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Assessment of Some Mineral Elements (Ca, Na, K, Mg, Fe, Mn Cu and Zn) and their Nutritional Intake of Two Traditional Leafy Vegetables: Leaves of *Corchorus Olitotorius (Tiliaceae)* and *Hibiscus Sabdariffa (Malvaceae)*

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***Abstract* – The objective of this study was to estimate some mineral elements (Ca, Na, K, Mg, Fe, Mn, Cu and Zn) of two traditional leafy vegetables: *Corchorus Olitorius (Tiliaceae)* and *Sabdariffa Hibiscus (Malvaceae)* and investigate the nutritional intake and the roles of these micro nutrients in the human body. The vegetable material studied was purchased on Abobo market in Abidjan and analyzed with regard to these mineral elements by atomic absorption spectrophotometer (AAS) after its identification in the Floristic Laboratory of Abidjan Houphouët Boigny University. The obtained results revealed that these samples of *Corchorus Olitorius (Tiliaceae)* and *Sabdariffa Hibiscus (Malvaceae*) analyzed contain more Macronutrients Potassium (K: 13.33 to 26.00 mg / g d.m), Calcium (Ca: 12.74 and 14.02 mg / g d.m) and the trace element iron (Fe: 0.54 to 0.92 mg / g d.m).**

Nutrient intakes of these nutrients abundant in these leafy vegetables were: 4.7 g/ day for potassium; 0.8 to 1 g / day / for Calcium and 9-16 mg / day for Iron. Contents of Micronutrients of traditional vegetables studied, are on the whole a little higher than leafy vegetables from abroad, such as, spinach, but the variability of the concentration of Micronutrients leafy vegetables in general would be due to external factors such as soil fertility, season, maturity, growing conditions, etc. We should also note that the nutritional intakes of these Micronutrients in the human body evolve from the fact significant and rapid changes in lifestyle and eating habits. All these highly valuable Micronutrients data dosed in these two Leafy vegetables make these important nutritional food supplements for certain segments of the population in Côte d'Ivoire.

***Keywords* – Intake, Nutritional Supplements, Leafy Vegetables, Micronutrients, Minerals.**

I. INTRODUCTION

A vegetable crop is strictly potherbs with some parts are edible. In his culinary sense, the word vegetable is any edible part of a plant, fungus or several algae which is not sweet to taste. Also included under this name plant providing condiments and herbs [1] .The edible portion may be a plant root (carrot), a rod (celery), a sheet (lettuce), flower (artichoke), fruit (pepper), a bulb (onion), tuber (potato) or a seed (maize). [2]. That said, a vegetable that is consumed for the plant leaf is a leafy vegetable (e.g. Spinach) .The leafy vegetables are often eaten raw. Some cooked and are prepared in various ways. From a nutritional point of view, these vegetables are low in calories, rich in fiber, minerals, protein and vitamins. These exceptional qualities make leafy vegetable food supplement.[3]. African vegetables, which are part of these edible plants, are increasingly known for their importance in contributing to the food security of millions of people in rural and urban areas. [4] These vegetables by rural Africans for consumption as a food premises are called traditional because they are rooted in their diet. [5] Traditional leafy vegetables, long overshadowed by leafy vegetables from Europe emerging as a remedy in the fight against micronutrient deficiencies (vitamins, minerals). [6] They are part of the African plant species diversity multipurpose [7]. Nutrients are all food substances that the body absorbs and uses to operate. Food becomes nutrients by the action of the digestive juices. We are now able to identify the main nutrients, measure and refine their work in the maintenance of health and prevention of disease. However the total amount of food chemicals is virtually incalculable. Moreover, this chemistry can be changed according that the food is more or less fresh, cooked, grilled, fermented, etc. [8] Leafy vegetables are highly nutritious foods that provide important nutrients necessary for proper functioning of the human organism [9]; [10]. Generally these vegetables prominently in the diets of people in the world, particularly in Africa, Asia and Oceania, where they provide an essential part of nutritional and medicinal purposes [11] This partly explains the interest in our work to know about the contents of some essential minerals leafy vegetables consumed by certain strata of the Ivorian population and that prove to be important dietary supplements. [12]

Our study focuses on two of these traditional leafy vegetables namely sheets *Corchorus Olitotorius (Tiliaceae)* and *Hibiscus sabdariffa (Malvaceae),* two plants respectively called "Kparala" and "Dah" in the local language.

