obtain a glycemic index value of 'wassa-wassa'. To do this, a glycemic index study of corn flour porridge was carried out in 4 non-diabetic volunteers of apparent good health. The results obtained, compared with those of the literature, allowed us to validate our study's method of glycemic index thus adopted.

3. Results

3.1. Total Sugars Content of 'pre-cooked and dried *wassa-wassa*'

The determination of the total sugars from five samples of the 'pre-cooked and dried *wassa-wassa*' gave the results which are recorded in Table 1.

Table 2. Total sugars content of 'pre-cooked and dried *wassa-wassa*'

'wassa-wassa pre-cooked and dried'	mg/g 'pre-cooked and dried <i>wassa-wassa</i> '	Average in total sugars (mg/g)	Standard Deviation (SD)
N°1	483.55	483.55	1.31
N°2	482.34		
N°3	484.76		
N°4	482.13		
N°5	484.97		

From this average of 483.55 mg per 1 gram of 'pre-cooked and dried wassa-wassa', the amount of pre-cooked and dried wassa-wassa (M) containing 50 grams of carbohydrates is:

The mass M is equal to 103.4 grams of 'pre-cooked and dried wassa-wassa'.

All individuals subjected to the consumption of 'pre-cooked and dried wassa-wassa' had a glycaemic response that varied from one individual to another (Table 3) and from one intake of the test food to another (Figure 1 - Figure 14). It was the same for the area under the curve. The glycaemic response of subjects who ingested the tested food had a curve that reached a peak before regressing. In the majority of cases, these different glycaemic response curves showed their peak at 30 minutes after ingestion of the food. The mean glycaemic index of the pre-cooked and dried wassa-wassa was 36.83% and the standard deviation was 6.74.

Subject 1

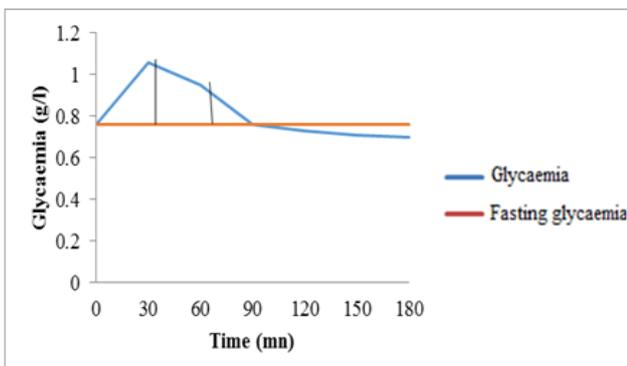


Figure 1. Area under the curve in subject 1 with 'Precooked and dried wassa-wassa'

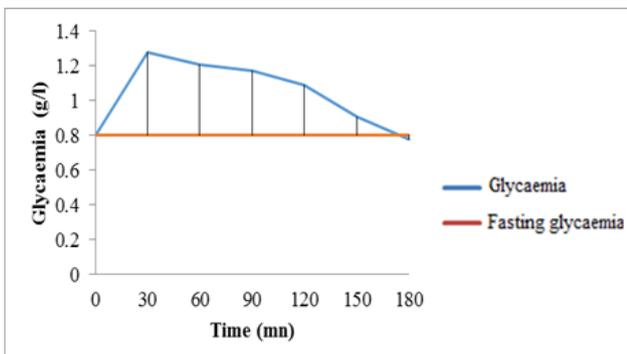


Figure 2. Area under the curve in subject 1 with soft bread

Subject 2

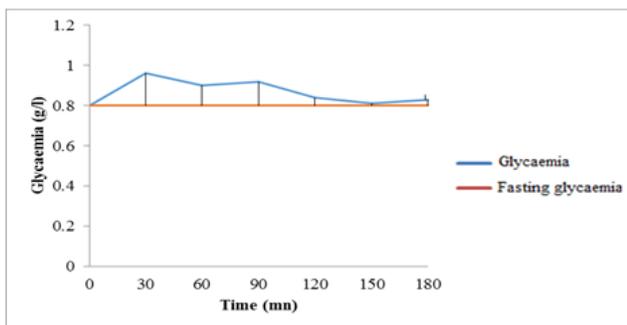


Figure 3. Area under the curve in subject 2 with 'Precooked and dried wassa-wassa'

