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**REVIEW ARTICLE**

# PHYTOCHEMICAL STUDY AND ANTI-RADICAL ACTIVITY OF CLEOME VISCOSA LINN OF THE TOGOLESE FLORA

**Komi Michael Fulbert Adanlemegbe[1 *], Kokou Agbékonyi Agbodan[2], Kodjo Selom Evenamede[1], Kossi Issa Saloufou[1], Nagba Yendoubé Gbandjaba[1], Oudjaniyobi Simalou[1], Essowè Badenèzi Potcho[1], Kafui Kpegba[1] and Pakoupati Boyode [1]**

[1]Laboratoire de Chimie Organique et des Substances Naturelles (Lab COSNat)), Faculté des Sciences Département de Chimie, Université de Lomé, Togo

[2]Laboratoire de Génie de Procédés et des ressources Naturelles (LAGEPREN), Faculté des Sciences Département de Chimie, Université de Lomé, Togo

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**ABSTRACT**

*Cleome viscosa* L. is a plant widely used to treat various diseases and grows on degraded or marginal agricultural lands. This study is aimed to investigate the phytochemical screening and anti-radical activity of *Cleome viscosa.*An ethnobotanical survey was conducted. Alkaloids were checked using BOUCHARDAT reagent and flavonoids were detected using SHINODA reagent. The 1,1-Diphenyl-2-Pycril Hydrazil (DPPH) free radical scavenging and the Ferric-Reducing Antioxidant Power (FRAP) assays were used to highlight the antioxidant activities. The ethnobotanical investigations conducted show that women (57%) uses more *Cleome viscosa than* men (47%) to fight diseases. Phytochemical screening revealed that *Cleome viscosa contains* alkaloids, flavonoids, saponins and tannins.The DPPH free radical value is 16.18± *0.024* mg of quercetin per gram of plant material and the FRAP value is 986.88± *0.012* µmol/L equivalent in $Fe^{2+}$ per gram of plant material. Our result shows that *Cleome viscosa* possesses phytochemical compounds and anti-radical activity.



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## INTRODUCTION

Health problems in Africa today are still very worrying. More than 80% of the African population use medicinal plants (OMS, 2012). These medicinals plants are used for the treatment of many pathologies. Active drugs are discovered from isolated medicinal plant and microorganisms. On the planet 300,000 species of medicinal plants are listed. In tropical countries of Africa 200,000 species of medicinal plants are counted (Kolling, 2010). Togo, a subtropical country has these medicinal plants. *Cleome Viscosa* L., family (Capparidaceae) is a widely distributed herb with yellow flowers and long slender pods containing seeds (figure1). The whole plant is sticky in nature and has a strong odour resembling asafoetida. *Cleome viscosa* L., is a sticky annual herb found as a common weed in plains of Pakistan, India, China and in Togo (Akobundu *et al*., 1987). The species are found in woods, sandy soils, meadows, roadside and rocky soils (Packialakshmi, 2014). It is called ''somboessou'' in ''ewe'' language of Togo. In traditionnal medicine, leaves, seeds, roots and stem of *Cleome viscosa* are used to fight malaria, hemorrhoids, fever, headaches, abscesses, vomiting, sinusitis and wounds.

***Corresponding author:*** **Komi Michael Fulbert Adanlemegbe,** Vocational Teacher in Finance and Marketing, VHSE Department.

The whole herb is used in the treatment of inflammation, middle ear, wounds and ulcers (Devi, 2002; Devi, 2003; Ahouansinkpo, 2016). The decoction is used as an expectorant and digestive stimulant (Lakshmi, 2011; Lazzeri, 2004) The vapour from a steaming decoction of the whole plant is inhaled to treat headache (Shveta Saroop And Veenu Kaul, 2015; Lev, 2002). Phytochemicals are bioactive compounds obtained from the plants and are applied in traditional medicine. In plant 2 types of metabolites are produced : Primary metabolites and Secondary metabolites (Pragadheeswari, R., & Sangeetha, 2016). Primary metabolites participated in the nutrition and reproduction of the plant. Secondary metabolites plays a role in the interaction of the organism with its environnement. Secondary metabolites are synthesize in all parts of the plant like bark, leaves, stem, root, flower, fruits, seeds, etc. Oxydative stress in commonly defined as a disturbance in the balance between the production of free radicals and antioxydant defenses. Antioxydant property is shown by a compounds such as flavonoids, tannins isoflavones, and phenolic (Fattouch, 2007; Zheng, 2001). Moreover, the benefits of phenolic antioxidant compounds from plants in prevention of chronic diseases have been reported (Sies, 2012; Watson, 2011). In view of it's traditional claim in literatures, researches have focused on its biological and pharmacological properties.

