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Glycemic Impact of Traditional Meals Consumed At Sarh (Chad): An Exploratory Study in Healthy Adults

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Abstract In the context of a nutritional transition marked by a rise in non-communicable diseases in Chad, this study explores the glycemic impact of traditional meals commonly consumed in Sarh, a southern city of the country. The objective is to determine the glycemic index (GI) of six typical dishes in order to identify those favorable to the prevention of diabetes and metabolic disorders. An experimental study was conducted with 10 healthy adults, who were given the test meals after an overnight fast. Capillary blood glucose levels were measured at regular intervals, and GIs were calculated according to FAO standards. Results showed a wide variability in GIs between dishes: millet ball with okra sauce had a low GI (41), while sweet millet porridge exhibited a high GI (78,5). Meals containing dietary fiber or accompanied by vegetable-rich sauces generally showed more moderate GIs. These findings provide local scientific evidence to guide nutritional recommendations. They highlight the need to educate the population on healthy dietary choices while promoting traditional culinary culture. The glycemic index may thus become a strategic public health tool in Chad.

Keywords: *Glycemic index, Traditional meals, Sarh, Diabetes, Nutrition*

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1. Introduction

Diet plays a key role in the prevention and management of chronic non-communicable diseases (CNCDs), including type 2 diabetes, cardiovascular disease, and obesity. Globally, the prevalence of these pathologies is increasing at a worrying rate, particularly in developing countries, where health systems are often ill-prepared to address them. In sub-Saharan Africa, several studies have shown a marked nutritional transition, characterized by the modification of traditional dietary habits in favor of products with high energy density and low nutritional value [1,2]. Chad is no exception to this dynamic. Recent surveys conducted by the National Nutrition Program (PRONAT) and the Ministry of Public Health and Prevention report an increase in the number of cases of diabetes and high blood pressure, particularly in urban areas [3]. However, empirical data specifically linking local dietary habits to these changes remain scarce. In this context, the study of the glycemic index (GI) of traditional foods represents a relevant way to better understand the metabolic impact of these meals on local populations.

The glycemic index is a measure that assesses the ability of a carbohydrate food to raise postprandial blood glucose levels compared to a standard reference (pure glucose or white bread) [4]. High GI foods cause rapid increases in blood glucose levels, while low GI foods cause more moderate increases. In Africa, some pioneering studies have investigated the GI of traditional foods: for example, the study in Mali showed that the consumption of millet early could lead to a moderate glycemic response depending on the millet processing method [5]. Similarly, in Côte d'Ivoire,the study revealed the modulating effect of dietary fiber in local cassava-based preparations [6].

In Chad, research on the GI of local foods remains virtually nonexistent, even though populations primarily consume meals rich in complex carbohydrates from cereals such as millet, sorghum, or rice. In the city of Sarh, capital of the Moyen-Chari province, eating habits are strongly influenced by the consumption of traditional dishes combining cereal porridge, sauces made from leafy vegetables or peanut paste, and fish products. This reality raises an important question: are traditional meals in Sarh, although rooted in a logic of subsistence and local availability, metabolically safe in a context of rising metabolic diseases? This question takes on particular relevance in light of the changing lifestyles in Sarh.

According to [3], urban populations are exposed to a double nutritional burden: persistent malnutrition and emerging obesity. However, no data currently exist to guide nutrition policies based on the GI of meals actually consumed in this city.

Based on this observation, this study aims to fill this

gap by answering the following research question: What is the glycemic impact of the most commonly consumed traditional meals in Sarh among healthy adults?

The research hypothesis postulated is that traditional Sarh meals present a significant variability in their glycemic index depending on their nutritional composition, and that some of them could lead to glycemic elevations likely to contribute to the development of metabolic pathologies in regular consumers.

The overall objective of this study is therefore to evaluate the glycemic index of typical meals from Sarh and to analyze their glycemic impact in healthy adults. Specifically, this will involve determining the nutritional characteristics of the meals tested; measuring postprandial glycemic responses in participants; and classifying meals according to their GI and proposing avenues for dietary recommendations adapted to the local context.