The *Corchorus Olitotorius (Tiliaceae)* where Jew's mallow is an annual, high-cut, straight and sparsely branched. Its leaves are alternate, oval, lance-shaped and toothed. It is reported in tropical Africa, as wild or cultivated vegetable in many countries.

The leaves of *Corchorus Olitotorius (Tiliaceae*) are used fresh, like spinach in Tunisia, a powdered spice in Egypt and in soups in Lebanon. [8] In Côte d'Ivoire the *Corchorus Olitotorius (Tiliaceae)* is a food used as a leaf vegetable mucilaginous. The leaves provide a sticky cooked sauce, okra comparable to [13]. [14].

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The leaves of *Corchorus Olitotorius (Tiliaceae)* cannot be kept long. The product is often sold on the day of harvest, and is constantly kept moist. If it is cooled to 20 ° C can keep about a week and in cold storage for several weeks. If the leaves are dried and pulverized, the product may be stored for at least 6 months. [14].

The second plant that is the subject of our study is the *Hibiscus sabdariffa (Malvaceae)* where Guinea sorrel, an herbaceous plant in the *Malvaceae* family [15] probably originated in Africa, where it could have been domesticated. [16] It is a common plant especially in the savannah areas of West and Central Africa. It is often seen as breakaway plant crops. This plant is also known in Egypt and Mexico. [17] In Africa, *Sabdariffa Hibiscus (Malvaceae)* is an important leaf vegetable in two main uses: as a vegetable and for the preparation of a beverage "ex. Hibiscus". Young shoots and leaves of *Hibiscus Sabdariffa (Malvaceae)* are used as cooked or finely chopped vegetables in sauces. These sauces are eaten with boiled tubers or grains or rice [9], [18]; [15] In the United States, leaves and young shoots of *Hibiscus Sabdariffa (Malvaceae)* are also eaten raw in salads. [19]

Traditional leafy vegetables should be cooked before general consumption. Indeed, consumption of uncooked leafy vegetables can sometimes have drawbacks on the functioning of the body. [20] Studies have also revealed that traditional leafy vegetables also contain antinutritional factors as oxalic acid whose presence prevents the absorption of calcium ions acid substances. It binds thereto in the blood to form kidney stones. [21]

It will be specifically assayed in this work by atomic absorption spectrophotometer some minerals (Ca, Na, K, Mg, Fe, Cu, Mn and Zn) leafy vegetables *Corchorus Olitotorius (Tiliaceae)* and *Hibiscus Sabdariffa (Malvaceae)* purchased from the Abobo market in Abidjan.

Indeed minerals are a significant fraction of Micronutrients making these leafy vegetables valuable Food products. This fraction consists of Micronutrient minerals two groups:
Macro elements and trace elements [8]

It is now possible to determine the role of many nutrients from food science knowledge (Nutrition, Biochemistry, Food Toxicology in Food Safety, etc.). Some trace elements are absolutely vital, others merely desirable or beneficial. [8]

To show the importance in the diet of these minerals leafy vegetables studied, we will investigate their nutritional intake and their roles in the human body.

II. Material and Methods

Vegetable Material

The study focuses on two species of traditional leafy vegetables called in the vernacular "Kprala" and "Dah". This plant material purchased Abidjan Abobo market, comes from growers located Anyama (17 km from Abidjan), have been identified scientifically in the Floristic institute of Abidjan Felix Houphouët Boigny University. These are the plants *Corchorus Olitotorius* (*Tiliaceae*) (Fig.1) and *Sabdariffa Hibiscus (Malvaceae)* (Fig.2).

The samples of these leafy vegetables were analyzed for their mineral elements in the Laboratory of SODEMI (Society Development mining) in Abidjan by atomic absorption spectrophotometer (AAS).

Fig.1. *Corchorus Olitorius (Tiliaceae)* [21]

Fig.2. *Hibiscus Sabdariffa* (*Malvaceae)* [22]

Chemical Analysis

The Atomic Absorption spectrophotometer was used to evaluate the mineral plant material.

Principle of Analysis

The sample is previously incinerated in a muffle furnace and the ash thus obtained is dissolved in acid.

