International Journal of Advanced Research in Chemical Science (IJARCS)
Volume 9, Issue 2, 2022, PP 11-16
ISSN No. (Online) 2349-0403
DOI: http://dx.doi.org/10.20431/2349-0403.0902002
www.arcjournals.org

Composition Table and Antioxidant Activities of Five Leafy Vegetables in the South of Mali

Cheickna DAOU[1*], Ousmane KEITA[2], Alou BARRY [1],Julien COULIBALY[2], Mamadou WELE[2]

[1]*Food technology laboratory.Institute of Applied Sciences of University of Sciences, Techniques and Technologies of Bamako (USTTB) – Mali, BP: 423 Bamako, Mali.*
[2]*Food Biochemistrylaboratory. Institute of Applied Sciences of University of Sciences, Techniques and Technologies of Bamako (USTTB) – Mali, BP: 423 Bamako, Mali.*

Corresponding Author:** ***Cheickna DAOU, *Food technology laboratory.Institute of Applied Sciences of University of Sciences, Techniques and Technologies of Bamako (USTTB) – Mali, BP: 423 Bamako, Mali*

Abstract:

Introduction: *In Mali, leafy vegetables are used by population in nutrition as food supplement and ingredients of the sauces. They also have various therapeutic virtues such as antioxidant activities.*

Objective: *The purpose of this study is to evaluate the physicochemical composition and the antioxidant activity of the leaves of Arachis hypogaea, Solanum aethiopicum, Hibiscus sabdariffa, Ipomea batatas and Manihot esculentus from four different zones in the south of Mali.*

Methods: *Moisture, ashes, proteins, lipids, carbohydrate and minerals are determined respectively by dehydration at 105°C, incineration at 600°C, Kjeldahl, Soxhlet and Anthrone. The antioxidant activity of the aqueous and the methanolic extracts was evaluated by the DPPH and Ferric Reducing Antioxidant Power (FRAP).*

Results: *Provenance has little influenced different parameters. The leaves of Manihot esculentus Gantz from Bamako have the lowest moisture content (2.66 %) while those of Arachis hypogaeaof Ségou showed the lowest ash content (4.44 %) however, those from Bamako has the lowest oil content (1.3 %). The leaves of Hibiscus sabdariffa de Bamako and Arachis hypogaea have showed the lowest carbohydrates content (3.22%).The results showed that methanolic andaqueous extracts of Arachis hypogaea et de Solanum aethiopicum have the highest inhibition percentage80.65%, 79.76 %, 96.97 %, et 94.04 % à la concentration de 5 mg/mL respectively.*

Conclusion: ***S****tudied leaves vegetables are very rich in nutrient and present antioxidant activities. It would be important to evaluate their biological activities.*

Keyword: *leaves vegetables, domestic, composition table, antioxidant activities*

1. Introduction

Leaves vegetables play an important role in the dietary regimes of all the people in the world, particularly in Africa, Asia and Oceanic, where they provide the essential part of nutritional and medical need[1].

Sub-Saharan Africais endowed with a great diversity of food plants, among these are leaves vegetables. [2]. They play an important role in agriculture, food and generate significant income in both rural and urban areas. [3].

In Mali, leaves vegetables such as *Arachis hypogaea*, *Solanum aethiopicum*, *Hibiscus sabdariffa, Ipomea batatas* and *Manihot esculentus* occupy a prominent place in the eating habit. They are grown as vegetable plants and sold in markets. In addition, they have various therapeutic virtues such as antioxidant activities and very beneficial against cardiovascular diseases.[4] [5].

Oxidative stress is involved in many diseases as a trigger or associated with complications. Most oxidative stress-induced diseases appear with age because aging decreases antioxidant defenses and increases mitochondrial radical multiplication. [6], [7], [8].

Oxidant stress is the main initial cause of several diseases.[9]. It is the potentiating factor the appearance of multi-acting diseases such as diabetes, rheumatism, Alzheimer's and cardiovascular diseases. [10].

