Assessment of nutritional value of *Solanum aethiopicum* and *Solanum melongena* fruits consumed in Burkina Faso

Abstract

In Burkina Faso, low micronutrients intake is one of factors responsible of under five years children malnutrition. Research on local food to find best vegetables rich in micronutrients is a way to improve children nutrition. The aim of this study is to assess micronutrients content of *Solanum aethiopicum* and *Solanum melongena* grown in Burkina Faso. From three markets of Ouagadougou city, fresh samples of fruits of the two plants have been purchased. After one month drying in laboratory temperature, the dried samples were used to determine content of of Calcium (Ca), Magnesium (Mg), Potassium (K) , Sodium (Na), Phosphor (P), Iron (Fe) and Zinc (Zn) using flam photometer and atomic absorption spectrophotometer. The results showed high content of K, Mg and Ca in the fruits. The content of Na, P is also satisfying. Fe and Zn known as trace elements are also well represented in the two fruits. The values were 3582, 187, 126, 87, 29, 21 and 2 mg/100 g for K, Mg, Ca, Na, P, Fe and Zn, respectively for the fruits of *S. aethiopicum*. *S. melongena* fruits had 2991, 317, 207, 135, 30, 6 and 4 mg/100 g for K, Ca, Mg, Na, P, Fe and Zn, respectively.

These two fruits are important sources of micronutrients and must be included in children diet to improve their nutritional status.

Keys words: *Solanum aethiopicum*, *Solanum melongena*, Fruits, micronutrients, Children, nutrition

1. Introduction

In Burkina Faso, the nutritional survey in 2021 showed prevalence of 9.7% and 21.6% for moderate acute malnutrition and chronic malnutrition, respectively [1]. The prevalence of anemia was 72 % [2]. Malnutrition is an underlying causes of 35% death in under five years

children [3]. The contributing factors to this malnutrition are poverty associated to inadequate diet and lack of health care [4, 5]. In many household, under five years children diet is dominated by cereals porridges. These porridges have low density of nutrients unable to cover their nutritional needs [5]. This situation led to low intake of micronutrients which are essential for cells metabolism, tissues growth and body development [6]. Vegetables are valuable sources of micronutrients [7, 8]. Therefore, they must be used in children diet to help in their balanced nutrition and well-being. In Burkina Faso, there are varieties of vegetables. But, insufficient data exist on their content in micronutrients. Therefore, investigation to select vegetables with high micronutrients content is needed. *S. aethiopicum* and *S. melongena* are herbaceous plants cultivated in Burkina Faso. They are from Solanaceae family and measure 1.5 m [8]. In Burkina Faso, the leaves and fruits of *S. aethiopicum* are consumed raw or cooked in sauce. For *S. melongena*, only the fruits are consumed in sauce. In the food composition table from Burkina Faso, data on micronutrients such as P, Mg, K, Na for *S. aethiopicum* fruits or P, Mg, K, Na, Zn for *S. melongena* fruits are not available [9]. The aim of this study is to assess micronutrients content in the fruits of *S. aethiopicum* and *S. melongena* grown in Burkina Faso.

2. Matarial and Methodes

2.1. Sampling

The samples of cool fruits of S. *aethiopicum* and *S. melongena* have been collected in three markets of Ouagadougou city, Burkina Faso. These samples have been washed and dried in the laboratory at 25°C during one month and reduced in powder with a grinder (mark NIMA, model NO: BL - 888A, Japan). The powder has been filtered by a filter with meshes of 0.5 millimeter of diameter and then, kept in plastic sachets at the laboratory temperature until analyses. The micronutrients analyses have been done in triplicate with the samples.

2.2. Micronutrients content analyses

The following micronutrients: P, K, Na, Mg and Ca from the dried fruits have been analysed after mineralization of samples by humid voice according to Houba et al. [10]. In three tubes, 0.5 g of sample 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 extracted solution. The samples have been let to rest during 2 h at least. After this time, they have been heated with temperatures varying between 100-340 ˚C. The mixture obtained after heating has been cooled to the ambient temperature during 24 h and then, has been diluted to 2/3 of the tubes, stirred, cooled down again and completed to 75 ml with the distilled water. After stirring and emptying, a quantity of the solution has been used for:

- the dosage of the total phosphor with the autosensor (model SKALAR 1000) to 880 nm using the ammonium molybdate as indicator.
- the dosage of Magnesium and Calcium after dilution in the Lanthane [(La $(NO_3)_3$ $6H_2O$)] respectively to 285.2 nm and 422.7 nm with an atomic absorption spectrophotometer (model PERKIN ELMER A100).
- the dosage of Sodium and Potassium with a flame photometer (model CORNING 400).