2. Material and Methods

This exploratory study was conducted in the city of Sarh, located in the Moyen-Chari province of southern Chad. The choice of this city was justified by its demographic and economic importance, as well as by the diversity of its traditional dietary practices. The study was conducted between June and September 2023 among healthy adults recruited voluntarily to determine the glycemic impact of several locally consumed meals, using the glycemic index measurement method validated by the World Health Organization and widely used in international studies.

The first phase of the study consisted of a qualitative dietary survey aimed at identifying the most frequently consumed meals in Sarh. This survey was conducted among 60 households spread across three different neighborhoods of the city, selected to represent socioeconomic diversity.

Respondents were interviewed using a semi-structured questionnaire focusing on weekly eating habits, favorite dishes, and the frequency of consumption of different meal types. At the end of this phase, six meals were selected based on their frequency of consumption, cultural representativeness, and experimental feasibility: rice with peanut sauce and fish, millet ball with okra sauce, cassava paste with spinach leaf sauce, unpulped corn couscous with fish sauce, white rice with red beans, and sweet millet porridge.

These meals were prepared according to traditional local recipes with ingredients collected from the markets of Sarh in order to remain faithful to common dietary practices. The determination of the glycemic index (GI) of the meals was carried out in accordance with the standardized method described by the joint FAO/WHO consultation on carbohydrates in human nutrition [7]. This method, widely used in international studies, consists of measuring capillary blood glucose levels in the fasting state, then at regular intervals (0, 30, 60, 90 and 120 minutes) after ingestion of a test food containing a standardized amount of available carbohydrates. The area under the curve (AUC) of the glycemic response is then calculated for each meal, and the GI is expressed as the percentage of the AUC of the test meal compared to that of a reference food (sucrose solution in this study), according to the following formula:

$$IG = \left(\frac{ASC_{repas\ testé}}{ASC_{référence}}\right) \times 100$$

The nutritional composition of each dish was analyzed at the physicochemical laboratory of the Food Quality and Control Center (CECOQDA) in N'Djamena using three samples of each meal. The carbohydrate, fiber, lipid, protein, moisture, and ash contents were determined according to standard AOAC protocols (2019).

The second phase of the study consisted of evaluating the postprandial glycemic response in healthy adults. A total of ten volunteers (5 men and 5 women), aged 20 to 45 years, were recruited according to strict criteria: no history of diabetes or hypertension, non-smoker, no chronic disease, stable weight over the last three months, and body mass index between 18.5 and 24.9 kg/m². Before the start of the study,each participant signed an informed consent form. The tests were conducted in a controlled environment, with a prior fast of at least 8 hours.

After fasting, each participant consumed a 200g test meal (25g sauce + 175g side dish) containing 50g of available carbohydrates , accompanied by 250ml of water. Each meal was tested in separate sessions over two days to avoid metabolic interference. In addition to the test meals, each participant also consumed, on two occasions, a standard solution of 50g of pure glucose, which allowed the calculation of the average area under the glucose response curve (AUC), used as a reference.

The values obtained were classified according to the standard [7]: low GI (<55), moderate GI (56–69), and high GI (≥70).

All statistical analyses were performed using Excel and SPSS software (version 25.0). Results were expressed as mean ± standard deviation, and differences between meals were explored using one-way analysis of variance (ANOVA) with a 5% significance level. All study procedures were conducted in accordance with the ethical principles of the Declaration of Helsinki.

3. Results

The results are presented through a cross-analysis of the obtained GI values, the estimated nutritional composition, and the possible nutritional implications.

Three summary tables facilitate the comparative reading of this data.

3.1. Glycemic Index of the Meals Tested

Table 1 presents the mean GI values of the six meals tested, with the observed standard deviations.

