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Proximate and Phytochemical Profile of *Cirsium arvense* Leaves

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The aim of this study is to investigate the proximate and quantitative phytochemical components of the leaves of *Cirsium arvense.* Fresh leaves of *Cirsium arvense* were collected from Achara Autonomous community in Obowo Local Government Area of Imo State, Nigeria and identified by a plant taxonomist from the department of plant science and biotechnology, River state university, Nigeria. Proximate and quantitative phytochemical analysis of *C. arvense* leaf were carried out using standard methods. Results of the proximate composition revealed that Carbohydrate content (59.284%) was high, followed by protein (11.55%) with energy value of 340.198 Kcal. The dry matter was 85% with moisture content of 15%, fat (6.318%), ash content (4.361%) and fibre (3.487%). The quantitative phytochemical analysis revealed the presence of alkaloids (Lunamarin

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(3.7340ug/ml), saponin (Sapogenin (5.7077ug/ml), phytate (19.2702ug/ml), Cynagenic glycoside (17.148ug/ml), flavonoids (Flavan 3 ol (10.5455ug/ml), Rutin (7.0365ug/ml), Flavonoes (4.1051ug/ml), Flavone (3.7603ug/ml), with flavonoids in high concentrations. The result from this study has revealed the chemical constituents embedded in this plant leaf and will provide needed information to researchers in the area of herbal medicine.

Keywords: Cirsium arvense; proximate; qualitative; phytochemicals; medicinal.

1. INTRODUCTION

"Medicinal plants have been playing an essential role in the development of human culture. As a source of medicine, Medicinal plants have always been at forefront virtually all cultures of civilizations. Medicinal plants are regarded as rich resources of traditional medicines and from these plants many of the modern medicines are produced. For thousands of years, medicinal plants have been used to treat health disorders, to add flavor and conserve food and to prevent diseases epidemics. The secondary metabolites produced by the plants are usually responsible for the biological characteristics of plant species used throughout the world" [1].

According to Bassam [2] he explained that the term medicinal plants include a various types of plants used in the practice of using herbs to treat illnesses and some of these plants have a medicinal activity.

Medicinal plants are rich in phytochemicals, which have been used as a source of raw material in medicine since ancient times. Phytochemicals has been known to have some biochemical activities in the body system, some of these activities include; anti-microbial activity, anti- cancer activity, anti-ulcer activity, anti-asthmatic activity etc.

"Green leafy vegetables occupy an important place among the food crops as they provide adequate amount of vitamins and minerals for human consumption. In addition to their nutritional value, vegetables also contain phytochemicals which exhibit some protective and disease preventive effects, thus, making them serve a dual function against a number of biochemical, physiological and metabolic disorder" [3].

"Phytochemicals are bioactive compounds in plants that could provide health benefits which are beyond the benefits of basic nutrition. They are basically secondary metabolites which are known to possess certain medicinal properties against pathogenic organisms" [4-6].

"Cirsium is a genus of perennial and rarely annual prickly Asteraceae plants. It gets its name from the Greek word "khirsos," which means "swollen vein." According to the Plants of the World online collections at the Royal Botanic Gardens of Kew, there are around 450–480 recognized species in this genus" [7].

"Cirsium arvense is a medicinal plant of family Asteraceae. Its extensive horizontal and vertical root system stores considerable carbohydrate reserves, allowing the plant to resist diverse weed management techniques" [8]. Since creeping thistle also thrives in grazing areas and unmanaged (disturbed) environments [9], it is considered a noxious weed and invasive plant in the world.

However, *Cirsium arvense* has been used as a food and medicinal plant for centuries. Numerous ethnobotanical studies have documented medicinal and health-promoting uses of the whole plant [10], and phytochemical analyses [11] have built on this traditional ecological knowledge and identified plant metabolites of medicinal interest.

This study evaluated the phytochemicals and proximate composition in *C. arvense* leaf sample.

2. MATERIALS AND METHODS

2.1 Collection and Identification of Plant Leaf Sample

Fresh leaves of *Cirsium arvense* were collected from Achara Autonomous community in Obowo Local Government Area of Imo State, Nigeria and identified by a plant taxonomist from the department of plant science and biotechnology, Rivers State University, Nigeria. The fresh leaves were were dried in room temperature in the absence of sunlight and ground after which it was stored in an air tight container for subsequent analysis.