This study was aimed to investigate the phytochemical screening and anti-radical activity of *Cleome viscosa.*

**Classification**


**Figure 1.** ***Cleome viscosa*** **plant (17)**

## MATERIALS AND METHODS

**Ethnobotanical survey**

**Situation of the study area:** The survey was carried out in 9 localities belonging to 5 Cities of Togo namely: Golfe City (Bè market, Nukafu market and Agoè market), Vo City (Vogan and Akoumapé), Bas-mono City (Kpetsou), Lacs City (Aného and Anfoin) and Notsè in Haho City (Figure 2)

**Survey methodology:** To cover the five prefectures, the survey was conducted in 9 randomly selected locations (Ardilly, 2006). The randomly selected respondents are mostly adults (Assogbadjo *et al*., 2008). Nevertheless some people from the classes of young and old are also taken into account. The survey was done thanks to a sheet developed after an exploratory survey. The sections of the survey concern in particular the medicinal uses of *Cleome viscosa* and the used parts of the plant. To facilitate the interview with the people surveyed, the survey was conducted in the local language (Ewe) of Togo.

**Sample and preparation of the extracts:** *Cleome viscosa* was collected in march 2016 from kpetsou near Afagnan in Togo. The aerial portions were identified and authenticated by the Herbarium of Lome University. The plant samples were left at room temperature for two weeks. The different parts of the plant were then separated. Each part was pulverized using an electric grinder.

The powder of the leaves, fruits and the whole stem and root are stored. After 10 g of the powder of leaves, 10 g of the powder of fruits and 10 g of the powder of a mixture of stem and root were macerated with 100 ml of of differents kinds of solvents as dichloromethane, ethanol and the water-ethanol mixture in order to increase their polarities. The mixtures obtained are incubated for 3 days. All the mixtures are then filtered on the Whatman filter paper. Rotavapor is used to evaporate our mixtures. We obtained the dry extracts. The dry extracts were stored in refrigerator at 4 ° C till further analysis.
**Phytochemical tests:** Phytochemical screening refers to all methods and techniques for the detection of active chemical groups in the plant. The whole phytochemical screening was performed according to standard methods described by (Badiaga *et al*. 2008).

**Alkaloids detection:** Alkaloids were checked using BOUCHARDAT reagent. Two drops of Bouchardat reagent were addea to 6 mL of the extract. The appearance of a brown-black, brown-earth or yellow-brown precipitate indicates a positive reaction of presence of alkaloids. The presence of brown-black, brown-earth or yellow-brown colour precipitate means a positive reaction.

**Flavonoids detection:** To isolate flavonoids, a few drops of the 10% soda are added to 6 mL of the extract. The presence of a yellow-orange colour indicates a positive reaction.

**Saponins detection**: To indentified saponins 10 mL of the extract is made in the tube. The foam persistence obtained after a few minutes shows the presence of the saponins.

**Tannins detection**: To detecte the amount of tannins, 1 mL of the 10% lead acetate is added to 3 mL of the extract.
The presence of blue, blue-black, whitish or brownish colour precipitate indicates a positive reaction.

**Anti-radical tests**

**Diphenyl-2-Pycril Hydrazil(DPPH) Assay**

**Kinetic study**: For the kinetic study of the reaction of the DPPH• with the sample, a mixture was made in a tube containing 100 µl of the extract at 100 g/L and 2 ml of the solution of the DPPH• at 100 µmol/L. This preparation was homogenised with the vortex. We also examined the regular time interval which is 40 mimutes. The optical density is then recordedat 517 nm with the spectrophotometer UV-VIS 5100B SPECTROPHOTOMETER. Ethanol is used as control and is recordedunder the same conditions.

**Antiradical power evaluation with DPPH**

A study was performed to evaluate the antiradical power. The method, inspired by the works of Molyneux (Molyneux, 2004) and Constantin *et al* (Dabire *et al*., 2011), is based on the reduction of the DPPH radical by a molecule (AH) leading to the formation of the 2,2-diphenyl-1-picrylhydrazine (DPPH-H) and the radical (A●) according to the following equation :

DPPH● + AH □ DPPH-H + A●

The reagent is prepared daily with an optical density which must be between 0.85 and 1. We also prepared a quercetin solution at a range of concentations between 5-30 mg/L. After, 2 mL of the DPPH • $10^{-4}$ mol.$L^{-1}$ solution is added to 100 µL of the extract. The mixture is homogenised with the vortex and is incubated at room temperature for 40 minutes. The UV- VIS Spectrophotometer is used to recorder the optical density at 517 nm. Ethanol is also used as control and is recorded under the same conditions. The analysis is repeted trice in a very short time. The absorbance mesures help us to established the

"anti-radical potential". Based on the calibration regression equation established, the equivalent of quercetin per gram of dry extract mg EQ/g plant material) was determined.

