International Journal of Food Science and Nutrition
www.foodsciencejournal.com
ISSN: 2455-4898
Received: 24-03-2025, Accepted: 23-04-2025, Published: 09-05-2025
Volume 10, Issue 3, 2025, Page No. 6-10

Nutrient composition and *In vitro* iron bioavailability of some widely consumed foods in the lekie division of Cameroon

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Abstract
The Lekie Division in Cameroon is characterised by intensive farming, mostly cocoa, tubers and vegetables. Such a population requires a balanced diet in order to carry out its activities successfully. The aim of this study was to identify the foods most commonly consumed by this community and to provide information on the nutrient content of these foods. Using a 07-day food diary from the various households visited, the most commonly consumed foods were identified and then analysed using standard AOAC methods. SPSS 20.0 software was used for the statistical analyses. Groundnut sauce, cassava leaves, okok and zom for sauces and cassava, rice and plantain for accompaniments were the foods most consumed in the locality. These foods were very rich in lipids and carbohydrates, but low in iron and copper. Salted Kpem which appeared as the richest iron dish just presented 7.03 mg of iron per 100g of dry matter. Similarly, the bioavailability of iron in these foods was low, and once aigain, Salted Kpem appeared with the best iron bioavailability which was only 2,15%. This study showed that in the Lekie Division, the population consumes essentially what it produces. However, the food they consume is much higher in calories, but low in certain key minerals such as iron.

Keywords: Nutritient composition, iron bioavailability, food, lekie division, Cameroon

Introduction
Good feeding practices, food preparation, dietary diversity and food distribution within a community promote an adequate supply of energy and nutrients which is very necessary for individuals and especially for people engaged in intense physical or rural activity, as is the case for the populations of the Lekie Division in Cameroon [28]. Food security exists when all human beings have physical and economic access at all times to sufficient, safe and nutritious food to meet their energy needs and food preferences for a healthy and active life. The aim of this study was to identify the foods most commonly consumed by this community of people living in the Lekie Division and to provide information on the nutrient content of these foods.

Methodology
1. Ethical consideration
This work was carried out with strict respect for the physical, moral and psychological integrity of all participants. Authorisation to carry out this study was obtained from the Centre regional research ethics committee (N°02057/CRERSHC/2022), by issuing an ethical clearance. The administrative and traditional authorities of the Lekie Division were met and informed of the objectives of this study, with the aim of obtaining their consent and soliciting their support in carrying out this work.

2. Data collection and sample analysis
The field team consisted of a main supervisor, a principal investigator and local community health workers. The latter visited households day after day for 07 days. The most commonly consumed foods were identified, then collected from households in the various localities surveyed and taken to the laboratory, where they were analysed using standard AOAC methods. The *in vitro* bioavailability of iron was studied using the method described by [14].

3. Statistics analysis
The statistical analysis was carried out by the IBM/SPSS 20.0 software for Windows using the ANOVA test followed by Post Hoc Tukey test for the comparison of means. The results were presented in the form of average ± standard deviation and Microsoft Excel 2016 was used for graphical representations.

Results
Table 1 : Inventory of the foods most commonly consumed by the population of the Lekie Division of Cameroon

N°	Common names	Vernacular names	Scientific names	Food forms	Mains ingredients
1	Groundnut sauce	*Fian Owondo*	*Arachis hypogea*	Light sauce	Groundnut + Palm oil
2	Cassava leaves without salt	*Pkwem isusuga*	*Manihot utillisima*	Thick sauce	Cassava leaves + palm nut juice
3	Zom leaves	*Zom*	*Solanum aethiopicum*	Thick sauce	Zom leaves + Groundnut + salt-free palm nut juice
4	Gnetum leaves	*Okok*	*Gnetum africanum*	Thick sauce	Gnetum leaves + Groundnut + palm nut juice.
5	Salted cassava leaves	*Pkwem nkou*	*Manihot utillisima*	Thick sauce	Cassava leaves + Groundnut + Palm oil
6	Cassava	*Moun*	*Manihot esculenta*	Slice	Cassava
7	Rice	*Oles*	*Oryaza sativa*	Grain	Rice
8	Plantain	*Ikouan*	*Musa sp.*	Slice	Plantain
9	Cocoyam	*Mebanga*	*Xanthosoma sp.*	Slice	Cocoyam
10	Cassava fufu	*Vuvu à moun*	*Manihot esculenta*	Loaf	Cassava flour

