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Comparative assessment of *Allium cepa* and *Amaranthus hybridus* leaves nutritional values consumed in Burkina Faso

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ABSTRACT: Malnutrition for children aged under five years in Burkina Faso is a health problem. Research to contribute for a balanced nutrition of these children is needed. The aim of this study was to assess the nutritional values of *Allium cepa* and *Amaranthus hybridus* leaves consumed in Burkina Faso.

The cool leaves of these plants have been purchased in three markets of Ouagadougou and allow to air-dry in laboratory at 25 °C. The nutritional values have been analysed for following minerals (Calcium, Potassium, Magnesium, Phosphor, Sodium, Iron and Zinc). For minerals content analyses, the atomic absorption spectrophotometer and flam photometer methods have been used.

The results showed that the two leaves had high content in Calcium, Potassium, Phosphor and Magnesium. For *Allium cepa,* the leaves mean content in Calcium, Potassium, Phosphor and Magnesium were 881 mg/100 g; 2657 mg/100 g; 324 mg/100 g and 204 mg/100 g, respectively. Iron (81 mg/100 g) and Zinc (4 mg/100 g), which are trace elements were also high. For *Amaranthus hybridus* leaves, the Calcium, Potassium, Phosphor and Magnesium content were 606 mg/100 g; 3573 mg/100 g; 222 mg/100 g and 475 mg/100 g. The trace elements Iron and Zn were 5 mg/100 g and 2 mg/100 g, respectively. *Allium cepa* leaves had highest content in Calcium, Phosphor, Iron and Zinc compared to *Amaranthus hybridus* leaves.

This study showed that leaves of *Allium cepa* and *Amaranthus hibridus* have important nutritional values. Included these leaves in children diet will contribute to their nutritional balanced.

KEYWORDS: Vegetables leaves, nutritional values, children, diet, nutrition.

1 INTRODUCTION

The prevalences of moderate acute malnutrition and chronic malnutrition are 9.7% and 21.6% respectively for children aged under five years in Burkina Faso [1]. The low nutrient intake associated to a lack of health care contribute to malnutrition [2, 3]. Low intakes of minerals are associated with a disturb use of macronutrients which impairs tissues formation in the body. Improve children diet including vegetables leaves will contribute to fight against malnutrition [4, 5, 6]. Therefore, investigations to found different vegetables with high nutritional values are needed. *Allium cepa* and *Amaranthus hybridus* leaves are vegetables commonly consumed in Burkina Faso. But, there is a lack of information on their nutritional values [7]. Therefore, knowledge on their nutritionals values will encourage their use and improve children diet quality.

Allium cepa is a herbaceous plant from Amaryllidaceae family. It measures about 60 cm in height. The leaves and bulbs are consumed as sauce. *Amaranthus hybridus,* is also a herbaceous plant from the Amaranthaceae family. It is approximately 2.5 m in height. The leaves are consumed mixed in sauce [8, 9].

The objective of this study was to assess the nutritional values of *Allium cepa* and *Amaranthus hybridus* leaves consumed in Burkina Faso.

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2 MATERIALS AND METHODS

2.1 SAMPLES COLLECTION

The cool leaves of *Allium cepa and Amaranthus hybridus* have been purchased in three markets of Ouagadougou, Burkina Faso. The 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 until analyses. With the samples, the minerals content have been analysed in triplicate.

2.2 MINERALS CONTENT ANALYSES

The following minerals: Calcium (Ca), Potassium (K), Magnesium (Mg), Phosphor (P) and Sodium (Na), from the dried leaves of *Allium cepa and Amaranthus hybridus* have been analysed after mineralization of samples according to Houba et al. methods [10]. 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 Mg and Ca 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 Na and K with a flame photometer (model CORNING 400). Ranges of standards solutions were prepared for the dosage of minerals. These ranges are provided as follows:
- P: a solution (300 ppm) of K-hydrogenophosphate (K_2HPO_4) permitted to achieve a range of concentration between 3 and 15 ppm.
- K and Na: a standard solution of Na-K (100 ppm) permitted to prepare a range concentration between 0 and 10 ppm.
- Mg and Ca: standards solutions of Mg (1000 ppm) and Ca (1000 ppm) permitted to prepare concentration ranges between 5 and 30 ppm for the Ca, 0.5 and 3 ppm for Mg.

For Zn and 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 °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

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

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

Table 1. 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 Ca is the second mineral found with high concentrations as 876 mg/100 g; 883 mg/100 g and 885 mg/100 g, respectively for market 1, market 2 and market 3. P and Mg are also well concentered. For trace elements, Fe is found more concentered with 83 mg/100 g; 81mg/100 g and 79 mg/100 g respectively for market 1, market 2 and market 3. Zn content is also significant as trace elements. Minerals content between the samples for the three markets showed significant differences (Table 2). For all the samples, the mean concentrations in Ca, K and P were 881 mg/100 g; 2657 mg/100 g and 324 mg/100 g. Trace elements Fe and Zn mean concentrations were respectively 81 mg/100 g and 4 mg/100 g (Table 2).

Table 2. 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

Amaranthus hybridus leaves minerals content also showed high concentration in K. These concentrations were 3549 mg/100 g; 3600 mg/100 g and 3571 mg/100 g, respectively for the leaves from market 1, market 2 and market 3 as shown in Table 3.