2.2 Quantitative Phytochemical Analysis of *Cirsium arvense* Leaves

Quantitative phytochemical analysis of *Cirsium arvense* leaf was carried out using standard methods as described by Nwauche et al*.,* 2024.

2.3 Preparation of Samples for HPLC

Ten (10) mg of powdered plant extracts of sample was dissolved in 10 ml of ethanol to get final concentration of 1mg/ml subsequently the solution was filtered using 0.45µm syringe filter (millipore) for sterilization. 1 mg of each standard was dissolved individually in 1ml of ethanol and sterile filtered through 0.45 µm syringe filter (millipore) before subjecting to HPLC analysis.

2.4 Procedure

The prepared samples of extracts and standards were used for HPLC. Binary system (Waters) equipped with PDA detector connected to system processor was used for analysis. The system used Empower software with standard certification for analysis of the results. A maximum pressure of 2500 psi and minimum of 1500 psi was maintained. The HPLC of solvents was run at 200 nm to 600 nm wavelength using reverse phase C-18 column. During the run, a flow rate 1ml/min was maintained using binary mode of gradient system. Various combinations of the solvents 20:80, 80:20, 60:20, 50:50 of ethanol and water were used respectively. Ultimately for achieving best resolution of peaks the experiment was performed at 50:50 ratio of the solvent (ethanol and water). To identity the compounds, several standards of the secondary metabolites were used. The peaks were identified by comparing the retention time (RT) of the standard compounds with that of different peaks obtained in HPLC analysis of extracts.

2.5 Proximate Analysis of *Cirsium arvense* Leaves

Proximate analysis of *Cirsium arvense* leaf was carried out using standard methods as described by AOAC [12] and modified by Kalu et al*.,* [3]

Carbohydrate was determined by the difference method (100- (protein + fat + moisture + ash).

The nitrogen value, which is the precursor for protein of a substance, was determined by micro-Kjeldah/method. The Nitrogen value was converted to protein by multiplying to a factor of 6.25. The moisture and ash were determined using the weight difference method, while determination of crude fat of the sample was done using soxhlet type and the direct solvent extraction method. Energy value was calculated using Atwater factor method [(9 x fat) + (4xcarbohydrate) + (4xprotein)]. All the proximate values were reported in percentage.

3. RESULTS AND DISCUSSION

3.1 Results

The Table 1 above showed the results of the different phytochemical compositions found in the plant leaf. The phytochemicals shows that the phytate content was high with the value of 19.2702 ug/ml, followed by Cynagenic glycoside with the value of 17.148 ug/ml and the lowest been Proanthocyanin with the value of 0.2619 ug/ml.

Table 1. Quantitative phytochemical composition of *Cirsium arvense* plant leaf extract

Phytochemicals	Concentration (ug/ml)
Proanthocyanin	0.2619
Lunamarin	3.7340
Naringin	14.0827
Cardiac glycoside	3.9370
Flavan 3 ol	10.5455
Anthocyanin	7.2410
Ribalinidine	10.9252
Naringenin	2.6361
Spartein	6.6768
Rutin	7.0365
Cynagenic glycoside	17.148
Flavonoes	4.1051
Steriods	12.8758
Kaempferol	5.2899
Epicatechin	8.2188
Phytate	19.2702
Flavone	3.7603
Oxalate	11.0380
Resveratol	3.8885
Sapogenin	5.7077
Epinhedrine	13.5202

The Table 2 showed the results of the different proximate compositions found in the plant leaf. The proximate composition showed that the carbohydrate content is higher with the value of 59.284%, followed by moisture content 15.00% and the lowest been fiber with the value of 3.487%.

4. DISCUSSION

4.1 Phytochemical Studies of *Cirsium arvense* Plant Leaf

The results of the quantitative phytochemical investigation of the plant leaf is presented in Table 1 above. The different phytochemicals are from different family of polyphenols such as flavonoids, also phytates, steroids, cardiac glycosides, oxalate, alkaloids, saponins with the flavonoids which are polyphenols in higher quantity. These phytochemicals has been known to have some biochemical activities in the body system, some of these activities include; anti-microbial activity, anti- cancer activity, anti-ulcer activity, anti-asthmatic activity etc. According to Aggarwal [13], "the plants of the genus Cirsium of the family Asteraceae contain 350 species across the world. Phytochemical investigations showed that it contains flavonoids, phenols, polyacetylenes, and triterpenoids".

