



Phytochemical and mineral profiling of anti-fertilizer plants used by pygmy women in the town of Mbandaka in the Democratic Republic of the Congo: Case of *Ipomoea involucrata* P.Beauv. and *Piptadeniastrum africanum* (Hook.f.) Brenan

Ruth Katunda^{1*} , Jean Jacques Amogu¹ , Jean-Paul Nzundu¹ , Florent Mukeba³ ,
Didier Dianzuangani¹ , Paulin Mutwale^{2,4} , Odette Kabena¹  and Félicien Lukoki¹ 

Received 14 September 2023, Revised 29 November 2023, Accepted 25 December 2023, Published online 31 December 2023

ABSTRACT

This study was carried out to determine the phytochemical and mineral composition of *Piptadeniastrum africanum* (Hook.f.) Brenan and *Ipomoea involucrata* P. Beauv., two plants presumed anti-fertilizers, were cited during an ethnobotanical survey carried out in 2018 among indigenous women in Mbandaka and the surrounding area. Micrography was carried out, followed by determination of mineral composition by ICP-AES and SAA, and the TLC for a highlight of the various phytochemical compounds making up these two plants. The study determined the relative structure of the multiple cells and tissues making up these plant drugs, including numerous raphids characteristic of *Ipomoea involucrata* and calcium oxalate crystals characteristic of *Piptadeniastrum africanum*. Among the chemical compounds, those directly linked to female anti-fertility have been highlighted. These include flavonoids, tannins, phenolic compounds, and terpenoids. Elemental analysis revealed mineral salts and trace elements directly influencing reproduction, such as iron, zinc, calcium, sodium, and arsenic. Even if these data make it possible to justify the activity of these two plants in reproductive health, it is, however, necessary for an in-depth study on the in vitro evaluation to determine the clear anti-fertilizing activity of these plants used, raw, by indigenous women.

Keywords: Contraception, Native women, Heavy metals, Raphides

¹Department of Biology, Faculty of Sciences, University of Kinshasa, BP 190 Kinshasa XI, Democratic Republic of the Congo

²Center for the Study of Natural Substances of Plant Origin, Faculty of Pharmaceutical Sciences, University of Kinshasa, BP 212 Kinshasa XI, Democratic Republic of the Congo

³Department of Biology, Faculty of Sciences, National Pedagogical University, Democratic Republic of the Congo

⁴Department of Geography, Geostrategy, Environment and Spatial Planning, Human Science Research Center (CRESH), 33, Avenue Comité Urbain, Commune de la Gombe, BP 3474, Kinshasa/Gombe, Democratic Republic of the Congo

*Corresponding author's email: marikatunda@gmail.com (Ruth Katunda)

Cite this article as: Katunda, R., Amogu, J.J., Nzundu, J.P., Mukeba, F., Dianzuangani, D., Mutwale, P., Kabena, O. and Lukoki, F. 2023. Phytochemical and mineral profiling of anti-fertilizer plants used by pygmy women in the town of Mbandaka in the Democratic Republic of the Congo: Case of *Ipomoea involucrata* P.Beauv. and *Piptadeniastrum africanum* (Hook.f.) Brenan. *Int. J. Agril. Res. Innov. Tech.* 13(2): 64-69. <https://doi.org/10.3329/ijarit.v13i2.70858>

Introduction

Birth spacing still does not sit well with the conjugal duty of women in the Democratic Republic of Congo, particularly in traditional pygmy societies, where women constantly seek to ingratiate themselves with their husbands or to be the favorite in the case of polygamy (Bahuchet and Maret, 2000). To this end, pygmy women, reputed to be sexually active, often resort to all their ancestral pharmacopeia to satisfy the sexual appetite and shrink the vagina or space births (Kabena et al., 2018). Ethnobotanical studies have revealed that these practices are often

observed among low-income people due to the often inaccessible cost of allopathic medicines and the cultural acceptability of traditional system medicines (Diame, 2010).

However, scientific work continues to prove that the biological effects induced by these medicinal plants are due to secondary metabolites and chemical compounds, which mainly act on the reproductive system (Enitome, 2017).

At the same time, with the economic situation, we are witnessing a change in the practices and



aspirations of women, in terms of sexuality, who increasingly resort to the ancestral pharmacopeia, no longer to satisfy only their sexual appetite but rather especially to space births.