**Ferric Reduction Antioxident Power (FRAP) assay:** The redaction capacity of *Cleome viscosa* extract was evaluated by FRAP (Ferric Reduction Antioxident Power) assay that analazyes the blue-colored $Fe^{2+}$ - TPTZ formed by the reduction of $Fe^{3+}$-TPTZ. The test was carried out according to the method described by Nair *et al* (23). We prepared 25 µL of simple which is incubated 5 minutes in the darkness with 175 µL FRAP rageant (300 mM acetate buffer, pH 3.6: 10 mM TPTZ in 40 mM HCl: 20 mM $FeCl_3 \cdot 6H_2O$ in 40 mM HCl, 10:1:1, *v/v/v*). Quercetin was used as an external standard (calibration curve obtained for 200–2000 µmol/L). The absorbance was measured at 593 nm with UV-VIS 5100B SPECTROPHOTOMETER. The test was performed in triplicate from which the standard deviations were calculated. The result is expressed as µmol/L equivalents of $Fe^{2+}$.

**Statistical analysis:** Results were analyzed statistically using the OriginPro 9.0 software. Data were expressed as means ± standard deviation (SD) of experiments performed in triplicate. One-way analysis of variance (ANOVA), principal component analysis (PCA) and Pearson correlation coefficient (ρ) were used to evaluate and correlate the results with each other.
The statistical significance between results for different samples and between results for samples and controls were set at $P < 0.05$.

## RESULTS AND DISCUSSION

## RESULTS

**Ethnobotanical data:** In our study, 53% of the subject were women and 47% were men. Our data indicated that 88% of the subject were adult aged beteween 30 and 60 years old (figure 3). In 82% of the cases, *Cleome viscosa* is used to fight diseases. *Cleome viscosa* could also be used combined with other plants such as Hyptis suaveolens and Azadirachta indica to fight differents kinds of deseases (Figure 4). All the subject said that *Cleome viscosa* treatment is taken by inhalation or by decoction using the whole plant or the leaves. To evaluate the effect of *Cleome viscosa* on differnts kinds of deseases, an investigation was conducted. We not that cleome viscosa is used to treat malaria in 83% of cases. In 71% cases, *Cleome viscosa* treated headache. The palnt treated hemorrhoids, wounds and abscesses in 59% of cases. Our survey indicated that *Cleome viscosa* treated vomiting in 30%. Our study showsed that sinusitis and toothaches are treated by the plant in 6% of cases (figure5).

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**Phytochemical studies of *Cleome viscose:*** A study was carried out to evaluate the phytochemical compound of *Cleome viscosa*. Our result shows that in the dichloromethane, alkaloids and tannins were present in the fruits, leaves, stems and roots. Flavonoid and saponins were present in the leaves stems and roots but were absent in fruits. The ethanolic extract revealed that the flavonoids and tannins were present in all the three extracts (fruits, leaves and stems-roots). Alkaloids and saponins were present in the leaves but were absent in the fruits, stems and roots. The mixture water-ethanol indicated that flavonoids and tannins were present in all the three extacts (fruits, leaves and stems-roots). We note that alkaloids were present in the leaves but were absent in fruits and stems-roots. Saponins are present in leaves and stems-roots but are absent in fruits. The majority of the compounds (alkaloids, flavonoids, saponins and tannins) is found in the leaves extracts (table 1).

**Kinetics of the reaction between *Cleome viscosa* L. and DPPH•**

The kinetic study of the reaction between *Cleome viscosa* L. and DPPH• show a rapid reduction between 0 and 20 minutes. We note that it becomes slow between 20 and 40 minutes. Our observation shows that the extract reacted with the DPPH free radicalreaching a steady state in about 40 minutes (Fig 6).

**Determination of the quercetin equivalent with DPPH•** Using our measurements, we draw the curve optical density as a function of quercetin concentration (Figure 17). We note that the correlation coefficient is $R^2 = 0.9957$. The equation obtained is $Y = -0.00733 X + 0.94859$. We finally determined the anti-radical power which is 16.18 mg of quercetin per gram of plant material (Figure7).

**FRAP (Ferric-Reducing Antioxidant Power) essay:** As determined by the FRAP essay we draw the curve optical density as a function of $Fe^{2+}$ concentration (Figure 17). We note that the correlation coefficient is $R^2 = 0.9984$. The equation obtained is $Y = 0.0008 X + 0.0605$. We finally determined the anti-radical power which is 986.88 $\pm$ *0.012* µmol / L of $Fe^{2+}$ per gram of plant material (Fig 8).

