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Nutrient Intake and Impact of the Consumption of Two Street Foods (Garba and Rice Eggplant Sauce) in Humans

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Abstract

Many lifestyle factors can affect health, but nutrition is an important, modifiable, and powerful factor in promoting health, preventing and treating disease, and improving quality of life. Inadequate dietary intake, regardless of the cause, can have negative effects on human growth and development. Analysis of tuna "Garba" and rice with eggplant sauce consumed in Abidjan (Côte d'Ivoire) revealed low levels of water-soluble B vitamins. Also, the analysis of these dishes observed the presence of histidine, leucine, valine, glutamine, arginine, cysteine and alanine. The tuna "Garba" (Gab) dish showed levels in amino acids ranging from 69.8 ± 1.33 to 764 ± 2.08 mg/kg and 77.1 ± 1.95 to 754.67 ± 2.8 mg/kg in the eggplant sauce rice (Risa) dish. During 15 days of consumption of these dishes by the wistar rats, anthropometric parameters, namely body length and abdominal circumference, showed a significant increase in the rats consuming the rice eggplant sauce. The rats showed BMI, Lee's Index and Adipocyte Index ranged from 0.27 ± 0.01 to 0.31 ± 0.01 g/cm^2; 0.25 ± 0.01 to 0.26 ± 0.00 cm and 1.67% ± 0.25% to 1.96% ± 0.21% respectively. The nutritional profiling of these two street foods by LIM and SAIN score presented poor profiles.

Keywords

Nutritional Values, Tuna Garba, Rice Eggplant Sauce, Nutritional Profiling, Abidjan (Côte d'Ivoire)

1. Introduction

Population health is currently the focus of much attention due to the high prevalence of chronic diseases [1] [2]. Having a healthy and balanced diet is one of the most effective ways to prevent chronic diseases and excessive weight gain [3]. Therefore, educating people to develop good eating habits is an important health prevention goal. Street food is a variety of ready-to-eat or home-prepared foods and beverages that can be consumed on the street without further preparation [4]. These foods are typically marketed by vendors and hawkers on the street or in other similar public places. Although street foods are valued for their unique flavor and convenience, they also contribute significantly to the nutritional status of the population [5]. According to the FAO, approximately 2.5 billion people eat street food every day [6]. Indeed, street food also provides food security for low- and middle-income people, a livelihood for the urban income population and a large portion of the population in many developing countries [7]. In Africa, this industry occupies areas of high economic activity and high population concentration [8]. These diets widespread well as elsewhere than in Côte d'Ivoire, affect daily eating habits of millions of urban residents [9]. In Côte d'Ivoire, especially in Abidjan, there are so many kinds of street food sold, among which Garba and rice eggplant sauce occupy an important place on the market and socio-economic. Indeed, Garba is composed of cassava semolina (attiéké), fried fake tuna, fresh chillies, tomatoes, fresh onions, and is sometimes accompanied by mayonnaise and cooking broth (maggi cube) [10]. Rice is a cereal grown in tropical, subtropical and warm temperate regions, and its fruit is rich in starch. It is the world's main cereal for human consumption [11]. With different sauces according to the customers' preferences, these street meals are part of the local essential foods and prized by Ivorians [12]. Given their importance of consumption by all age groups and social classes, it would be important to evaluate its impact in human development and growth. Thus, the objective of our study is to evaluate the nutritional contribution of these dishes and its impact on humans in order to contribute to the nutritional and health security in the Ivorian.

2. Material and Methods

2.1. Material Biological

It is composed of "Garba' rice with eggplant sauce" and the young rats (*Rattus norvegicus*). The food used for testing was purchased at the market from traders in the communes of the Autonomous District of Abidjan (Côte d'Ivoire). The young rats raised in the Biology and Health laboratory were recovered from their mothers after weaning.

2.2. Methods

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2.2.1. Site and Sample Collection

A total of two hundred samples of "Garba" and rice eggplant sauce were randomly purchased from vendors and restaurant owners located in Abobo, Cocody and Yopougon, three communes in the Autonomous District of Abidjan. Sampling was carried out every day over a period of ten days. The samples were collected in their various sales packages (Photograph 1), placed in coolers and transported to the laboratory of the Biological Resource Centers (CeReB) of the Institut Pasteur de Côte d'Ivoire (IPCI) for biochemical analysis.