Table 2. Proximate composition of *Cirsium arvense* plant leaf extract

Parameters	Concentration (%)
Fibre	3.487
Fat	6.318
Ash	4.361
Moisture	15.00
Protein	11.55
Carbohydrate	59.284
Energy Value	340.198 Kcal
Dry Matter	85.00

"The phytochemical analysis of plants provides information on the chemical constituents of plants that is required for the discovery of therapeutic agents and the information obtained may be of great value in unveiling new sources of such compounds as precursors for the synthesis/production of complex chemical substances and used in folkloric remedies" [14].

"Flavonoids represents highly diverse class of secondary metabolites and they constitute the largest and most important group of polyphenolic compounds in plants. The therapeutic effects of many traditional medicines may be related in many cases to the presence of these polyphenols" [15]. For example, a wide variety of pharmacological activities have been reported for these substances, including antiviral [16] anti-allergic [17] antiplatelet [18] anti-estrogenic, anti-cancerogenic, anti-inflammatory, anti-proliferative, anti-angiogenic, and antioxidant properties, and their ingestion typically produces no or very little toxicity [19]. Flavonoids were also reported to act in the gastrointestinal tract, having antispasmodic [20], anti-secretory, anti-diarrhoeal [21] and antiulcer properties [22].

"Flavonoids are now considered as an indispensable component in a variety of nutraceutical, pharmaceutical, medicinal and cosmetic applications. This is attributed to their anti-oxidative, anti-inflammatory, anti-mutagenic and anti-carcinogenic properties" [3] coupled with their capacity to modulate key cellular enzyme function [23]. "There are reports showing that phenolic compounds, including flavonoid compounds in plant extracts, have protective effects on the gastric and intestinal mucus" [24]. "Thus, these compounds, due to their antioxidant effects, can be helpful in healing ulcers by eliminating free radicals. Flavonoids heal deep necrotic ulcers and prevent the large shedding of epithelial cells" [25]. "Previous research has shown that flavonoids can increase the rate of gastric ulcer healing by increasing the synthesis of endogenous prostaglandins, inhibiting the secretion of histamine, and eliminating Helicobacter pylori and anti-acid secretory agents" [26].

"A flavonoid that has been studied in some detail is rutin (quercetin-3-rhamnosylglucoside), a natural flavone derivative. It has been reported to prevent gastric mucosal ulceration in animal models including reserpine" [27] acidified ethanol [28] and absolute and 50% ethanol [22]. "The antioxidant mechanism of action of flavonoids, especially garcinol, rutin and quercetin, is due mainly the presence in their structures of an o-dihydroxy in the B ring (catechol), and additionally a 2, 3 double bond in conjugation with a 4-oxo function, as well as the presence of hydroxyl groups in positions 3, 5 and 7" [29,30].

Recent studies on phytate indicate despite being somewhat demonized for its ability to reduce mineral absorption, phytic acid actually has some potentially beneficial properties.

Sabiu et al*.,* [31] investigated "the protective role of *Spondias mombin* and *Ficus exasperate* anti-ulcer activity in indomethacin induced rats, the phytochemical screening saw the presence of flavonoids, and phenols which were also found in the current investigation".

Hamisu and Ashiru [32] investigated the proximate analysis and anti-ulcer activity of

methanolic extract of *Moringa oleifera*. The presence of tannins, flavonoids, saponins, phenols, alkaloids and glycosides were all shown to be present. Saponins are known for their ability to reduce inflammation and enhance mucosal defense mechanisms [33]. This result also correlates with the phytochemical result of this current research with *Cirsium arvense*.

In recent years, researchers revealed numerous biological potentials of *P. pabularia* including, antimicrobial, antifungal, antibacterial and anti-proliferative actions [34]. The essential oils of *P. pabularia* showed noticeable free radical quenching action and anti-diabetic, neuroprotective, and lipid-lowering (anti-obesity) actions [35]. It is believed that the biological actions of *P. pabularia* are due to their phytochemical contents, phenolic, flavonoids, coumarins, terpenoids, and glycosides [35,36] and these phytochemicals were all discovered to be present in this recent study of *Cirsium arvense* leaf extract.