## DISCUSSION

The present study was aimed to investigate the phytochemical screening and anti-radical activity of *Cleome viscosa*. We note that, 53% of the subject were women and 47% were men. This result means that women uses cleome viscosa than men to fight diseases. All the subject said that *Cleome viscosa* treatment is taken by inhalation or by decoction using the whole plant or the leaves. This result confirms those resulting from the work of Yedomonhan *et al* who shows that *Cleome viscosa* treatment is taken by inhalation or by decoction (Adomou, 2012). Additionnaly our investigation shows that cleome viscosa is used to fight malaria and headache. Our result is in agreement with that reported by Yedomonhan *et al* which indicated that *Cleome viscosa* is used to treat malaria and wounds (Adomou, 2012). The phytochemical screening is used to identify some bioactives substances that can be derived from plants. The phytochemical compounds identified in *Cleome viscosa* is alkaloids, flavonoids, saponins and tannins. The leaves extracts accumulate all the compounds identified (alkaloids, flavonoids, saponins and tannins). Our study confirms that Ghosh's *et al* who shows that Cleome viscosa L. contains flavonoids, tannins, saponins and alkaloids (Packialakshmi, 2014; Sivaraman, 2014; Bose *et al*., 2011).

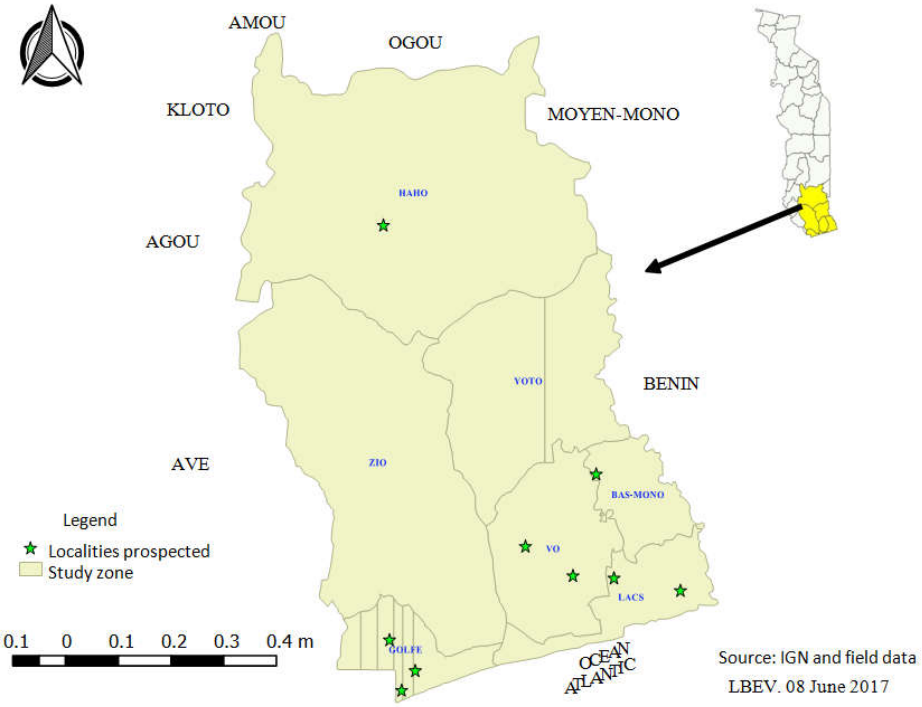


**Figure 2. Map of the ethnobotanical study area**

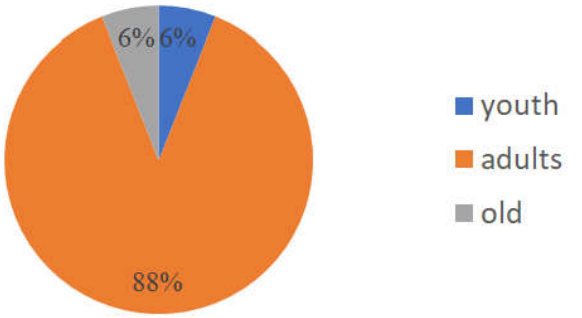


**Figure 3 : Frequency of people surveyed by age group**

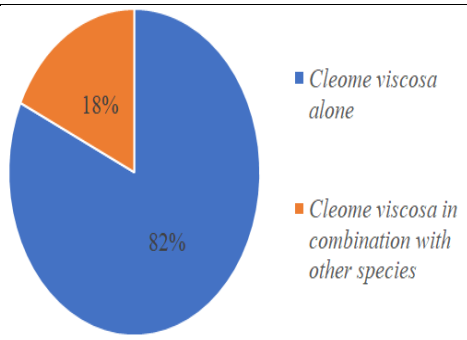


**Figure 4 : How to use *Cleome viscosa* L.**

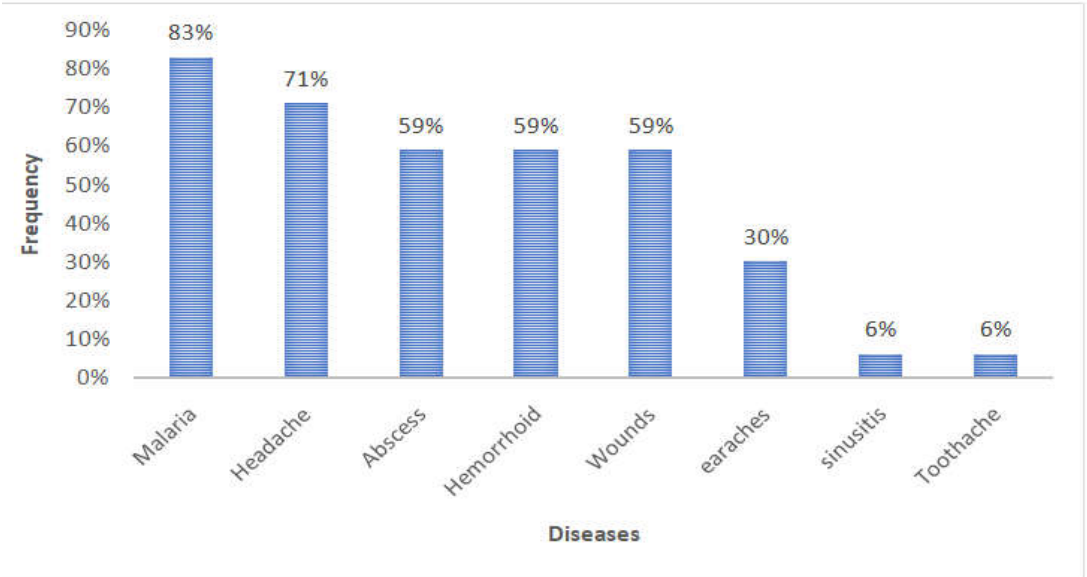


**Figure 5. Diseases treated with *Cleome viscosa* L.**

**Table 1 : Results of the phytochemical study of *Cleome viscose***

| Family of compounds | Dichloromethanolic extracts | | | Ethanolic extracts | | | Hydroethanolic extracts | | |
|---|---|---|---|---|---|---|---|---|---|
| | Fruits | Leaves | Stem - Roots | Fruits | Leaves | Stem - Roots | Fruits | Leaves | Stem - Roots |
| Alkaloids | + | + | + | - | + | - | - | + | - |
| Flavonoids | - | + | + | + | + | + | + | + | + |
| Saponins | - | + | + | - | + | - | - | + | + |
| Tannins | + | + | + | + | + | + | + | + | + |

+ : Detected; - : Not detected.