Photograph 1. Garba and rice eggplant sauce bought from the shopkeepers.

2.2.2. Preparation of Sample

In the laboratory, the dishes were weighed using a precision balance. Once weighed, these dishes were removed from their packaging and boned (remove the fish bones). Then, all the dishes from each commune were put together, crushed and homogenized to make a single dish of Garba and rice with eggplant sauce in order to compensate for certain variabilities due to the method of cooking and the use of ingredients. These dishes were reweighed and freeze-dried to obtain the different flours for the different analyses (**Figure 1**).

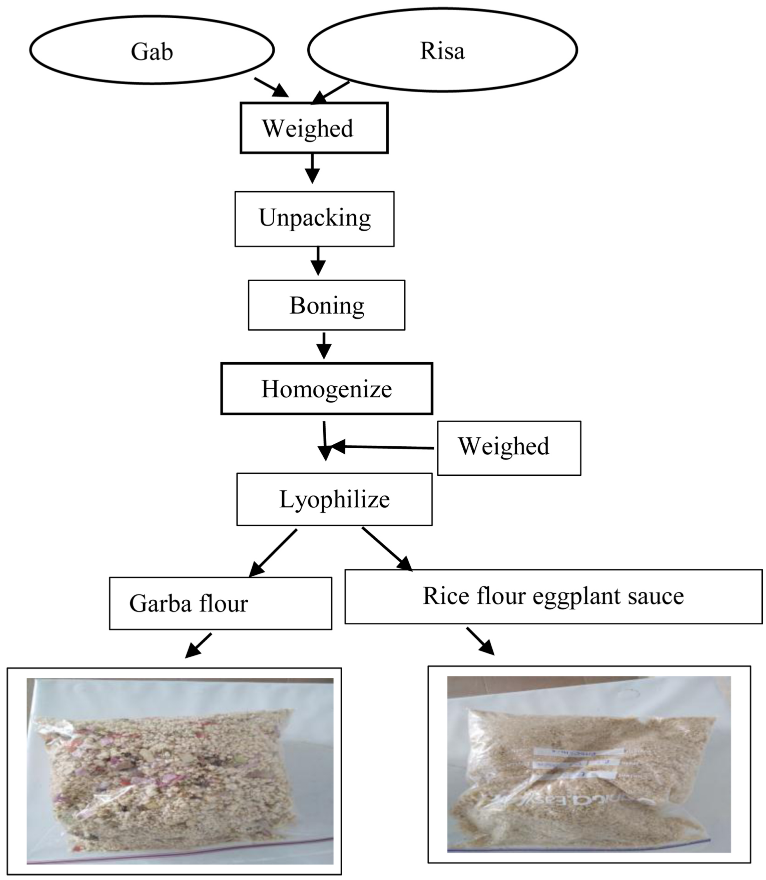

Figure 1. Flour production diagram for different dishes.

2.2.3. Animals and Diet

Wistar rats (*Rattus norvegicus*) of both sexes (n twenty; Biology and Health animal house of the UFR BIOSCIENCES of the University Félix Houphouët-Boigny Abidjan, Côte d'Ivoire) weighed between 50 and 60 g on average and aged 45 ± 5 days were individually housed in metabolic cages equipped with urine and fecal separators, in temperature-controlled rooms (25˚C to 26˚C), with 12 hours of daylight and a 12-hour period of darkness, and the humidity percentage was 70% to 80%, with free access to food during the entire experimental period. Rats were fed a formulated control diet (RTP) rich in herring fish (*Clupea harengus*) protein with the following composition: 65% Corn starch (Merck), 16% protein, 8% mineral blend formula AIN 93M [13] and vitamin blend formula AIN 76A [14], 3% Agar-agar cellulose and 8% palm vegetable oil, a control diet without protein (RSP) isocaloric consisting of all the ingredients mentioned except protein, one diet composed of tuna "Garba" dishes (Gab) and one dish composed of rice eggplant sauce (Risa) all freeze-dried and submitted to the rats for fifteen days.