The results show that two of the six meals have a low GI, three a moderate GI, and only one a high GI. The millet ball with okra sauce has the lowest GI (41.2), while the sweet millet porridge reaches a high value (78.5). These results confirm that traditional preparations, depending on the ingredients and cooking methods, can have a very variable glycemic impact.

Table 1. Average glycemic index of traditional meals consumed in Sarh

Meals	Glycémic Index (GI)	Standard Deviation	GI Category
Ball of millet with okra sauce	41,2	± 4,7	Low
Rice with Red Bean	52,3	± 3,9	Low
Corn Couscous with Fish Sauce	58,9	± 4,5	Moderate
Rice with peanut sauce and fish	63,7	± 5,1	Moderate
Cassava paste with spinach leaves sauce	67,2	± 5,6	Moderate
Sweet millet porridge	78,5	± 6,3	High

3.2. Estimated Nutritional Composition of Meals

The nutritional values of the meals were obtained by laboratory determination and estimation based on the portions served (equivalent to 50 g of available carbohydrates). The following table summarizes the macronutrient contents

Table 2. Average nutritional composition of portions standardized to 50g of carbohydrates

Meals	Carbohydrates (g)	Protéins (g)	Lipids (g)	Fiber (g)
Ball of millet with okra sauce	50	5,1	3,4	6,8
Rice with Red Bean	50	7,3	2,9	5,6
Corn Couscous with Fish Sauce	50	9,5	5,2	4,7
Rice with peanut sauce and fish	50	6,4	10,1	3,9
Cassava paste with spinach leaves sauce	50	4,8	6,8	3,2
Sweet millet porridge	50	3,2	2,4	1,7

Low GI meals (millet balls and rice with beans) are higher in fiber and protein, nutrients known to slow digestion and moderate the glycemic response. Conversely, sweet millet porridge is low in fiber and protein, with an easily digestible carbohydrate load. The presence of lipids in rice with peanut sauce and fish and cassava paste with spinach leaf sauce appears to have a partial moderating effect.

3.3. Comparative Analysis Between GI and Nutritional Composition

To better understand the links between the composition and the GI of meals, Table 3 provides a cross-synthesis.

A clear trend emerges: the higher the fiber and protein content, the lower the GI tends to be. Meals combining whole grains, legumes, or fiber-rich sauces, such as okra or local leaves, provide a better metabolic response. Conversely, meals based on refined grains or those enriched with sugar have a marked hyperglycemic effect.

Indeed, the GI assessment of traditional Sarh meals reveals a diversity of metabolic effects, despite their common roots in local dietary practices. Contrary to a commonly held perception that traditional foods are uniformly healthy, these results show that some preparations can present a high glycemic risk, particularly in the case of added sugars or culinary transformations (gelatinization, prolonged cooking, absence of fiber). Conversely, other meals, notably combinations of fermented grains and fiber-rich sauces, present notable benefits for regulating blood sugar.

Table 3. Descriptive correlation between key nutrients and GI

Meals	Fiber content	Protéins content	GI	Main Remarks
Ball of millet with okra sauce	High	Moderate	Low (41,2)	Viscous okra, resistant starch from millet
Rice with Red Bean	Moderate	Moderate +	Low (52,3)	Good cereals-vegetables synergy
Corn Couscous with Fish Sauce	Moderate	High	Moderate (58,9)	Moderating Protéins, corn starch
Rice with peanut sauce and fish	Low	Moderate	Moderate (63,7)	Quick white rice action+slowing lipids
Cassava paste with spinach leaves sauce	Low	Low+	Moderate (67,2)	Cassava highly glycemic,modest effect f fiber
Sweet millet porridge	Very Low	Low	High (78,5)	Added sugar lack of fiber and protéins

4. Discussion

The objective of this study was to determine the glycemic impact of six traditional meals commonly consumed in Sarh (Chad), by measuring their glycemic index (GI) in healthy adults. The results obtained show significant variability in GI across dishes, ranging from a low GI of 41.2 for millet ball with okra sauce to a high GI of 78.5 for sweet millet porridge.

