Minerals content of *Cleome gynandra and Allium cepa* leaves grown in Burkina Faso

Abstract

Aims: Unbalanced minerals intakes contribute to malnutrition status for children aged under five years. Research to select vegetables with high minerals content is needed in low-income country like Burkina Faso. The aim of this study is to determine the minerals content of *Cleome gynandra* and *Allium cepa* leaves grown in Burkina Faso.

Methods: The leaves of these plants have been purchased in three markets of Ouagadougou. After drying in laboratory at 25 °C, the samples have been used for minerals analyses (Calcium, Potassium, Magnesium, Phosphor, Sodium, Iron and Zinc). To determine the minerals content, atomic absorption spectrophotometer and flam photometer methods have been used.

Results: The two vegetables had high content in Calcium, Potassium, Phosphor and Magnesium. For *Cleome gynandra* leaves, the mean content were 2555; 1178; 441; 347 mg/100 g respectively for Calcium, Potassium, phosphor and Magnesium. For Iron and Zinc as traces element, significant content were found with 53 and 5 mg/100 g, respectively. For *Allium cepa* leaves, the mean content in these minerals were also high with 881; 2657; 324; 204 mg/100 g, respectively. Iron and Zinc content were also in significant levels with 81 and 4 mg/100 g, respectively. The mean content in Calcium, Phosphor, Magnesium, Sodium, Iron and Zinc of *Cleome gynandra* leaves were highest compared to *Alium cepa* leaves.

Conclusion: This study showed that *Cleome gynandra* and *Allium cepa* are excellent sources of minerals. Promote the high consumption of these two vegetables will contribute to solve children anemia and malnutrition problems.

Keys words: *Cleome gynandra* leaves, *Allium cepa* leaves, minerals content, nutrition

1. Introduction

Malnutrition for children aged under five years remains a public health problem in Burkina Faso. The prevalence of moderate acute malnutrition and chronic malnutrition are 9.7% and 21.6% respectively [1]. The lack of health care and an unbalanced nutrition due to poverty contribute to children malnutrition [2]. In many household, cereals porridges are frequently consumed by children with a low nutrients content [3]. Low intakes of minerals is associated with a disturb use of macronutrients which impairs tissues formation in the body. Included vegetables leaves and fruits in children diet can contribute to fight against malnutrition [4, 5, 6]. Then, research to select more vegetables rich in minerals is needed. In Burkina Faso, *Cleome gynandra* and *Allium cepa* leaves are two vegetables commonly consumed. But, there is a lack of information on their minerals content [7]. Therefore knowledge on the minerals content of these two vegetables will encourage the high consumption by children in the household.

Cleome gynandra is a herbaceous plant from Cleomaceae family and can measure about 60 cm in height. The leaves are eat as sauce. *Allium cepa*, is also a herbaceous plant from Amaryllidaceae family. It measure about 60 cm in height. The leaves and bulbs are consumed as sauce.

The objective of this study is to determine minerals content of *Cleome gynandra* and *Allium cepa leaves* grown in Burkina Faso.

2. Materials and Methods

2.1. Samples collection

The samples of cool leaves of *Cleome gynandra* and *Allium cepa* have been purchased in three markets of Ouagadougou, Burkina Faso. These samples have been washed and dried to 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 (25 °C) until analyses. With the samples, the minerals content have been analysed in triplicate.

2.2. Minerals content analyses

The following minerals: Calcium, Potassium, Magnesium, Phosphor and Sodium, from the dried leaves of *Cleome gynandra* and *Allium cepa* have been analysed after mineralization of samples according to Houba et al. [8]. In three tubes, 0.5 g of sample ground to 0.5 mm was weighed and 5 ml of the extraction solution (sulphuric acid - selenium - salicylic acid: 7.2%) was added in each tube. A Blanc solution was 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 between 100-340 °C. The mixture obtained after heating has been cooled to the ambient temperature during 24 h and then 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 were prepared for the dosage of minerals. These ranges are provided as follows:

- Phosphor: a solution (300 ppm) of potassium hydrogenophosphate (K_2HPO_4) permitted to achieve a range of concentration between 3 and 15 ppm.

- Potassium and Sodium: a standard solution of Sodium-potassium (100 ppm) permitted to prepare a range concentration between 0 and 10 ppm.