2.2.4. Proximal and Mineral Analyses

Proximal analyses were performed in triplicate on the samples. This analysis included the following: moisture, total lipids, crude protein, carbohydrates and ash. Moisture content was estimated by drying the samples to a constant weight at 105˚C using the oven method [15]. Lipid determination was performed by the Soxhlet extraction method. The ash content was determined by igniting the sample at 550˚C in a muffle for a period of 5 - 6 hours until the sample was completely free of carbon particles while total nitrogen was determined by the Kjeldahl method as described by Vlieg [16] and a factor of 6.25 was used to convert the total nitrogen to crude protein content of the samples. The total carbohydrate content was calculated by using the equation: 100 − (%moisture + %proteins + %lipids + %ash) [17]. Mineral analyses were performed according to the method [18]. The contents of minerals, including Calcium, Sodium, Potassium, Phosphorus and Iron were analyzed using an atomic absorption spectrophotometer (model SHIMADZUS 5, type A.A-6200).

2.2.5. Determination of Water-Soluble Vitamins

The contents of water-soluble vitamins were described by Rougereau [19] and determined by high performance liquid chromatography (HPLC) type SHIMADZU SPD 20A equipped with a UV detector (PAD) at 325 nm and C18 ODS column (250 × 4.6 of Cluzeau de France).

2.2.6. Determination of Some Amino Acids

The extraction of some amino acids was performed according to the modified method [20]. 1 g of delipidated sample powder prepared in 10 mL of 6N HCl was dried at 110˚C in an oven for 24 h and then under nitrogen flow. The dry residue was taken up in 10 mL of 0.2 N sodium citrate at pH 2.3. The homogenized mixture was centrifuged at 3000 rpm for 25 min at 0˚C. The collected supernatant was filtered through a Whatman #4 paper and then through a 0.45 µm diameter millipore filter (Sartorius AG, Goëttingen, Germany). The treated supernatant was stored at −20˚C before analysis. The amino acid composition of the samples was determined after hydrolysis with 6 M HCl with 1% phenol at 150˚C for 60 minutes. The solvent used was a solution of sodium acetate (45 mM; pH 5.9) and a mixture of 30% sodium acetate (105 mM, pH 4.6) and 70% acetonitrile. The detector was selected at 280 nm.

2.2.7. Determination of Some Amino Acids

The extraction of some amino acids was performed according to the modified method [20]. 1 g of delipidated sample powder prepared in 10 mL of 6N HCl was dried at 110˚C in an oven for 24 h and then under nitrogen flow. The dry residue was taken up in 10 mL of 0.2 N sodium citrate at pH 2.3. The homogenized mixture was centrifuged at 3000 rpm for 25 min at 0˚C. The collected supernatant was filtered through a Whatman #4 paper and then through a 0.45 µm diameter millipore filter (Sartorius AG, Goëttingen, Germany). The treated supernatant was stored at −20˚C before analysis. The amino acid composition of the samples was determined after hydrolysis with 6 M HCl with 1% phenol at 150˚C for 60 minutes. The solvent used was a solution of sodium acetate (45 mM; pH 5.9) and a mixture of 30% sodium acetate (105 mM, pH 4.6) and 70% acetonitrile. The detector was selected at 280 nm.

2.2.8. Anthropometric Parameters of Young Rats Fed the Different Diets

1) Variation in body length (BL) and abdominal circumference (AC)

The variation in the dimensions of different parts of the body is a parameter that attests to the nutritional efficiency of different diets. Thus, body length (LB) and abdominal circumference (AC) were assessed using a non-stretchable plastic tape measure with an accuracy of 0.1 cm according to the method described by Silva [21].

For the length measurement, the lying young rat is held so that it does not move. Then the tape measure is placed so that it touches the nose at the tail and the measurement is taken. For the determination of AC, the rat was elongated and the measurement was taken by the hip circumference. The growth, reflected by the change in body length (CL) and abdominal circumference (AC) is obtained respectively by the difference between the final length and the initial length. It is expressed in cm.

$$\text{LB} = \text{Length}\left(\text{final} - \text{initial}\right) \tag{1}$$

$$\text{CA} = \text{Circumference}\left(\text{final} - \text{initial}\right) \tag{2}$$

With:

LB: Body length;

AC: Abdominal Circumference.