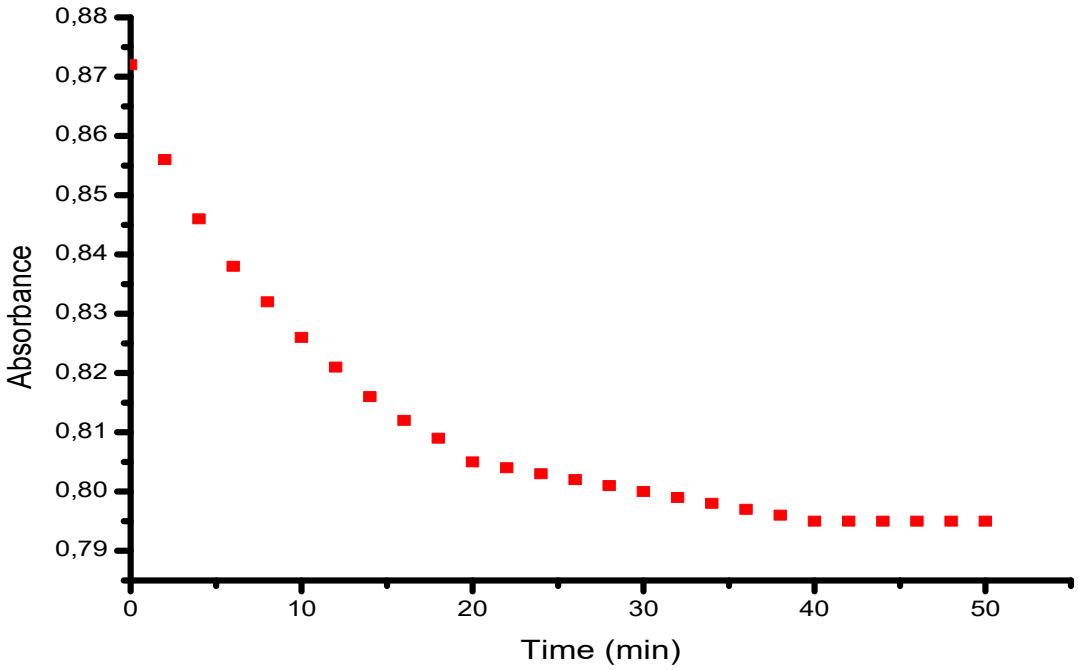


**Figure 6. Curve of the kinetics of the reaction with the radical DPPH**

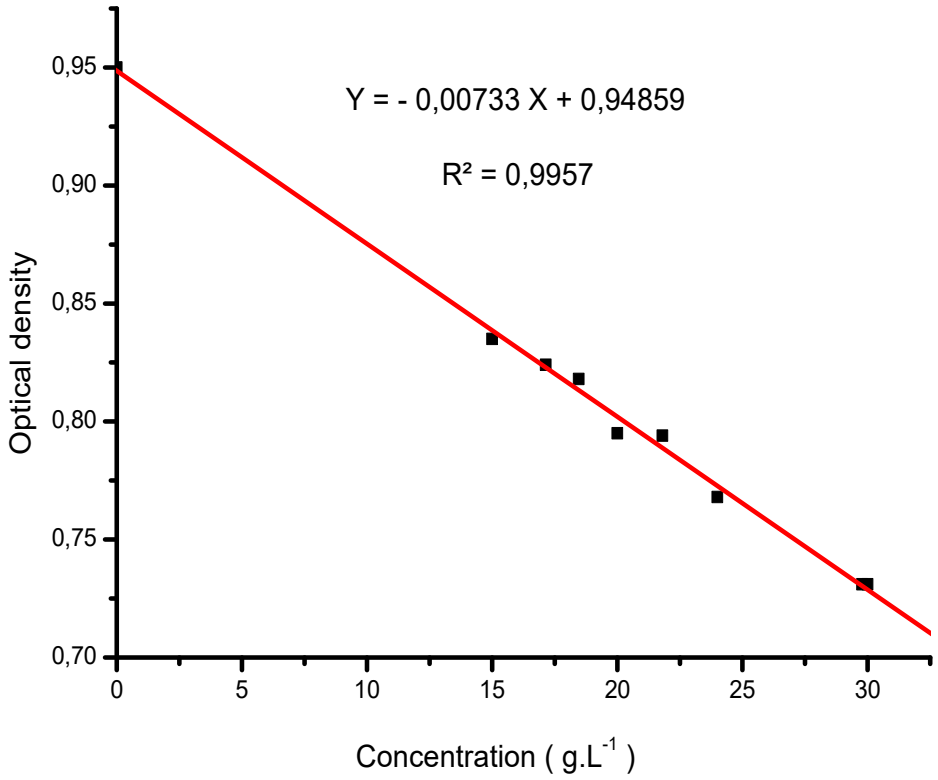


**Figure 7. Calibration curve for quercetin**

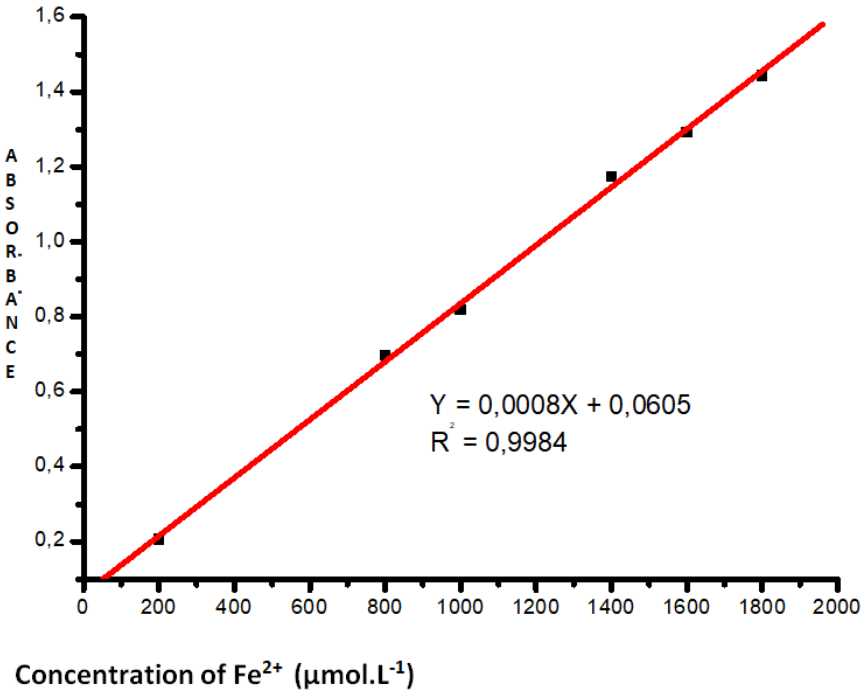


**Figure 8. Calibration curve of $Fe^{2+}$**

**Table 2. Results of the anti-radical tests of *Cleome viscosa***

| Reaction time (min) | Equivalent quercetin (mg/g) | Equivalent to $Fe^{2+}$ (µmol/L/g) |
|---|---|---|
| 40 | 16,18 ± 0.024 | 986,88 ± 0.012 |