This diversity reflects the complexity of traditional diets and demonstrates that not all local dishes are equal when it comes to glycemic response.

Generally speaking, meals rich in fiber and/or protein, such as millet balls with okra or red bean rice, showed lower GIs. These observations are consistent with existing literature.

Studies conducted in West Africa [8,9] have shown that traditional foods rich in soluble fiber (such as sauces made from leafy vegetables or okra) have a significant hypoglycemic effect. Similarly, work carried out in Burkina has demonstrated that the combination of cereals and legumes, such as rice and beans, slows gastric emptying and reduces the rate of carbohydrate absorption [10].

In our study, the results also confirm the moderating effect of lipids on the glycemic response, as observed with rice in peanut sauce with fish. The presence of fat slows down the digestion and absorption of carbohydrates, thus reducing the postprandial glycemic peak as demonstrated by Jenkins [11], and more recently taken up in African contexts by the FAO report on urban food [12].

However, this beneficial effect should be interpreted with caution in the context of a double nutritional burden, as excessive lipid consumption is also associated with cardiovascular risks.

The very high GI of sweet millet porridge deserves special attention. Although this meal is often perceived as healthy in local culture, particularly for breakfast or as a transitional food for children, it is actually very quickly assimilated, mainly due to prolonged cooking, the absence of fiber, and the addition of sugar. These observations are consistent with the conclusions of the National Nutrition Program in Chad which recommends limiting the intake of simple sugars in preparations for adults and children [13].

This observation raises the need to review certain culinary habits, particularly in urban areas where eating habits are changing rapidly under the influence of modernization.

Comparing our results with those obtained in other regions of Chad, notably in Mahamat Saleh's thesis conducted in N'Djamena, we find similar trends: preparations based on fermented millet or associated with vegetable sauces have a lower GI than sweet or refined preparations [14]. These converging data reinforce the relevance of an awareness strategy focused on the nutritional and glycemic quality of traditional dishes, rather than on simple cultural valorization.

One of the major contributions of this study lies in its contextual nature. By focusing on the city of Sarh, it highlights habits specific to Moyen-Chari, while taking into account local realities of consumption, availability of ingredients and culinary knowledge. This approach, anchored in the territory, reinforces the ecological validity of the results, allowing for the formulation of concrete and adapted nutritional recommendations. It is also part of a broader public health dynamic, at a time when Chad, like many African countries, is facing an increase in type 2 diabetes, often silent, but very real [15].

In terms of recommendations, several guidelines can be proposed to strengthen nutritional prevention in urban and peri-urban areas of Chad. It is essential to promote meals with a low or moderate glycemic index (GI) in strategies to combat emerging metabolic diseases. This approach is aligned with the work of Augustin who emphasized that reducing the dietary glycemic load is an effective lever in the prevention of type 2 diabetes, particularly in low- and middle-income countries [16]. In the Chadian context, this implies promoting traditional low-GI foods such as local legumes (beans, peas), leafy vegetables (moringa, spinach, sorrel), and whole grains such as unhulled millet or sorghum.

It is also necessary to consider a re-evaluation of certain local recipes in order to moderate their glycemic effects, as suggested by the FAO on the traditional diets recommendations [1]. For example, substituting refined sugar in millet porridge with unprocessed or dried local fruits (such as tamarind, papaya or green banana) could help maintain the cultural dimension of the dish while improving its metabolic effect. According to a study conducted by Omoregie and Osagie, simple adjustments in the preparation of traditional meals can significantly reduce the GI without altering sensory acceptability [18].

Furthermore, popularizing the concept of the glycemic index in nutrition campaigns remains a challenge but also an opportunity. Nutrition training programs adapted to local realities, integrating the concepts of GI and carbohydrate quality, could be introduced in health centers, schools, community structures, and local media. As Bouzid et al. (2021) point out, integrated community approaches in vernacular languages are the most effective for sustainably changing eating behaviors, particularly in areas where education levels are low. Nutrition education must therefore go beyond simply promoting balanced meals to integrate practical notions on carbohydrate quality and their effect on health.