2) Determination of Lee's Index (LI), Adipocyte Index (AI) and Body Mass Index (BMI)

The following anthropometric parameters BMI, Adipocyte Index and Lee's Index were determined according to the calculation method of [22] [23] Thus, obesity was defined by a BMI greater than 0.68 g/cm^2.

$$\text{BMI} = \text{BW}/\text{BL} \tag{1}$$

$$\text{AI}\left(\%\right) = \text{TBF}/\text{FBW} \tag{2}$$

$$\text{LI} = \sqrt[3]{\text{PC}}/\text{BL} \tag{3}$$

With:

BW: Body weight;

BL: Body length;

$\sqrt[3]{\text{PC}}$: Cubic root of body weight;

TBF: Total body fat;

FBW: Final body weigh.

2.3. Nutritional Profile

The nutrient profile system is described according to the method of [24] whose principle is based on the formula for calculating the indicators.

$$\text{SAIN} = \frac{\dfrac{\left(\dfrac{\text{Protein}}{\text{ANC protein}} + \dfrac{\text{Fiber}}{\text{ANC fiber}} + \dfrac{\text{Vitamin C}}{\text{ANC vitamin}} + \dfrac{\text{Calcium}}{\text{ANC Ca}} + \dfrac{\text{iron}}{\text{ANC Iron}}\right) * 100}{5}}{\text{Denergy density}\left(\dfrac{\text{kcal}}{100\text{ g}}\right)}$$

$$\text{LIM} = \frac{\left[\dfrac{\text{Sodium}}{3153} + \dfrac{\text{SFA}}{22} + \dfrac{\text{added sugars}}{50}\right] * 100}{3}$$

With:

ANC Protein = 65 g; ANC Fiber = 30 g; ANC Vitamin C = 110 mg; ANC Calcium = 900 mg; ANC Iron = 12.5 mg. (SFA = amount of saturated fatty acids (g/100 g)).

The values of the SAIN and LIM obtained are plotted on a graph used to classify the foods into four (4) groups. The graph considers two thresholds of acceptability (SAIN > 5 and LIM < 7.5).

2.4. Statistical Analysis

All analyses were performed in triplicate. Results were then calculated using Microsoft Excel software (Microsoft Corporation, Redmond, WA) and followed by a nonparametric t-Student test for comparison of means using Graph Pad Prism 8 software. The significance level was set at ($P < 0.05$).

3. Results

3.1. Proximal and Mineral Composition

The proximal composition study of the dishes is presented in Table 1. The result shows that the levels of moisture, ash, total protein and total carbohydrates vary from 2.12 ± 0.03 to 72.38 ± 0.19 and are higher in the Risa than in the Gab. Lipid

Table 1. Proximal composition of the different dishes.

Parameters (g/100 g MS)	Dishes		
	Gab	Risa	p-value
Humidity (%)	56.56 ± 1.44^{a}	71.87 ± 0.2^{b}	0.0005
Ash	2.12 ± 0.03^{a}	2.52 ± 0.05^{b}	0.002
Fat	9.26 ± 0.01	4.62 ± 0.02	<0.0001
Protein	8.85 ± 0.03^{a}	12.45 ± 0.1^{b}	<0.0001
Carbohydrates	69.26 ± 0.12^{a}	72.38 ± 0.19^{b}	<0.0001

Gab: Garba Risa: Rice with eggplant sauce; DM: dry matter [25]. The mean values of 3 replicates followed by their standard deviations, assigned with the same letter do not show significant differences ($p > 0.05$) within the same line and the values assigned with different letters on the same line show a significant difference ($p < 0.05$).

levels were high in the Gab (9.26 ± 0.01 g/100 g DM) and Risa (4.62 ± 0.02). The proximal composition analysis revealed a significant difference ($p < 0.05$). The results of the mineral composition are presented in **Table 2**. The levels of macroelements (calcium, phosphorus, sodium and potassium) in the dishes obtained vary from 1357 ± 1.53 to 4512 ± 1.15 (mg/kg) with high levels of calcium, phosphorus and sodium in the Risa dish with a significant difference ($p < 0.05$) and a high content of potassium in the Gab dish 3723 ± 6.08 mg/kg. Regarding the trace element, the analysis of iron gave a content of 0.043 ± 0.00 mg/kg for the Gab dish and a content of 0.054 ± 0.00 mg/kg for the Risa dish. The statistical analysis showed no significant difference ($p > 0.05$).

