ISSN: 2644-2981

Global Journal of Nutrition & Food Science

DOI: 10.33552/GJNFS.2024.05.000602

Iris Publishers

Research Article

Comparative Study of *Solanum Aethiopicum* Leaves and Fruits Nutritional Quality

Charles W. Yaméogo[1]*, Boubacar Savadogo[1], Franck Garanet[1], and Charles Parkouda[2]

[1]*Centre National de la Recherche Scientifique et Technologique/Institut de Recherche en Sciences de la Santé, Ouagadougou, Burkina Faso*

[2]*Centre National de la Recherche Scientifique et Technologique/Institut de Recherche en Sciences Appliquées et Technologies, Ouagadougou, Burkina Faso*

***Corresponding author:** Dr Charles W Yaméogo, Centre National de la Recherche Scientifique et Technologique/Institut de Recherche en Sciences de la Santé, Ouagadougou, Burkina Faso

Received Date: April 10, 2024

Published Date: July 09, 2024

Abstract

Malnutrition in children aged under five years is a public health problem in Burkina Faso. Research to find indigenous vegetables with best nutritional quality are important for children diet. The purpose of this study was to assess and compared the nutritional quality of Solanum aethiopicum leaves and fruits consumed in Burkina Faso. The cool leaves and fruits have been purchased in three markets of Ouagadougou and allow to air-dry during one month in the laboratory at 25 ◦ C. The dry leaves and fruits have been analyzed for the following minerals composition: potassium (K), calcium (Ca), magnesium (Mg), sodium (Na), phosphor (P), iron (Fe) and zinc (Zn). The analyses have been done in triplicate using the atomic absorption spectrophotometer and flam photometer methods. The results showed for Solanum aethiopicum leaves, high contents in K (3064 mg/100 g), Ca (1048 mg/100 g), Mg (666 mg/100 g) and P (327 mg/100 g). The trace elements contents were also high: Fe (12 mg/100 g) and Zn (20 mg/100 g). Compared to the leaves, the fruits contents in K and Fe were high. However, the fruits had lower contents in Ca (126 mg/100 g), Mg (187 mg/100 g), P (29 mg/100 g) and Zn (2 mg/100 g).

This study showed that the two vegetables are good sources of minerals and the leaves with highly nutritional quality.

Keywords: Indigenous Vegetables; Nutritional Quality; Children; Nutrition

Introduction

Malnutrition in children aged under five years is a public health problem in Burkina Faso. The nutritional survey of 2021 showed prevalence of 9.7% and 21.6% respectively for moderate acute malnutrition and chronic malnutrition [1]. The prevalence of anemia is 72 % [2]. This malnutrition is due to a poor nutritional quality of food with low contents in minerals like potassium (K), magnesium (Mg), calcium (Ca), sodium (Na), phosphor (P), iron (Fe) and zinc (Zn) [3]. Therefore, including indigenous vegetables with high nutritional quality is a way to improve children diet and to fight against malnutrition [4,5]. Solanum aethiopicum leaves and fruits are indigenous vegetables available and consumed in Burkina Faso. The current food composition table from Burkina Faso give insufficient information on minerals composition of Solanum aethiopicum leaves and fruits [6]. Data on minerals like K, Mg, Na, P and Zn for Solanum aethiopicum leaves or P, Mg, K and Na for the fruits are not available. Solanum aethiopicum is an herbaceous plant which is from the Solanaceae family. It measures about 1.5 m in height. The leaves and fruits are consumable and can be eaten raw or as sauce [7]. The objective of this study was to assess and compared the nutritional quality of Solanum aethiopicum leaves and fruits grown and consumed in Burkina Faso.

Materials and Methods

Sampling

The samples of cool leaves and fruits of Solanum aethiopicum have been purchased in three markets of Ouagadougou, Burkina Faso. These cool samples have been watched and dried in the laboratory at 25 ◦C for one month and reduced in powder with a grinder (mark NIMA, model NO: BL - 888A, Japan). The powder has been sifted by a sifter with meshes 0.5 millimeter of diameter and then, kept in plastic sachets to the laboratory at 25 ◦C until analyses. The contents analyses have been done in triplicate with the dry's samples.