Minerals are then assayed by atomic absorption spectrophotometer (Varian 5) according to the following steps:

- Digestion of the sample
- Injection of the sample into the atomic absorption spectrophotometer equipped with an electro thermal atomization system

- Measurement of the absorbance at a specific wavelength of the element to be measured

Operating procedure

Weigh 0.1 g of each sample to be analyzed in platinum crucibles. Moisten with a small amount of diminished water. Add to each crucible 5 ml of hydrofluoric acid (HF), 2 drops 50% sulfuric acid. Place on a hot plate and allow it to evaporate until dry. Then take a second time with 5 ml of HF, 2 drops of 50% sulfuric acid.

Completely evaporated to dryness and then take the dry residue with 10 ml of 50% HCl and let stand 10 minutes on the hot plate. Transfer the solutions in flasks of 100 ml. Make up to 100 ml with deionizer water. Mix and let stand overnight. Then to read the SAA taking care to prepare standard solutions for each element to be determined Plot the calibration curve and determine the content by comparison.

III. RESULTS

The results are given in Table 1. They reveal that in both vegetables Potassium (K) is the most abundant Macronutrient. Its content ranges from 14.16 mg / g d.m (*Hibiscus Sabdariffa)* to 26.00 mg / g d.m (Corchorus Olitotorius). And iron is the most abundant trace element with content from 0, 54 mg / g d m (*Corchorus Olitotorius*) and 0.92 mg / g d.m (*Hibiscus Sabdariffa*)

Table I: Mineral composition of leafy vegetables (mg/g d.m)

Minerals	*Corchorus Olitotorius (Tiliaceae)	*Hibiscus Sabdariffa (Malvaceae).
Calcium (Ca)	12,74-13,14	13,05-14,02
Sodium (Na)	0,24-0,25	0,27-0,33
Potassium (K)	25,93-26,00	13,33-14,16
Magnesium (Mg)	4,05-4,21	4,10-4,22
Fer (Fer)	0,54-0,56	0,89-0,92
Cuivre (Cu)	0,16-0,18	0,01-0,01
Zinc (Zn)	0,01-0,01	0,06-0,06
Manganèse(Mn)	0,04-0,04	0,28-0,29

*The values indicated in the columns represent the results of two trials

IV. DISCUSSION

It is now possible to evaluate and establish the role of many nutrients from food science knowledge (Nutrition, Biochemistry, Food Toxicology and Food Safety). Some of these are mineral nutrient substances in small amounts in the body; they all are not synthesized by the body. Minerals are called essential Micronutrients (Table 1). Foods such as leafy vegetable (Fig. 1, 2) provide. These minerals and Micronutrients play many roles in the body tissues, their contribution is very important for the human body.

The results (Table 1) of our study indicate that leaf vegetable *Corchorus olitorius* and *Hibiscus Sabdariffa* contain various minerals including macro and trace elements (Table 1)

Regarding the macro elements dosed in leafy vegetables *Corchorus olitorius* and *Hibiscus Sabdariffa* there Calcium, Potassium, Sodium and Magnesium (Table 1).

The contents of Calcium (Ca), in the leafy vegetable *Corchorus Olitorius* and *Hibiscus Sabdariffa* studied, are between: 12.74 and 14.02 mg / g d.m (Table 1). Those are lower than contents (Ca: 15.46 to 56.63 mg / g d.m) given by Ocho-Anin Atchibri et al [12] relating to various other traditional leafy vegetables of Côte d'Ivoire. The works of Tchiégang and Aissatou [23], on the leaves of *Corchorus Olitorius* Cameroon, indicate a calcium content (Ca: 7.80 mg / g d.m) lower than ours (Table 1). Chen and Saad [24] also dosed in the leaves of *Corchorus Olitorius*, a calcium content (Ca: 0, 97- 1, 22 mg / g d.m) different to ours (Table 1). In comparison, spinach, leafy vegetable from abroad, has a content of Calcium (Ca: 0.99 mg / g d.m) lower than those of our two traditional leafy vegetables studied [25]. Calcium is the most abundant mineral in the human body. And metabolism do not make. 99% of calcium contributes to the formation and strong bones and teeth. Non bone Calcium, despite its small share (1%), involved in many vital functions: blood clotting, muscle contraction neural conduction, hormone release [26]. A diet rich in calcium (milk and dairy products, dark green leafy vegetables, small canned fish, pulses) makes the stronger and more resistant vital organs, while ensuring good health. [27]. Calcium is excreted in the feces, in urine. The recommended daily intake of calcium is 0.8 to 1 gram per adult. But, needs, calcium, differ by age and activity of the individual and excess calcium is not without risk. Excess calcium increases the risk of kidney stones but can also cause problems of a psychological or nervous. It can also cause loss of appetite, nausea and vomiting, and muscle pain [27].

