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Research Article

Comparative Evaluation of the Morphological Aspects and the Nutritional Values of *Urera trinervis* and *Gnetum africanum* in Wild Medium and Domestic Medium

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Abstract: This study concerns the evaluation morphological and nutritional of two wild vegetable-sheets domesticated by the northern population of the districts of Brazzaville, in particular *Urera trinervis* and *Gnetum africanum*. A physical analysis was made on the morphological aspects of the sheets of the two plants according to the zone of harvest and the chemical analyses relate to the content of dry matter, proteins, lipids, glucids, ashes et mineral elements. The results show that the sheets of domestic *Urera trinervis* are broader than those of wild *Urera trinervis* ($p<0.05$) and have petioles longer than wild *Urera trinervis* ($p<0.001$). As for the length of sheets and the number of ribs, the difference is not significant between the two samples ($p>0.05$). The Sheets of wild *Gnetum africanum* are broader than the sheets of domestic *Gnetum africanum* ($p<0.001$) and have the petioles longer than those of *Gnetum africanum* domestic ($p<0.05$). As for the length of the sheets and the number of ribs, the two samples do not present any significant difference ($p>0.05$). Being nutritional quality, the results show that the contents of proteins of the sheets of *Urera trinervis* wild and domestic presents no difference significant ($p>0.05$), 15.06±0.36/100 g of dry matter for *Urera trinervis* wild and 14.50±0.25 g/100 g of matter dry for *Urera trinervis* domesticated. The contents of proteins of *Gnetum africanum* are of 20.80±0.2/100 g of mS for the wild sample and 19.03±0.22 g 100 g dry matter for domesticated sample ($p<0.0$ 5). The two vegetable-sheets are rich in calcium, potassium and iron with contents respectively 3990±0.02, 1820±0.03 and 4.98±0.01 mg/100 g dry matter for *Urera trinervis* and 950±00.00 mg; 1680±00.00 g and 29±00.00 mg/100 g of dry matter for *Gnetum africanum*. The domestication of *Urera trinervis* and *Gnetum africanum* does not modify in a significant way nutritional qualities of studied vegetables. These results appear adapted to promote and integrate certain wild vegetables in agrarian truths systems in order to fight against their disappearance and to contribute to the food safety of the populations.

Keywords: Domestication, food value, *Gnetum africanum*, nutriments, *Urera trinervis*, wild vegetables sheets, zone of harvest

INTRODUCTION

In Africa, more of the third of the population access to a sufficient food in quantity does not have; the populations often have recourse to the wild species of which the vegetables (Ambe, 2001) to meet their food needs and to ensure the food safety (Jansen Van Rensburg *et al*., 2004). These vegetables sheets contain micro nutriments (vitamins, minerals) which contribute to the wellbeing of the organization (Lêniféré *et al*., 2012; FAO, 1988; Rubaihayo, 1996), present good nutritional values (Tchiengang and Kitikil, 2004) and unquestionably constitute a source of antioxydants making it possible to fight against the cardiovascular diseases and cancers. Thus, a considerable quantity of plants either wild and or domestic can also constitute, from their composition, an appreciable rock salt complement and proteins in the food (Ern, 1979). But, much of animal and vegetable species are in the process of disappearance because of several phenomena (factors), among which: bush fires, deforestation, the abusive use of the species consumables, poaching, turning into a desert. This disappearance of the species can have serious nutritional consequences. Some populations arrive to the domestication of some species in the process of disappearance in order to satisfy their food and nutritional needs. Thus the northern population of the districts of Brazzaville (capital of the

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Republic of Congo) arrives to domesticate *Urera trinervis* (hochst. Ex krauss) Friis and *Gnetum africanum* both plants wild in order to fight against this phenomenon and to ensure their food needs. But their nutritional impact was not given yet. It is within this framework that this present study is registered.

Thus, the principal objective of this study is to determine the nutritive impact of the domestication of *Urera trinervis* and *Gnetum africanum* according to the zone of harvest in order to promote the domestication of the wild plants.

The specific objectives are:

- To determine the content of macro nutriments and biogenic salts of the sheets of *Urera trinervis* and *Gnetum africanum*.
- To compare the nutritional composition of each species in the two mediums (wild medium and medium domesticate) in order to release the negative or positive impact on the nutritive level of domestication.
- To promote the domestication and the use of *Urera trinervis* and *Gnetum africanum*, in order to reduce the pressure on the wild resources while contributing to the incomes of the local communities.