The table above shows the foods most commonly consumed by people in the Lekie Division. These are ranked from 1 to 5 for sauces and from 6 to 10 for side dishes, according to their importance in the daily household diet. Common names, vernacular names, scientific names, food forms and the main ingredients in the composition of these differents foods are also presented in this table. The table shows that Groundnut sauce is the most widely consumed sauce in households, followed by cassava leaves without salt, zom and okok, while cassava is the most popular side dish, followed by rice and plantain.

Table 2 : Macronutrient content of the foods most consumed by the population of the Lekie Division of Cameroon (g/100g DM and FM)

Ech	Dry matter (g/100g FM)	Proteins (g/100g DM)	Fats (g/100g DM)	Carbohydrates (g/100g DM)	Fibers (g/100g DM)	Ash (g/100g DM)
MA	43.56±0.2	2.67±0.07	0.67±0.5	92.2±2.2	3.43±0.38	0.99±0.0
OK	34.04±0.4	16.7±0.06	56.3±6.0	23.2±2.6	3.71±0.03	0.09±0.3
PS	19.80±0.6	28.3±0.05	41.3±2.5	19.4±1.6	4.40±0.06	6.59±0.5
SA	18.15±0.5	30.1±0.04	40.3±2.8	17.5±2.8	3.73±0.08	8.33±0.6
PL	20.45±0.5	5.01±0.07	1.00±0.0	88.3±1.1	2.56±0.07	3.09±0.0
RI	27.30±0.4	7.76±0.07	0.67±0.3	83.1±4.4	2.51±0.06	6.09±0.1
PK	20.04±0.8	12.7±0.07	54.0±1.0	25.6±1.6	3.76±0.05	3.90±0.4
ZO	25.18±2.2	24.5±0.25	60.7±2.5	8.56±1.0	3.15±0.02	3.09±0.0
CM	22.40±0.4	1.81±0.06	0.98±0.0	92.7±0.7	3.13±0.04	1.40±0.1
MC	32.02±0.3	9.97±0.05	0.36±0.0	82.3±0.8	3.32±0.02	4.10±0.5

Ech : Samples ; SA : Groundnut sauce ; ZO : Zom ; KP : Kpem ; OK : Okok ; PS : Salted Kpem ; MA : Cassava ; RI : Rice ; PL : Plantain ; CM : Cassava fufu ; MC : Cocoyam

The table above shows the average dry matter, protein, fat, carbohydrate, fibre and ash content of the various foods. There was a significant difference between all the foods ($p < 0.05$). Dry matter content ranged from 18.15 g/100g MF for Groundnut sauce to 43.56 g/100g MF for cassava. Protein content ranged from 1.81g/100g DM for the cassava fufu to 30.1g/100g DM for the Groundnot Sauce. Fat content ranged from 0.36g/100g DM for Cocoyam to 60.7g/100g DM for Zom. Carbohydrate content ranged from 8.56g/100g DM for Zom to 92.7g/100g DM for Cassava fufu. Fiber contents ranged from 2.51g/100g DM for rice to 4.4g/100g DM for salted Pkem. Ash content varied from 0.09g/100g DM for Okok to 8.33g/100g DM for Groundnut sauce.

Table 3 : Micronutrient content of the foods most consumed by the population of the Lekie Division of Cameroon (mg/100g DM)