The contents of Potassium (K) in the leafy vegetable *Corchorus Olitorius* and Hibiscus Sabdariffa vary between: 13.33 and 26.00 mg / g d.m. These contents of Potassium (K) are lower than those (K: 30.34 to 224.03 mg / g d.m) given by Ocho-Anin Atchibri *et al* [12] which relate to various other traditional leafy vegetables of Côte d'Ivoire. Chen and Saad [24] also dosed in leaves of *Corchorus Olitorius* higher contents of Potassium (K: 64.10 to 78.50 mg / g d.m) than ours. Note here also that the content of Potassium (K: 5.58 mg / g d.m) of spinach, a leafy vegetable from abroad is lower than those of two traditional leafy vegetables studied [25]. Potassium is a mineral necessary for metabolism, but is abundant in the diet. The abundance can have a beneficial effect while the excess is unlikely because the human body eliminates it easily. The kidney is the major route of excretion of potassium. But it can also lose potassium from the gut and sweat. Fruits and vegetables are a major source of potassium in the diet. The recommended daily intake of 4.7 grams is easily obtained with a varied diet that includes enough vegetables. Potassium is toxic at a concentration greater than 25 g, what happens in case of renal dysfunction, lower insulin levels, an injection of some drugs, acidosis (low pH, excess acid in the body). This content of potassium in the blood plasma is called hyperkalemia. It creates heart disease by influencing the

pace of the heartbeat and can lead to death. Symptoms of hyperkalemia are trembling, paralysis, heart palpitations and nausea. A lack of potassium is called hyperkalemia. It also causes heart disease. It can come from digestive problems, of certain medications, a heat stroke. Symptoms of potassium deficiency are cramps, hypertension, irritability, thirst, tingling in the fingertips, digestive disorders, urinary excess, nausea and lower reflexes and muscle weakness in extreme cases. Lack or excess of potassium is discovered during a blood test [28].

The Contents of Sodium (Na) in the leafy vegetables *Corchorus Olitorius* and Hibiscus Sabdariffa studied are between 0.24 and 0.33 mg / g d.m Both leafy vegetables studied contain less sodium (Na) compared to the contents of other Macronutrients studied ((Table 1). Chen and Saad [24] also dosed in leaves of *Corchorus Olitorius* a sodium (Na: 4.44 mg / g d.m) than ours (Table 1). The content of Sodium (Na: 0.79 mg / g d.m) of spinach, a leafy vegetable abroad is lower than those of these two traditional leafy vegetables studied [25]. Sodium is a relatively abundant vital mineral in the human body. He participates in acid-base balance and also allows proper functioning of the neuromuscular system's main elimination is via the urine. Sodium is not synthesized by the body; it must be made in sufficient quantities by our diet, where it is present as sodium chloride. Foods that contain it are numerous and come from both the plant world animal. Recommendations for the recommended nutrient intakes evolve from the fact significant and rapid changes in our lifestyles and our eating habits. A minimum intake of 2 g / day would be required to ensure the organization in its functions and a maximum of 8 g / day may also be established. Beyond this deadline, adverse effects can sustain as a higher risk of developing cardiovascular disease. [29]

