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Chemical Composition of the Leaves of Four Wild Plants Eaten as Vegetables in Kisangani (DR Congo)

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Abstract: ***The African tropical forest, in particular that of the DR Congo, constitutes an important reservoir of both animal and plant biodiversity including wild food plants. The leaves of Corchorus tridens, Curcubita pepo, Solanum macrocarpon and Xanthosoma sagittifolium, four spontaneous plants, are consumed less in Kisangani (DR Congo) as vegetables. Various culinary recipes are made with these leaves. Quantitative and qualitative analysis were carried out on the leaves of these plant species in order to determine their nutritional value. It appears from this analysis that the investigated leaves contain proteins (3.47-7.21%), lipids (2.6-4.2%), fibers (2.35-2.51%), sugars (0.6-4.67%), minerals, vitamins and polyphenols. The mineral content (mg/100g) of these leaves varies: calcium (113-985), magnesium (42-890) and iron (16.75-28.26); that of vitamins (mg/100g) also varies: vitamin C (4.13-75), vitamin A (0.13-0.22), vitamin B_1 (0.13-0.64), vitamin B_2 (0.05-0.21) and vitamin B_6 (0.09-0.52). These results show that these wild leafy vegetables are a potential source of nutrients and polyphenols, which justify their food use by the population of Kisangani.***

Keywords: Spontaneous plants, leafy vegetables, nutrients, chemical analysis, Kisangani.

1. Introduction

Wild food plants, largely neglected, unknown or underutilized by a large part of the population, can also contribute to the fight against undernourishment and malnutrition, a thorny problem in developing countries which nevertheless have of significant wild food biodiversity. These plants contain nutrients, their inclusion in the diet will contribute to food security and human nutritional health.

The leaves of *Corchorus tridens*, *Curcubita pepo*, *Solanum macrocarpon* and *Xanthosoma sagittifolium*, four spontaneous plants, are eaten in Kisangani (DR Congo) as vegetables, alone or mixed with other vegetables. Sometimes a mixture of the leaves of *X. sagittifolium*, *Ipomea batatas* and *Talinum triangulare* is used. Various culinary local recipes are made with these leaves on which is added smoked or salted fish and sometimes smoked bush meat.

Some studies have shown the food use of the leaves of these plants, especially in DR Congo, Cameroon, Mali and Nigeria [1], [2] and [3]. Others, including that of [4] have shown that edible wild plants can play an important role in the economy of many families in DR Congo.

Therefore, the aim of this study was to investigate the chemical composition of the leaves of these plants in order to know their nutritional value.

2. Material and Methods

2.1 Plant material

The plant material investigated consists of the leaves *Corchorus tridens*, *Curcubita pepo*, *Xanthosoma sagittifolium* and *Solanum macrocarpo*. Leaves of these plants used as leavy vegetales were collected in Kisanagani (RD Congo) and identified at the Faculty of Sciences of the University of Kisangani.

2.2 Chemical analyses

Drying sample at 105°C was used as method of determination of humidity. Nitrogen content was determined using Kjeldahl method and multiplied by 6.25 to get protein content. Lipids were determined by Soxhlet extraction; the method described by [5] was used for determination of sugars.

Acid-base digestion was used for the determination of fibers and titrimetry for titratable acidity. Ashes were determined by incineration of samples in a muffle furnace at 550°C. These ashes were then dissolved in hot HNO_3 and the dissolved mineral elements (Ca, Mg and Fe) were determined according to the methods described by [6].

Vitamins (A, B_1, B_2, B_6 and C) were determined by the methods described by [7]. The Meyer and Drangedorff tests were used to detect alkaloids while the foam test and the $FeCl_3$ test were used to detect saponins and polyphenols according [8]. Terpenes and sterols were detected according [9]. The methods described by [10] were used for detection of oxalates, cyanides, nitrates and nitrites.

3. Results and Discussion

Chemical analyses of the leaves of four wild plants consumed as vegetables were carried out, the results of these investigations are in tables 1 to 5.

Table 1: Proximative composition of the analyzed leaves

Species	*C. tridens*	*C. pepo*	*S. macrocarpon*	*X. sagittifolium*
Family	Tiliaceae	Curcubitaceae	Solanaceae	Araceae
% Humidity	71.07	84, 03	79, 03	86.40
% Proteins	4.48	3.47	7, 21	4.07
% Fat	2.60	2, 40	3, 40	4.20
% Ash	5.12	4, 20	3, 28	1.75
% Fibers	2.51	2.35	*	*
% Sugars	0.60	4.67	2, 53	3.42
Energy (KJ/100g)	188.17	324.49	290.87	355.24

*means no data

It appears from the table 1 that the water content of the species analyzed varied between 86.40% and 71.07%, the highest content was observed in *X. sagittifolium*.

The protein content of the leaves analyzed varied between 3.47% and 7.21%. The highest content was observed in *S. macrocarpon* (7.21%). This content was higher than that obtained by [11] for the leaves of *Catha polypetala* (2.16%). However, it was found to be lower than the values observed for the leaves of *Basella rubra* Limn (7.8%) and *Beta vulgaris* (12.33%) analyzed in 2011 by [12].

The leaves investigated showed a low lipid content (2.60%-4.20%). This content is higher than that of the leaves of *Oxalis corniculata* Limn (0.8%), but lower than those of *B. rubra* Lim (11.4%) and *Ipomea batatas* Lam (6.4%) also analyzed in 2011 by [12].