Table 2. Mineral composition of different dishes.

Parameters (mg/kg)	Dishes		
	Gab	Risa	p-value
Calcium	1519 ± 0.58^{a}	2585 ± 3.21^{b}	<0.0001
Sodium	4460 ± 2.89^{a}	4512 ± 1.15^{b}	<0.0001
Potassium	3723 ± 6.08^{b}	2234 ± 1.15^{a}	<0.0001
Phosphorus	1357 ± 1.53^{a}	2310 ± 0.58^{b}	<0.0001
Iron	0.043 ± 0.00^{a}	0.054 ± 0.00^{a}	0.0624
Ca/P	1.14 ± 0.02^{a}	1.12 ± 0.00^{a}	-
Na/K	1.20 ± 0.00^{a}	2.02 ± 0.01^{b}	-

Gab: Garba Risa: Rice with eggplant sauce; DM: dry matter [25]. The mean values of 3 replicates followed by their standard deviations, assigned with the same letter do not show significant differences ($p > 0.05$) within the same line and the values assigned with different letters on the same line show a significant difference ($p < 0.05$).

3.2. Water-Soluble Vitamin Content

Table 3 shows the water-soluble vitamin content of the food consumed. The results show that the B vitamins contents vary from 0.07 ± 0.01 (mg/100 g) to 11.7 ± 0.6 (μg/100 g) with high contents in the Gab dish. The statistical analysis showed a significant difference ($p < 0.05$) in the different dishes except for vitamin B3 where it presented no significant difference ($p > 0.05$).

3.3. Composition of Amino Acid

The composition amino acids of these dishes is recorded in **Table 4**. The results of the analysis showed high contents of histidine, valine and arginine in the Gab of the levels ranging from 120.30 ± 1.08 to 764 ± 2.08 mg/100 g with a statistical difference $p < 0.05$. Risa presented high levels of leucine, glutamine, cysteine and alanine with levels varying from 77.1 ± 1.99 to 125.4 ± 1.15 mg/100 g. The statistical analysis noted a statistical difference $p < 0.05$ between the different dishes.

Table 3. Composition of water-soluble vitamins in the dishes.

	Dishes			
Water-soluble vitamins (mg/100 g)	**Gab**	**Risa**	**p-value**	**Daily recommendation**
B1	1.02 ± 0.07^{b}	0.32 ± 0.07^{a}	0.0025	1.1 mg
B2 (μg/100 g)	4.63 ± 0.02^{b}	3.7 ± 0.23^{a}	0.0385	0.014 mg
B3	0.1 ± 0.00^{a}	0.08 ± 0.01^{a}	0.0913	16 mg
B5	0.28 ± 0.01^{b}	0.07 ± 0.01^{a}	0.0002	8.4 mg
B6 (μg/100 g)	11.7 ± 0.6^{b}	7.91 ± 0.31^{a}	0.005	0.014 μg
B9	1.4 ± 0.06^{b}	1.01 ± 0.07^{a}	0.0115	0.2 mg
B12 (μg/100 g)	1.34 ± 0.05^{b}	0.9 ± 0.12^{a}	0.024	2.5 μg

Gab: Garba Risa: Rice with eggplant sauce. The mean values of 3 replicates followed by their standard deviations, assigned with the same letter do not show significant differences ($p > 0.05$) within the same line and the values assigned with different letters on the same line show a significant difference ($p < 0.05$).

Table 4. Composition of amino acids.

	Dishes		
Parameters (mg/100 g)	**Gab**	**Risa**	**p-value**
Histidine	222.2 ± 0.99^{b}	211.1 ± 1.07^{a}	0.002
Leucine	90.87 ± 0.58^{a}	94.63 ± 0.61^{b}	0.001
Valine	764 ± 2.08^{b}	754.67 ± 2.8^{a}	0.0556
Glutamine	69.8 ± 1.33^{a}	77.1 ± 1.99^{b}	0.038
Arginine	120.30 ± 1.08^{b}	93.07 ± 1.76^{a}	0.0002
Cysteine	102.4 ± 0.4^{a}	107.3 ± 0.4^{b}	0.001
Alanine	107.4 ± 1.53^{a}	125.4 ± 1.15^{b}	0.0007

Gab: Garba Risa: Rice with eggplant sauce. The mean values of 3 replicates followed by their standard deviations, assigned with the same letter do not show significant differences ($p > 0.05$) within the same line and the values assigned with different letters on the same line show a significant difference ($p < 0.05$).