The contents of Magnesium (Mg) in the leafy vegetables *Corchorus Olitorius* and *Hibiscus Sabdariffa* studied are between: 4.05 and 4.22 mg / g d.m These contents of Magnesium (Mg) are lower than Magnesium (Mg 3.94 to 19.47 mg / g d.m) given by Ocho-Anin Atchibri *et al* [12] which relate to the contents of various other traditional leafy vegetables of Côte d'Ivoire). The works of Tchiégang Aissafou [23] relating to leaf vegetable *Corchorus Olitorius* and *Hibiscus Sabdariffa* of Cameroon also give content Magnesium (Mg: 14.6 mg / g d.m) and Mg: 25.10 mg / g d.m) superior to ours (Table 1). The content of Magnesium (Mg: 0.79 mg / g d.m) dosed in spinach, a leafy vegetable abroad is lower than those of two traditional leafy vegetables, vegetable material in our study [25]. Magnesium is one of the most abundant in the half body is located in the principal bone minerals. It is a major constituent of the human body that regulates mental and emotional nervous system. It is essential for muscle relaxation and participates in the operation of the cardiac system. Magnesium is an excellent natural anti-stress, prevents sleep disorders. If we lack the nervous system starts and we become tired, irritable and emotional, our heartbeat is unbalanced. The daily requirements of magnesium are averaging 350 mg. If there is an intense physical activity, the requirements are higher because sweating causes a significant removal of magnesium. The most magnesium-rich foods are chocolate, legumes, whole grains, bananas, nuts (walnuts, almonds ...). Some waters are very rich in magnesium (50 mg per liter). [30]

Regarding trace elements dosed in leafy vegetables *Corchorus Olitorius* and *Hibiscus Sabdariffa*, there Iron, Copper, Zinc and Manganese (Table 1)

The contents of iron (Fe) of the two leafy vegetables vary from 0.54 to 0.92 mg / g d.m (Table 1). These values are close just below those contents Iron (Fe: 0.09 to 0.56 mg / g d.m) given by Anin Atchibri et al [12], which relate to various other leafy vegetables Ivory Coast, and Iron content (Fe: 0.7 mg / g d.m) found by Leung et al [31] which refers the leafy vegetable *Corchorus Olitorius*.

Tchiégang and Aissafou [23] found in leafy vegetable *Hibiscus Sabdariffa* of Cameroon iron content (Fe: 0.08 mg / g d.m) lower than ours (Table 1). We also note that the content of iron (Fe: 0.03 mg / g d.m) of spinach, leafy vegetable from abroad, is less than those of two traditional leafy vegetables studied. [25]

Iron is a mineral essential for the proper function of the body and we must take care to have a diet that provides an adequate intake. It is essential to the production of hemoglobin in red blood cells and smooth muscle function. Iron deficiency causes anemia, a source of great fatigue that can result in clinical signs (pallor, shortness of breath, extreme fatigue ...). Anemia is usually accompanied by a reduction in physical and mental abilities, weakening of the immune system. An adult male should consume 16 mg of iron per day and a woman 9 mg. There are two types of iron: Heme iron of animal origin is present in meat (especially red meat), fish and animal products. It is well absorbed (about 25%). The non-heme iron content in products of plant origin, eggs and dairy products and is less well absorbed (only 5%). Some substances help iron absorption such as vitamin C, others hinder such as tea, coffee and fibers. [32].

The contents of copper (Cu) in the leafy vegetables *Corchorus Olitorius* and *Hibiscus sabdariffa* are between 0.01 and 0.18 mg / g d.m (Table 1). Both leafy vegetables contain a copper content which is close to that (Cu: 0.01 mg / g d.m) work of Favier et al [33] related to different batches of spinach purchased on the market Constantine (Algeria). Works of Mpundu et al [34] also gives mineral content (0.02 to 0.04 mg / g d.m) related to various leafy vegetables of Lubumbashi (Congo), slightly higher than ours. The content of copper (Cu: 0.01 mg / g d.m) of abroad spinach leafy vegetable approximates that of two traditional leafy vegetables studied [25]. Copper is an essential trace element and it must have a diet that gives to the body. The body contains less than one gram of copper. Copper is absolutely necessary for metabolism and among his various duties, he is involved in the formation of hemoglobin in the maintenance of cartilage, bones, in the fight against infections and proper functioning of the heart. Copper is used in osteoarthritis. It is an anti-inflammatory by excellence. It has an anti-anemic and antiseptic function. It regulates thyroid, helps the absorption of fat and strengthens the immune system. Copper deficiency leads to increased risk of cardiovascular disease, anemia

(because copper helps in the absorption of iron), Osteoporosis (because copper is actively involved in bone mineralization). An overdose of copper causes so much damage that a deficiency, it can cause nausea, vomiting and severe liver impairment. Copper requirements are 2 Micrograms and are found in liver, shellfish, nuts and chocolate. Potatoes, Raisins Lentils Beans. But vitamin C, fructose, sugar and alcohol can decrease copper. One of the major pathways of copper removal, it is the sweat [35]. The zinc contents (Zn) in leafy vegetables *Corchorus Olitorius* and *Hibiscus Sabdariffa* is between: 0, 01-0, 06 mg / g m (Table 1). Leafy Vegetables *Corchorus Olitorius* and *Hibiscus Sabdariffa* contain Zinc content which is close to that (Zinc: 0.05 mg / g d.m) work Favier *et al*. [33] related to different batches of spinach purchased on the market of Constantine (Algeria).