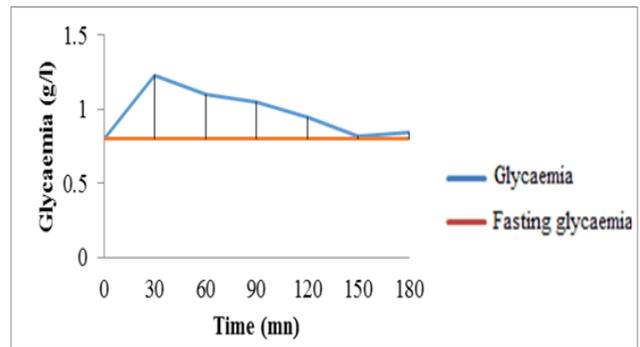


Figure 4. Area under the curve in subject 2 with soft bread

Subject 3

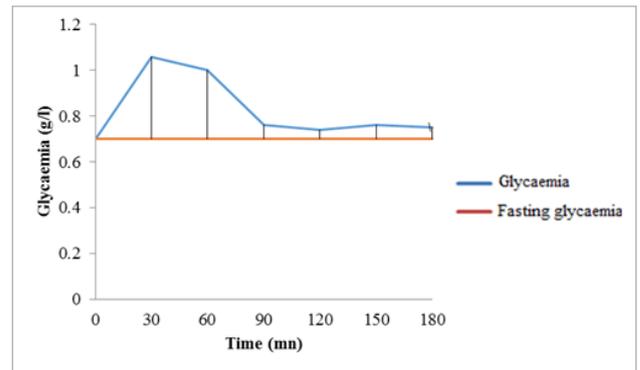


Figure 5. Area under the curve in subject 3 with 'Precooked and dried wassa-wassa'

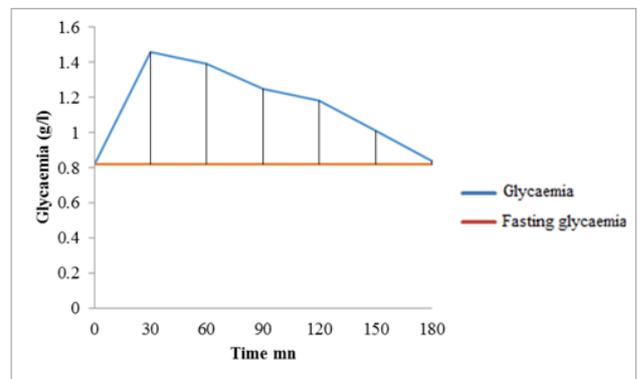


Figure 6. Area under the curve in subject 3 with soft bread

Subject 4

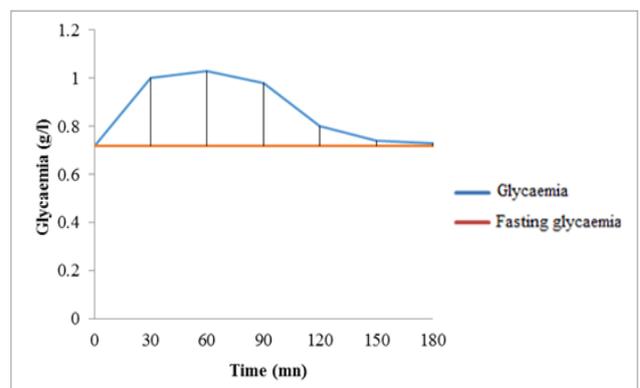


Figure 7. Area under the curve in subject 4 with 'Precooked and dried wassa-wassa'