3.4. Determination of Anthropometric Parameters

3.4.1. Body Length

The batches of rats fed the control diets (RSP, RTH) showed mean values in Body Length as a function of the initial day (D1) to the final day (D15) respectively from (14.17 ± 0.31 cm to 15.33 ± 0.95 cm and 14.33 ± 0.21 cm to 20.33 ± 0.42 cm and those of the batches of rats fed the test diets gave values from 14.5 ± 0.22 cm to 20 ± 0.37 cm; 14.5 ± 0.5 cm to 21 ± 0.00 cm for the Gab and Risa diets, respectively.

The Risa diet observed the value in Body Length from 14.5 ± 0.5 cm to 21 ± 0.00 cm. Statistical analysis showed a significant difference ($p < 0.05$) between the body lengths of different batches of rats fed the different diets (**Figure 2**).

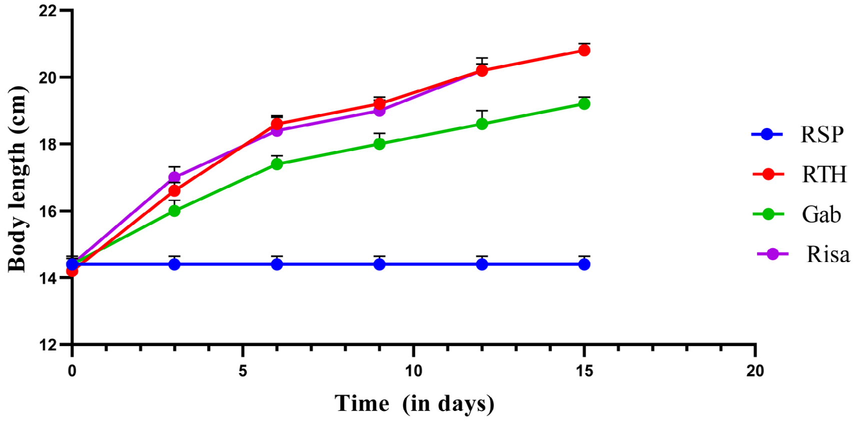

Figure 2. Body length of young rats fed different diets.

3.4.2. Abdominal Circumference (AC)

Analysis of abdominal circumference recorded mean values of 9.2 ± 0.2 cm to 5.4 ± 0.24 cm; 9.00 ± 0.45 cm to 12.6 ± 0.24 cm for rats fed the RSP and RTH control diets respectively. For the Gab and Risa test diets, respectively, the analysis recorded values of (8.6 ± 0.51 cm to 11.00 ± 0.45 cm and 10.00 ± 0.00 cm to 12.6 ± 0.24 cm). However, the value of abdominal circumference of rats fed the RTH diet was identical to that of rats fed the Risa diet. However, statistical analysis indicated a significant difference ($p < 0.05$) between all values of abdominal circumference of batches of rats fed the different diets (**Figure 3**).

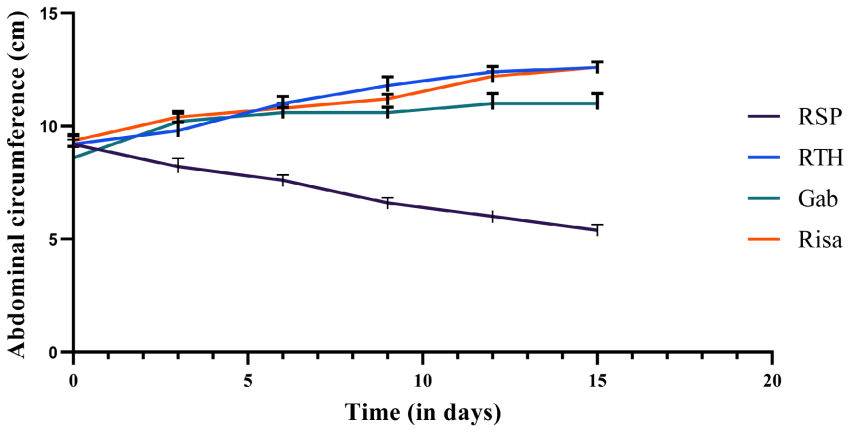

Figure 3. Abdominal circumference of young rats fed different diets.