Works of Mpundu *et al*. [34] presented by against mineral contents (Zn: from 0.05 to 0.20 mg / g d.m), relating to various leafy vegetables of Lubumbashi (Congo) superior to ours (Table 1). The content of zinc (Zn: 0.01 mg / g d.m) of a spinach leafy vegetable from abroad approximates to those of these two traditional leafy vegetables studied. [25] .Zinc is an essential element. So we have to absorb from food. We have the largest concentrations of zinc in our red blood cells in the eyes, the skin, in the hair, as in prostate and liver. [36]. It is a trace element necessary for the proper functioning of the cells of the epidermis; it helps the skin to heal and promotes the treatment of many skin problems (psoriasis, acne, skin infections). It affects the breathing, the endocrine system, immunity, reproduction and it has antioxidant and anti-inflammatory. If zinc deficiency, are occurring symptoms such as growth retardation, digestive disorders, dry skin, acne problems and scarring, fragile nails, hair loss, Zinc is a vital element that acts as an antioxidant and prevents the harmful effects of free radicals. The recommended dietary allowances for zinc is 15 mg per day, foods that are rich are the fish, meat and whole grains, soy, eggs, wheat bread, wheat germ. Such as iron, zinc animal is absorbed better than the one containing the plants. The absorption of zinc is inhibited by phytic acid, tannin by including in coffee and tea as well as by a large intake of calcium and iron. [35].

The Contents of Manganese (Mn) in the leafy vegetables *Corchorus Olitorius* and *Hibiscus Sabdariffa* are between 0.04 and 0.29 mg / g d.m (Table 1). The manganese content (Mn) of leaves Moringa Oleifera is situated in this range [37]. Taro leaves contain less (Mn: 0.007 g / g d.m). [38]. Manganese contents of these two traditional studied leafy vegetables are greater than that (Mn: 0.01 mg/ g d.m) of a leafy vegetable spinach [25]. Manganese is one of the trace elements, i.e. Micronutrients essential for the proper function of the human body. It plays an essential role in the activation of certain enzymes. It participates in the metabolism of sugars (glucose homeostasis) and in the synthesis of lipids, particularly cholesterol. It is indirectly involved in the synthesis of sex hormones. It also participates in the formation of the skeleton, connective tissue and the elimination of free radicals from the body. The body absorbs manganese inhalation and from the gastrointestinal tract. The manganese intake recommended for an adult is 1 to 2.5 mg /day. Manganese is present in many foods. Vegetables contain more than animal products. It is found in tea, cereals (whole wheat, barley, rye, and buckwheat), nuts (pecans, cashews, almonds, walnuts) and legumes (peas). Deficiency is characterized by a slowdown in growth, achieving the hair and nails (dermatitis, pigmentation disorders of the hair), lower blood cholesterol or altered reproductive functions. Excess manganese rather relates vegetarians due to the presence of manganese in large amounts in vegetables. Signs of overdose are mostly neurological headache, drowsiness. It is therefore recommended not to exceed 10 milligrams of manganese per day [39]. Unlike other mineral contents abroad leafy vegetables, such as spinach, leaves *Corchorus Olitorius* and *Hibiscus sabdariffa* appear to contain low contents of a mineral (Table 1). The variability of Micronutrient contents in leafy vegetables is due, according to Leung *et al* [31] to external factors such as soil fertility and fertilization.

V. Conclusion and Perspectives

Leafy vegetables *Corchorus Olitorius* and *Hibiscus Sabdariffa* are rich in essential minerals including Potassium, Calcium and Iron. They might be good nutritional supplements. As shown nutritional intake and the roles of their mineral Micronutrients in the human body, In prospective analyses of these leafy vegetables cooked would be possible to know the percentages to consume their mineral Micronutrients.

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