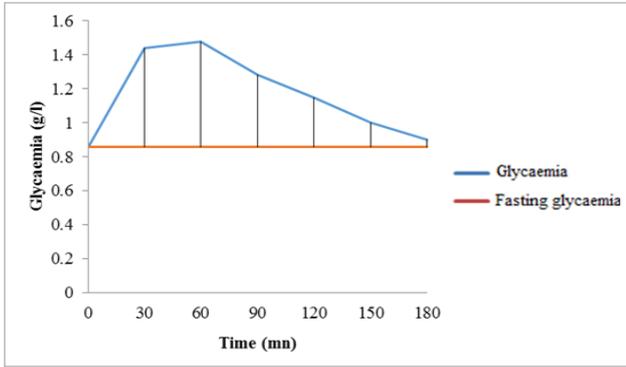


Figure 8. Area under the curve in subject 4 with soft bread

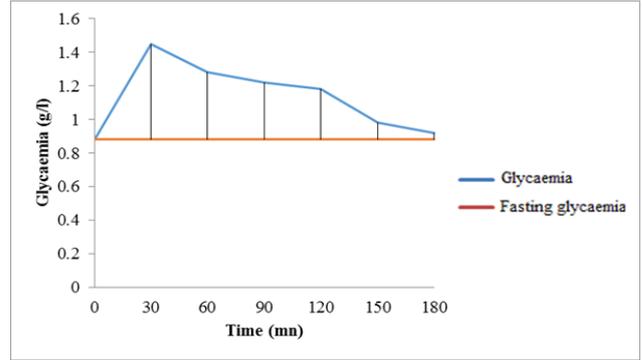


Figure 12. Area under the curve in subject 6 with soft bread

Subject 5

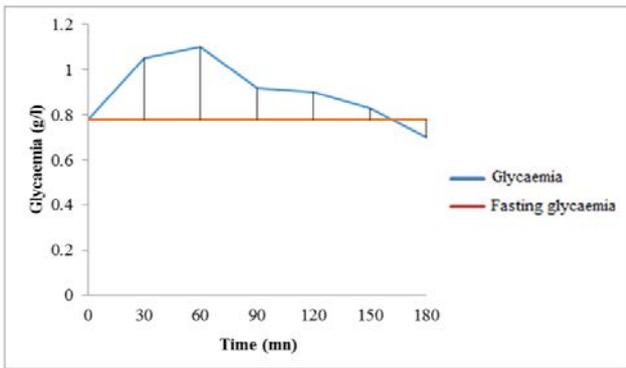


Figure 9. Area under the curve in subject 5 with 'Precooked and dried wassa-wassa'

Subject 7

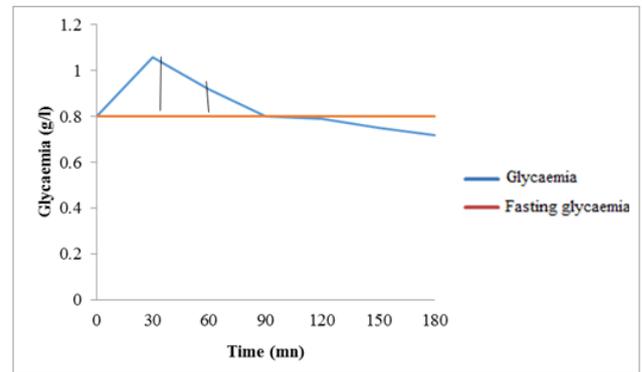


Figure 13. Area under curve in subject 7 with 'Precooked and dried wassa-wassa'

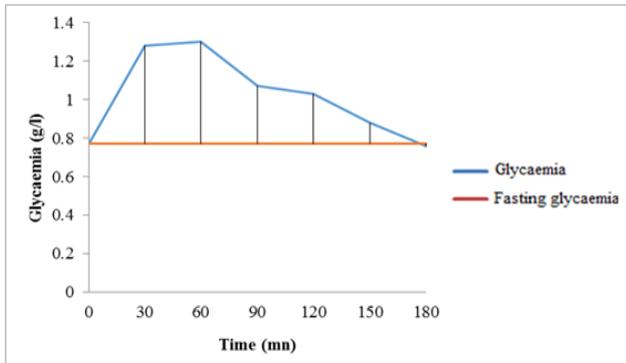


Figure 10. Area under the curve in subject 5 with soft bread

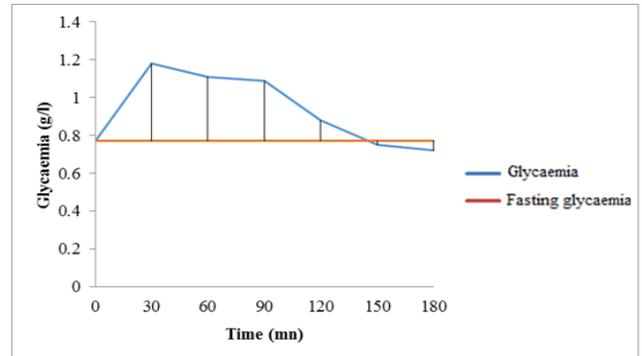


Figure 14. Area under the curve in subject 7 with soft bread

Subject 6

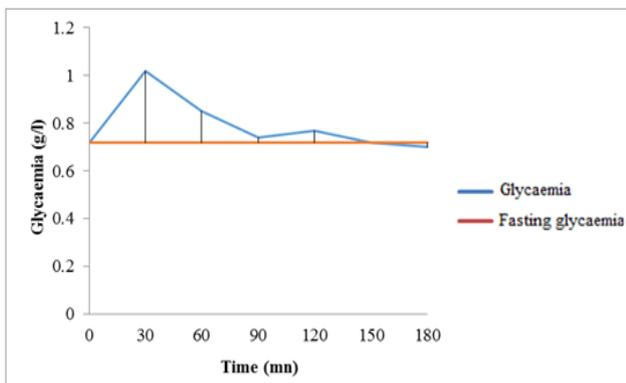


Figure 11. Area under the curve in subject 6 with 'Precooked and dried wassa-wassa'

