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Glycaemic response and insulin index in apparently healthy male adults following ingestion of some Nigerian meals

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Abstract

Background: There are available reports on the glycaemic indices (GI) of some local Nigerian diets but there is the dearth of information on insulinogenic responses to the diets which are also vital in chronic diseases prediction and management. Therefore, this study was carried out to determine the GI, glycaemic load (GL) and insulin index (II) of selected commonly consumed Nigerian diets.

Materials and Methods: Twelve apparently healthy males were recruited into this randomized cross over study. Meal tolerance testing (MTT) was carried out on each participant, on separate days, after an overnight fast using 50g available carbohydrate of each of yam flour paste (amala), wheat paste and cooked cowpea with 50g of glucose serving as the reference meal. Venous blood was collected at 0 minute and then postprandially at 30, 60, 90 and 120 minutes to determine the plasma levels of glucose and insulin. Thereafter, the area under the curve (AUC) of each meal was calculated using trapezoidal rule and then, GI, GL and II were calculated using appropriate formula. $P<0.05$ was considered as statistically significant.

Results: Wheat meal had the lowest GI, GL and II amongst the three meals. Also, the glucose mean area under the curve (AUC_G) of wheat was significantly lower compared with the reference meal. There were no significant differences in AUC_G of amala and cowpea meal when compared with the reference meal. Furthermore, the insulin mean AUC (AUC_I) of wheat meal was significantly lower when compared with the reference meal and cowpea meal.

Conclusion: Wheat meal had the lowest GI, lowest glycaemic response and provoked less insulin release compared with amala and cowpea meal. Therefore, consumption of whole, unprocessed wheat meal might be helpful in the prevention and management of diabetes mellitus.

Keywords: *Glycamic response, insulin index, Nigerian meals, wheat.*

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Résumé

Contexte: Il existe des rapports disponibles sur les indices glycémiques (IG) de certains régimes locaux nigérians, mais il y a une pénurie d'informations sur les réponses insulinogeniques aux régimes, qui sont également essentielles dans la prévision et la gestion des maladies chroniques. Par conséquent, cette étude a été réalisée pour déterminer l'IG, la charge glycémique (CG) et l'index d'insuline (II) de certains régimes nigérians consommés couramment.

Matériels et méthodes: Douze mâles apparemment en bonne santé ont été recrutés dans cette étude croisée randomisée. Un test de tolérance au repas (TTR) a été effectué sur chaque participant, après un jeûne de nuit, en utilisant 50g de glucides disponibles de pâte de farine d'igname (amala), de pâte de blé et de niébé cuite avec 50g de glucose comme repas de référence. Le sang veineux a été recueilli à 0 minute, puis de manière postprandiale à 30, 60, 90 et 120 minutes pour déterminer les taux plasmatiques de glucose et d'insuline. Par la suite, l'aire sous la courbe (ASC) de chaque repas a été calculée en utilisant la règle trapézoïdale et ensuite, GI, CG et II ont été calculés en utilisant la formule appropriée. $P<0,05$ a été considéré comme statistiquement significatif.

Résultats: Le repas de blé avait l'IG, CG et II plus bas parmi les trois repas. De plus, la surface moyenne du glucose sous la courbe (ASC_G) du blé était significativement plus faible par rapport au repas de référence. Il n'y avait pas de différences significatives dans l'ASC_G de l'amala et de la farine de niébé par rapport au repas de référence. De plus, l'ASC moyenne (AUC_I) de l'insuline de la farine de blé était significativement plus faible que celle du repas de référence et de la farine de niébé.

Conclusion: Le repas de blé a présenté la plus faible IG, la réponse glycémique la plus faible et a provoqué moins de libération d'insuline comparativement à l'amala et au niébé. Par conséquent, la consommation de farine de blé entière non transformée pourrait être utile dans la prévention et la gestion du diabète sucré.