Although the contraceptive methods of traditional medicine appeal more to Pygmy women in the town of Mbandaka, the unmet need for contraception remains among a good number of women, most of whom are afraid of the harmful side effects of these traditional practices (Zieran *et al.*, 2004; Lazare, 2017).

As the recipes are prepared in a raw way, they contain all the chemical compounds present in the plant. As a result, even compounds with a toxic effect (heavy metals) on the reproductive system would be directly administered. This represents a danger to the health of indigenous women, who frequently use these plants as the contraception method for excellence. No in-depth study has yet been carried out to identify the phytochemical compounds linked to anti-fertilizing activity or to determine their net activity.

Based on these observations, we propose to undertake a study to determine the composition of secondary metabolites and minerals (mineral salts and trace elements) of two medicinal plants, *Piptadeniastrum africanum*, and *Ipomoea involucreta*, frequently used successfully as contraceptive agents in the traditional pharmacopeia of the pygmies of the City of Mbandaka in the Democratic Republic of Congo. The results of this study would serve as a springboard for the design of better-quality contraceptives and would contribute to the enhancement of the traditional pharmacopeia of this region.

Materials and Methods

Biological material

The biological material consists of leaves of *Ipomoea involucreta* (Convolvulaceae) and bark of *Piptadeniastrum africanum* (Fabaceae) collected at the Botanical Garden of Eala in the town of Mbandaka, in the former Province of Equateur, Democratic Republic of Congo in July 2021.

The identification of the plants collected in the field was carried out at the Herbarium of the Botanical Garden of Eala in Mbandaka and/or at the Laboratory of Systematic Botany and Plant Ecology of the Department of Biology of the Faculty of Sciences of the University of Kinshasa (Herbarium IUK) under herbal numbers: Devred 744 and Pauwels 247 for *Piptadeniastrum africanum* and Carrington 80 and Robyns 4264 for *Ipomoea involucreta*.

Conditioning

Harvested leaves and bark were dried respectively for one and two weeks at room temperature ($\pm 27^{\circ}\text{C}$) in the shade (in the absence of sunlight).

Sample spraying

After the drying time has elapsed, the biological materials are reduced to a fine powder using a Moulinex grinder and then sifted using a USA Standard testing Steve brand sieve with a diameter of 1 mm. This made it possible to obtain a fine powder with a grain size of ± 1 mm.

Microscopic examination of powders (Micrography)

This review is based on the fact that the cellular elements undergo a simple slippage during spraying, which affects their shape, content, or associations very little. I did not understand. Each plant is characterized by one or more particular histological elements; these cellular forms are also found in the powder and make it possible to characterize it. It, therefore, makes it possible to detect falsification quickly from a botanical point of view.

Thus, the examination is carried out after heating the preparation based on fine powders and Steimetz's reagent, and the results are obtained after focusing at 40X magnification of an optical microscope.

Phytochemical analysis

The fine powders obtained after grinding the leaves and the bark served as base materials for obtaining the extracts (methanolic or ethanolic) to be used.

The different chemical analyses are carried out by phytochemical screening according to the method described by Kapepula *et al.* (2016). This is a qualitative analysis based on coloring and/or precipitation reactions carried out on dry plant drugs of *Piptadeniastrum africanum* and *Ipomoea involucreta*.

Determination of elemental composition by ICP-AES and SAA

The contents of the following minerals: P, Ca, Mg, Na, Co, K, Zn, Mn, Ni, Se, Pb, Cd, Al, Ba, Cr, and As were evaluated by Coupled Plasma Optical Emission Spectroscopy by Induction (ICP-AES). Atomic Absorption Spectroscopy (AAS) was used for Iron and Copper according to the method detailed by Mukeba (2021). The concentrations of the elements in the solution were determined by comparing the sample's and standard solutions' respective light intensities. The results were then transferred to the sample in mg kg^{-1} . These analyses were carried out in triplicate for each of the species studied under the following working conditions:

ICP-AES working conditions

- Instrument : ICAE S (Optima 8300 Perkin Elmer, USA);
- Power : 1500W;
- Plasma gas flow : 8 L/n;
- Nebulizer : 0.70 L/min;
- Auxiliary gas flow : 0.20 L/n;
- Plasma burn height : 5–22 mm
- Reading time : 1-5s (max 45s);
- Flow time : 1s (max 10s);
- View: Radial.

