Leafy vegetables consumed in Western of Ivory Coast as valuable sources of vitamins

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Abstract : *This study aimed to characterize vitamins of Abelmonschus esculentus, Celosia argentea, Ipomea batatas, Manihot esculenta and Myrianthus arboreus, five leafy vegetables consumed in Western Ivory Coast. These leaves were HPLC analysis for vitamins A, B1, B2, B9, C and E. Vitamins content was significantly different ($p < 0.05$) for these leafy vegetables. Vitamin A is present in all the leaves with ratio between 770±5.03 and 76092.50±42.15IU/100g. Only leaves of M. esculenta contain vitamin E at 101±3.01mg/100g. For these leaves, ratio of vitamin B1 varying from 1300±3.55 to 2928.70±4.33mg/100g. Vitamin B2 is between 27±0.66 and 1355.10±2.21mg/100g whereas vitamin B9 is from 5.80±0.11 to 792.40±1.14mg/100g. Vitamin C is very low in different leaves and ranges from 2.40±0.21 to 26.70±1.09mg/100g. These results show leafy vegetables consumed in Western Ivory Coast were valuable sources of nutrients and can contribute to food security.*

Keywords - *Leafy vegetables, vitamin A, vitamin B, vitamin C.*

I. INTRODUCTION

African Leafy Vegetables (ALVs) are considered as valuable sources of nutrients with some having important medicinal properties [1, 2] Indeed, these plants substantially contribute to proteins, minerals, vitamins, fiber and other nutrients which are usually in short supply in daily diets of population in rural areas [3]. These leafy vegetables contain micronutrients that contribute to the well-being of the body [4, 5]. Vitamins are essential organic compounds, in small quantities for the proper functioning of the body. They are also called biocatalysts because they activate the enzymes to ensure the proper functioning of the body and growth in children. They are also involved in the synthesis of hormones and genetic material [6]. The sustainable use of plant resources is seen as an indispensable approach. Given the socio-economic conditions of the present life, it is important for the population to know the composition of micronutrients (Vitamins) in food, and especially in the surrounding wild food plants, to stop their ignorance and establish a well-balanced diet [7]. Ethno-botanical studies have stated that most people in Western of Ivory Coast consume indigenous green leafy vegetables such as *Abelmoschus esculentus* "Gombo", *Celosia argentea* "Soko", *Ipomea batatas*"Patate",*Manihot esculenta* "Manioc" and *Myrianthus arboreus*"Tikliti" through confectionary soups [8, 9]. In order to promote healthy and balanced diets, we consider it important to show the value of leafy vegetables consumed in the west of the Ivory Coast through the knowledge of the vitamin profile.

II. MATERIALS AND METHODS

Plant materials

Leafy vegetables were collected at maturity from cultivated farmlands located at Dabou (Abidjan District, Ivory Coast). These plants were authenticated by National Floristic Center (University Felix Houphouët Boigny, Abidjan- Ivory Coast). The collected plants were destalked, washed with distilled water, drained at ambient temperature and oven-dried (Memmert, Germany) at 60 °C for 72 h [10]. The dried materials obtained were ground with a laboratory crusher (Culatti, France) equipped with a 10 µmmesh sieve. The dried powdered samples obtained were stored in polythene bags at 4°C until further analyses.

Chemicals

All solvents (Methanol and Acétonitrile) were purchased from Merck. Standards used (Vitamine B1, B2, B9, C, E and A) were purchased from Sigma-Aldrich. All chemicals used in the study were of analytical grade.

HPLC analysis

One (1) g of dried powdered sample was dissolves in to 20 ml of methanol. The mixture was filtered through a 0,45µm Corning syringe filter prior to 20 µL injection into the 717 autosampler HPLC system (Waters, USA). The column used for vitamins separation was a C18 Sunfire (4.6 x 250 mm, 5 µm). The HPLC solvent gradient included Methanol/Acétonitrile (v/v). Samples were analyzed at 1.2 mL/min with a 20 min. Vitamins A, B1, B2,

B9, C et E were identified and quantified using HPLC-purified standards. Chromatograms were generated at 260 nm.

T = Aire E*PE*100 / Aire T*PT with:
Aire T: surface of the witness
Aire E: surface test
PE: mass test
PT: mass of the witness

Statistical Analysis

All analyses were carried out in triplicates and data expressed as means ± standard deviation. One way analysis of variance (ANOVA) and Duncan's multiple range test (DMRT) were carried out to assess significant differences between means ($p<0.05$) using XLStat 2017 software.

III. RESULTS AND DISCUSSION

The table below shows the vitamin content of the leafy vegetables consumed in the west of Ivory Coast. With regard to fat-soluble vitamins, vitamin A has been identified in the different leaves with the exception of "Soko" leaves. Values range from 770 ± 5.03 to 76092.50 ± 42.15 IU. Cassava has the best grade followed by potato (50627.50 ± 22.05 IU), okra (8387.50 ± 11.18 IU) and "Tikliti" (770 ± 5.03 IU). The results obtained in the leaves of cassava, potato and okra are higher than those of the Burkina Ministry of Health in dried Cowpea leaves (2970 IU) and dried Corchorus leaves (5082 IU) [11] and in dried baobab leaves (5012.70 IU) [12]. Vitamin A is involved in vision, growth and in reducing mortality from respiratory and diarrheal diseases [13]. Dried leaves and millet of cassava, sweet potato and okra could be used to supplement infant flours and pasta to meet the vitamin A requirements of children estimated at 1320 IU [14].