MATERIALS AND METHODS

Vegetable material: the material of work was consisted of the sheets of wild *Urera trinervis* coming from the secondary forest of Léfini (village located at 200 km of the north of Brazzaville, capital of Congo) and of the sheets of *Gnetum africanum* wild, bought at the road station of College Thomas SANKARA coming from the primary forest of Ollombo, with 350 km of Brazzaville. As for *Urera trinervis* and *Gnetum africanum* domestic, these samples were collected in pieces of the inhabitants of talangaï (northern district of Brazzaville).

Methodology:

Place of identification: The sample of *Urera trinervis* was brought to the laboratory of botany of the Center of studies on the Vegetables Resources (C.E.R.VE) of the Delegation General of Research Scientific and Technical (DGRST) has Brazzaville of March 12, 2014 to March 24, 2014 for the determination of the species.

The samples were used to determine the morphological characteristics and to carry out the chemical analyses. The morphological characteristics related to the length and the width of the sheet, the length of the petiole and the number of veins of the sheet.

Preparation of the samples for the chemical analyses: The sheets of *Urera trinervis* and *Gnetum africanum* were weighed then dried with the drying oven at the temperature of 70°C until stabilization of the mass. With the resulting one from this drying, the sheets were crushed using a mini electric crusher 8PL41 (warning, France). The powder obtained was used for the chemical analyses.

Determination of the water content: The water content was determined by a drying of the sheets of *Urera trinervis* and *Gnetum africanum* to the drying oven of mark thermosi SR3000. A mass M_1 of sheets fraiches was weighed and placed at the drying oven at the temperature of 70°C. Drying was stopped after obtaining the constant mass M_2 and the difference in weight gives the water content reported to 100 g of fresh matter.

Determination of the content of lipid: The content of lipids of each sample was determined by extraction according to the method with the soxhlet by using cyclohexane like solvent of extraction according to the protocol hereafter: 50 g of the powder resulting from the crushing of the sheets of *Urera trinervis* or *Gnetum africanum* was placed in a cartridge which in its turn is placed in the soxhlet. In an empty balloon of 250 mL weighed beforehand (M_0), one pours 150 mL solvent. The balloon is heated during 4 heures then cooled. The solvent is evaporated by rotovapor. After evaporation, the balloon containing of lipids is weighed (M_1). The difference in mass between the balloon containing of lipids and the empty balloon gives the mass of lipids reported to 100 g of vegetable matter.

Determination of the content of proteins: The total nitrogen content was determined by the method of kjedahl (AOAC, 1990) which consists of the mineralization of the organic matter by the concentrated sulfurique acid, in the presence of a catalyseur.

The contents of proteins were determined by the method of Kjeldahl by using a coefficient of conversion of protein nitrogen of 6.25.

Determination of the content of glucides: sugars were extracted by their solubility in ethanol after delipidation of the broyat of the sheets of *Urera trinervis* and *Gnetum africanum*.

Determination of the content total rock salt (ashes): The contents in total mineral salt were determined by incineration with the muffle furnace at a temperature of 550°C during 8 h. Once the 8 h passed, the furnace was extinct and one let cool the ashes obtained until the ambient temperature. Ashes were left the furnace then weighed with a balance of precision.

Determination of the contents rock salt: K, Ca, Mg, Na, Fe, P: The minerals (K, Ca, Mg, Na, Fe, P) were analyzed starting from the solution of ashes by Atomic Absorption Spectrometry (S.A.A) or emission of flame. For the determination of these minerals, the solution of

Table 1: Morphological aspects of the large sheets *of Urera trinervis* according to the zone of harvest

Physical characteristics	*Urera trinervis* wild	*Urera trinervis* domestic	Significativity
Length (cm)	12.23±1.42	13.62±0.31	p>0.050
Width (cm)	6.46±0.28	7.25±0.43	p<0.050
Length of the petiole (cm)	2.46±0.38	5.17±0.68	p<0.001
Number of ribs	4±00.00	4.25±0.43	p>0.050

The values are the mean±standard deviation for n = 3

Table 2: Morphological aspects of the large sheets of *Gnetum africanum* according to the zone of harvest