Ech	Calcium	Magnesium	Iron	Zinc	Copper
MA	236.3±18.2	69.30±7.00	0.40±0.14	6.04±0.36	0.001±0.0
OK	274.0±14.2	200.6±21.2	1.77±0.18	7.97±0.18	0.001±0.0
PS	596.0±19.6	143.6±28.5	7.03±0.12	26.5±0.83	0.001±0.0
SA	216.3±16.4	186.1±20.0	2.83±0.18	9.65±0.15	0.001±0.0
PL	364.0±3.60	59.30±6.50	0.94±0.13	5.81±0.27	0.001±0.0
RI	206.3±19.9	22.30±6.10	0.61±0.09	6.67±0.04	0.001±0.0
PK	438.0±27.6	172.6±10.5	3.62±0.16	5.91±0.10	0.001±0.0
ZO	296.0±5.20	153.1±21.1	3.45±0.10	10.0±0.33	0.001±0.0
CM	263.0±4.40	69.30±7.50	1.10±0.02	7.59±0.31	0.001±0.0
MC	317.3±14.0	32.70±3.20	0.37±0.06	7.90±0.32	0.001±0.0

Ech : Samples ; SA : Groundnut sauce ; ZO : Zom ; KP : Kpem ; OK : Okok ; PS : Salted Kpem ; MA : Cassava ; RI : Rice ; PL : Plantain ; CM : Cassava fufu ; MC : Cocoyam

The table above shows the average levels of calcium, magnesium, iron, zinc, copper and phytates in the various foods. There was also a significant difference between all the foods ($p < 0.05$). Calcium levels ranged from 206.3mg/100g DM for rice to 596.0mg/100g DM for salted Kpem. Magnesium levels varied from 22.3mg/100g DM for Rice to 200.6mg/100g DM for Okok. Iron levels varied from 0.37mg/100g DM for Cocoyam to 7.03mg/100g DM for salted Kpem. Zinc levels varied from 5.81mg/100g DM for Plantain to 10mg/100g DM for Zom. Copper levels were trace in all the foods.

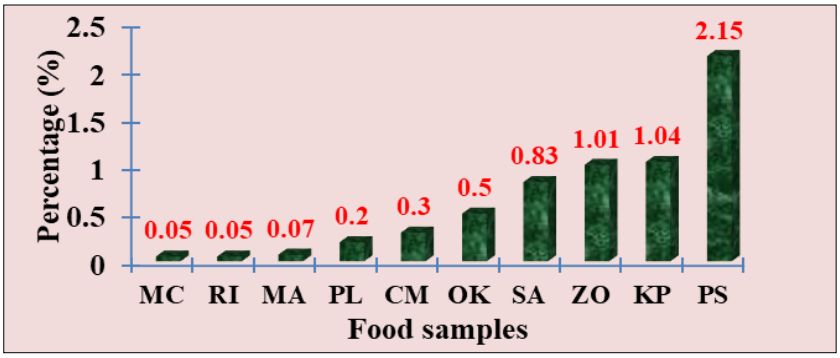

Fig1 : Percentage of *in vitro* bioavailability of iron in the foods most commonly consumed by the population of the Lekie Division of Cameroon (%)

The figure above shows the percentages of *in vitro* bioavailability in the various foods. These percentages were very low in all the foods. However, they ranged from 0.05% for Rice and Cocoyam to 2.15% for Salted Kpem.

Discussion

Macronutrient content of the foods most consumed by the population of the Lekie Division of Cameroon (g/100g DM)

Dry matter and water content are key food parameters. Knowledge of the water content of a food product is of vital importance in that it makes it possible to estimate the shelf life of a food product and to predict its storage conditions [4]. Dry matter content ranged from 18.15 g/100g MF for Groundnut sauce to 43.56 g/100g MF for cassava, and significant differences (P<0.05) were observed between the different foods. This result was similar to that obtained by [21] in Cameroon, but different from that obtained by [26].

Protein levels ranged from 1.81g/100g DM for fufu to 30.1g/100g DM for Groundnut Sauce. Significant differences (P<0.05) were observed between the different feeds. A diet containing sauces based on legumes, nuts and seeds, Cucurbitaceae and leafy vegetables, like that of the Lekie population is generally rich in protein [21]. Our results were similar to those obtained by [9]. Proteins are basic, building blocks for a growing organism. They also play a role in the body's defence system and cover the nitrogen expenditure required for tissue renewal and the synthesis of certain compounds involved in the proper functioning of the body (enzymes, hormones) [24]. They also constitute an alternative source of energy for the body insofar as they provide 4kcal or 17kj per gram.