4.2 Proximate Composition of Plant Leaves

The results of investigations of the proximate composition (%) of the plant leaves were presented in Table 2. Results of the proximate composition revealed that Carbohydrate content (59.284%) was high, followed by protein (11.55%) with energy value of 340.198 Kcal. The dry matter was 85% with moisture content of 15%, fat (6.318%), ash content (4.361%) and fibre (3.487%). Hamisu and Ashiru [32] investigated the Proximate Analysis and Anti-Ulcer Activity of Methanolic Extract of *Moringa Oleifera*. The proximate composition was recorded to be Fibre 21.28 Moisture 7.36, Ash content 12.63, Carbohydrate 45.60, Protein 6.99 and Lipids 15.4. The result of this recent research is in tandem with Hamisu and, Ashiru [32] investigation as it equally shows a high concentration in carbohydrate content of the *Cirsium arvense* plant leaf extract.

Proteins act as enzymes, hormones and antibodies. They are responsible for the formation of bones, teeth, hair and the outer layer of skin and they help maintain the structure of blood vessels and other tissues [37]. Regular uses of plant food rich in protein make an invaluable addition to a diet [38]. The result revealed that the leaves of the plant are good sources of protein.

“Results from epidemiological studies reveal that increased fiber consumption may help in the reduction of certain diseases such as diabetes, coronary heart diseases, colon cancer, obesity, high blood pressure and various digestive disorders” [3]. “Dietary fiber has been associated with alternations of the colonic environment that protect against colorectal diseases. It provides protection by increasing faecal bulk, which dilates the increased colonic bile concentration that occurs with a high-fat diet” [39].

“Adequate intake of dietary fibre can lower the serum cholesterol level, and thus risk of coronary heart disease, hypertension, diabetes, breast cancer and constipation. Dietary fibers alter the colonic environment in such a way as to protect against colorectal diseases. They provide protection by increasing fecal bulk, which dilutes the increased colonic bile acid concentrations that occur with a high fat diet” [37].

This is one benefit derivable from the consumption of *Cirsium arvense.* The ash composition of a food is the amount of minerals substances left after the carbon material must have been burnt off [40]. The result obtained from this research suggest that the plant leaves contained little mineral substances after the ashing process.

The moisture content of any food is an index of its water activity and it is used as a measure of stability and susceptibility to microbial contamination. The higher moisture content provides for greater activity of water soluble enzymes and coenzymes needed for metabolic activities of leafy vegetables. This suggests that the leaves will not be stored for a long time as higher water content enhances microbial action [41].

“Carbohydrates are the human body’s key source of energy, providing 4 calories of energy per gram. Carbohydrates provide the body with a source of fuel and energy that is required to carry out daily activities and exercise” [37]. The leaves of *Cirsium arvense* has shown to be a good source of carbohydrate. A 100 g of the leaves can provide 6-10% of the recommended daily allowance for carbohydrate.

5. CONCLUSION

The leaf sample had different phytochemicals which fall under different class such as flavonoids, phenols, phytate, cyanogenic

