Available online at *www.ujpronline.com*
Universal Journal of Pharmaceutical Research
An International Peer Reviewed Journal
ISSN: 2831-5235 (Print); 2456-8058 (Electronic)

REVIEW ARTICLE

THE THERAPEUTIC POTENTIAL OF *NEWBOULDIA LAEVIS* (P. BEAUV.): REVIEW OF ITS TRADITIONAL USES AND SOME PHARMACEUTICAL ACTIVITIES IN THE LAST DECADE

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Article Info:

Article History:
Received: 6 April 2025
Reviewed: 13 May 2025
Accepted: 20 June 2025
Published: 15 July 2025

Cite this article:
NOUDAMADJO A, GLINMA B, KPADONOU-KPOVIESSI B, MEDEGAN FAGLA S, GOUETI B, AGNIMONHAN H, TOKLO PM, LOKO LEY, GBAGUIDI FA, KPOVIESSI SDS. The therapeutic potential of *Newbouldia laevis* (P. Beauv.): Review of its traditional uses and some pharmaceutical activities in the last decade. Universal Journal of Pharmaceutical Research 2025; 10(3): 83-90.
http://doi.org/10.22270/ujpr.v10i3.1364

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Abstract

Natural products of plant and marine origin have been used traditionally to treat disease since antiquity. Traditional medicine uses different organs of the plant to treat many diseases, including leaves, flowers, stems and roots. Despite the advances in modern medicine, herbal medicine still offers many advantages. This study focused on traditional and scientific research informations on *Newbouldia laevis*. The plant's ethnobotanical, medicinal and biological uses have been studied. Research studies have reported on some extracts obtained from different organs of the plant. Extracts contain several secondary metabolites, for example : polyphenols, tannins, steroids, terpenoids, sterols, alkaloids, flavonoids, anthraquinolones, glycosides, essential oils, etc. Various health benefits are claimed for extracts and compound isolated from plant organs. These scientific studies then represented the area of excellence of the plant's pharmaceutical activity. People was interested in using plants because they had both therapeutic and nutritional qualities. In this article, we have highlighted several key works completed (ethnobotanical, pharmaceutical activities) on *Newbouldia laevis* for the past decade. The ethnobotanical and biological studies revealed the medicinal plant's potential, which needs to be developed and protected. This study built on previous research and applications in order to guide future refill work.

Keywords: Biological properties, extracts, medicinal plant, scientific investigations.

INTRODUCTION

Development is not limited to economic growth alone, but also integrates social, environmental and cultural aspects[1]. The use of herbs by man for therapeutic purposes started right from the development of human culture. It is essential to bring the notion of sustainability to the valorization of endogenous knowledge of the use of medicinal plants, which are natural resources. Modern medicine lacks new treatments and the effectiveness of drugs such as antibiotics is declining, meaning plant based treatments are in demand. Bacteria and viruses have gradually adapted to drugs (antibiotics) and resistance is increasing[2]. Antimicrobial resistance (AMR) is a threat to global health and development. It requires urgent action across multiple sectors if sustainable development goals are to be met[3]. As a result, new approaches are urgently necessary and indispensable to combat the various diseases that are resistant to modern treatments. Medicinal plants play a key role in global health systems, providing therapeutic aids to humans

and animals. They help treat diseases and support good health[4]. They serve as reliable sources of treatment for diseases across various regions of the world. As gifts of nature, plants have been used since ancient times to cure countless ailments. They have greatly advanced medicine, especially in fighting infections. Although traditional medicine is in high demand for treating endemic diseases, it faces several regulatory issues that negatively impact its credibility and effectiveness[5]. Africa has a rich plant biodiversity, with many used as medicines[6]. This practice is recognised by the WHO[7]. The WHO says 21,000 plants could be used as medicines, but more than 30% are already used. Medicinal plants are used to provide medicine and food for most people living in rural areas of developing countries such as Togo, where resources are limited[8,9]. Different organs of plants are active against diseases due to different secondarymetabolites. This time-honoured knowledge of plant properties is based on empirical observation and passed down through generations[10,11]. They have therapeutic properties and are mainly food plants, which is why they are important for people's health[12]. For decades, people have treated themselves with plants for everything from the common cold to malaria[13]. The traditional practices and medicinal use of plants can be explained by a lack of essential medicines, inadequate healthcare and the high cost of medicines[2]. *N. laevis*, commonly known as tree of life, is a purple-flowering plant that is widely distributed in many parts of Africa. It is one the plant which is used in traditional medicine for many years[14]. *N. laevis* is native to tropical Africa and grows in a variety of moist and well-drained soils[15,16]. This plant is medium-sized and from the bignonaceae family. The study reviewed literature published on *N. leavis* between 2015 and 2025 using scientific journals, books, masters and thesis reports, conference papers and other documents.