Minerals contents analyses

The following minerals: P, K, Na, Mg and Ca from the dried leaves and fruits of Solanum aethiopicum have been analyzed after the sample's mineralization by humid voice according to Houba et al. [8]. In three tubes, 0.5 g of samples ground to 0.5 mm has been weighed and 5 ml of the extraction solution (sulphuric acid - selenium - salicylic acid: 7.2%) have been added in each tube. A blanc solution has been prepared with 5 ml of the extraction solution. The samples have been let to rest for 2 h at least. After this time, they have been heated with temperatures varying between 100-340 ◦C. The mixture gotten after heating has been cooled to the ambient temperature during 24 h and then, has been diluted to 2/3 of tubes, agitated, cooling again and completed to 75 ml with the distilled water. After agitation and decanting, a quantity of the solution has been used for:

a) the dosage of total phosphor with the autosensor (model SKALAR 1000) to 880 nm using the ammonium molybdate as indicator.

b) the dosage of Mg and Ca after dilution in the Lanthane [(La (NO3)3 6H2O)] respectively to 285.2 nm and 422.7 nm with an atomic absorption spectrophotometer (model PERKIN ELMER A100).

c) the dosage of Na and K with a flame photometer (model CORNING 400). Ranges of standards solutions have been prepared for the dosage of minerals. These ranges are given as follows:

d) P: a solution (300 ppm) of potassium hydrogenophosphate (K2HPO4) permitted to achieve a range of concentration varying between 3 and 15 ppm.

e) K and Na: a standard solution of Na-K (100 ppm) permitted to prepare a range concentration between 0 and 10 ppm.

f) Mg and Ca: standards solutions of Mg (1000 ppm) and Ca (1000 ppm) permitted to prepare concentrations ranges varying between 5 and 30 ppm for Ca, 0.5 and 3 ppm for Mg.

For Zn and Fe analyses, 0.5 g of samples ground to 0.5 mm has been weighed in three tubes. Then, 5 ml of the extraction solution with nitric acid (HNO3; 65%), sulphuric acid (H2SO4; 96%) and perchloric acid (HClO4; 70%) were added in each tube. A blanc solution has been prepared with 5 ml of the extraction solution. The samples have been let to rest during 2 h at least. After this time, they have been heated with temperatures varying between 75-240 ◦C. The mixture gotten after heating has been cooled to the ambient temperature during 24 h and then, has been diluted to 2/3 of tubes, agitated, cooling again and completed to 75 ml with the distilled water. After agitation and decanting, a quantity of the solution has been used for Fe and Zn analyses in atomic absorption, respectively to 219.9 nm and 248.3 nm. The concentration range of standard solution has been 6 to 36 ppm for Fe and 1 to 6 ppm for Zn.

Statistical analysis

The data analysis has been performed using the software SPSS version 22.0. Data have been expressed as average (± standard deviation). The differences between the averages for minerals composition have been tested using the one-way analysis of variance. The Significant differences between the mean have been set to 5% level.

Results

The study showed high concentrations in K from the sample collected in the three markets as shown in Table 1.

These concentrations were 3146; 2985 and 3062 mg/100 g respectively for the sample of market 1, market 2 and market 3. The Ca is the second mineral with high concentrations (1107; 995; 1041 mg/100 g), followed by Mg (657; 677 and 665 mg/100 g). Fe and Zn, known as trace elements, also had high concentrations with 13; 11 and 10 mg/100 g for Fe respectively from market 1, market 2 and market 3. For Zn, we found 18; 23 and 20 mg/100 g respectively for market 1, market 2 and market 3. Significant differences for all minerals have been found between the samples of the three markets (Table 1).

Table 1: Contents of minerals in dry leaves of *Solanum aethiopicum* (mg/100g)

Minerals	Market 1 (Averages ± SD)	Market 2 (Averages ± SD)	Market 3 (Averages ± SD)	P-value for difference
Ca	1107 ± 8	995 ± 9	1041 ± 9	< 0.05
Mg	657 ± 7	677 ± 9	665 ± 5	< 0.05
Na	63 ± 2	95 ± 5	74 ± 8	<0.05
K	3146 ± 3	2985 ± 5	3062 ± 7	< 0.05
P	421 ± 5	239 ± 9	321 ± 5	< 0.05

Fe	13 ± 3	11 ± 2	10 ± 4	< 0.05
Zn	18 ± 4	23 ± 1	20 ± 5	< 0.05

From Table 2, the averages concentrations in K, Mg and Ca for all the samples were respectively 3064; 666 and 1048 mg/100 g. For trace elements Fe and Zn, the averages concentrations for all the samples were respectively 12 and 20 mg/100 g.