SAA working conditions

- Instrument : SAA (Anat 400 Perkin Elmer, USA),
- Flame temperature : 2800°C,
- Acetylene pressure : 0.9-1.0 bar,
- Atmospheric pressure : 4.5–5 bar,
- Reading time : 1 to 10 seconds (maximum 60 seconds),
- Flow time : 3-4 seconds (maximum 10 seconds).

Results and Discussion**Micrographic profile of herbal drugs**

The microscopic profile of the leaf powder of *Ipomoea involucrata* is shown in Figure 1 below:

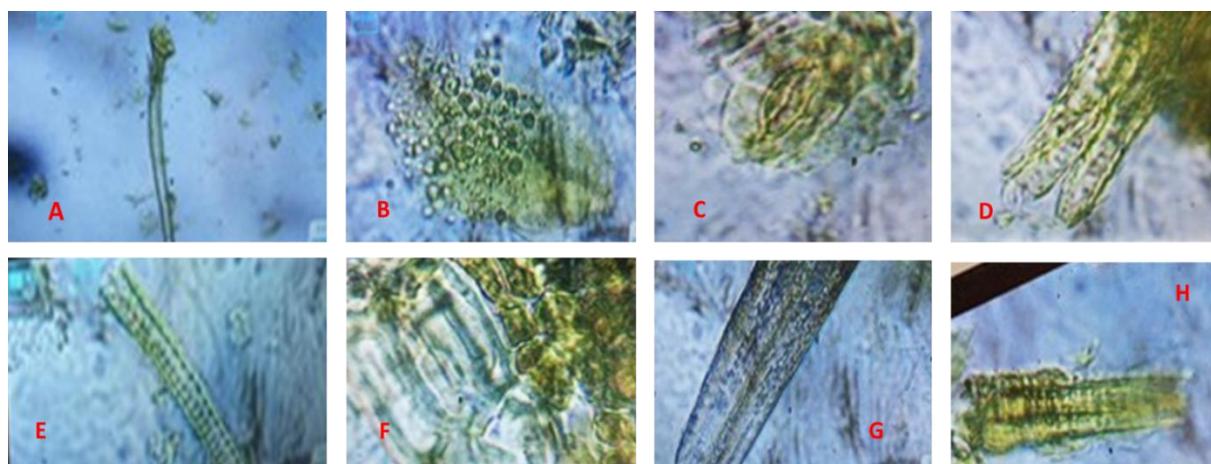


Figure 1. Microscopic profile of *Ipomoea involucrata*: Tectorial hairs (A), oil droplets (B), stomata (C), Sclerotic fibers (D), Vessels Fragment (E), Sclerides (F), Raphides (G) and conducting vessels (H).

The microscopic profile of *P. africanum* bark powdered is shown in Figure 2 below:

