Research Article

Evaluation of mineral contents in *Cleome gynandra* leaves and stalks from Burkina Faso

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Abstract

Cleome gynandra is an herbal plant highly consumed and appreciated by populations from Burkina Faso and other parts of Africa. Two samples of *Cleome gynandra* were collected and submitted to a comparative analysis by ICP-AES to determine the content of nutritive and toxic elements in leaves and stalks as fresh or boiled material. *Cleome gynandra* leaves and stalks contained important quantities of calcium and potassium. But the fresh leaves contained higher contents in calcium, magnesium, sodium and phosphorus than the fresh stalks. The boiling practice of fresh leaves and stalks reduced the mineral contents by 30 to 70%. These results indicate that *Cleome gynandra* represents a real potential source for mineral nutrients in human nutrition.

Key words: *Cleome gynandra*, leaves, stalks, boiling effect, mineral, ICP-AES

Résumé

Cleome gynandra est une herbacée très consommée et appréciée par les populations au Burkina Faso et dans les autres régions de l'Afrique. Deux échantillons de *Cleome gynandra* ont été collectés et soumis à une analyse comparative par ICP-AES pour déterminer la concentration en éléments minéraux nutritifs et toxiques dans les feuilles et tiges sous forme fraîche ou bouillie. Les feuilles et les tiges de *Cleome gynandra* contiennent une importante quantité de calcium et de potassium. Néanmoins les feuilles fraîches contiennent plus de calcium, magnésium, sodium et phosphore que les tiges fraîches. La pratique de la cuisson des feuilles fraîche et des tiges fraîche réduit de 30 à 70 % la concentration des éléments minéraux. Ces résultats obtenus indiquent que *Cleome gynandra* représente un potentiel réel comme source d'éléments minéraux nutritifs dans l'alimentation humaine. .

Mots-clés: *Cleome gynandra*, feuilles, tiges, effet de cuisson, éléments minéraux, ICP-AES

Introduction

Cleome gynandra L. (syn. C. pentaphylla L., Gynandropsis gynandra Briq., G. pentaphylla DC.) of Capparidaceae (Capparaceae) family is an african and asian plant, widely distributed in Africa subtropical savannah region (Ekpong, 2009; Nyalala and Grout, 2007). In several African countries, *C. gynandra* plays a great role in the food, in particular in rural areas and during food scarcity periods (Bognounou, 1994). Several studies concerning the composition of *C. gynandra* reported that the leaves constitutes a rich source of proteins, vitamins (A and C) and mineral salts (calcium and iron) (Bognounou, 1994; Ochuodho *et al.*, 2006; Chweya and Mnzava, 1997). It is one of the traditional plants, relatively useless, which culture presents a strong potential to improve the human nutrition. In addition the high demand in urban areas isn't covered by garden culture production. For that the plants is becoming rare and expensive.

C. gynandra is also used as indigenous medicine for the treatment of stomach aches, headaches, cramps, nervous convulsions, malaria, fevers, inflammations, intestinal parasites (Mishra *et al.*, 2011). It has been administered to facilitate childbirth and possesses antibacterial, antifungal, antineoplastic, antiarthritic and antioxidant properties (Anbazhagi *et al.*, 2009). Recently, Narendhirakannan *et al.* (2007) have reported the presence of many biologically active phyto chemicals such as triterpenes, tannins, anthroquinones, flavonoids, saponins, steroids, resins, lectins, glycosides, sugars, phenolic compounds, and alkaloids in the extract of *C. gynandra.*

This plant was listed in Burkina Faso where it contributes to the household food safety during drought (Bognounou, 1994). The fresh leaves and young tender vegetable are usually used as sauces ingredients. In other areas, leaves and young tender stalks are boiled, the water is discarded, and they are then combined with other food. Previous studies showed that boiling and drying the leaves may reduce vitamin C content by up to 81% and 95% respectively (Mathooko and Imungi, 1994; Sreeramulu *et al.*, 1983). Moreover the mineral content of boiled leaves and stalks as nutrient and as toxic metals has not yet been well documented.

Our objective was to establish a complete profile concerning mineral elements and potential contaminants in the edible parts of this plant. The effect of boiling on the mineral elements concentrations will also be determined.