Physical characteristics of the sheets	*Gnetum africanum* wild	*Gnetum africanum* domestic	Significativity
Length (cm)	8.82±0.33	8.50±0.70	p>0.050
Width (cm)	4.22±0.26	3.35±0.25	p<0.001
Length of the petiole (cm)	0.70±0.18	0.52±0.05	p<0.050
Number of ribs	3.25±0.50	3.00±0.00	p>0.050

The values are the mean±standard deviation for n = 3

Table 3: Values of the macro-nutriments of the samples of *Urera trinervis* according to the zone of harvest

Values in macro-nutriments	*Urera trinervis* wild	*Urera trinervis* domestic	Significativity
Moisture (g/100 g of fresh matter)	76.01	74.04	p>0.05
Lipids (g/100 g of dry matter)	1.66±0.02	1.74±0.04	p>0.05
Proteins (g/100 g of dry matter)	15.06±0.36	14.50±0.25	p>0.05
Glucids (g/100 g of dry matter)	7.60±0.58	8.21±0.32	p>0.05
Energy (kcal)	105.58	106.44	p>0.05

The values are the mean±standard deviation for n = 3

lanthanum with 1% and one range standard which differ compared to each biogenic salt were used.

Determination of the energy value: the corresponding energy value was calculated by using the specific coefficient of Merrill and Watt (1955) for proteins, the lipids and the glucids.

Analyze statistical: It was carried out starting from the software Microsoft office Excel 2007. The test of student or of comparison was used. It makes it possible to decide if the difference observed between the two movements is ascribable to a systematic cause or if it can be regarded as the effect of a randomly which had fluctuation.

RESULTS AND DISCUSSION

Morphological aspects: The results on the morphological aspects of the larges sheets of *Urera trinervis* according to the zone of harvest are presented in Table 1.

This results show that *Urera trinervis* domestic has the sheets which show the characteristic following: length of the sheet 13.62±0.3 cm, width of the sheet 7.25±0.43 cm, length of the petiole 5.17±0.68 cm and a number of ribs 4.25±0.43. The characteristics of *Urera trinervis* wild are: length of the sheet 12.23±1.42 cm; width of the sheet 6.46±0.28 cm, length of the petiole 2.46±0.38 cm and a number of ribs 4±0.00.

It is deduced from this table which the sheets of domestic *Urera trinervis* are broader than those of wild *Urera trinervis*. This difference is significant (p<0.05).

Domestic *Urera trinervis* presents sheets having petioles longer than wild *Urera trinervis*. This difference is highly significant (p<0.001). As for the length of sheets and the number of veins, the difference is not any significant difference between the two samples (p>0.05).

The National Institute for the Agronomic Study of the Congo Belgian (1948) had given like physical characteristics of *Urera trinervis*: petiole: 2-6 cm; sheets: length 6-17 cm and width 2.5-10 cm. These values correspond to those found in our study. It is noticed that for the same studied species, the width of the sheets and the dimension of petioles vary wild sample with the domestic sample. This variation could be explained by the nature of the ground of culture of the plant.

The results on the morphological aspects of the large sheets of *Gnetum africanum* according to the zone of harvest are presented in Table 2. This table shows that the wild sheets of *Gnetum africanum* are broader (4.22±0.26 cm) that the sheets of domestic *Gnetum africanum* (3.35±0.25 cm) and the sheets of wild *Gnetum africanum* have longer petioles (0.70±0.18 cm) that those of domestic *Gnetum africanum* (0.52±0.05 cm). The difference is highly significant for the width of the sheets (p<0.001) and significant p our length of the petiole (p<0.05). As for the length of the sheets and the number of ribs, the two samples do not present any significant difference (p>0.05).

The works of Tabuna (2000) had described like physical characteristics of *Gnetum africanum*: petiole 0.3-cm; break into leaf: length 5-14 cm and width 2-5 cm, a number of ribs 3-6 pairs. These values correspond to those found in our study.

Food value in macronutrients: Table 3 presents the contents in macro-nutriments of the samples of *Urera trinervis* according to the zone of harvest.