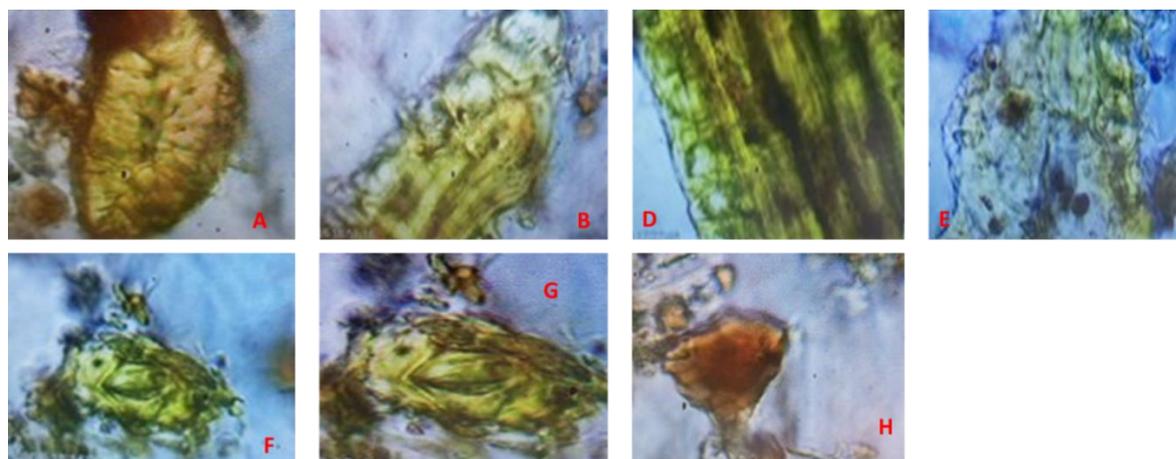


Figure 2. Microscopic profile of *P. africanum*: Sclerides (A), sclerotic fibers (B), parenchyma (C), tracheids+starch grains (D), tanniferous cells (E), sclerids (F) and crystals (G).

Therefore, the histological elements obtained for each species are characteristic of the powders of the plants studied.

It is imperative to point out the presence of numerous raphides in *Ipomoea involucrata*. The study by [Hao and Zhong \(2008\)](#) proved that raphides produce severe toxic reactions by facilitating the passage of toxins through the skin when the tissue containing the raphides also contains these toxins. Furthermore, plants containing calcium oxalate raphide can injure the skin and mucous membranes and cause irritation, numbness, and a burning sensation with swelling ([John *et al.*, 2005](#)).

In the current state of our knowledge, there is no data on the microscopy of the powders of these plants. These characteristic elements, therefore, constitute a database for the identification and authentication of these medicinal plants for further research.

Elemental composition of plants by ICP-AES and SAA

Analyses revealed the presence of mineral salts and trace elements in different proportions in the two plants, as shown in Tables 1 and 2 below:

Table 1. Concentration of mineral salts expressed in mg kg⁻¹ (ppm) of dry matter (Average ± SD, n=3).

Element	Mineral salt concentration expressed in mg kg ⁻¹ (ppm)	
	<i>Ipomoea involucrata</i>	<i>Piptadeniastrum africanum</i>
Potassium	15073 ± 348.19	4643.7 ± 35.34
Phosphorus	1808.9 ± 121.43	3709.5 ± 201.53
Calcium	18863 ± 64.29	673 ± 8.30
Sodium	1138.7 ± 7.77	3064.7 ± 41.681
Magnesium	6011 ± 49.57	530.27 ± 7.45

Significant concentrations of mineral salts were found in both species. It should be noted high concentrations of potassium (15073 mg kg⁻¹) and calcium (18863 mg kg⁻¹) in the leaves of *Ipomoea*

involucrata and those extremely low in calcium (673 mg kg⁻¹) and magnesium (530.27 mg kg⁻¹) in the bark of *Piptadeniastrum africanum*.

Table 2. Concentration of trace elements expressed in mg kg⁻¹ (ppm) of dry matter (Average ± SD, n=3).

Elements	Mineral salt concentration expressed in mg kg ⁻¹ (ppm)	
	<i>Ipomoea involucrata</i>	<i>Piptadeniastrum africanum</i>
Iron	279.87 ± 6.16	435.030 ± 23.95
Zinc	14.88 ± 7.05	73.307 ± 12.00
Copper	27.19 ± 0.58	78.040 ± 0.99
Manganese	186.70 ± 1.94	3035.000 ± 9.07
Selenium	684.03 ± 228.41	488.100 ± 55.15
Cobalt	20.50 ± 19.76	16.050 ± 8.27
Cadmium	21.24 ± 6.13	20.060 ± 9.27
Arsenic	201.35 ± 32.17	82.490 ± 78.07
Nickel	67.00 ± 51.67	61.500 ± 33.97
Aluminum	1775.00 ± 2.65	1032.700 ± 9.81
Barium	66.14 ± 5.25	1048.000 ± 5.97
Lead	ESD	419.07.000 ± 348.25

Aluminum (1775 mg kg⁻¹ and 1032.7 mg kg⁻¹) and selenium (684.03 mg kg⁻¹ and 488.1 mg kg⁻¹) are elements present in large quantities in the two plants. In addition, high concentrations of lead (419.07 mg kg⁻¹), barium (1048 mg kg⁻¹), iron (435.03 mg kg⁻¹), and manganese (3035 mg kg⁻¹) are found in the bark of *Piptadeniastrum africanum* and that of arsenic (201.35 mg kg⁻¹) in the leaves of *Ipomoea involucrata*.