However, despite their multiple virtues and the great interest they arouse in some consumers, very little data exist on these leafy vegetables.

2. Material and Methods

2.1. Plant Material

The plant material was composed of leaves powder of *Arachis hypogaea*, *Solanum aethiopicum*, *Hibiscus sabdariffa*, *Ipomea batatas* et de *Manihot esculentus.*

2.2. Methods

Sampling

Leaves of vegetables and plants were purchased with producers or harvested in the bush. These samples came from five locations chosen at random whose Banamba, Bamako, Bougouni, Kati and Ségou. The leaves were dried in the shade in the laboratory and sprayed.

Extraction

12.5 gpowder of each sample were introduced into 100 mL of distilled water and the set was boiled for 2 hours. Similarly, 12.5 g of each sample were introduced in 100 mL of methanol and the set was stirred for 2 hours. After cooling and filtration, the extracts were concentrated at rotavapor at 40°C then, the concentrated extracts were frozen and then lyophilized.

Determination of Moisture Content and Dry Matter

Moisture and dry matter content have been determined using oven at 105°C according to the formulas:

$$\% \text{ moisture} = [(P1 - P0) / PE] \times 100$$

Dry matter = 100 – % moisture with: P0 = weight of empty cup; P1= weight of cup after oven treatment; PE = weight of sample

Determination of Total Ash Content

The muffle furnace set at 600°C was used to determine the total ash content according to the formula:

$\% \text{ Ash} = [(P1 - P0) / PE] \times 100$, with: P0 = weight of empty crucible; P1= weight of crucible after incineration; PE = weight of sample

Dosage of Proteins

The total protein content was determined by the method of Kjeldahl according to the following formula:

$\% \text{ Protein} = [[(V_1 - V_0) \text{ x } T \text{ x } 0,014 \text{ x } 100] / m] \text{ x } 6,25$, with: V_1 = Volume of H_2SO_4used for titration of sample; Vo = Volume of H_2SO_4used for titration of blank, T = Concentration of sulfuric acid (0,5 mol/L); m = weight of sample.

Dosage of Lipids

Total lipid content was determined by the method of Soxhlet using formula:

% lipids = [(P1-P0) / PE] X100, with: P0 =weight of empty balloon; P1 = weight of balloon containing lipid; PE =weight of sample.

Dosage of Carbohydrates

The Anthrone method was used to assay total carbohydrates in the samples at 630 nm. The concentration of each sample was determined from the standard calibration curve of glucose.

Determination of Antioxidant Activity of Extracts by DPPH Method

The antioxidant activity of aqueous and methanolic extracts were evaluated by the DPPH method at 515 nm. Methanol has been used as negative control and ascorbic acid as positive control. The following formula was used to determine the percentage of radical inhibition:

I (%) = [(Abs sample - Abs negative control) / Abs sample] x 100

With: *I (%)*: Percentage inhibition; *Abs sample*: Absorbance of sample;

Abs negative control: Absorbance of negative control.

Determination of Antioxidant Activity of Extracts by FRAP Method

The reducing iron activity by the aqueous and methanolic extracts was evaluated by the FRAP method at 700nm with ascorbic acid as positive control.

2.3. Statistical Analysis

The experiences were made in triplicate and every value represents an average. The average, the standard deviation and the ANOVA test were made on the basis of the «Minitab" software. As for the figures, they were made from Excel software.

3. Results and Discussion

3.1. Physicochemical Composition of Domestic Leaves-vegetables

The tables I, IIand III represent the physicochemical of the leave vegetables.