As regards lipids in the foods analysed, levels varied from 0.36g/100g DM for Cocoyam to 60.7g/100g DM for Zom. Significant differences (P<0.05) were observed between the different foods. All the sauces analysed had high lipid contents. This can be explained by the fact that most of the sauces are prepared using groundnuts and palm nuts, which considerably raise the lipid content of these foods. Lipids which provide 9 kcal/g or around 37KJ, are an important source of energy and also help to enhance the sensory qualities of food products [16]. However, excessive fat intake in the diet of individuals slows down the digestion and absorption of carbohydrates and can lead to dietary imbalance [17] [6]. Our results were similar to those obtained by [21].

The carbohydrate content of foods were high for all the foods analysed. They ranged from 8.56g/100g DM for Zom to 92.7g/100g DM for Cassava fufu. Here again, significant differences (P<0.05) were observed between the different foods. These carbohydrate contents can be explained by the fact that the accompanying supplements (tuber, plantain and cereal) are known to be rich in starch and therefore in carbohydrates, as are these sauces which contain nuts and seeds. Sugars in general play a role that is mainly energetic, but also structural (they are part of the composition of the body's fundamental tissues : cartilage, nucleic acids, mucus, antigenic substances) [24]. Our results were different to those obtained by [12] and [26].

Fibers levels in the foods analysed ranged from 2.51g/100g DM for rice to 4.4g/100g DM for salted cassava leaves. Significant differences (P<0.05) were observed between the different foods. Dietary fibers, mainly insoluble fibers, regulates intestinal transit and captures part of the lipids and carbohydrates, which helps to regulate blood sugar levels and prevent excess cholesterol. Thanks to their high degree of saturation, these fibers have a positive effect on overweight and metabolic diseases [10]. Our results were same to those obtained [2], and higher than those obtained by [21].

Ash contents in the foods ranged from 0.09g/100g DM for Okok to 8.33g/100g DM for Groundnut sauce. The differences were significant (P<0.05). These results were similar to those of [21] and [2].

Micronutrient content of the foods most consumed by the population of the Lekie Division of Cameroon (mg/100g DM)

Calcium levels in the analysed foods ranged from 206.3mg/100g DM for Rice to 596.0mg/100g DM for salted cassava leaves. Significant differences (P<0.05) were observed between the different feeds. Such high calcium levels could be justified by the high proportion of legumes, nuts and seeds, and leafy vegetables in the daily diet of this population. Calcium promotes better growth and mineralisation of bones and teeth. These results were superior to those of [20].

Magnesium levels varied from 22.3mg/100g DM for Rice to 200.6mg/100g DM for Okok. Here again, significant differences (P<0.05) were observed between the different foods. Magnesium is involved in iron metabolism, but high magnesium consumption could increase parasitaemia, as magnesium is a cofactor in the energy metabolism of Plasmodium [13]. Some of the magnesium levels obtained were similar to those obtained by [26] while others were similar to those obtained by [21].

Iron levels ranged from 0.37mg/100g DM for Cocoyam to 7.03mg/100g DM for salted cassava leaves. Significant differences (P<0.05) were observed between the different foods analysed. Overall, iron is very low in the diets of the people of Lekie, due to low consumption of foods of animal origin, and low proportions of leaves in preparations, even though these leaves are known to be rich in iron [8]. Iron promotes oxygenation of the blood in cells and muscles. Similarly, by forming part of haemoglobin, it is effective in preventing anemia [18]. In addition, an iron-deficient diet protects against malaria [19] because the Plasmodium responsible for malaria penetrates iron-rich erythrocytes to continue its [23]. The iron levels obtained were similar to those obtained by [26], and lower than those obtained by [21].

Zinc levels in the foods analysed ranged from 5.81mg/100g DM for Plantain to 10mg/100g DM for Zom. Significant differences (P<0.05) were observed between the different feeds. These levels can be explained by the populations' diet, which includes green leaves that contain abundant zinc [1], although their proportion is low in the preparations. These levels were similar to those obtained by [21], for group 4 foods and those of [3]. Zinc is important for brain development and immune system function [25]. Zinc deficiency in humans can lead to stunted growth, hypogonadism, anorexia, lethargy, skin changes and blindness [22].