These results show the presence of heavy metals in the two samples analyzed, including those with physicochemical properties, allowing them to cross biological barriers and accumulate in tissues, thus causing damage to the reproductive health of women. These include, among others, cadmium, aluminium, nickel, arsenic, selenium and lead. In relation to these elements, previous studies show, in particular, that:

- Cadmium has the potential to induce the appearance of endometrial cancer ([Wolf and Akesson, 2008](#); [Cho *et al.*, 2013](#));
- Cadmium has the ability to accumulate in the placenta, so it is toxic for the development of the fetus ([Skakkebaek *et al.*, 2001](#));
- Women's exposure to cadmium and arsenic leads to the depletion of follicular capital. In women exposed to cadmium and arsenic, the average time required for conception is 4.70 ± 2.27 months, while it is 1.72 ± 1.31 months in unexposed women (p < 0.0001) ([Mukendi *et al.*, 2018](#));
- Several experimental and epidemiological studies have shown that nickel (Ni 2+) is genotoxic ([Costa *et al.*, 2002](#); [Chen *et al.*, 2003](#)).

Furthermore, nickel is recognized as having a carcinogenic potential (Denkhaus and Salnikow, 2002). In 1990, nickel and nickel compounds were classified by the International Agency for Research on Cancer (IARC) in group 1 “potential carcinogen for humans”.

Nickel is also an allergen responsible for contact dermatitis (UKWIR, 1996);

- Many studies have explored the potential existence of a relationship between lead exposure and reproductive effects. The results are contradictory, but overall, the available data suggest a link between blood lead and the occurrence of abortions, preterm deliveries, impaired sperm, and therefore, male fertility, as well as female fertility (Amara *et al.*, 2016);
- Aluminum is one of the toxic substances that can affect male and female fertility.

Phytochemical composition by TLC

TLC analysis showed the presence of flavonoids and phenolic acids in both plants. These results agree with those found by Ateufack *et al.* (2015); Esien *et al.* (2017); Mbiantcha *et al.* (2017) and Sinan *et al.* (2020).

The leaves of *Ipomoea involucreta* contain chlorogenic acid, anthraquinones, coumarins, terpenoids, as well as gallic tannins and the bark of *Piptadeniastrum africanum* contains anthocyanins, terpenoids, gallic and catechin tannins.

The significant presence of these phytochemicals may help justify their use as a means of birth spacing by Aboriginal women based on reports of previous studies that demonstrate that flavonoids and phenolic compounds block ovulation and destroy the estrous cycle. Sharma *et al.* (2013) also show that tannins, alkaloids, and saponins contribute to interrupting the estrous cycle. Furthermore, these compounds lead to a reduction in the weight and diameter of the uterus, of its myometrium and endometrium, indicating an uterotrophic effect.

The same study also shows that saponins, tannins, flavonoids and cardiac glycosides contribute to reducing egg count.

The search for alkaloids gave a negative result for both species. This is different from the results of Esien *et al.* (2017) and Sinan *et al.* (2020).

Conclusion and Recommendations

The general aim of this study was to evaluate the phytochemical, qualitative and quantitative chemical composition, as well as the characteristic elements of *Piptadeniastrum africanum* and *Ipomoea involucreta*, plants used by pygmy women in Mbandaka.

The phytochemical composition was determined to detect the presence of active ingredients to understand the use of these plants as a means of contraception in indigenous pharmacopeia. In

addition, the chemical analysis was done to have an overall view of the different chemical elements that the raw recipes used would contain and the micrography made it possible to ensure that there was no involuntary falsification, which could mow the results of the analyses, in the powders used as biological study material.

The characteristic histological elements allowing the identification of these two species have been highlighted. This study shows that these two species have various secondary metabolites that directly impact female fertility, namely flavonoids, tannins, terpenoids and phenolic compounds, as demonstrated by previous studies. This justifies the use of these plants as a means of birth spacing. Moreover, certain minerals found in the drugs of these two species are considered to have direct positive or negative effects on female fertility. This is the case for calcium, sodium, potassium, magnesium, arsenic, nickel, cadmium, lead and aluminum.