Table1. *Physicochemical Composition of Solanum aethiopicum leaves*

Origin	Moisture (%)	Dry matter (%)	Ash (%)
Bamako	3.93 ± 0.30^{AB}	96.07 ± 0.30^{AB}	17.73 ± 0.08^{C}
Banamba	4.42 ± 0.17^{AB}	95.58 ± 0.17^{AB}	18.5 ± 6.06^{A}
Bougouni	5.65 ± 1.58^{A}	94.35 ± 1.58^{B}	17.17 ± 0.29^{D}
Kati	4.74 ± 0.22^{AB}	95.28 ± 0.22^{AB}	16 ± 0.00^{E}
Ségou	3.99 ± 0.70^{B}	96.01 ± 0.70^{A}	21.13 ± 0.32^{B}

Table2. *Physicochemical Composition of Hibiscus sabdariffa leaves*

Origin	Moisture (%)	Dry matter (%)	Ash (%)
Bamako	4.46 ± 0.30^{C}	95.54 ± 0.30^{A}	7.95 ± 0.08^{AB}
Banamba	6.29 ± 0.25^{C}	93.71 ± 0.25^{A}	9.17 ± 0.3^{A}
Bougouni	4.83 ± 0.09^{C}	95.17 ± 0.09^{A}	8.67 ± 3.01^{A}
Kati	15 ± 0.29^{A}	85 ± 0.29^{C}	7.1 ± 0.07^{B}
Ségou	12.08 ± 1.59^{B}	87.92 ± 1.59^{B}	8.14 ± 0.2^{AB}

Table3. *Physicochemical Composition of Manihot esculentus leaves*

Origin	Moisture (%)	Dry matter (%)	Ash (%)
Bamako	2.66 ± 0.05^{AB}	97.34 ± 0.05^{A}	8.29 ± 0.25^{A}
Banamba	5.48 ± 0.27^{A}	94.52 ± 0.27^{B}	8.23 ± 0.06^{A}
Bougouni	3.86 ± 0.22^{C}	96.14 ± 0.22^{AB}	8.33 ± 0.58^{A}
Kati	4.21 ± 0.15^{BC}	95.79 ± 0.15^{A}	8.00 ± 0.00^{A}
Ségou	3.85 ± 0.11^{C}	96.15 ± 0.11^{A}	8.69 ± 0.63^{A}

The moisture rate of these vegetables leaves ranges between 2.66 % and 15 %. This result is significantly different from that found by Yao et al. (2020) whose values vary between 78.02 % and 93.73 %. This difference could be explained by the fact that their samples were in the fresh state.

The Ash content of vegetables leaves is 4.44 % to 21.13 %. These values are greater than those of Prisacaru et al. (2017) who found as a certain content of 2.82 % when estimating heavy metal levels in green leaves vegetables.

Nutritional and Energy Characteristics of Leaves-vegetables

Nutritional and energy characteristics of leaves vegetables are represented in the tables IV, V and VI.

Table4. *Nutritional and energy characteristics of Solanum aethiopicum leaves*

Origin	Carbohydrates (%)	Lipids (%)	Proteins (%)	Energy value
Bamako	5.70 ± 0.46^{A}	3.33 ± 0.29^{B}	5.18±0.68^{C}	73.53±5.67^{B}
Banamba	4.24 ± 0.42^{B}	3.5 ± 0.87^{B}	7.73±0.20^{B}	79.39±7.16^{B}
Bougouni	5.58 ± 0.21^{A}	3.33 ± 0.47^{AB}	7.96±0.41^{B}	87.13±6.03^{B}
Kati	5.39 ± 0.48^{A}	2.33 ± 0.23^{B}	8.18±0.07^{B}	75.26±0.80^{B}
Ségou	5.41 ± 0.37^{A}	5.17 ± 0.76^{A}	10.28±0.03^{A}	109.26±7.53^{A}

Table5. *Nutritional and energy characteristics of Hibiscus sabdariffa leaves*

Origin	Carbohydrates (%)	Lipids (%)	Proteins (%)	Energy value
Bamako	3.28 ± 0.27^{C}	5.00 ± 0.5^{A}	3.35±0.37^{D}	71.51±4.35^{AB}
Banamba	4.81 ± 0.44^{AB}	4.00 ± 0.5^{AB}	5.90±0.66^{B}	78.84±2.63^{A}
Bougouni	5.99 ± 0.52^{A}	4.5 ± 0.82^{A}	4.58±0.26^{BC}	82.78±10.05^{A}
Kati	3.96 ± 0.91^{BC}	2.31 ± 0.76^{B}	3.88±0.16^{CD}	52.16±10.39^{B}
Ségou	3.78 ± 0.01^{BC}	2.4 ± 0.73^{B}	5.54±0.09^{AB}	58.90±6.30^{B}