glycosides. These different properties showed the leaf to possess some medicinal properties and can be used to fight against some pathogenic organism. The proximate composition revealed a high composition of carbohydrate and protein and thus the leaf can be used as a source of nutrient in diet.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Refaz D, Mohd S, Parvaiz Q. General overview of medicinal plants: A review. The journal of phytopharmacology. 2019;6 (6):349-351.
2. Bassam A. Clinical Pharmacy Discipline, School of Pharmaceutical Sciences, University of Sains Malaysia. Pharmaceutical Analytical Acta. 2012;3:10.
3. Kalu EC, Ikewuchi CC, Ayalogu EO, Nwauche KT. Proximate and Phytochemical Profile of Melanthera biflora Leaves. International Journal of Biochemistry Research & Review. 2019; 25(4):1-12.
4. Kelechi GN, Kelechi OD, Udochukwu AS, Friday AC, Uzoma AK. Some Bioactive Nutrient chemical Composition and Effect of Datura stramonium Leaf Extract on body Weight using Wistar Albino Rats. Journal of Biochemistry International. 2023;10 (1):13-22.
5. Benjamin A, Nchekwue O, Chioma A, Amadike U, Majesty D. Elemental, amino acid and phytochemical constituents of three different species of eggplant fruits. Int. J. Med. Arom. Plant. 2013;3(2):200-203.
6. Duru MKC, Arukwe U, Amadi BA. Bioactive constituents and macronutrients composition of “UDU” an anti-malarial concoction used in Umunchi village in Isiala Mbano L.G.A. of imo State, Nigeria. International Science Research Journal. 2011;3:61-64.
7. Marmitt DJ, Shahrajabian MH. Plant species used in Brazil and Asia regions with toxic properties. Phytotherapy Research. 2021;35:4703–4726.
8. Favrelière EA, Ronceux J, Pernel JM, Meynard. Nonchemical Control of a Perennial Weed, Cirsium Arvense, in Arable Cropping Systems. A Review. Agronomy for Sustainable Development. 2020;40(4):31.
9. Tiley GE. Biological flora of the British Isles: *Cirsium arvense* (L.) scop. Journal of Ecology. 2010;98(4):938-983.
10. Chhikara AP, Rohilla L, Singh D, Kumar R, Antil P, Dahiya. Cirsium arvense: A Multi-potent Weed. Annals of Biology. 2020;36 (3):442–447.
11. Kenny OTJ, Smyth D, Walsh C, Kelleher CM, Hewage N, Patrick Brunton. Investigating the Potential of under-utilised Plants from the Asteraceae Family as a Source of Natural Antimicrobial and Antioxidant Extracts. Food Chemistry. 2014;161:79–86.
12. AOAC. Official method of analysis. 15th edition, Association of officiating analytical Chemists, Washington DC; 1990.
13. Aggarwal G, Kaur G, Bhardwaj G, Mutreja V, Sohal HS, Nayik GA, Bhardwaj A, Sharma A. Traditional Uses, Phytochemical Composition, Pharmacological Properties, and the Biodiscovery Potential of the Genus Cirsium. Chemistry. 2022;4(4): 1161-1192.
14. Nwauche KT, Ugwu GM, Berezi EP. Nutritive and Non-Nutritive Bioactive Components of Limonia acidissima Leaves. Asian Journal of Microbiology and Biotechnology. 2023;8(2):1-7.
15. Manach C, Morand C, Demigné C, Texier O, Régérat F, Rémésy C. Bioavailability of rutin and quercetin in rats. FEBS letters. 1997;409(1):12-16.
16. Critchfield JW, Butera ST, Folks TM. Inhibition of HIV activation in latently infected cells by flavonoid compounds. AIDS research and human retroviruses. 1996;12(1):39-46.
17. Cheong H, Ryu SY, Oak MH, Cheon SH, Yoo GS, Kim KM. Studies of structure activity relationship of flavonoids for the anti-allergic actions. Archives of pharmacal research. 1998;21: 478-480.
18. Carotenuto A, Fattorusso E, Lanzotti V, Magno S, De Feo V, Cicala C. The