Table 3. Content of minerals in dry leaves of Amaranthus hybridus (mg/100 g)

Minerals	Market 1 (Mean ± SD)	Market 2 (Mean ± SD)	Market 3 (Mean ± SD)	P-value for difference
Calcium	633 ± 4	581 ± 2	604 ± 2	< 0.05
Potassium	3549 ± 2	3600 ± 1	3571 ± 3	< 0.05
Phosphor	201 ± 2	246 ± 2	218 ± 3	< 0.05
Magnesium	488 ± 1	467 ± 2	470 ± 1	< 0.05
Sodium	37 ± 1	42 ± 1	35 ± 2	<0.05
Iron	5 ± 1	5 ± 1	6	< 0.05
Zinc	2	2	4	< 0.05

SD: standard deviation

The Ca was found to be the second mineral in high concentration with 633 mg/100 g; 581 mg/100 g and 604 mg/100 g for market 1, market 2 and market 3, respectively. The Fe showed levels of 5 mg/100 g; 5 mg/100 g and 6 mg/100 g from market 1, market 2 and market 3, respectively. For Zn, concentrations were 2 mg/100 g; 2 mg/100 g and 4 mg/100 g for market 1,

market 2 and market 3, respectively. Comparison of minerals content between the samples for the three markets showed significant differences (Table 3). For all the samples, the mean concentrations in K, Mg and Ca were 3573 mg/100 g; 606 mg/100 g and 475 mg/100 g, respectively. Trace elements Fe and Zn mean concentrations for all the samples were 5 mg/100 g and 2 mg/100 g, respectively (table 4).

Table 4. Mean content of minerals in dry leaves of Amaranthus hybridus for the three markets (mg/100g)

Minerals	Mean ± SD for three markets
Calcium	606 ± 26
Potassium	3573 ± 25
Phosphor	222 ± 22
Magnesium	475 ± 11
Sodium	38 ± 4
Iron	5 ± 0.4
Zinc	2 ± 0.4

SD: standard deviation

Comparison of minerals content showed that leaves of *Allium cepa* had highest content in Ca, K, Fe and Zn compared to leaves of *Amaranthus hybridus.* However, K and Mg were more concentered in *Amaranthus hybridus* (Table 5).

Table 5. Mean minerals content between Allium cepa and Amaranthus hybridus dry leaves (mg/100 g)

Minerals	*Allium cepa* (Mean ± SD)	*Amaranthus hybridus* (Mean ± SD)
Calcium	881 ± 5	606 ± 26
Potassium	2657 ± 4	3573 ± 25
Phosphor	324 ± 3	222 ± 22
Magnesium	204 ± 4	475 ± 11
Sodium	35 ± 3	38 ± 4
Iron	81 ± 2	5 ± 0.4
Zinc	4 ± 1	2 ± 0.4

SD: standard deviation

4 DISCUSSION

Comparison of minerals content showed that leaves of *Allium cepa* content in Ca, K, Fe and Zn were highest compared to leaves of *Amaranthus hybridus.* However, K and Mg were more concentered in *Amaranthus hybridus* leaves. These concentrations differences are due to the ability of each leaves to draw the desired minerals from the soils.

From this study we found *Allium cepa and Amaranthus hybridus* leaves to be good sources of Ca, K, P, Mg, Na, Fe and Zn. Current food composition table from Burkina Faso was established since 2005 and had not data on Mg, Na and P content for *Allium cepa* leaves or Mg, Na and P content for *Amaranthus hybridus* leaves [7]. Therefore, this study allows to have new data available and improve the knowledge on the nutritional values of these two vegetables.

We compare the content of these leaves with other vegetables previously studier [11, 12]. The content in Ca, Mg, K and Zn of *Allium cepa* leaves were lower compared to *Solanum aethiopicum* leaves (Ca: 1048; Mg: 666; K: 3064 mg/100 g; Zn: 20 mg/100 g). Compared to *Alium cepa* leaves, *Moringa oleifera* leaves content are highest in Ca: 2098 mg/100 g; P: 351 mg/100 g, and Mg: 406 mg/100 g, but lower in K: 1922 mg/100 g and Fe: 28 mg/100 g. Compared to *Amaranthus hybridus* leaves, *Moringa oleifera* leaves had highest content in Ca: 2098 mg/100g, P: 351 mg/100 g, Fe: 28 mg/100 g and Zn: 5 mg/100 g, but lower content in K: 1922 mg/100 g and Mg: 406 mg/100 g. Our study compared with other from Nigeria, showed highest content in Ca, Mg and K from *Amaranthus hybridus* leaves which were 44.15 mg/100; 231.22 mg/100 g and 54. 2 mg/100 g, respectively [13].

The findings showed that these leave are good sources in minerals which are important for children nutritional balanced [14]. These minerals are essential for body cells functions [15, 16]. Fe and Zn are minerals involved in immunity and fight against infectious diseases [16, 17]. Promote these leaves for children diet will have more benefit to improve their nutritional status.

5 CONCLUSION

The study showed important nutritional values of *Allium cepa* and *Amaranthus hibridus* leaves. Promote these leaves for children diet will contribute to their nutritional balance and fight against malnutrition.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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