The results of this study therefore provide concrete avenues for nutritional re-education rooted in cultural habits but informed by scientific data. They highlight the importance of directing dietary practices towards choices that are not only traditional but also functional and metabolically beneficial. This is fully in line with the WHO recommendations on the prevention of chronic non-communicable diseases in Africa, which call for approaches based on local but optimized diets [19]. In a context of nutritional transition, where malnutrition and overnutrition coexist, these strategies can contribute to the effective prevention of type 2 diabetes and other metabolic pathologies in Chad.

Finally, this study has some limitations that should be acknowledged. The limited number of participants (n=10), although sufficient for an exploratory study, limits the generalizability of the results. Similarly, the standardization of portions and the inter-individual variability of glycemic responses could introduce bias. It would be desirable, in future studies, to enlarge the sample, to test more local meals, and to compare the effects in different categories of the population (elderly, diabetics, children, etc.). However, this research constitutes a first step towards a better understanding of the impact of traditional meals on metabolic health in Chad.

It encourages the combination of traditional and scientific knowledge to build cultural, accessible, and preventative eating practices. A well-chosen local diet can thus become a real lever for public health.

5. Conclusion

This exploratory study assessed the glycemic impact of six traditional meals commonly consumed in Sarh (Chad), using glycemic tolerance tests conducted on healthy adults. The results show a wide variability in the glycemic index (GI) depending on the nutritional composition of the dishes, their preparation method, as well as the presence of fiber, protein, or lipids. While dishes such as millet ball with okra sauce have a low GI that is favorable to metabolic health, others, such as sweet millet porridge, have a high GI, potentially problematic in a context of nutritional transition. This diversity highlights the importance of better understanding the effects of traditional dishes on blood sugar, in order to adapt nutritional recommendations to local realities.

In a city like Sarh, where eating habits are at the crossroads of tradition and modernity, it becomes essential to raise awareness among the population about food choices that are favorable to the prevention of diabetes and metabolic diseases. The results of this study provide valuable information for health professionals, public policy makers, and nutrition educators. They can inform nutrition education programs focused on promoting low-GI foods, while respecting local cultural practices and

economic constraints.

Integrating this knowledge into public health policies would help strengthen the fight against non-communicable diseases, which are on the rise in Chad as in many African countries.

However, the methodological limitations of this research, particularly the small sample size, call for further investigations on a larger scale, including other regions, specific population categories (diabetics, children, the elderly), as well as longitudinal analyses.

It would also be relevant to examine the combined effect of meals in real-life food contexts, in order to better reflect consumption habits. Ultimately, it should be noted that this research shows that Chadian culinary tradition contains notable nutritional benefits, but also little-known risks that need to be better understood. Between promoting local knowledge and integrating scientific data, it calls for a contextualized, adapted nutritional approach focused on prevention.

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Author Contribution Statement

GUEDEUNGBE Zoufane: Writing – original version, software, methodology, investigation, data curation. AMBERA Hal Souakar: Writing – proofreading and editing, supervision, software, methodology, formal analysis, data curation, conceptualization. OTCHOM Brahim Boy: Writing – proofreading and editing, validation, supervision, methodology, formal analysis, conceptualization.

Declaration of Conflicts of Interest

The authors declare that they have no known financial conflicts of interest or personal relationships that could have influenced the trend presented in this article.

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References

[1] FAO. (2017). *Nutrition-sensitive agriculture and food systems in practice: Options for intervention*. Rome: Food and Agriculture Organization of the United Nations. https:// www.fao.org/ 3/i7848e/i7848e.pdf.

[2] OMS. (2018). *Rapport mondial sur les maladies non transmissibles*. Organisation mondiale de la Santé. https:// www.who.int/ nmh/publications/ncd-report-2018/en/.