flavonoids of Allium neapolitanum. Phytochemistry. 1997;44(5):949-957.
19. Havsteen BH. The biochemistry and medical significance of the flavonoids. Pharmacology & therapeutics. 2002;96(2-3):67-202.
20. Lima JT, Almeida JR, Barbosa-Filho JM, Assis TS, Silva MS, da-Cunha EV, Silva BA. Spasmolytic action of diplotropin, a furanoflavan from Diplotropis ferruginea Benth., involves calcium blockade in guinea-pig ileum. Zeitschrift für Naturforschung B. 2005;60(10):1093-1100.
21. Di Carlo G, Autore G, Izzo AA, Maiolino P, Mascolo N, Viola P, Capasso F. Inhibition of intestinal motility and secretion by flavonoids in mice and rats: structure-activity relationships. Journal of Pharmacy and Pharmacology. 1993;45(12):1054-1059.
22. La Casa C, Villegas I, De La Lastra CA, Motilva V, Calero MM. Evidence for protective and antioxidant properties of rutin, a natural flavone, against ethanol induced gastric lesions. Journal of ethnopharmacology. 2000;71(1-2):45-53.
23. Panche AN, Diwan AD, Chandra SR. Flavonoids: an overview. Journal of nutritional science. 2016;5:47.
24. de Lira Mota KS, Dias GEN, Pinto MEF, Luiz-Ferreira Â, Monteiro Souza-Brito AR, Hiruma-Lima CA, Batista LM. Flavonoids with gastroprotective activity. Molecules. 2009;14(3):979-1012.
25. Hosseinzadeh H, Karimi G, Ameri M. Effects of Anethum graveolens L. seed extracts on experimental gastric irritation models in mice. BMC pharmacology. 2002; 2:1-5.
26. Olaleye SB, Farombi EO. Attenuation of indomethacin-and HCl/ethanol-induced oxidative gastric mucosa damage in rats by kolaviron, a natural biflavonoid of Garcinia kola seed. Phytotherapy Research: An International Journal Devoted to Pharmacological and Toxicological Evaluation of Natural Product Derivatives. 2006;20(1):14-20.
27. Barnaulov OD, Manicheva OA, Shelyuto VL, Konopleva MM, Glyzin VI. Effect of flavonoids on development of experimental gastric dystrophies in mice.Pharmaceutical Chemistry Journal. 1984;18:544-549.
28. Izzo AA, Carlo GD, Mascolo N, Capasso F, Autore G. Antiulcer effect of flavonoids. Role of endogenous PAF. Phytotherapy Research. 1994;8(3):179-181.
29. Russo A, Acquaviva R, Campisi A, Sorrenti V, Di Giacomo C, Virgata G, Vanella A. Bioflavonoids as antiradicals, antioxidants and DNA cleavage protectors. Cell biology and toxicology. 2000;16:91-98.
30. Pietta PG. Flavonoids as antioxidants. Journal of natural products. 2000;63(7): 1035-1042.
31. Sabiu S, Garuba T, Sunmonu T, Ajani E, Sulyman A, Nurain I, Balogun A. Indomethacin-induced gastric ulceration in rats: Protective roles of Spondias mombin and Ficus exasperata. Toxicology reports. 2015;2:261–267.
32. Abdu H, Ashiru Garba A. Proximate analysis and anti-ulcer activity of methanolic extract of Moringa oleifera. African Scholar Journal of Agriculture and Agricultural Technology. 2021;20 (1):188-201.
33. Nwauche KT, Berezi EP, Okari KA. Phytochemical Profiling of Cymbopogon flexuosus Leaves. International Journal of Science and Research Archive. 2024;13 (01):3239–3247.
34. Sakinehsalehi Zahri S, Razavi SM. Cytotoxic effect of Prangos Pabularia extract on HELA cell line a medicinal plant. International Journal of Medical Research & Health Sciences. 2016;5(11): 547-552.
35. Bahadori MB, Asghari B, Dinparast L, Zengin G, Sarikurkcu C, Abbas-Mohammadi M, Bahadori S. Salvia nemorosa L.: A novel source of bioactive agents with functional connections. LWT. 2017;75:42-50.
36. Numonov S, Bobakulov K, Numonova M, Sharopov F, Setzer WN, Khalilov Q, Aisa HA. New coumarin from the roots of Prangos pabularia. Natural product research. 2018;32(19):2325-2332.
37. Nwauche KT, Anacletus FC, Ighorodje-Monago CC. Assessment of Fatty Acid, Proximate and Quantitative Phytochemical Compositions of Matured Stem of Costus afer (Bush Cane). Journal of Drug Delivery and Therapeutics. 2018;8(6):217-224.
38. Wardlaw GM. Perspectives in nutrition, 4th Edn. London: McGraw-Hill; 1999.
39. Dillard CJ, German JB. Phytochemicals: Nutraceuticals and human health. Journal of the Science of Food and Agriculture. 2000;80(12):1744–1756.
40. Ikewuchi CC, Ikewuchi CJ, Ayalogu OE, Onyeike NE. Proximate and phytochemical

profile of Sansevieria liberica, Gérôme and Labroy. Journal of Applied Science and Environmental Management. 2010;14(2): 103–106.

41. Vasconcellos PC, Zacarias D, Pires MA, Pool CS, Carvalho LR. Measurements of polycyclic aromatic hydrocarbons in airborne particles from the metropolitan area of São Paulo City, Brazil. Atmospheric Environment. 2003;37(21): 3009-3018.

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