Thus, we suggest that extensive studies on the clear activity of these plants in reproductive health be carried out and that the active principles responsible are isolated with a view to the development of "organic contraceptive pills" to improve the use of these plants in traditional reproductive health care.

Acknowledgements

Our thanks go to the various laboratories which allowed the realization of this work, namely the Laboratory of Microscopy and that of Botany, systematics and Ecology of the Department of Biology of the University of Kinshasa; the Center for the Study of Natural Substances of Plant Origin (CESNOV in acronym) of the Faculty of Pharmaceutical Sciences of the University of Kinshasa; the Mineral Analysis Laboratory of the OCC (LAMI in acronym) in Lubumbashi and the Plant Biotechnology Laboratory of the Regional Center for Nuclear Energy in Kinshasa (CRENK in acronym).

References

- Amara, A., Bisson, M., Hulot, C. and Marescaux, N. 2016. Plomb et ses dérivés inorganiques. Ineris - Fiche de données toxicologiques et environnementales des substances chimiques. 170p.
- Ateufack, G., Domgnim, M.C.E., Mbiantcha, M., Dongmo, F.B.R., Nana, D. and Kamanyi, A. 2005. Gastroprotective and ulcer healing effects of *Piptadeniastrum africanum* on experimentally induced gastric ulcers in rats. *BMC Complement Altern Med.* 15: 214. <http://doi.org/10.1186/s12906-015-0713-5>
- Bahuchet, S. and Maret, P. 2000. Les peuples des forêts tropicales. APFT - ULB, Centre d'Anthropologie Culturelle, Bruxelles, Belgique. 459p.
- Chen, C.Y., Wang, Y.F., Huang, W.R., Huang, Y.T. 2003. Nickel induces oxidative stress and genotoxicity in human lymphocytes. *Toxicol. Appl. Pharmacol.* 189: 153-159. [http://doi.org/10.1016/S0041-008X\(03\)00086-3](http://doi.org/10.1016/S0041-008X(03)00086-3)