The reason why cleome viscosa is used in traditional medicine is that, plant contains alkaloids, flavonoids, saponins and tannins, which works as potent antioxidants, antiradicals, diuretics, purgatives, disinfectants, analgesics, anti-inflammatories, antipyretics and antipasmodics. Similar developpement has been obtained by Ngene, *et al*. (Ngene, *et al* , 2015 ; Maestri, 2006). The antioxidant acivity of cleome viscoa was evaluated by the free radical DPPH and the FRAP methods. The DPPH free radical method offers an approche evaluating an antioxidant potential of a compounds an extract, or biological sources. In our essay based on the measurement of the scavenging capacity of cleome viscosa the value obtained is 16.18 ± *0.024* mg of quercetin per gram of plant material indicating the antioxidant property of cleome viscosa (fig.6). Additionally the FRAP essay uses antioxidants as reductants in a redox-linked colorimetric method employing an easily reduced oxidant as Fe(III). Also the FRAP essay can rank the reducing power and the antioxidant potential of a wide range of test compounds. By the FRAP test the result is 986.88 µmol / L of $Fe^{2+}$ per gram of plant material indicating that cleome viscosa has an antioxidant potential (fig 7). In our knowledge this is the first study reporting the anti-radical activity of *Cleome viscosa*.

The presence of flavonoids and tannins revealed by phytochemical tests may explain the anti-radical potency of cleome viscosa L.

## Conclusion

The present study was aimed to investigate the phytochemical screening and anti-radical activity of *Cleome viscosa.*

The ethnobotanical investigations conducted shows that women uses more cleome viscosa than men to fight diseases as malaria, fever, abscess, hemorrhoids, sinusitis and wounds. The findings of the study revealed that cleome viscosa possesses alkaloids, flavonoids, saponins and tannins which confer to the plant it's ani-radical activity. The majority of the compounds (alkaloids, flavonoids, saponins and tannins) is located in the leaves extracts. This could provide a strong argument in favor of the use of cleome viscosa to fight malaria, fever, abscess, hemorrhoids, sinusitis and wounds. Further studies are needed to quantify same chemical groups and isolate the actives principles responsibles for the treatement.

**Conflict of interests:** Authors declare no conflict of interests. We declare that the work described in the manscribed is new and has not been published previously.

**Ethical considerations:** Ethical consideration has been completely observed by the authors.

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## Author Contributions

Authors' contributions Komi Michael Fulbert ADANLEMEGBE conducted the full work.Kafui KPEGBA, Kokou Agbékonyi AGBODAN, Pakoupati BOYODE and Oudjaniyobi SIMALOU supervised the experiments; Kossi Issa SALOUFOU, participated in the writting process.Essowè Badenèzi POTCHO and Kodjo Selom EVENAMEDE gave

technical support via the using of apparatus. all authors contributed to the writing of the manuscript and confirmed publication of the final version.

## REFERENCES


Deventhiran, M., W. John Wyson, M. Sheik Noor Mohamed, K. Jaikumar, P. Saravanan, D. Anand*, 2017. Comparative Phytochemical Analysis of Wild and Micropropagated *Cleome Viscosa L. JAPS,* Vol. 7 (04), pp. 083-088Ahouansinkpo, E., Atanasso, J., Dansi, A., Adjatin, A. Orobiyi Azize and Sanni, A. 2016. Ethnobotany, Phytochemical Screening and Toxicity Risk of *Cleome gynandra* and *Cleome viscosa*, two traditional leafy vegetables consumed in Benin.

Akobundu I., Agyakwa C., 1987. A Handbook of West African Weeds. *IITA Ibadan, Nigeria*, 564p

Ardilly P., 2006. Les techniques de sondage : Editions Technip.

Assogbadjo A. E., Kakaï R. G., Chadare F., Thomson L., Kyndt T., Sinsin B., & Van Damme P., 2008. Folk classification, perception, and preferences of baobab products in West Africa: consequences for species conservation and improvement. *Economic Botany*, 62(1), 74-

Badiaga M. Etude ethnobotanique, phytochimique et activités biologiques de *Nauclea latifolia* Smith, une plante médicinale africaine récoltée au Mali. PhD thesis, University of Blaise Pascal - Clermont-Ferrand II, 2011. NNT:2011CLF22187.

Bose, U., Bala, V., Ghosh T, Gunasekaran, K, Rahman A., 2011. Antinociceptive Cytotoxic and antibacterial activities of Cleome viscosa leaves. *Rev. bras. farmacogn.* 21, 165-169.