Mots-clés: *Réponse glycémique, indice d'insuline, repas nigérian, blé*

Introduction

Nutrition is an intricate issue with myriads of factors and variables which impact on metabolic health and incidence of disease [1]. It is therefore not surprising that medical nutrition therapy remains a cornerstone in the prevention and management of chronic diseases such as diabetes. Almost four decades ago, Burkitt and Trowell [2] propounded the dietary fiber hypothesis which showed that foods that are high in fiber are protective against certain metabolic diseases due to the ability of fiber to reduce the rate of nutrient influx from the gut. Observational studies have also shown that high intake of whole grains, is associated with lower body mass index (BMI), improved insulin sensitivity, reduced risk of type 2 diabetes mellitus (T2DM) and of premature death [3-5].

An extension of the dietary fiber hypothesis, known as glycaemic index (GI) concept, was reported in 1980 [6]. It is a measure used to assess the blood glucose raising potential of the available carbohydrate in high carbohydrate foods [1]. Invariably, it is an index of glycaemic response of a fixed amount of available carbohydrate from a test food to the same amount of available carbohydrate from a standard food (glucose or white bread) consumed by the same person [7-9]. Epidemiological and dietary intervention studies suggest that a low GI diet is beneficial for blood glucose control especially, in patients with T2DM. In contrast, foods with high GI contribute to insulin resistance, increased T2DM risk, obesity, cardiovascular disease and cancer [10,11].

Another concept which quantifies the impact of a carbohydrate-containing meal or a single food eaten in a "normal" portion has on blood glucose level is called glycaemic load (GL) [12]. It is a measure of the potency of a carbohydrate food on glycaemia and is calculated using the GI and the grams of available carbohydrate in the portion size [1]. Although there have been controversies over the clinical applications of GI and GL especially, in nutritional epidemiology, these concepts still remain important in planning for many dietary interventions. However, the GI and GL concepts do not reflect, in its entirety, the relationship between dietary factors and physiological insulin secretion provoked by foods. Therefore, comprehensive understanding of this relationship could be important in the dietary management and prevention of chronic diseases [13]. The quest for this understanding led to the development of insulin index concept which is used to classify foods according to their postprandial insulin response [14]. The index is similar to GI and GL, but rather than relying on blood glucose levels, it is based on blood insulin levels. As it is well known that carbohydrate is the primary stimulus for insulin secretion, protein rich foods are also known insulin secretagogue and, when combined with carbohydrate, act synergistically to raise insulin concentrations and reduce glycaemia [15,16]. This concept thus has an advantage of taking care of all food contents and not the carbohydrate content only as all dietary components and their metabolic interactions need to be considered in order to allow for an all-inclusive approach to determining insulin demand [13].

Insulin index concept has been shown to be useful in the management of type 1 diabetes mellitus and hyperlipidaemia [17]. It has been shown that consumption of low GL foods results in a reduced postprandial rise of insulin [18]. Furthermore, slow gastric emptying, decreased hunger, increased satiety, and decreased voluntary food intake are associated with low GI/GL meals [19-21]. Although there are available reports on GI of some commonly consumed Nigerian diets, there is paucity of information on the postprandial insulin response to the diets which could be vital in energy recommendation. This study was therefore carried out to provide information on this gap in knowledge with the hypothesis that there are potential differences in GI and insulin responses following the ingestion of selected Nigerian diets.

Methodology

Study participants

Twelve apparently healthy males with regular eating habits were enrolled into this randomized cross-over study. They were adults (25 – 35 years), non-smokers and were neither underweight nor overweight. All the participants had no thyroid disease, metabolic disorders such as diabetes mellitus and were not allergic to any of the selected local diets. Also, the participants had no gastrointestinal disease and had no history of abdominal surgery or family history of diabetes.

Ethical consideration

This study was reviewed and approved by the University of Ibadan/University College Hospital (UI/UCH) Joint Ethics Committee. Also, written informed consent was obtained from each study participant.