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

For Zinc and Iron 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 °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 Iron and Zinc 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 Iron and 1 to 6 ppm for Zinc.

2.3. Statistical analysis

For data analysis, the software SPSS version 22.0 has been used. Data were expressed as mean (± standard deviation). The one way analysis of variance has been used to test the differences between the mean content of minerals. The Significant difference between the mean was set to 5% level.

3. Results

The study on *Cleome gynandra* leaves showed high concentrations in Calcium from the samples collected as shown in the Table 1.

Table 1: Minerals content in dry leaves of *Cleome gynandra* (mg/100 g)

Minerals	**Market 1** (Mean ± SD)	**Market 2** (Mean ± SD)	**Market 3** (Mean ± SD)	**P-value for difference**
Calcium	2556 ± 5	2551 ± 4	2559 ± 5	<0.05
Potassium	1182 ± 2	1175 ± 3	1179 ± 3	<0.05
Phosphor	436 ± 2	446 ± 3	442 ± 4	<0.05
Magnesium	344 ± 3	348 ± 5	350 ± 3	<0.05
Sodium	98 ± 1	95 ± 2	102 ± 4	<0.05
Iron	52 ± 3	50 ± 1	56 ± 2	<0.05
Zinc	5	6 ± 1	4 ± 1	<0.05

SD: standard deviation

These concentrations were 2556; 2551 and 2559 mg/100 g for market 1, market 2 and market 3, respectively. The second minerals with high concentration from the markets is the Potassium (1107; 995; 1041 mg/100 g). Phosphor and Magnesium are also present in satisfactory concentrations. The Iron and Zinc know as trace elements were found in high concentrations with 52; 50 and 56 mg/100 g for Iron respectively from market 1, market 2 and market 3. For Zinc, the content was 5; 6 and 4 mg/100 g respectively for market 1, market 2 and market 3. The differences in content for all minerals were significant between the samples of the three markets (Table 1). The mean concentration for Calcium, Potassium, Phosphor and Magnesium were 2555; 1178; 441 and 347 mg/100 g, respectively (Table 2). For trace elements Iron and Zinc, the mean concentrations were 53 and 5 mg/100 g, respectively.

Table 2: Mean content of minerals in dry leaves of *Cleome gynandra* for the three markets (mg/100 g)

Minerals	**Mean** ± SD **for three markets**
Calcium	2555 ± 4
Potassium	1178 ± 3
Phosphor	441 ± 5

Magnesium	347 ± 3
Sodium	98 ± 3
Iron	53 ± 3
Zinc	5 ± 1

SD: standard deviation

Minerals content of *Allium cepa* leaves showed high concentrations in K. These concentrations were 2652; 2657 and 2661 mg/100 g respectively for market 1, market 2 and market 3 as shown in Table 3.

Table 3: Content of minerals in dry leaves of *Allium cepa* (mg/100 g)

Minerals	**Market 1** **(**Mean ± SD)	**Market 2** **(**Mean ± SD)	**Market 3** **(**Mean ± SD)	**P-value for difference**
Calcium	876 ± 4	883 ± 3	885 ± 5	<0.05
Potassium	2652 ± 6	2657 ± 4	2661 ± 5	<0.05
Phosphor	324 ± 2	327 ± 4	320 ± 3	<0.05
Magnesium	200 ± 2	208 ± 3	203 ± 3	<0.05
Sodium	34 ± 3	38 ± 2	32 ± 3	<0.05
Iron	83 ± 2	81 ± 1	79 ± 2	<0.05
Zinc	4 ± 1	6	3 ± 1	<0.05

SD: standard deviation

The Calcium is the second mineral found with high concentrations (876; 883; 885 mg/100 g), respectively for market 1, market 2 and market 3. Phosphor and Magnesium are also present in satisfactory concentrations. For trace elements, Iron is found more concentered with 83; 81 and 79 mg/100 g respectively for market 1, market 2 and market 3. Zinc content is also significant as traces element. Minerals content between the samples for the three markets showed significant differences (Table 3). For all the samples, the mean concentrations in

Calcium, Potassium and Phosphor were 881; 2657 and 324 mg/100 g. Trace elements Iron and Zinc mean concentrations were respectively 81 and 4 mg/100 g (Table 4).