Table 2: Averages contents of minerals in dry leaves of *Solanum aethiopicum* for the three markets (mg/100g)

Minerals	Averages ± SD for three markets
Ca	1048 ± 56
Mg	666 ± 10
Na	77 ± 16
K	3064 ± 81
P	327 ± 91
Fe	12 ± 2
Zn	20 ± 3

The results showed high contents of minerals in the fruits of Solanum aethiopicum. The contents in K were found highest, followed by Mg and Ca for the samples from the three markets (Table 3).

Table 3: Contents in mg/100 g of minerals in dry fruits of *Solanum aethiopicum*

Minerals	Market 1 (Averages ± SD)	Market 2 (Averages ± SD)	Market 3 (Averages ± SD)	P-value for difference
Ca	124 ± 2	120 ± 3	134 ± 1	0.002
Mg	191 ± 5	172 ± 4	199 ± 3	0.002
Na	88 ± 3	77 ± 1	96 ± 2	< 0.001
K	3562 ± 8	3584 ± 5	3601 ± 9	< 0.001
P	34 ± 4	28 ± 2	24 ± 1	< 0.001
Fe	20 ± 1	20 ± 2	22 ± 2	< 0.001
Zn	2 ± 0.1	2	3 ± 0.2	< 0.001

The contents in K were 3562, 3584 and 3601 mg/100 g for the samples from market 1, market 2 and market 3, respectively. The contents in Mg were 191, 172, and 199 mg/100 g for the market 1, market 2 and market 3, respectively. The contents in Fe and Zn, known as trace elements were lower compared to the other minerals. The averages contents in K, Mg, and Ca for all the samples were 3582, 187 and 126 mg/100 g (Table 4).

A comparison between the leaves and fruits composition is shown in Table 5. Highly contents in K and Fe for Solanum aethiopicum fruits were found. However, the contents in Ca, Mg, P, Fe and Zn were highly in the leaves compared to the fruits (Table 5).

Table 4: Averages contents in mg/100 g of minerals in dry fruits of *Solanum aethiopicum*

Minerals	Averages ± SD for three markets
Ca	126 ± 7
Mg	187 ± 14
Na	87 ± 10
K	3582 ± 20
P	29 ± 5
Fe	21 ± 1
Zn	2 ± 1

Table 5: Minerals levels between *Solanum aethiopicum* dry leaves and fruits (mg/100 g)

Minerals	*Solanum aethiopicum* leaves (Averages ± SD)	*Solanum aethiopicum* fruits (Averages ± SD)
Ca	1048 ± 56	126 ± 7
Mg	666 ± 10	187 ± 14
Na	77 ± 16	87 ± 10
K	3064 ± 81	3582 ± 20
P	327 ± 91	29 ± 5
Fe	12 ± 2	21 ± 1
Zn	20 ± 3	2 ± 1

Discussion

The results showed for Solanum aethiopicum leaves, high contents in K (3064 mg/100 g), Ca (1048 mg/100 g), Mg (666 mg/100 g) and P (327 mg/100 g). The trace elements Fe and Zn contents were also high: (Fe: 12 mg/100 g; Zn: 20 mg/100 g). Compared to the leaves, the fruits contents in K and Fe were high. However, the fruits had lower contents in Ca (126 mg/100 g), Mg (187 mg/100 g), P (29 mg/100 g) and Zn (2 mg/100 g). These results could be explained by the high capacity of the leaves to extract from the soil Ca, Mg, P and Zn. Analyses between the minerals contents for each vegetable showed significant difference from different markets. This difference is linked to the soils composition which can have a variation in terms of minerals [9, 10]. Alium cepa and Moringa oleifera leaves are also consumed in the household in Burkina Faso. Contents in Ca, K, Mg and Zn of Solanum aethipicum leaves were found to be highly compared to those of Alium cepa leaves (Ca: 881 mg/100 g; K: 2657 mg/100 g; Mg: 204 mg/100 g; Zn: 4 mg/100 g) [11]. The contents in K, Mg and Zn of Solanum aethiopicum leaves were also highly compared for those of Moringa oleifera leaves (K: 1922 mg/100 g; Mg: 406 mg/100 g; 5.4 mg/100 g) [9].

The findings showed that leaves of Solanum aethiopicum had a high nutritional quality compared to the fruits. Due to lack of data on Solanum aethiopicum leaves contents in minerals, we compare the data of the fruits with those from other countries. Compared to our study, those conducted in Nigeria, showed lower contents in Ca (31 mg/100 g), Mg (59.5 mg/100 g), K (447.5 mg/100 g), P (109.1 mg/100 g), Zn (7.7 mg/100 g) and Fe (2.5 mg/100 g) [12]. A study using fruits from Ghana showed lower contents in Ca (170 mg/100 g), K (2150 mg/100 g), Mg (190 mg/100 g) P (260 mg/100 g), Fe (3.97 mg/100 g) and Zn (1.06 mg/100 g) [5]. The difference of these findings from different countries is due to difference in soils component variation.