3.4.3. Body Mass Index (BMI)

The BMI values of the rats ranged from 0.26 ± 0.01 to 0.32 ± 0.01 g/cm^2. The control batches observed values of 0.26 ± 0.01 g/cm^2 and 0.32 ± 0.01 g/cm^2 respectively for the RSP, RTH diets. For the experimental diets (Gab and Risa), the BMI values were 0.27 ± 0.01 g/cm^2 and 0.31 ± 0.01 g/cm^2 respectively. However, the RTH diet noted the high value in BMI of (0.32 ± 0.01 g/cm^2. However, the statistical analysis presented a significant difference ($p < 0.05$) between the BMI values of the rats fed with the different diets (Table 5).

Table 5. Body mass index, Lee's and Adipocyte index.

	Dietary regimens			
Parameters	RSP	RTH	Gab	Risa
BMI (g/cm^2)	0.26 ± 0.01^a	0.32 ± 0.01^b	0.27 ± 0.01^a	0.31 ±0.01^b
LI (cm)	0.26 ± 0.00^a	0.26 ± 0.00^a	0.25 ± 0.01^a	0.26 ± 0.00^a
AI (%)	0.92 ± 0.02^a	2.45 ± 0.68^a	1.67 ± 0.25^a	1.96 ± 0.21^a

3.4.4. Lee Index (LI)

The Lee index of rats fed with the respective diets (RSP, RTH, Gab and Risa) recorded values of (0.26 ± 0.00 cm; 0.26 ± 0.00 cm; 0.25 ± 0.01 cm and 0.26 ± 0.00 cm). On the other hand, batches of rats fed the different diets showed essentially identical values. Statistical analysis revealed no significant difference ($p > 0.05$) between the Lee index of all batches of rats fed the different diets (Table 5).

3.4.5. Adipocyte Index (AI)

Adipocyte index levels are presented in Table 5. The analysis revealed AI contents ranging from 0.92% ± 0.02% to 2.45% ± 0.68%. For the control batches (RSP and RTH), the AI contents were 0.92% ± 0.02% and 2.45% ± 0.25%, respectively. For the batches of rats fed the Gab and Risa diets, the analysis recorded levels of 1.67% ± 0.25% and 1.96% ± 0.21% respectively. On the other hand, the diet (RTH) recorded the high AI value (2.45% ± 0.25%). There is no significant difference ($p > 0.05$) between the AI contents of all batches of rats fed with the different diets.

3.5. Determining the Nutritional Profile

Figure 4 shows the SAIN and LIM indicators for Garba (Gab) and rice with eggplant sauce (Risa) respectively. The SAIN score for Gab and Risa is 9.8% and 16.40%, respectively. The LIM score was 61.15% and 54.7% for Gab and Risa respectively.

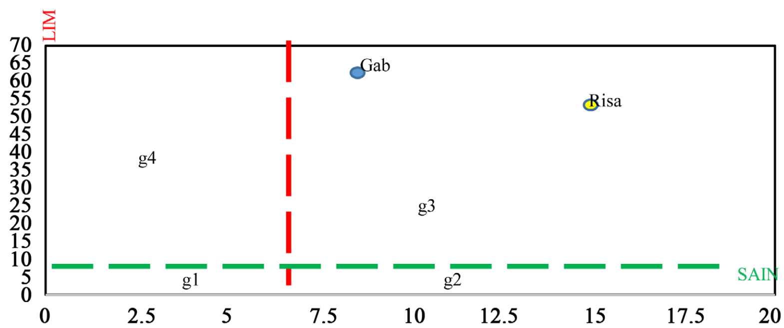

Figure 4. Nutritional profile of the different dishes. g1. recommended foods for health (SAIN > 5 and LIM < 7.5). g2. neutral foods (SAIN < 5 and LIM < 7.5). g3. foods recommended in small quantities or from time to time (SAIN > 5 and LIM > 7.5). g4. foods to limit (SAIN < 5 and LIM > 7.5).