The leaves of *X. sagittifolium* exhibited the lowest ash content. The contents obtained were lower than that of *Daucus carota* (11.05%) or B. rubra (9.01%) analyzed respectively by [13] and [12]. They were however higher to that of *Brassica oleraceae* Var Capitata L. (1.05%) obtained by [14].

The fiber content of the leaves (2.35% and 2.5%) of the two species analyzed were less rich in fiber than *B. oleraceae* (3.77%) analyzed by [14].

Sugar content was found in low levels in most of the plants analyzed, especially in *C. tridens* (0.6%). They were all less rich in sugars than *Solanum malongena* (12.3%) analyzed in 2012 by [15].

Table 2: Mineral content of the analyzed leaves

Plant species	Ca (mg/100g)	Mg (mg/100g)	Fe (mg/100g)
C. tridens	912	540	16, 75
C. pepo	985	890	24, 32
S. *macrocarpon*	165	79	28, 26
X. sagittifolium	113	42	21, 47

The results presented in table 2 showed that the leaves of *C. pepo* were richer in calcium (985 mg/100g) and magnesium (890 mg/100g) followed by *C. tridens* (912 mg/100g and 540 mg/100g). These calcium and magnesium contents were higher than those of *Hymenocardia ulmoides* leaves (30 mg/100g) analyzed in 2011 by [16].

It was observed that the leaves of *S. macrocarpon* are richer in iron (28.26 mg/100g) followed by those of *C. pepo* (24.32 mg/100g). They contain more iron than *Primula auriculata* (20.38 mg/100g) and *Catha polypetala* (11.06 mg/100g) analyzed by [11]. They are however less rich in iron than the leaves of *H. ulmoides* (30 mg/100g) analyzed in 2011 by [16] as well as *Beta corolliflora* (37.13 mg/100g) analysed by [11] in 2011.

Table 3: Vitamin content of the analyzed leaves

Plant Species	Vit C mg/100g	EqVit A mg/100g	Vit B1 mg/100g	Vit B2 mg/100g	Vit B6 mg/100g	EqAC cit g/100g
C. tridens	75, 00	0, 22	0, 13	0, 05	0, 09	0, 06
C. pepo	29, 57	0, 06	0, 44	0, 16	0, 18	0, 52
S. *macrocarpon*	38, 02	0, 09	0, 09	0, 10	0, 23	0, 24
X. sagittifolium	4, 13	0, 13	0, 25	0, 21	0, 11	0, 15

Legend: EqVit A and EqAc Cit mean respectively Equivalent Vitamin A and Equivalent citric acid.

These results revealed that the leaves of *C. tridens* had the highest content of vitamin C (85 mg/100g), followed by those of *S. macrocarpon* (38.02 mg/100g). Except *X. sagittifolium*, these leaves were found to be richer in this vitamin compared to *Talinum triangulare* (6.6 mg/100g) and *Cyphostema adenaucole* (22 mg/100g), two leafy vegetables eaten in Kisangani, analyzed by [17]. They also contained more vitamin C than the leaves of *Cola Bruneelii* (12 mg/100g) analyzed by [18].

It was observed that the leaves of *C. tridens* (0.22mg/100g) were richer in vitamin A equivalent, followed by *X. sagittifolium* (0.13 mg/100g). The leaves of *C. pepo* had the highest vitamin B_1 level (0.44 mg/100g). This content was higher than those of *T. triangulare* (0.13 mg/100g) and *Anona riticulata* (0.11 mg/100g) analyzed respectively by [19] and [20].

For vitamin B_2 content, the highest value was found in the leaves of *X. sagittifolium* (0.21 mg/100g), while the lowest was in *C. tridens* (0.05 mg/100g. Compared to *A. riticulata* (0.08 mg/100g) and *Ficus carica* (0.06 mg/100g) analyzed by [20], the vitamin content of *X. sagittifolium* was found to be high.

S. macrocarpon showed the highest rate of vitamin B_6 (0.23 mg/100 g). This rate, lower than that of *Musa spp* (0.47 mg/100g), was however higher than that of *F. carica* (0.06 mg/100g) reported by [20]. *C. pepo* leaves exhibited high acidity (0.52g/100g) followed by *S. macrocarpon* (0.24g/100g) and *X. sagittifolium* (0.15g/100g).

Table 4: Phytochemical groups of the analysed leaves

Plants species:	*C. tridens*	*C. pepo*	*S. macrocarpon*	*X. sagitiffolium*
Alkaloids	-	-	+	-
Polyphenols	-	+	+	+
Saponins	-	+	-	+
Sterols and terpens	-	-	-	-

Legend: + and-mean respectively presence and absence

It emerges from this table 4 that the polyphenols are present in the leaves of three plant species (*C. pepo*, *S. macrocarpon* and *X. sagitiffolium*). Dietary intake of these natural antioxidants can help fight free radicals. [21] have also indicated the presence of polyphenols in the leaves of wild food plants of Masako (Kisangani, DR Congo).

Table 5: Undesirable or toxic substances of the analysed leaves

Plant Species	*C. tridens*	*C. pepo*	*S. Macrocarpon*	*X. sagitiffolium*
Oxalates	-	-	-	-
Cyanides	-	-	+	+
Nitrates	-	-	-	-
Nitrites	-	-	-	-

Legend: + and-respectively mean presence and absence

As shown in Table 5, the leaves investigated were free oxalates, nitrites and nitrates. Cyanides were found in the leaves of *S. macrocarpon* and *X. sagitiffolium*, they could be removed during cooking.

4. Conclusion

The presented results showed that the leaves analyzed had nutritional potential and could contribute to the diversification of vegetables consumed in Kisangani (DR Congo), in particular to fight against malnutrition and undernourishment.

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