Table1: Vitamins profile of the five leafy vegetables studied.

Vitamins	Leafy vegetables				
	A. esculentus	*C. argentea*	*I. batatas*	*M. esculenta*	*M. arboreus*
Vitamin A (UI/100g)	8387.50 ±11.18^{c}	nd	50627.50±22.05^{b}	76092.50±42.15^{a}	770 ±5.03^{d}
Vitamin B1 (mg/100g)	1588.70 ± 3.27^{b}	1352.70 ± 2.85^{d}	2928.70 ± 4.33^{a}	1300 ± 3,55^{e}	1461.80 ± 4.09^{c}
Vitamin B2 (mg/100g)	27 ± 0.66^{e}	1355.10 ± 2,21^{a}	841.50 ± 1.73^{b}	305.80 ± 2.15^{c}	76.10 ± 1.01^{d}
Vitamin B9 (mg/100g)	60 ± 1.07^{c}	6.10 ± 0.14^{d}	792.40 ± 1.14^{a}	761.70 ± 1.34^{b}	5.80 ± 0.11^{e}
Vitamin C (mg/100g)	2.40 ± 0.21^{e}	26.70 ± 1.09^{a}	5,50 ± 0.06^{c}	18.50 ± 0.73^{b}	3.60 ± 0,06^{d}
Vitamin E (mg/100g)	nd	nd	nd	101 ± 3.01^{a}	nd

Data are represented as Means±SD (n = 3). Means in the lines with no common superscript differ significantly ($p<0.05$). nd: No determined.

Regarding vitamin E, it was detected only in cassava leaves (101 ± 3.01 mg / 100g). Cassava leaves could be used for the supplementation of infant foods whose daily requirements for vitamin E are estimated at 6 mg [15]. Vitamin E is an antioxidant that facilitates the absorption of vitamin A, the formation of red blood cells and the reduction of cellular aging [16, 17]. Dried and milled cassava leaves could be used as a supplement in the diet of children and the elderly.

Regarding water-soluble vitamins, vitamin B1 or Thiamine is the most abundant followed by B2 and finally B9. The contents of vitamin B1 oscillate between 1300 ± 3.55 and 2928.70 ± 4.33 mg/100g. The sweet potato and cassava leaves record the highest and lowest values, respectively. When okra leaves (1588.70 ± 3.27 mg/100g), "Soko" (1352.70 ± 2.85 mg/100g) and "Tikliti" (1461.80 ± 4.09 mg / 100g) have intermediate levels. These levels are higher than those of dry pepper (0.38 mg), dry okra (0.26 mg) and baobab leaves (130 mg) [12, 17, 18]. For vitamin B2, it ranges from 27 ± 0.66 to 1355.10 ± 2.21 mg / 100g. The leaves of Soko (1355.10 ± 2.21 mg / 100g), sweet potato (841.50 ± 1.73 mg / 100g) and cassava (305.80 ± 2.15 mg / 100g) have the highest levels while Tikliti (76.10 ± 1.01 mg / 100g) and okra (27 ± 0.66 mg / 100g) recorded the lowest levels. The leaves studied have higher levels than those of Fuglie [19] in dried *Moringa olifiera* leaves; in dried baobab leaves [12] and Burkina Faso Ministry of Health [11] in dried guinea-dried leaves. Finally, for vitamin B9, the levels vary from 5.80 ± 0.11 to 792.40 ± 1.14 mg / 100g. The consumption of leafy vegetables studied could cover the daily requirement of vitamin B9 estimated at 0.33 mg [20]. The high vitamin B levels may be due to the method of drying the leaves. The studied ground leaves could be used to sprinkle baby porridges and dishes

in low-income household sauces, cakes and donuts to prevent malnutrition as B vitamins intervene in the fight against Beriberi, the use of vitamin B in the metabolism of amino acids and nucleic acids [14]. Vitamin C is a water-soluble vitamin and the levels detected in dried leaves range from 2.40 ± 0.21 to 26.70 ± 1.09 mg/100g. The leaves of cassava (18.50 ± 0.73 mg/100g) and "Soko" (26.70 ± 1.09 mg/100g) have contents greater than 10 mg where as sweet potato, "Tikliti" and "Okra" have contents of 5.50 ± 0.06; 3.60 ± 0.06 and 2.40 ± 0.21 mg/100g respectively. These results are similar to those of the Ministry of Health of Burkina Faso who obtained grades greater than 10 mg in dry pepper (12 mg/100g) and pepper dry (93 mg/100g) [11]. These low level could be explained by the instability of this vitamin at high temperatures [21, 22]. Consumption of vegetables should be supplemented with fruit to cover the daily requirement estimated at 40 mg as recommended by FAO [14]. Vitamin C is a water-soluble antioxidant that promotes the absorption of iron by chelation or by keeping iron in reduced form [14].

IV. CONCLUSION

The results obtained in this study show that the leafy vegetables consumed in the west of Ivory Coast contain an appreciable amount of vitamins. They can therefore be considered as valuable sources of vitamins. The leafy vegetables studied could therefore contribute to the improvement of human health and should be used as a source of nutrients to supplement other major diets. However, it is necessary to take into account other aspects such as the bioavailability of these nutrients and the effect of various processing methods on the nutritional value of these leafy vegetables.

ACKNOWLEDGMENT

The authors duly acknowledge the National Floristic Center (University Felix Houphouët Boigny, Abidjan- Ivory Coast).

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