Copper levels were trace in all the foods. This could be explained by a diet low in seafood and certain legumes. These results were lower than those obtained by [6] and [21]. Copper is involved in iron absorption, metabolism and the formation of elastic and connective tissues. It also has an enzymatic function, acting as a cofactor in certain enzymatic reactions in the body [7].

***In vitro* bioavailability of iron of the foods most consumed by the population of the Lekie Division of Cameroon (%)**

The *in vitro* bioavailability of iron in the foods analysed ranged from 0.05% for rice and Cocoyam to 2.15% for salted cassava leaves. This low percentage of bioavailability could be explained by the essentially plant-based diet of these populations, characterised by low consumption of activators of iron absorption such as vitamin C and animal proteins [27] [11]. Our results were in agreement with those (<5%) reported in the literature for a predominantly plant-based diet [15]. However, although these percentages were low for all foods, salted cassava leaves showed the highest percentage of iron bioavailability (2.15%) due to the presence of smoked fish in its preparation.

Conclusion

In summary, this study shows that in the Lekie Division, people essentially consume what they produce. However, the food they eat is much higher in calories, but low in certain key minerals such as iron. In view of these findings, nutritional education needs to be planned as a matter of urgency, lest the consequences of micronutrient deficiencies in general, and iron deficiency in particular, have an impact on health and economic performance in this Division.

Ethical approval

All procedures performed in this study were approved by the ethical research committee of the Centre regional research ethics committee of Cameroon (N°02057/CRERSHC/2022).

Funding

This work was supported by the first author's family.

Credit authorship contribution statement

Noah Guy : conceptualization, study design, data collection, data analysis and interpretation, drafting of the manuscript, reviewing of the manuscript.
Fokou Elie : conceptualization, study design, literature review, data interpretation, revision of the manuscript.
Bebbe Fadimatou : study design, literature review, data interpretation, revision of the manuscript.
Haddison Eposi : study design, literature review, revision of the manuscript.
Kuagny Mouafo Ronald Blaise : literature review, data interpretation, revision of the manuscript.

Declaration of conflict interest

The authors declare that the have no known conflict of interest or personal relationship that coul have appeared to influence the work reported in the paper.

Acknowledgements

The authors are grateful to anonymous contributors for the achievement of this work.