Materials and Methods

Materials

Two samples representing about 10 plants each (1 and 2) of fresh *Cleome gynandra* (locally known as "Kinebdo") were collected in March, 2009 from the Zogona market in Ouagadougou (Burkina Faso). Chemical reagents, HNO_3 and H_2O_2 used for the samples digestion and the standard solutions were purchased from BDH (Canada). All reagents used were analytical grade. Distilled and deionized water was used to prepare samples and standards for analysis. The microwave oven used for the digestion was MARS X Press mark. All measurements were performed with an ICP-AES VARIAN, VISTA-MPX models and provided by an automatic sampler.

Methods

Pretreatment of samples

Cleome gynandra samples were washed with distilled water. The leaves and stalks were then separated. Thereafter, the leaves and stalks were divided into two parts, one part was boiled and the other dried in an oven at105°C for 24 hours.

Boiling process

100 g of fresh *Cleome gynandra* (leaves or stalks) was boiled in 200 mL of distilled water. After 90 minutes, the broth was filtered and the plant material was successively dried first at room temperature (24 hours) and later, in an oven at 105°C (overnight). The aqueous filtrate was then evaporated under vacuum with a rotatif evaporator apparatus until a dry residue was obtained

Digestion process for mineral content determination

Before the digestion process, each sample was pulverized, dried in an oven at 105°C (overnight) and then led for cooling in a desiccator. 0.5 g of dry sample was taken into a beaker (50 ml) and 5 ml of concentrated nitric acid and 0.5 ml of 30% (v/v) hydrogen peroxide were added. The

digestion process was carried out into two steps. At first, the mixture was heated during 2 hours at 70°C. After cooling, the yellow solution obtained was transferred in a teflon sealed tube; then the tube was placed on the focused microwave system, and submitted to 105 W power for 10 min, and allowed to cool for 5 min. The solution was diluted to 25 mL with deionized water.

Results and discussion

The analysis concern mineral content in fresh and boiled parts of *C. gynandra* of elements including sodium (Na), potassium (K), magnesium (Mg), calcium (Ca), manganese (Mn), aluminium (Al), iron (Fe), copper (Cu), zinc (Zn) and heavy metals as cadmium (Cd), lead (Pb), chromium (Cr).

For the all experiment, nine (9) samples were studied, either five from sampling 1 or four from sampling 2 as showed in Table 1.

Table1: Raw and boiled samples from Burkina Faso *Cleome gynandra* edibles parts

Samples	***Fresh parts***	***Boiled parts***
1	*Leaves* *Stalks*	*Boiled leaves* *Boiled stalks* *Boiled extract*
2	*Leaves* *Stalks*	*Boiled leaves* *Boiled stalks*

Mineral contents in Cleome gynandra fresh leaves and stalks

Dry matter and moisture content in *Cleome gynandra* leaves and stalks samples are reported in the table 2. Mineral content including Na, K, Mg, Ca, Mn, Al, Fe, Cu, Zn, Ni, Cd, Pb, Cr and P were also given. The dry matter rates estimated in the leaves (11.30 %, 11.71 %) were respectively 1.6 and 2.1 times more than in the stalks (6.88 % and 5.48 %). These results are in agreement with those reported by Bognounou (1994).

Cleome gynandra leaves and stalks contain high amounts (Table 2) of macronutrients, including Ca, K, Mg, P and Na as well as micronutrients, which are Al, Cu, Fe, Mn and Zn. The highest concentrations of Ca, K, Mg, P and Na in the leaves were respectively 440 mg, 287.02 mg, 81.30 mg, 87.70 mg and 53.79. Nevertheless, highest contents in the stalks were respectively 240.10 mg, 362.00 mg, 35.10 mg, 42.70 mg and 37.26 mg per 100 g of fresh material. These results indicate that *Cleome gynandra* leaves and stalks contained large quantities of Ca and K, and except K, the fresh leaves had twice more Ca, Mg, Na and P content than the fresh stalks.

The micronutrients concentration in the leaves samples were generally in the same order of level as the stalk samples. The higher concentrations of Al, Cu, Fe, Mn and Zn in *C. gynandra* stalks (respectively 0.19 mg, 0.04 mg, 0.32 mg, 0.14 mg and 0.20 mg per 100 g of fresh stalks) were lower than those identified in the leaves (respectively 1.05 mg, 0.13 mg, 1.63 mg, 0.53 mg, and 0.47 mg per 100 g of fresh leaves). The fresh stalks had four times less amount of Al, Cu, Fe and Mn elements than fresh leaves. Comparing the data in this present report with previous studies, it appears that *Cleome gynandra* leaves collected in Burkina Faso contain about the same quantities of Ca, Mg and Fe elements as those grown in South Africa, Ghana and Kenya (Bognounou, 1994; Anbazhagi *et al.*, 2009). However, it was noted that the concentrations of Na and P in the present study were higher than those reported by Chweya and Mnzava (1997), Bognounou (1994) and Glew *et al.* (2009).