4. Discussion

The consumption of certain foods and nutrients, and possibly other substances influence the functioning of the body, protect against diseases, restore health and determine the standard of living. The nutritional profile of the two dishes revealed the presence of water-soluble vitamins and certain amino acids, both of which are very important for health. [26]. Indeed, a diet that contains sufficient quantities of amino acids and water-soluble vitamins is beneficial for the body of the consumers. These vitamins play a role in the metabolism of amino acids, lipids, neoglucogenesis, the synthesis of several neurotransmitters, hemoglobin, histamine and energy metabolism [27]. In addition, thiamine (B1) is a coenzyme. It is thought to be important in the synthesis of fatty acids, steroids, nucleic acids and aromatic amines that are precursors of a range of neurotransmitters and other bioactive compounds essential for brain function [28]. Vitamin B2, on the other hand, would be essential for energy production. It would also play an indirect role as an antioxidant, while vitamin B9 helps with protein requirements by enabling the synthesis of brain chemical messengers and nucleic acids for DNA and RNA [29]. The tuna garba dishes and eggplant sauce rice showed relatively low levels of B vitamins below the standard set by [30]. The low levels of B vitamins in the dishes could be explained by the effect of uncontrolled heat treatment applied during cooking by leaching. Indeed, according to [31], vitamin losses are generally higher for longer cooking processes or higher heating temperatures. These results corroborate those obtained by [31] regarding vitamins B3 and B6. The leaching loss of vitamin B3 during immersion cooking is greater than during microwave cooking, in which case the vitamins are released directly into the fluid medium [32]. Regular consumption of these foods would therefore lead to anaemia in consumers, as a lack of folate (B9) in the diet prevents red blood cells from dividing to form new ones. They remain in the immature form known as megaloblasts [33] [34].

The higher level of amino acids in rice with eggplant sauce as opposed to Garba with tuna shows that the consumption of this food would be more favorable to the body. Indeed, these necessary amino acids are essential metabolites throughout the manufacturing process of the body's constituents, which implies that they must be obtained entirely from the diet [35]. In order to maintain excellent health, it is essential to draw the attention of street food consumers to the direction of their choice.

The Ca/P ratios of the dishes recorded insignificant values greater than 1. According to [36], a food would be good when the Ca/P ratio is greater than 1. Thus, the consumption of these foods could prevent the mineral and osmotic imbalance that could lead to inflammations. Gab and Risa presented Na/K ratios significantly higher than 1 with that of rice with eggplant sauce giving 2.02 the highest ratio. These ratios are higher than the recommended value of 1. These ratios are thought to be due to the high sodium content and low potassium levels observed in the dishes, which would be a problem for hypertensive and elderly people who consume them [25]. In this regard, [37] indicate that a food rich in potassium would lead to a decrease in blood pressure and reduce the risk of cardiovascular disease. The evaluation of anthropometric parameters allowed the detection of possible obesity in an individual [38]. The body mass index (BMI) values measured on the rats in this study would not present any risk of obesity. Indeed, the values obtained are in the range (0.38 to 0.68 g/cm^2) of normal rats described by [38]. The nutrient contents [36] contained in the diets (RTH and Risa) would explain the growth in body length and abdominal girth of the rats. The obtained results are in agreement with those of [39] and [40], using the cafeteria diet and snail (*Limicolaria flammea*) meal, respectively, of the protein-rich foods incorporated in the rat diet.

The evaluation of the nutritional quality of the food by the LIM and SAIN score profiling system showed contents higher than the recommended standards for the holy foods respectively for garba (9.8%) and (16.4%) for rice with eggplant sauce and the foods to be limited (61.15%) for garba tuna and (54.7%) for rice with eggplant sauce. Because of the SAIN and LIM score higher than the norm, these foods are classified in class 3. These results are largely superior to those observed by [41] who obtained values of (43%) during a study in Tunisia on the nutritional profile of restaurant food sold in markets. However, these dishes are to be consumed from time to time and in moderation because of its poor nutritional profile.

5. Conclusion

It emerges from our study that the consumption of these street foods, although they contain nutritious contributions, due to the bad profile that these dishes contain, their consumption by the men must be supplemented to correct certain deficiencies notably in water solubles vitamins and amino acids inescapable in the manufacture and in the synthesis of certain metabolisms. Also, the consumption of these dishes did not present any risk factor of obesity during these fifteen days and with abdominal circumferences and length in normal size.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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