The table shows that the sheets fraiches of *Urera trinervis* are rich in water with water contents

Table 4: Contents of macro-nutriments of the samples of *Gnetum africanum* according to the zone of harvest

Values in macro-nutriments	*Gnetum africanum* wild	*Gnetum africanum* domestic	Significativity
Moisture (g/100 g of fresh matter)	62.70	63.06	
Lipids (g/100 g of dry matter)	3.06±0.150	4.02±0.160	p<0.001
Proteins (g/100 g of dry matter)	20.09±0.042	19.03±0.042	p<0.010
Glucids (g/100 g of dry matter)	18.69±0.020	21.59±0.060	p<0.001
Energy (kcal/100 g of dry matter)	182.66	198.66	p<0.050

The values are the mean±standard deviation for n = 3

Table 5: Comparison of the contents of macro-nutriments and the energy value of the vegetable-sheets of *Urera trinervis* and of *Gnetum africanum* with other vegetable-sheets usually consumed in Africa

Scientific name	Moisture (g/100 g of fresh matter)	Proteins (g/100 g of dry matter)	Lipids (g/100 g of dry matter)	Carbohydrates (g/100 g of dry matter)	Energy (kcal)
Manihot[b] *e.*	71.70	7.00	1.00	18.30	110.20
Moringa[b] *o.*	74.70	8.10	0.60	14.10	94.20
Cuervea[c] *i.*	61.22	9.56	4.00	25.77	177.36
Hibiscus[b] *c.*	84.80	3.50	0.20	10.30	57.00
Hibiscus[d] *s.*	87.63	18.39	2.54	37.26	245.46
Amarenth[e] ssp	-	4.60	0.20	8.30	53.40
Cicharium[e] *e.*		1.50	0.20	4.30	25.00
Urera[a] *t.* domestic	74.04	14.50	1.74	8.21	106.44
Gnetum[a] *a.* domestic	63.06	19.03	4.02	21.59	198.66

[a]: Our values; [b]: Ndong *et al*. (2007); [c]: Mbemba *et al*. (2013); [d]: Tchiengang and Kitikil (2004); [e]: FAO (1979)

respectively of 76.01 g/100 g from fresh matter for wild *Urera trinervis* and 74.04 g/100 g of fresh matter for *Urera trinervis* domestic.

The water content of the sheets is comparable with that found by Fortin (2001) for *Moringa* will *oléifera* (74.70%).

The contents of proteins of the two samples does not present any significant difference (p>0.05), 15.06±0.36 g/100 g of dry matter for *Urera trinervis* wild and 14.50±0.25g/100 g of dry matter for *Urera trinervis* domestic.

The contents of lipids of the samples of wild *Urera trinervis* and domestic *Urera trinervis* are respectively of 1.66±0.02 and 1.74±0.04 g/100 g of dry matter. This difference is no significant (p>0.05).

This table also shows that the contents of glucids sheets of wild *Urera trinervis* and domestic *Urera trinervis* do not present a significant difference (p>0.05).

The contents of macro-nutriments found in our study approach those announced by Marcel and Bienvenu (2012) on wild *Urera trinervis*, except, the contents of proteins which appear higher with those of our study and that the difference could be explained by the nature of the ground of the zone of harvest.

These nutriments (proteins, lipids, glucides) of the two samples brings respective energies 105.58 kcal for the wild samples and 106.44 kcal for the domestic samples. The difference of the energy value of the two samples is not significant (p>0.05).

The contents of macro nutriments of the samples of *Gnetum africanum* according to the zone of harvest are presented in Table 4.

These results show that the water content of the sheets of G*netum africanum* domestic is of 63.06 fresh matter g/100 g. This content is slightly higher A that of *Gnetum africanum* wild 62.70 fresh matter g/100 g. This value approaches that found by Mbemba *et al*. (2013) for *Cuervea isangiensis* where, the water content was 61.22%.

This table shows that the contents of proteins of *Gnetum africanum* are of 20.80±0.2 g/100 g of dry matter for the wild sample and 19.03±0.22 g/100 g of dry matter for the domestic sample with a significant difference p<0.05.

The wild samples present respectively lower values for the lipids and for the glucids has those of the domestic samples with differences highly significant p<0.001.

The contents of proteins found in our study are higher announced those are by Mialoundama (1996), of value 16.59 g/100 g of dry matter and those of the lipids and the glucids are higher have those of our values with respective contents: 6 g/100 g of dry matter of lipids and 30 g/100 g dry matter of glucids.