Table6. *Nutritional and energy characteristics of Manihot esculentus Gantz leaves*

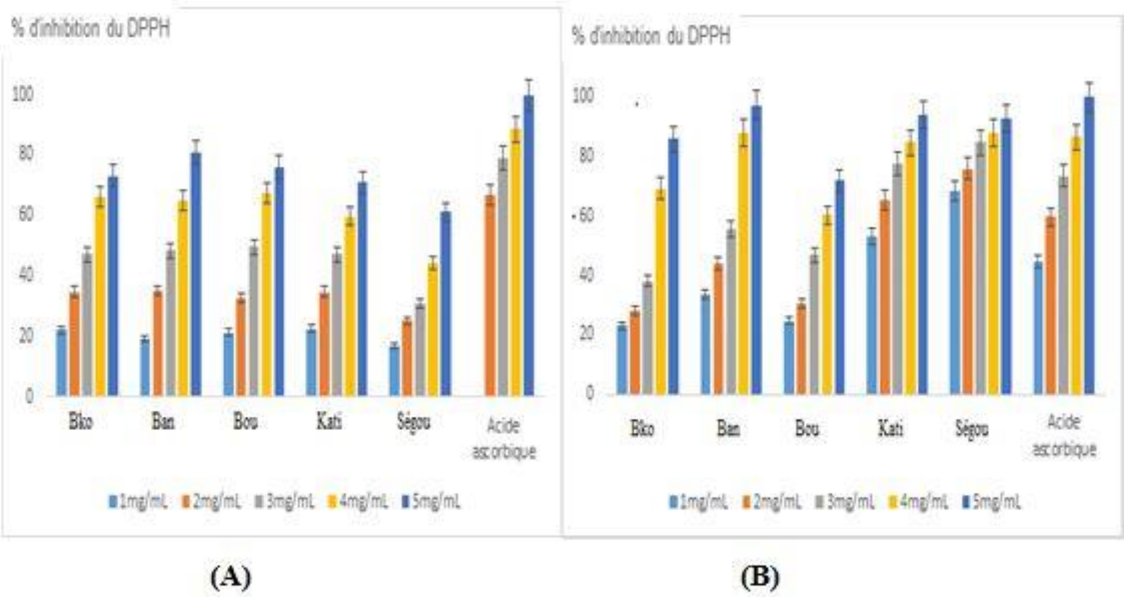
Origin	Carbohydrates (%)	Lipids (%)	Proteins (%)	Energy value
Bamako	5.81 ± 0.66^{A}	7.33 ± 0.76^{A}	5.10 ±0.47^{D}	109.68 ±8.22^{BC}
Banamba	5.39 ± 0.31^{A}	5 ± 0.87^{C}	8.67 ±0.34^{C}	101.24 ±8.35^{C}
Bougouni	3.57 ± 0.02^{B}	7.83 ± 0.58^{A}	10.52 ±0.26^{AB}	126.85 ±5.87^{A}
Kati	6.19 ± 0.41^{A}	5.33 ± 0.29^{BC}	11.23 ±0.18^{A}	117.67 ±2.01^{AB}
Ségou	4.99 ± 0.69^{A}	6.67 ± 0.29^{AB}	10.37 ±0.18^{B}	121.46 ±3.34^{AB}

These leaves vegetables are rich in lipids (1.37 à 7.83 %). These values are greater than those found by Yao et al. (2020) in fresh vegetables (0.20 to 0.69 %). The proteins ensure the renewal of cells and the growth of children. The proteins content between 3,35 et 11,53 % are greater than those obtained by Moussa et al. (2007) (*Manihot esculentus* = 7 %).