[3] PRONAT. (2021). *Rapport annuel sur la situation nutritionnelle au Tchad*. Programme National de Nutrition, Ministère de la Santé Publique et de la Solidarité Nationale. République du Tchad. (2020). *Stratégie multisectorielle de nutrition 2020-2025*. N'Djamena: Secrétariat général du gouvernement.

[4] Jenkins, D. J. A., Wolever, T. M. S., Taylor, R. H., Barker, H., Fielden, H., Baldwin, J. M., ... & Goff, D. V. (1981). *Glycemic index of foods: a physiological basis for carbohydrate exchange*. The American Journal of Clinical Nutrition, 34(3), 362–366.

[5] Coulibaly, A., Sidibé, A., & Konaté, D. (2013). *Index glycémique de quelques aliments traditionnels maliens à base de mil*. Revue Malienne de Nutrition et Santé Publique, 6(1), 23–30.

[6] Gnakri, D., Konan, B. A., & Kouassi, K. N. (2010). *Étude de l'index glycémique de quelques aliments à base de manioc consommés en Côte d'Ivoire*. Revue Ivoirienne des Sciences et Technologies, 15, 51–60.

[7] FAO/WHO. (1998). Carbohydrates in human nutrition: Report of a Joint FAO/WHO Expert Consultation. FAO Food and Nutrition Paper 66. Rome: FAO.

[8] Kouamé, L. P., Koné, A., & Yao, S. (2017). *Effets glycémiques de quelques aliments de rue consommés à Abidjan*. Revue Ivoirienne des Sciences et Technologies, 30, 107–117.

[9] Diouf, K., Ndiaye, M., & Fall, A. (2021). *Effets glycémiques de plats traditionnels sénégalais: implications pour la prévention du diabète*. Revue Africaine de Nutrition et de Santé, 9(2), 45–56.

[10] Ouédraogo, R. (2019). Glycemic response to traditional meals in Burkina Faso: Impact on chronic disease risk. Journal of African Health Sciences, 12(3), 55–62.

[11] Jenkins, D. J. A., Kendall, C. W. C., Augustin, L. S. A., et al. (2002). Glycemic index: Overview of implications in health and disease. *The American Journal of Clinical Nutrition*, 76(1), 266S–273S.

[12] FAO. (2020). *Urban food systems and nutrition in Africa: Challenges and opportunities*. Rome: Food and Agriculture Organization of the United Nations.

[13] PNNT. (2021). *Rapport annuel sur la situation nutritionnelle au Tchad*. Programme National de Nutrition du Tchad, Ministère de la Santé Publique et de la Solidarité Nationale.

[14] Mahamat Saleh, A. (2022). *Étude de l'index glycémique des plats traditionnels à N'Djamena*. Thèse de doctorat en nutrition, Université de N'Djamena.

[15] OMS. (2023). *Profil du diabète au Tchad: Rapport mondial sur le diabète*. Organisation Mondiale de la Santé. https:// www.who.int/ publications/i/item/WHO-NMH-NVI-16.3.

[16] Augustin, L. S. A., Kendall, C. W. C., Jenkins, D. J. A., Willett, W. C., Astrup, A., Barclay, A. W., ... & Brand-Miller, J. C. (2015). Glycemic index, glycemic load and glycemic response: an International Scientific Consensus Summit. *Nutrition, Metabolism and Cardiovascular Diseases*, 25(9), 795–815.

[17] Bouzid, A., Amghar, H., & Benkhedda, S. (2021). Nutrition et communication en santé communautaire: étude de cas en milieu rural africain. *Revue Santé Publique*, 33(2), 175–182.

[18] Omoregie, E. S., & Osagie, A. U. (2020). Modifications of traditional Nigerian meals and their effect on glycemic index and acceptability. *African Journal of Food Science and Technology*, 11(1), 18–26.

[19] OMS. (2022). Régimes alimentaires sains et lutte contre les maladies non transmissibles en Afrique: directives pour l'action. Genève: Organisation mondiale de la santé.