Ranges of standards solutions have been prepared for the dosage of micronutrients. These ranges are provided as follows:

- Phosphor (P): a solution (300 ppm) of potassium hydrogenophosphate (K_2HPO_4) permitted to achieve a range of concentration varying between 3 and 15 ppm.
- Potassium (K) and Sodium (Na): a standard solution of Sodium-potassium (100 ppm) permitted to prepare a range concentration between 0 and 10 ppm.

- Magnesium (Mg) and Calcium (Ca): standards solutions of Magnesium (1000 ppm) and Calcium (1000 ppm) permitted to prepare concentration ranges varying between 5 and 30 ppm for the Calcium, 0.5 and 3 ppm for Magnesium.

For Zin (Zn) and Iron (Fe) analyses, 0.5 g of sample ground to 0.5 mm has been weighed in three tubes. Then, 5 ml of the extraction solution with nitric acid (HNO_3; 65%), sulphuric acid (H_2SO_4; 96%) and perchloric acid ($HClO_4$; 70%) 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 during

2 h at least. After this time, they have been heated with temperatures varying between 75-240 $^{\circ}$C. The mixture obtained after heating has been cooled down to the ambient temperature during 24 h and subsequently, has been diluted to 2/3 of tubes, stirred, cooling down again and completed to 75 ml with the distilled water. After stirring and emptying, a quantity of the solution has been used to analyse Fe and Zn in atomic absorption, respectively to 219.9 nm and 248.3 nm. A concentration range of standard solution has been 6 to 36 ppm for Fe and 1 to 6 ppm for Zn.

2.3. Statistical analysis

The software SPSS version 22.0 has been used to performed data analysis. Data have been expressed as mean (± standard deviation). The differences between the mean content of micronutrients have been tested using the one way analysis of variance. The Significant difference between the mean has been set to 5% level.

3. Results

The results from this study showed high content of micronutrients in the fruits of *S. aethiopicum*. The content of K was found highest, following by Mg and Ca for the samples from the three markets (table 1).

Table 1: Content in mg/100 g of micronutrients in dry fruits of *S. aethiopicum*

Micronutrients	**Market 1** **(**Mean ± SD)	**Market 2** **(**Mean ± SD)	**Market 3** **(**Mean ± 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

SD: standard deviation

The content of K were 3562, 3584 and 3601 mg/100 g for the samples from market 1, market 2 and market 3, respectively. The content of Mg were 191, 172, and 199 mg/100 g for the market 1, market 2 and market 3, respectively. The content of Fe and Zn know as trace elements were lower compared to the other micronutrients. The mean content of K, Mg, and Ca for all the samples was 3582, 187 and 126 mg/100 g (table 2).

Table 2: Mean content in mg/100 g of micronutrients in dry fruits of *S. aethiopicum*

Micronutrients	**Mean** ± 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

SD: standard deviation

In the Table 3, micronutrients content of *S. melongena* fruits have been shown. The content of K was highest, following by Ca and Mg (Table 3).

Table 3: Content in mg/100 g of micronutrients in dry fruits of *S. melongena*

Micronutrients	**Market 1 (**Mean ± SD)	**Market 2 (**Mean ± SD)	**Market 3 (**Mean ± SD)	**P-value for difference**
Ca	319 ± 4	327 ± 3	305 ± 3	< 0.001
Mg	206 ± 2	200 ± 4	215 ± 4	< 0.001
Na	132 ± 2	138 ± 1	136 ± 1	< 0.001
K	2987 ± 6	3012 ± 4	2976 ± 6	< 0.001
P	28 ± 2	25 ± 3	36 ± 3	0.001
Fe	5 ± 1	8 ± 2	6 ± 1	0.09
Zn	4 ± 0.2	3 ± 0.1	5 ± 0.3	0.09

SD: standard deviation

The content of K were 2987, 3012, 2976 mg/100 g for market 1, market 2 and market 3, respectively. Ca content were 319, 327 and 305 mg/100 g for market 1, market 2 and market 3, respectively. Trace elements Fe and Zn content were lower compared to the other micronutrients. The mean content for all the samples were 2991, 317, 207 and 135 mg/100 g for K, Ca, Mg and Na, respectively (Table 4).