Table 3. Glycemic Index of subjects

Subjects	Glycemic Index (%)
1	29.96
2	37.87
3	38.40
4	46.13
5	44.16
6	28.90
7	32.43

4. Discussion

4.1. Total Sugar Content of 'pre-cooked and dried wassa-wassa'

This study on the determination of the total sugar content 'pre-cooked and dried wassa-wassa gave a total

sugars value of 485.55 mg / g \pm 1.21. This value is lower than cossette flour yam established by (DANA) which is 795mg / g and higher than *amala*, which is 178.51mg / g [9].

4.2. Glycemic Index of 'wassa-wassa pre-cooked and dried'

The study performed in seven (7) non-diabetic volunteers yielded an average glycemic index of 36.83% \pm 6.74 with individual values ranging from 28.9% to 46.13%.

Referring to the classification of foods according to their glycemic index with soft bread as a reference food established by Jenkins and coll, in 1984, we can say that the 'pre-cooked and dried wassa-wassa' is part of the group of foods with glycemic index Very low (\leq 50). In this group there is fructose and fruits such as cherry, grapefruit and plum.

Thus 'pre-cooked and dried wassa-wassa' is less hyperglycemic than boiled yams, white rice and maize, which are part of the group of foods with intermediate glycemic index.

Several parameters may explain the lowering of the glycemic index from a dish or fruit consumed in various forms. Factors which may affect the glycemic index of a food include the nature of the starch, particle size, pH and amount of fiber, fat and protein content, in addition to method and Cooking's time [13,14,15]. The yam which constitutes the raw material of the 'precooked and dried wassa-wassa' undergoes in situ retrogradation mechanisms of the starch molecules. Indeed, during the process of the yam cossettes, the yam is soaked in hot water and then dried in the sun for about 3 days, losing almost all its water content with a progressive recombination of the starch molecules (retrogradation). This recombination reduces the digestibility of the starch molecule. The opposite phenomenon of retrogradation: gelatinization of starch is responsible for the high glycemic indexes found for boiled yam (52.9%) and pounded yam (82.6%) by Jumoh et al in 2008 [8].

The transformation process of yam into cossette results in an increase in its fiber content [8] (Jumoh et al., 2008). Numerous studies have shown the importance of viscosity (a property of the fiber content of the diet) on the postprandial glycemic response of foods [15,16].

In the production of 'pre-cooked and dried wassa-wassa', the yam cossette flour is rolled with a small amount of water and the grains obtained are steamed and dried in the oven, thereby maintaining retrogradation of starch molecules. In addition, the reconstitution of the 'pre-cooked and dried wassa-wassa' is done by soaking in hot water and steaming for a short time, so it is not boiled continuously like other meals. This could also reduce the partial availability of starch, as observed by reference [17] in other foods.

Since we did not find data on the glycemic index of wassa-wassa in the literature, we were obliged to determine the one of maize with the same reference food in order to be able to validate our results. Thus, we obtained a glycemic index of 88.16 \pm 8.45 on average with individual values varying from 79.9 to 99.63. This

glycemic index is well within the range given by Jenkins and coll (1984) which is 87 \pm 1 in normal volunteers.

5. Conclusion

This study allowed to have a more precise idea on 'pre-cooked and dried wassa-wassa'. In the one hand, it approved us to notice that one gram (1 g) of 'pre-cooked and dried wassa-wassa' contains 483.55mg of total sugars and in the other hand that 'pre-cooked and dried wassa-wassa' is a food with very low glycemic index.

These results contribute to the valorization of dietotherapy with regard to 'pre-cooked and dried wassa-wassa'. They also constitute prerequisites that, through comparative studies with other local foods, can be used to develop diets that are better adapted to diabetics.

With the increasing incidence of diabetes in the world, dietary modification and food restriction remains a cornerstone in the prevention and management of this disease. Consumption of certain monotonous foods, such as beans and other foods which content bean, in diabetic patients leads to poor compliance and subsequent poor glycemic control. Diets that include other local food such as 'pre-cooked and dried wassa-wassa' should be encouraged.

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