The Table 5 presents the comparison of the contents of macro-nutriments and of the energy value of the vegetable-sheets of *Urera trinervis* and of *Gnetum africanum* with other vegetables sheets usually consumed in Africa

This table shows that the water contents of the sheets of *Urera trinervis* (74.04%) and *Gnetum africanum* (63.06%) are comparable has those found by Ndong *et al*. (2007) for *Moringa oleifera* (74.7%) and Mbemba *et al*. (2013) for *Cuervea isangiensis* (61.22%). The contents of proteins of *Urera trinervis* and of domestic *Gnetum africanum* found in the study higher than those several vegetable-sheets consumed in Africa and are made these two vegetable-sheets of the true sources of plant proteins. Content of proteins found in the sheets of *Gnetum africanum* is close to that found by Tchiengang and Kitikil (2004) for *Hibiscus* S. The rate of glucids found in *Urera trinervis* is equal to that announced by FAO (1979) in *Amarente* ssp., which is of 8.3 g/100 g of dry matter.

The contents in mineral elementss (mg/100 g of dry matter) and in ashes g/100 g of dry matter) of *Urera trinervis* wild and domestic are presented in Table 6.

Table 6: Values in mineral elements (mg/100 g dry matter) and in ashes (g/100 g dry matter) of *Urera trinervis* wild and domestic

Elements	*Urera trinervis* wild	*Urera trinervis* domestic	Significativity
Ashes (mg/100 g of dry matter)	14.50±0.02	15.58±0.02	p<0.001
Calcium (mg/100 g of dry matter)	2920±0.03	3990±0.02	p<0.001
Magnesium (mg/100 g of dry matter)	720±0.04	600±0.02	p<0.001
Potassium (mg/100 g of dry matter)	2420±0.04	1820±0.03	p<0.001
Phosphorus (mg/100 g of dry matter)	17760±0.01	4270±0.03	p<0.001
Fe (mg/kg)	4.32±0.03	4.985±0.01	p>0.050
Na (mg/100 g of dry matter)	10.0±0.00	10.0±0.00	p>0.050

The values are the mean±standard deviation for n = 3

Table 7: Values in mineral elements (mg/100 g of dry matter) and in ashes (g/100 g dry matter) of G*gnetum africanum* wild and domestic

Elements	*Gnetum africanum* wild	*Gnetum africanum* domestic	Significativity
Ashes (g/100 g of ms)	6.9±0.042.0	7±0.02	p<0.010
Calcium (mg/100 g of ms)	1060±00.0	950±00.00	p<0.010
Magnesium (mg/100 g of ms)	505±05.0	220±00.00	p<0.001
Potassium (mg/100 g of ms)	1410±00.0	1680±00.00	p<0.010
Fe (mg/kg)	15.5±05.0	29±00.00	p<0.001
Na (mg/100 g of ms)	10.0±00.0	20±00.00	p<0.001

The values are the mean±standard deviation for n = 3

Table 8: Comparison of the nutritive compositions of domestic *Urera trinervis* and other vegetables (mg/100 g of dry matter)

Scientific names	Potassium (mg)	Calcium (mg)	Phosphorus (mg)	Magnesium (mg)	Iron (mg)
Cuervea isangiensis [b]	820	3060	10930	1645	11.53
Moringa o [e].	Nd	1270	360	1910	3.81
Dancus carota [c]	195	68	73	37	0.70
Hibiscus c [e].	Nd	1590	530	1990	4.24
Solanum l. [C]	540	117	49	63	4.00
Manihot esculenta [C]	448	210	84	31	1.80
Endiva [d]	324	38	36	13	0.40
Urera t. [a] domestic	1820	3990	4270	600	4.98
Gnetum a [a] domestic	1680	950		220	29.00

[a]: Our values; [b]: Mbemba *et al*. (2012); [c]: Broin (2012); [d]: FAO (1979); [e]: Tchiengang and Kitikil (2004)

This table shows that the contents in ash, calcium, magnesium and phosphor of wild *Urera trinervis* are, respectively of 14.50±0.02 g/100 g dry matter; 2920±0.03 mg/100 g of dry matter; 720±0.04 mg/100 g of dry matter; 2420±0.04 mg/100 g of dry matter and those of domestic *Urera trinervis* are, respectively of 15.58±0.02 g/100 g of dry matter; 3990±0.02 mg/100 g of dry matter; 600±0.02 mg/100 g of dry matter; 1820±0.03 mg/100 g of dry matter and 4270±0.03 mg/100 g of matter dries. One notes for the same species a highly significant difference (p<0.001) between the two localities of harvest in these various minerals and total rock salt. This difference could be explained by the quality of various grounds of culture. The contents of iron and sodium do not present any significant difference (p>0.05).