Pragadheeswari, R., & Sangeetha, K. (2016). *Diabetic Foot Wound Care Treatment Using Cleome Viscosa Herb.* Paper presented at the International Conference on Information Engineering, Management and Security.

Dabire C, Nebie RHC, Belanger A, Nacro M, Sib FS. Effet du séchage de la matière végétale sur la composition chimique de l'huile essentielle et l'activité antioxydante d'extraits de *Ocimum basilicum* L. Int J Biol Chem Sci. 2011;5(3):1082-95. doi: 10.4314/ijbcs.v5i3.72218.

Devi BP, Boominathan R, Mandal SC. 2002. Evaluation of anti-diarrhoeal activity of *Cleome viscosa* L. extract in rats. *Phytomedicine* 9(8): 739-742.

Devi BP, Boominathan R, Mandal SC. Evaluation of anti-pyretic potential of *Cleome viscosa* L. (Capparidaceae) extract in rats. Journal of Ethnopharmacology 2003; 87(1): 11-13.

Fattouch S, Caboni P, Coroneo V, Tuberoso CI, Angioni A, Dessi S, *et al*. Antimicrobial activity of Tunisian quince (Cydonia oblonga Miller) pulp and peel polyphenolic extracts. J Agric Food Chem. 2007;55(3):963-9. doi: 10.1021/jf062614e.

Kolling M. Winklev K. et Von Deden M, 2010. "For someone who's rich, it's not a problem." Insights from Tanzania on diabetes health-seeking and medical pluralism among Dar es Salam's urban poor. *Globalization and Health*, 6:8.

Lakshmi SP, Bindu RN. A comparative study on the anthelmintic potential of *Cleome viscosa* L. and *Cleome burmanni* W. & A. Ind J Phar Sci2011; 73(1): 98-100.

Lazzeri L, Leoni O, Maniki LM. Biocidal plant dried pellets for biofumigation. Industrial crops and products 2004; 20: 59-65.

Lev E. Reconstructed material medica of the Medieval and Ottoman at Sham. Journal of Ethnopharmacology 2002; 80: 167-179.22)

Maestri D., Nepote V., Lamarque A, Zygadlo J., 2006. Les produits naturels comme antioxydants. Phytochimie.Les progrès de la recherche, 105-135, Filippo Imperato.

Mohtasheem ul Hasan M, Salman A, Munnawar S, Iqbal A. Analgesic and Antiemetic activity of *Cleome viscosa* L. Pak J Bot. 2011; 43(1): 119-2.

Molyneux P. The use of the stable free radical diphenylpicrylhydrazyl (DPPH) for estimating antioxidant activity. Songklanakarin J Sci Technol. 2004;26(2):211-9.

Nair VD, Dairam A, Agbonon A, Arnason JT, Foster BC, Kanfer I. Investigation of the Antioxidant Activity of African Potato (Hypoxis hemerocallidea). J Agric Food Chem. 2007;55(5):1707-11. doi: 10.1021/jf0619838.

Ngene JP, Ngoule CC, Pouka Kidik CM. 2015. Importance dans la pharmacopée traditionnelle des plantes à flavonoïdes vendues dans les marchés de Douala est (Cameroun). *J Appl Biosci*. 88:8194-210. doi: 10.4314/jab.v88i1.6.

OMS. 2012. Stratégie pour la médecine traditionnelle : 2007–2011. Genève

Packialakshmi, N. Oviya, K. 2014. Antimicrobial Activity, Phytochemical Analysis and HPLC Screening Of *Cleome viscosa.* L. *Bio. Med. Research,* 1 : 1-8.

Shveta Saroop and Veenu Kaul, Preliminary phytochemical analysis of *cleome viscosa* - a lesser explored crop of economic importance, 2015

Sivaraman, G., Gabriel Paulraj, M. S. Ignacimuthu, N. A. Al-Dhabi, 2014. Bioefficacy of *Cleome viscosa*And *Sinapis alba* Seed extracts against helicoverpa armigera (hubner). *IJPAZ* 2, 3: 211-217.

Zheng W, Wang SY. Antioxidant activity and phenolic compounds in selected herbs. J Agric Food Chem. 2001;49(11):5165-70. doi: 10.1021/jf010697n. 15. Sies H, Hollman PC, Grune T, Stahl W, Biesalski HK, Williamson G. Protection by flavanol-rich foods against vascular dysfunction and oxidative damage: 27th Hohenheim Consensus Conference. Adv Nutr. 2012;3(2):217-21. doi: 10.3945/an.111.001578. 16. Watson RR, Preedy VR, Zibadi S. Polyphenols in human health and disease. London: Academic Press; 2013.


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