The amount of carbohydrate is included between 3,28 et 6,86 %. These carbohydrates are mainly concentrated in the form of starch (FAO, 1997).

Quantitative Analyzes of Antioxidant Activity of Methanolic Extract of Leaves Vegetables (% DPPH Inhibition)

Figures A and B represent the percentage ofDPPH inhibition of*Arachis hypogaea, Solanum aethiopicum.*



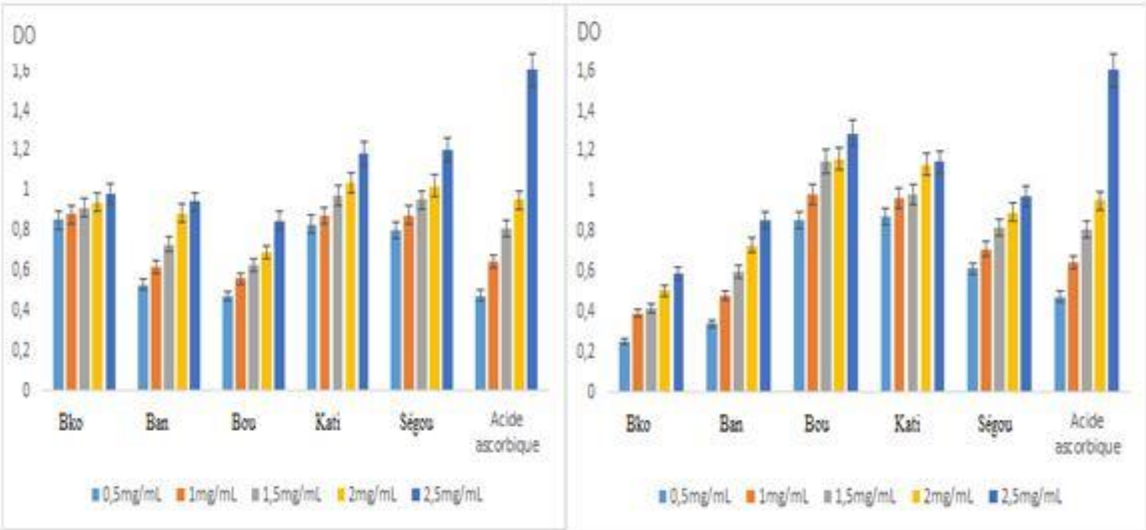
Bko: *Bamako*, *Ban: Banamba*, *Bou: Bougouni*

Figure1. *Percentage of DPPH inhibition by the methanolic extract of Arachis hypogaea (A) and Solanum aethiopicum (B)*

The results showed that the methanolic extracts of the leaves of *Arachis hypogaea* and *Solanum aethiopicum* have had the highest inhibition percentage respectively 80,65%, and 96,97 %. There remained low compared to that of ascorbic acid (99,78 %). Antioxidant molecules such as ascorbic acid, tocopherol, flavonoids and tannins reduce and discolute DPPH because of their ability to yield hydrogen. [11].

Quantitative Analyzes of Antioxidant Activity of Aqueous Extracts of Leaves Vegetables by FRAP Method

Figures C et D represent the reducing power of iron by the aqueous extracts of *Manihot esculentus* and *Ipomea batatas.*



(C) (D)

***Bko:** Bamako, **Ban:** Banamba, **Bou:** Bougouni*

Figure2. *Reducing power of iron by the aqueous extracts of Manihot esculentus (C) and Ipomea batatas (D)*

The antioxidant activity of aqueous extracts of leaves vegetables has been evaluated using FRAP method. The latter is simple, fast and reproductible test [13]. It is a universal and can be applied as well as plants, plasma, in organic and aqueous extracts [14].

4. Conclusion

This study showed that the leaves of *Arachis hypogaea*, *Solanum aethiopicum*, *Hibiscus sabdariffa, Ipomea batatas* et de *Manihot esculentus* are rich in nutrients and have antioxidant activities. They can contribute to supported malnutrition and cardiovascular diseases. Then we need to deepen the chemical and biological study.