Table 4: Mean content of minerals in dry leaves of *Allium cepa* for the three markets (mg/100 g)

Minerals	**Mean ± SD for three markets**
Calcium	881 ± 5
Potassium	2657 ± 4
Phosphor	324 ± 3
Magnesium	204 ± 4
Sodium	35 ± 3
Iron	81 ± 2
Zinc	4 ± 1

SD: standard deviation

The concentrations levels of minerals showed that *Cleome gynandra* leaves had highest contents in Calcium, Phosphor, Magnesium, Sodium and Zinc compared to *Allium cepa* leaves (Table 5). However, Potassium and Iron were more concentered in *Allium cepa* leaves.

Table 5: Minerals levels between *Cleome gynandra* and *Allium cepa* dry leaves (mg/100 g)

Minerals	***Cleome gynandra* (Mean ± SD)**	***Allium cepa* (Mean ± SD)**
Calcium	2555 ± 4	881 ± 5
Potassium	1178 ± 3	2657 ± 4
Phosphor	441 ± 5	324 ± 3
Magnesium	347 ± 3	204 ± 4
Sodium	98 ± 3	35 ± 3
Iron	53 ± 3	81 ± 2
Zinc	5 ± 1	4 ± 1

SD: standard deviation

4. Discussion

From this study we found *Cleome gynandra* and *Allium cepa* leaves to be excellent sources of Calcium, potassium, Phosphor, Magnesium, Sodium, Iron and Zinc. The mean content in Calcium, Phosphor, Magnesium, Sodium, Iron and Zinc of *Cleome gynandra* leaves were highest compared to *Alium cepa* leaves. Current food composition table from Burkina Faso was established since 2005 and had not data on *cleome gynandra leaves* minerals content [7]. Also, this table did not present data on Magnesium, Sodium and Phosphor content of *Allium cepa* leaves. Therefore, this study allows to have new data available and improve the knowledge nutritional value of these two vegetables.

These selected leaves have highest minerals content compared to other vegetables studier previously [5, 6]. The Calcium, Phosphor and Iron content are highest in *Cleome gynandra* leaves compared to *Solanum aethiopicum* leaves (Ca: 1048; 327; 12 mg/100 g). Also, *Cleome gynandra* leaves have highest content in Calcium, phosphor, Iron and Zinc compared to *Amaranthus hybridus* leaves (Ca: 606; 222; 5; 2 mg/100 g). *Allium cepa* leaves content in Calcium, Phosphor, Iron and Zinc are highest compared to *Amaranthus hybridus* leaves. A comparison of our study with others from Ivory Coast and Malawi showed differences on the minerals content. The mean content in Calcium, Magnesium and Phosphor found in our study are low compared to those from Ivory Coast (Ca: 3817; Mg: 1203; P: 2028 mg/100 g) [9]. However the mean content in Iron (26 mg/100 g) was low compared to our study (53 mg/100 g). Compared to our study, the data from Malawi study showed low content in Calcium (2209 mg/100 g), Iron (36 mg/100 g) and Zinc (3 mg/100 g) [10]. Due to the lack of information on *Allium cepa* leaves minerals content, we compared our data with those for the *Allium cepa* bulbs. From our Study, *Allium cepa* leaves have highest content in Calcium, Potassium, Magnesium, Phosphor, Iron and Zinc compared to the bulbs content found by Akinwande and Olatunde in Nigeria (Ca: 132; 1602; 98; 12; 3 mg/100 g) [11]. Through these findings, we demonstrate the excellent nutritional value of these two vegetables. The use of these vegetables in children diet will have an important role in their nutritional status [12]. They will provide essentials minerals which are involved in body cells functions [13]. Sodium and Potassium are used in body water regulation and the electrolyte balance [13, 14]. Zinc is a mineral involved in immunity, more metabolic pathways and cells divisions for tissues growth [14, 15]. Zinc is also important to fight against infectious diseases such as diarrhea, pneumonia and malaria [15]. The high content in Iron in these vegetables shows also their nutritional qualities. Then, include them in children diet will contribute to improve brain development, immunity and fight against anemia [15].

5. Conclusion

Through this study, we demonstrate the high content in minerals for *Cleome gynandra* and *Allium cepa* leaves grown in Burkina Faso. The high consumption of these leaves can improve children minerals bioavailability and fight against anemia and malnutrition.

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