Table 4: Mean content in mg/100 g of micronutrients in dry fruits of *S. melongena*

Micronutrients	**Mean** ± SD **for three markets**
Ca	317 ± 11
Mg	207 ± 8
Na	135 ± 3
K	2991 ± 18

P	30 ± 6
Fe	6 ± 1
Zn	4 ± 1

SD: standard deviation

The results showed that the fruits of *S. aethiopicum* had high content of K and Fe, but low content of Ca, Mg and Na compared to *S. melongena* (Table 5).

Table 5: Levels of micronutrients between *S. aethiopicum* and *S. melongena* dry fruits (mg/100 g)

Micronutrients	***S. aethiopicum*** **(**Mean ± SD)	***S. melongena*** **(**Mean ± SD)
Ca	126 ± 7	317 ± 11
Mg	187 ± 14	207 ± 8
Na	87 ± 10	135 ± 3
K	3582 ± 20	2991 ± 18
P	29 ± 5	30 ± 6
Fe	21 ± 1	6 ± 1
Zn	2 ± 1	4 ± 1

SD: standard deviation

4. Discussion

This study demonstrated that vegetables such as fruits of *S. aethiopicum* and *S. melongena* are good sources of micronutrients. The fruits are rich in K, Mg and Ca. Significant content in Na, P are also found. The content in Fe and Zn know as trace elements are satisfying. The finding showed *S. melongena* fruits to be best sources of Ca, Mg and Na compared to *S. aethiopicum* fruits. However, *S. aethiopicum* fruits are the best sources of K and Fe. This study provides new data on K, Ca, Mg, and P from fruits of *S. aethiopicum*. The study also provides new data on K, Mg, P, Na and Zn from fruits of *S. melongena*. The results showed differences in micronutrients content for the different markets. This is due to difference of micronutrients concentration in the soil for each site where the fruits were appropriated. The

composition of the soil can led a variation of minerals content [11, 12]. The content of Ca, Mg, K and Fe are highest in *S. aethiopicum* fruits compared to the content found in Nigeria by Michael et al. [13]: Ca (31 mg/100 g), Mg (59.5 mg/100 g), K (447.5 mg/100 g), Fe (2.5 mg/100 g). A study from Cameroon using *S. aethiopicum* fruits from Ghana [14], showed highest content of Ca (170 mg/100 g), Mg (190 mg/100 g), P (260 mg/100 g), compared to our study. However, the content of K (2150 mg/100 g), Fe (3.97 mg/100 g) and Zn (1.06 mg/100 g) are lower compared to our study. *S. melongena* fruits studied showed high content of micronutrients compared to other studies. Low content of Ca (2.0292 mg/100 g), Mg (0.8617 mg /100 g), Fe (0.1388 mg/100 g) and Zn (0.5592 mg/100 g) are found in the study from Nigeria [15]. Compared to our study, low content of 0.982 mg/100 g, 0.535 mg/100 g and 0.031 mg/100 g for Na, Fe and Zn, respectively were found in a study from Ivory Coast [16]. These differences between the countries are explained by the mineral composition in the soil in each country and climate variability. Our finding demonstrated that the two fruits are good sources of micronutrients. Therefore, the high frequency consumption by children can contribute to solve their micronutrients deficiencies. The micronutrients are used in main functions in the body. Calcium is used in bone development and muscles functions [16]. Sodium and Potassium are involved in cells hydric system regulation [13, 17]. Magnesium act as enzyme cofactor involved in glycolysis and DNA/RNA polymerases activities [16]. Iron and Zinc are involved in both immune and nervous system action and development [18, 19] . Malnourished children have low hemoglobin rate and exposed to infection. Iron and Zinc are required in small quantity in the body. Therefore, iron and zinc content in the two fruits are important to solve malnourished children anemia and infection problems.

5. Conclusion

S. aethiopicum and *S. melongena* fruits are both important sources of micronutrients such as Ca, Mg, K, Na, P, Fe and Zn. promote high consumption of these fruits by children will contribute in their balanced nutrition, growth and development.

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