Lêniféré *et al*. (2012) on work of vegetable-sheets (Amaranth, Morelle black) noted the same phenomene: the content beta-carotene of these vegetable-sheets varied from a place of harvest to another. Marcel and Bienvenu (2012) for the same species find the calcium contents (210 mg/100 g of dry matter); magnesium (270 mg/100 g of MS); potassium (12Ö mg/100 g of dry matter) lower to our values. As for the content of phosphor (18970 mg/100 g of ms), the value approaches with that found in our study with a value 17776±0.01 mg/100 g of dry matter for the wild sample. The content in sodium (10 mg/100 g of ms) observed in our study is lower than that announced by Marcel and Bienvenu (2012) with a value of 20 mg/100 g of dry matter.

The values in mineral elements mg/100 g of dry matter) and in ashes (g/100 g of dry matter) of *Gnetum africanum* wild and domestic are presented in Table 7.

These results show that the ash contents, of iron, potassium and sodium of the domestic samples are higher than those of the wild samples with one of highly significant difference (p<0.001) for iron, sodium and very significant for ashes and potassium (p<0.0 1). As for the contents of magnesium and of calcium, the wild sample presents higher values has those of the domestic sample with a highly significant difference for magnesium (p<0.001) and very significant for calcium (p<0.01). The domestic sample presents contents of iron, magnesium, potassium and calcium higher than those announced by Mbemba *et al*. (2012) for same wild vegetable with values respectively of 20.38±0.35 g/100 g of dry matter for iron, 160±0.00 g/100 g of dry matter for magnesium, dry matter 1170±30 g/100 g for potassium and 0.52±0.00 g/100 g of dry matter for calcium.

Comparison of the nutritive compositions of *Urera trinervis* and of *Gnetum africanum* with other vegetables: The compared contents of the nutritive compositions of *Urera trinervis* domestic and *Gnetuma fricanum* domestic with seven other vegetable-sheets consumed in the world are presented in Table 8.

It arises that the two vegetables sheets studied present contents of mineral elements significant compared to other vegetables consumed in particular *Cuervea isangiensis*, *Moringa oléifera*, *Dancus carota*, *Hibiscus* C., *Solanum* L., *Manihot esculenta* and *Endiva*, respectively.

Iron, oligoélément significant is strongly represented in *Gnetum africanum* (29 g/100 g of dry matter). But the contents of iron of *Urera trinervis* are almost identical to those found in other vegetables usually consumed like: *Hibiscus C* (4.24 g/100 g of dry matter) announced by Tchiengang and Kitikil (2004) and *Solanum L* (4.0 g/100 g of dry matter) mentioned by Broin (2012). The quantities of calcium and potassium found in our study are higher than seven consumed vegetables and will make these two vegetables sheets of the true sources of potassium and calcium.

CONCLUSION

The physical analysis of the studied vegetable sheets reveals some differences on the levels of morphology of the limb and the size of petioles. The domestic vegetable-sheets have less broad sheets and petioles plus neck R ts that those of vegetables wild. The two studied species do not present any significant difference ($p>0.05$) concerning the length and the number of veins of the sheets.

The domestication of *Urera trinervis* and *Gnetum africanum* does not modify in a significant way nutritional qualities of studied vegetables. These results appear adapted to promote and integrate certain wild vegetables in agrarian truths systems in order to fight against the food insecurity. This vegetables sheet presents the characteristics of a great interest on the nutritional level. These plants are a significant food resource for the populations, in particular rural, for the contents in proteins which is higher than that several vegetables sheets consumed in Africa. The contents of minerals of these two domestic vegetable-sheets studied are significant, especially out of calcium, potassium.

All things considered, the contribution of wild vegetables domesticated in the food practices appears by an increase in the contents of mineral elements and proteins. To make domestic plants a means of enrichment of food in the fight against malnutrition and of anemy by iron deficiency.

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