- Cho, S., Lee, C. and Pfeiffer Jr., R. 2013. Corporate social responsibility performance and information asymmetry. *J. Accoun. Public Policy*. 32: 71-83. <http://doi.org/10.1016/j.jaccpubpol.2012.10.005>
- Costa, M., Salnikow, K., Sutherland, J.E., Broday, L., Peng, W., Zhang, Q. and Kluz, T. 2002. The role of oxidative stress in nickel and chromate genotoxicity. *Mol. Cell Biochem*. 234-235(1-2): 265-275. http://doi.org/10.1007/978-1-4615-1087-1_30
- Denkhaus, E. and Salnikow, K. 2002. Nickel essentiality, toxicity, and carcinogenicity – *Critc. Rev. Oncol./Hematol*. 42(1): 35-56. [http://doi.org/10.1016/S1040-8428\(01\)00214-1](http://doi.org/10.1016/S1040-8428(01)00214-1)
- Diame, G.L.A. 2010. Ethnobotany and ecological studies of plants used for reproductive Health: A case study at Bia Biosphere Reserve in the Western region of Ghana. Accra, Ghana. 125p.
- Enitome E Bafor. 2017. Potential use of medicinal plants in reproductive disorders in women. The path to follow. *African J. Reprod. Health*. 21(4): 12. <http://doi.org/10.29063/ajrh2017/v21i4.1>
- Esièn David-Oku, AnyetieHenry Anwan and Emem Ekpenyong Udoma. 2017. Comparative phytochemical, proximate, vitamins and mineral nutrient composition of leaf, stem, and root of *Ipomoea involucrata* and *Milletia aboensis* from Southern Nigeria. *Saudi J. Med. Pharma. Sci*. 3(11B): 1216-1221. <http://doi.org/10.36348/sjmps.2017.v03i11.014>
- Hao, W.U. and Zhong, L.Y. 2008. Study on irritation of calcium oxalate crystal in Araceae plants. *Zhongguo Zhong Yao Za Zhi*. 33(4):380-4 (PMID 18533491).
- John T. Watson, Roderick C. Jones, Alicia M. Siston, Pamela S. Diaz, Susan I. Gerber, John B. Crowe and R. Duane Satzger, 2005. Outbreak of Food-borne Illness Associated with Plant Material Containing Raphides, *Clinical Toxicol*. 43(1): 17-21. <http://doi.org/10.1081/CLT-44721>
- Kabena, N.O., Katunda, M.R., Bikandu, K.B., Botefa, I.C., Ngombe, K.N., Pius, T., Mpiana, Mboloko, E.J. and Lukoki, L.F. 2018. Ethnobotanical study of plants used by Pygmies for reproductive health in Mbandaka and its surroundings / Equateur Province, DR Congo. *Int. J. Innov. Sci. Res*. 36(1): 19-29.
- Kapepula, P.M., Mungitshi, P.M., Franck, T., Mouithys-Mickalad, A., Ngoyi, M.D., Kalenda, P.D.T., Ngombe, N.K., Serteyn, D., Tits, M., Frédéricich, M. and Muyembe, J.J.T. 2016. Antioxidant potentiality of three herbal teas consumed in Bandundu rural areas of Congo Antioxidant potentiality of three herbal teas consumed in. *Nat. Prod. Res*. 6419. <https://doi.org/10.1080/14786419.2016.1263844>
- Lazare, P.B.M. 2017. Ethnobotanical and pharmacological study of plants used in contraception in traditional medicine in Brazzaville, Thesis defended for obtaining the Doctorate Diploma, Faculty of Science and Technology, Marien Ngouabi University, Republic of Congo. 120p.
- Mbiantcha, M., Almas, J., Shabana, S.U., Nida, D. and Aisha, F. 2017. Anti-arthritis property of crude extracts of *Piptadeniastrum africanum* (Mimosaceae) in complete Freund's adjuvant-induced arthritis in rats. *BMC Complemen. Alter. Med*. 17: 111. <http://doi.org/10.1186/s12906-017-1623-5>
- Mukeba Biduaya Florent. 2021. Phytochemical study and bioactivity of *Harungana madagascariensis* Lam. Ex Poiret and *Zanthoxylum gillettii* (De wild) PG Waterman, DEA dissertation, Department of Biology, University of Kinshasa, Congo. 149p.
- Mukendi, R.M., Banza, C.L., Nemery, B., Mukeng, C.K., Ngwe, J.T., Mwembo, A.T. and Kalenga, P.M. 2018. Women's exposure to metallic trace elements and decline in fertility: study conducted in mining areas of Haut-Katanga. *Rev. Congolese Nurse*. 2(2): 83-89.
- Sharma, R.K., Goyal, A.K. and Bhat, R.A. 2013. Antifertility activity of plants extracts on female reproduction: a review. *Int. J. Pharma. Biol. Sci*. 3(3): 493-514.
- Sinan, Kouadio Ibrahim, Annalisa Chiavaroli, Giustino Orlando, Kouadio Bene, Gokhan Zengin, Zoltan Cziaky, Jozsef Jeko, Mohamed Fawzi Mahomoodally, Marie Carene Nancy Picot-Allain, Luigi Menghini, Lucia Recinella, Luigi Brunetti, Sheila Leone, Maria Chiara Ciferri, Simonetta Di Simone and Claudio Ferrante. 2020. Evaluation of the pharmacological and phytochemical profiles of the stem bark extracts of *Piptadeniastrum* (Hook.f.) Brenan. *Biomolecules*. 10(4): 516. <https://doi.org/10.3390/biom10040516>
- Skakkebaek, N.E., Rajpert-De Meyts, E. and Main, K.M. 2001. Testicular dysgenesis syndrome: an increasingly common developmental disorder with environmental aspects. *Hum. Reprod*. 16(5): 972-978.
- UKWIR. 1996. A review of allergy and dermatitis associated with domestic water supplies - Report n°95/DW/05/14, UK Water Industry Research Limited eds. 27p.
- Woolf, A.D. and Akesson, K. 2008. Osteoporosis an Atlas of Investigation and Diagnosis, clinical publishing, OXFORD Center for Innovation, UK, 166p.
- Zieran, O., Geis, R.B., Tischer, S., Schwab, P., Matz, P. and Vollmer, G. 2004. Uterine effects of phytoestrogen 6-(1,1 dimethylallyl) naringenin in rat. *Planta. Med*. 70(7): 590-593. <https://doi.org/10.1055/s-2004-827178>