Boiling effect on the mineral contents

The dry matter and mineral content of boiled leaves (samples 1 and 2), boiled stalks (samples 1 and 2) and extract (sample 1 leaves) after boiling are summarized in table 2. Dry matter ratio is a little lower in the boiled stalks than in the boiled leaves. Concentrations of Ca, K, Mg, P and Na in the boiled leaves are in general higher than for fresh material boiled. The variations of micronutrients amount in the leaves and stalks due to the boiling are relatively less important than those observed with the macronutrients. Al, Cu, Fe, Mn and Zn concentrations in boiled leaves were significantly higher than for fresh material boiled. The concentrations of mineral element in *C. gynandra* boiled stalks were considerably lower than those of leaves. These data above indicate that, the mineral contents in general were reduced in the boiled leaves as well as in the boiled stalks.

A significant reduction of Na was observed in the leaves and stalks (respectively 70% and 55%). The decrease of K and Mg was medium, while that of Ca was less than 40%. The nutritional consequence of such practice should be taken into account. Indeed, mineral elements got reduction in the boiled parts but remain in the boiling extract. Subsequently, Ca, K, Mg, P and Na measurement into the leaves extract (sample 1) were respectively 140.40 mg, 136.10 mg, 34.00 mg, 21.27 mg and 29.23 mg per 100 g of fresh material.

Table 2: Minerals (mg/100 g of fresh material), moisture and dry matter content (% m/m) in Burkina Faso *Cleome gynandra* leaves and stalks

Parts	Fresh leaves		Boiled leaves*		Fresh stalks		Boiled stalks*		Leaves extract*	Literature data[a,b]
Samples	1	2	1	2	1	2	1	2	1	
Moisture (%)	88.70	88.29	--	--	93.12	94,52	--	---	---	81.8-89.6
Dry matter (%)	11.30	11.71	8.95	9.87	6.88	5.48	4.87	3.80	2.52	--
Aluminium	1.05	0.61	0.86	0.47	0.19	0.14	0.17	0.11	0.08	--
Calcium	440.00	365.00	281.90	240.80	240.10	144.70	138.30	85.50	140.40	213-434
Cadmium	0.0019	0.0018	0.0018	0.0017	0.0008	0.0006	0.0007	0.0004	0.0002	--
Chromium	0.0068	0.0059	0.0063	0.0049	0.0028	<0.0022	0.0024	<0.0015	0.0015	--
Copper	0.13	0.11	0.11	0.11	0.04	0.03	0.03	0.02	0.01	0.46
Iron	1.63	1.54	1.90	1.25	0.32	0.23	0.23	0.18	0.22	1-11
Potassium	287.02	245.70	140.52	94.80	362.00	261.00	172.40	123.50	136.10	410
Magnesium	79.55	81.30	36.16	36.72	35.10	27.80	16.61	15.24	34.00	86
Manganese	0.45	0.53	0.33	0.50	0.13	0.14	0.11	0.07	0,11	--
Sodium	53.79	51.48	16.30	16.58	18.51	37.26	8.28	16.61	29.23	33.6
Phosphorus	87.70	80.60	64.08	63.96	42.70	25.87	25.81	15.66	21.27	12
Lead	<0.0041	<0.0042	<0.0042	<0.0036	<0.0025	<0.0020	<0.0018	<0.0014	0.0011	--
Zinc	0.47	0.46	0.60	0.34	0.20	0.18	0.18	0.11	0.17	0.76

* calculated data: mg / 100 g of fresh boiled samples; a(Bognounou, 1994); b(Chweya and Mnzava, 1997)

Conclusion

The evaluation by ICP of mineral elements in the edible parts of *C. gynandra* showed that the specie provides important mineral nutrients for human alimentation and low concentrations of toxic minerals Cd, Pb and Cr are observed. When the fresh matter of *C. gynandra* was boiled in water, the mineral content in the plant material is dropped by 30 to 70%, and the difference represents the remained value in the boiled extract. It would be interesting to investigate a potential use of these boiling extracts as alimentary additives.

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