References

1. Alaoui L, Jaonina M, Keba N. Role of minerals (sodium, potassium, calcium and magnesium) in the prevention and management of arterial hypertension. Moroccan Journal of Agronomic and Veterinary Sciences,2020:20:110–111.
2. Amadi B, Duru M, Agomuo E, Amadi P, Onedibe O. Nutritional, phytochemical and sensory evaluation of 'Mberiagworagwo' traditional food of Uruagunnewi people in Anambra State, Nigeria. Journal of Advances in Biology and Biotechnology,2017:14(1):1–8.
3. Anigo K, Ameh A, Ibrahim S, Danbauchi S. Nutrient composition of complementary porridges formulated from malted cereals, soybean and groundnut used in northwestern Nigeria. African Journal of Food Science,2010:4(3):65–72.
4. Anshu R, Joshi J. Effect of processing method on nutritional quality of black soybean. Asian Journal of Dairy and Food Research,2018:37(2):162–164.
5. Bassey I, Kay M, Christopher E, Chukwujindu I. Formulation and nutritional evaluation of weaning food processed from cooking banana, supplemented with cowpea and peanut. Food Science and Nutrition,2013:7:130–138.
6. Davidson G, Ene-Obong H, Chinma C. Variations in nutrient composition of most commonly consumed cassava (Manihot esculenta) mixed dishes in South-Eastern Nigeria. Journal of Food Quality,2017:4:189–199.
7. EUFIC. Minerals: what is their role? Where are they found? http://www.eufic.org/article/en/expid/minerals/ accessed 10 January 2016 at 22h 42min.
8. FAO. West African food composition table. 2012.
9. Fokou E, Domgang F. Study of the nutritional potential of a few tin vegetables consumed in Cameroon (2) Evaluation of the protein fraction. Annales de la Faculté des Sciences - Biochemie,1987:1(4):97–110.
10. Henauer J, Frei J. Fibre-rich diet: the importance of fibre for people with paralysis. Paraplegiker Zentrum Uniklink Balgrist,2008:AG and CBA (3):1–9.
11. Hurrell R, Lynch S, Trinidad T, Dassenko S, Cook J. Iron absorption in humans: bovine serum albumin compared with beef muscle and egg white. American Journal of Clinical Nutrition,1988:47(1):102–107.
12. Kouebou C, Achu M, Nzali S, Chelsea M, Bonglaisin J, Kamda A, Djele P, Yadan G, Ponka R, Ngoh G, Nkouam G, Teuga C, Kana M. A review of composition studies of Cameroon traditional dishes: macronutrients and minerals. Food Chemistry,2013:140:483–494.
13. Maurois P, Gueux F, Rayssiguier Y. Protective effect of severe magnesium deficiency on Plasmodium chabaudi infection. Magnesium Research,1989:2(3):183–187.
14. Miller D, Schricker B, Rasmussen R, Van Campen D. An *in vitro* method for determination of iron availability from meals. American Journal of Clinical Nutrition,1981:34(10):2248–2256.
15. Minihane A, Rimbach G. Iron absorption and the iron binding and antioxidant properties of phytic acid. International Journal of Food Sciences and Technology,2002:37(7):741–748.
16. Mourot J, Lebret B. Modulation of pork quality by diet. INRA Animal Production,2009:22(1):33–40.
17. Murray R, Bender D, Botham K, Kennelly P, Rodwell V, Weil A. Harper Biochemistry. 2013:5:138–534.
18. Nay K, Horeau M, Loréal O, Derbré F. Iron metabolism: impact of hypoactivity and underlying mechanisms. Nutrition and Dietetics Notebook,2021:56:131–140.

19. Oppenheimer SJ, Gigson DF, Macfarlame SB, Moody JB, Harrisson C, Spencer A, Bunari O. Iron supplementation increases prevalence and effects of malaria: report on clinical studies in Papoua, New Guinea. Tropical Medicine and Hygiene,1986:80:603–612.
20. Ponka R, Nankap E, Tambe TS, Fokou E. Nutritional composition of some artisanal infant flours from Cameroon. International Journal of Innovation and Applied Studies,2016:16(2):280–292.
21. Ponka R, Fokou E, Fotso M, Achu BM, Tchouanguep MF. Methods of preparation and the energy, protein and mineral values of three Cameroonian dishes: "Corn chaff", "Nnam Owondo/Ebololo" and "Nnam Ngon/Ebobolo". African Journal of Food Agriculture Nutrition and Development,2005:5(1):113.
22. Prasad AS. Clinical biochemical and nutritional spectrum of zinc deficiency in human subjects: an update. Nutrition Reviews,1983:41:197–205.
23. Rouault TA, Klausner RD. Regulation of iron metabolism in eukaryotes. Current Topics in Cellular Regulation,1997:35:1–19.
24. Sguera S. Spirulina plantesis and its constituents, nutritional and therapeutic interests. Thesis of Doctor of Pharmacy, Henri Poincaré-Nancy University 1,2008:P.179.
25. Shankar A, Genton B, Tamja S, Arnold S, Wu L, Baisor M, Paino J, Tielsch JA, Alpers MA, West JKP. Zinc supplementation can reduce malaria-related morbidity in preschool children. American Journal of Tropical Medicine and Hygiene,1997:57:249–255.
26. Sharma S, Mbanya J, Cruickshank K, Tanya A, Xia C. Nutrient composition of commonly consumed composite dishes from the central province of Cameroun. International Journal of Food Science and Nutrition,2007:58:475–485.
27. Waldvogel-Abramowski S, Waeber G, Gassner C, Buser A, Freyc BM, Frevrate B, Tissot JD. Physiology of iron metabolism. Transfusion Medicine and Hemotherapy,2014.
28. WFP (United Nations World Food Programme). Rapid assessment of household securite alimentaire des menages dans la ville de N'djamena. 2019.