5. Acknowledgements

We thank rectorate of university of sciences, technic and technologies of Bamako-Mali (USTTB) for the financing of this study and Institute of applied sciences (ISA) for its realization.

Références

[1] Batawila K., Akpavi S., Wala K. & Akpagana K. Diversité et valorisation des légumes feuilles au Togo. Rapport de recherche, IPGRI,(2005), 37 p.

[2] Almekinders C. & Boef W. Encouraging diversity. The conservation and development of plant genetic resources. Intermediate Technology. Publication, London (UK), (2000), 14 P.

[3] Chweya J. A. & Eyzaguirre P. The biodiversity of traditional leafy vegetables. IPGRI Rome (Italy), (1999). 182 p.

[4] Bougandoura N., Bendimerad N. Evaluation de l'activité antioxydante des extraits aqueux et méthanolique de *Satureja calamintha ssp. Nepeta (L.)* Briq. Nature & Technologie. (2013) ; (9) : 15p.

[5] Bidié, A. P., N'guessan, B. B., Yapo, A. F., N'guessan, J. D., & Djaman, A. J.Activités antioxydantes de dix plantes médicinales de la pharmacopée ivoirienne. *Sciences &Nature*. (2011); 8(1-2), 1-12.

[6] Girondo F., Blache D., Monget A.D., Lombart M., Galan P. Effect of a two-year supplementation with low doses of antioxidant vitamins and/or minerals in elderly subjects on levels of nutrients and antioxidant defense parameters. J Am Col Nutr. (1997), 16: 357-365

[7] Sohal R.S., Mockett R.J., Orr W.C. Mechanism of Aging: an appraisal of the oxidative stress hypothesis. Free rad Biol Med. (2002), 33: 575- 86.

[8] Pincemail, J., Heusele, C., Bonté, F. Limet, R., & Defraigne, J. O. Stress oxydant, antioxydants nutritionnels et vieillissement. *Act Med Int*, (2001). *4*, 18-23.

[9] Mates J.M., Sanchez-Jimenez F.M. Role of reactive oxygen species in apoptosis: implications for cancer therapy. Int J Biochem Cell Biol. (2000)**,** 32:157-170.

[10] Sergeant C., Hamon C., Simonoff M., Constans J., Conri C., Peuchant C., Delmas- Beauvieux M-C., Clerc C., Pellegrin J.L., Leng B., Pellegrin I. & Fleury H. Oxidative Stress in Cancer, AIDS and neurodegenerative diseases. Editors: L. Montagnier, R. Olivier, C. Pasquier; Marcel Dekker. Inc. New YorkBasel-Hong Kong, (1998), 409-427.

[11] De Pooter H.L. et Schamp N. Comparaison of the volatils composition of some *Calamintha satureja* species. In: Progress in essential oil research. Ed. E-J. Brunk, Walter De Gruyter, Berlin. (1986), 139-150p.

[12] Hsu C.Y., Chan Y.P. & Chang J. Antioxidant activity of extract from *Polygonum cuspidatum*. Biol Res, ‘2007), 40:13-21.

[13] Benzie I.F.F. et Strain J.J. The ferric reducing ability of plasma as a measure of “antioxidant power” the FRAP assay. Analytical Biochemistry. (1996), 239, 70– 76.

[14] Li H-B., Wong C-C., et Cheng K-W., Feng C. Antioxidant properties in vitro and total Phenolic contents in methanol extracts from medicinal plants. Lebensmittel- Wissenschaft and Technology. (2008),41(3), 385–390.

Citation: *Cheickna DAOU et al."Composition Table and Antioxidant Activities of Five Leafy Vegetables in the South of Mali ", International Journal of Advanced Research in Chemical Science (IJARCS), vol. 9, no.2, pp. 11-16, 2022. http://dx.doi.org/ 10. 20431/ 2455-7153.0902002*