Through this study, we show that these vegetables are good sources of minerals which are essential for children's growth and development [13]. These minerals are involved in wide functions such as maintenance of heart rhythm, muscles contractibility, formation of bone and teeth, acid-base balance, regulation of cellular metabolism and enzymatic reactions [12]. Na and K are responsible for body water regulation and the electrolyte balance [12, 14]. Zn contributes to children's recovery from malnutrition because it is involved in the major metabolic pathways including proteins, lipid carbohydrate and energy [14]. It is also involved in immunity, in cells divisions for tissues growth and development [14, 15]). Fe deficiency among children aged under five years can impair their immunity and reduce efficacy to fight pathogens agents [15]. These two indigenous vegetables consumption will provide these minerals which are important for children growth and development.

Conclusion

This study showed that the two vegetables are good sources of minerals and the leaves with highly nutritional quality.

Acknowledgements

We thank Mr Ouédraogo Inoussa, head of the laboratory in the national office of soils, for his help with the samples analysis.

Conflict of Interest

None.

References

1. Ministère de la Santé/Direction de la Nutrition (2011) Enquête nutritionnelle Nationale. Rapport définitif. MS/DN p. 112.
2. Institut National de la Statistique et de la démographie (2022) Enquête Démographique et de Santé du Burkina Faso 2021. INSD/ICF pp. 39-41.
3. Annan RA, Webb P, Brown R (2014) Prise en charge de la malnutrition modérée (MAM): connaissances et pratiques en vigueur. UNICEF p 46.
4. Kamga RT, Kouame C, Atangana AR, Chagomoka T, Ndango R (2013) Nutritional Evaluation of Five Indigenous Vegetables. Journal of Horticultural Research 21(1): 99-106.
5. Jinazali H, Mtimuni B, Chilembwe E (2017) Nutrient composition of cat's whiskers (Cleome gynandra L.) from different agro ecological zones in Malawi. African Journal of Food Sciences 11(1) : 24-29.
6. Ministère de la Santé/Direction de la Nutrition (2005) Edition et vulgarisation d'une table de composition des aliments couramment consommés au Burkina Faso. MS/DN p 39.
7. Han M, Opoku KN, Bissa NAB, Su T (2021) *Solanum aethiopicum* : The Nutrient-Rich Vegetable Crop with Great Economic, Genetic Biodiversity and Pharmaceutical. Horticulture 126: 1-17.
8. Houba VJG, van Vark W, Walinga I, Vander Lee JJ (2020) Plant analysis procedure (part 7, chapter 2. 3). Department of soils sciences and analysis, Wageningen the Netherlands.
9. Yaméogo CW, Bengaly MD, Savadogo A, Nikiema PA, Traoré AS (2011) Determination of Chemical Composition and Nutritional Value of *Moringa oleifera* Leaves. Pakistan Journal of Nutrition 10 (3): 263-268.

10. Okeke HC, Okeke O, Nwanya KO, Offor CR, Aniobi CC (2021) Comparative Assessment of the Proximate and Mineral Composition of *Cucumis sativus* L. and *Solanum aethiopicum* L. Fruit Samples Grown in South Eastern and North Central Regions of Nigeria Respectively. Natural Resources 12: 237-249.

11. Charles W, Yaméogo, Franck Garanet. (2023) Minerals content of *Cleome Gynandra* and *Allium cepa* leaves grown in Burkina Faso. Asian Journal of Food Research and Nutrition 2(4): 412-417.

12. Michael U, Banji A, Abimbola A, David J, Oluwatosin S (2017) Assessment of variation in mineral content of ripe and unripe African eggplant fruit (*Solanum aethiopicum* L.) Exocarps. J. Pharmacog. Phytochem 6: 2548-2551.

13. FAO/WHO (1998) Vitamins and minerals requirements in human nutrition: report of a joint FAO/WHO. Second edition,WHO Library, Bangkok, Thailand, ISBN 9241546123 p 362.

14. Sunday EK, Hartline OO (2012) Nutrient Composition of Common Fruits and Vegetables in Nigeria. Journal of Biotechnology 15: 1336-1392.

15. UNICEF (1988) The state of the world children. UNICEF house, New York, ISBN92-806-3333-3: p 74.