METHODS

The search was for *N. laevis*: ethnobotanical and ethnomedicinal study, and then pharmacological activity. This study undertook a review of the available data on *N. laevis* and explored its prospective applications. This work has researched the applications of the plant *N. laevis* over the last decade and it may help researchers. Bibliographical review using PubMed, Google Scholar, Scopus, Google.be, Google.fr, Google.bj, Google Books and theses/ master's theses was searched over the last decade. A manual search was also done of references from the articles selected, especially those published between January 2015 and March 2025.

Botanical description of *N. laevis*

N. laevis is a small tree with fast-growing evergreen leaves (Figure 1). Its height is 3-8 metres west to east, and up to 20 metres east to west. *N. laevis*, also known as African hyssop, belongs to the Bignoniaceae family. It grows as a shrub, reaching 3-25 metres tall[17,18]. Its bole can reach up to 90 cm in diameter, though it is generally smaller. The tree is used medicinally in the area. It's often grown as a hedge or cultivated for its flowers[17]. The flowers grow in a panicle shape and are white and pink. They appear from December to January and the fruits follow in March. The fruits are 25 cm long and have wings on the 3 cm long seeds. Leaves of the plant are imparipinnate, with 3-6 pairs of toothed leaflets. They are 20 cm long and 10 cm wide[18]. *N. laevis* or Hyssop reproduces by seed. The most commonly used method of reproduction is cuttings, which are much faster[19]. Hyssop is found in dense forest remnants, fields, fallows and hut gardens and is used as fence posts in rural areas. *N. laevis* is a species of the Guinean zone and can establish and adapt to various types of climate[19].

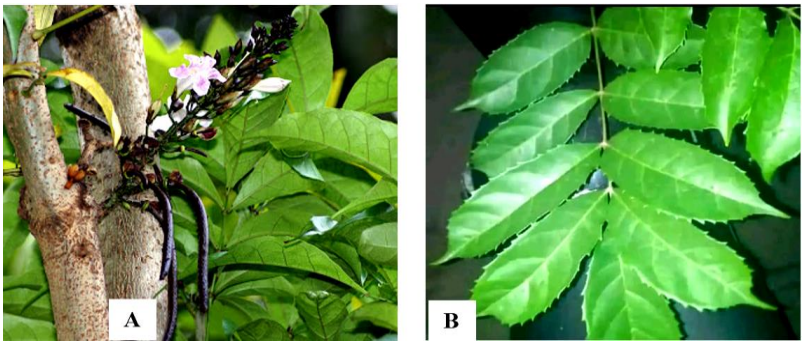

Figure 1: *N. leavis* (A: stems, leaves, flowers and fruits; B: leaves only).

Common Names

Also known as the Boundary Tree[20].

Some common Local names

The plant is known by different names. These names are used in different countries. In Benin for example, it is called Fon-Kpatin ou kpatinman, Désérégué ou désślégué, Abébéman, déssréman; Yoruba-Akoko, Avlé; Dendi-Deebu[19,21,23]. Ghana: Akan - sesemasa; Baule – tonzue; Krachi – bonchu[24]. Sénégal : koundiou bouro (Socé), Ngam, Egompa, Kôdomburu. *N. laevis* is called Akoko in Yoruba, ewe akoko Ogirisi in Igbo, Aduruku in Hausa, and Ikhimi in Edo[25-29].

Congo (RDC) : Mumbesi mbesi, mpéssémpéssé[30]. In Ivory Coast, *N. leavis* is called Bété-Gba buï; also Guéré-Bolu or Fulfulde-Sukunde. The Gambian people call it in different languages as Pulaar-kallihi, or Manding-kunjumburo and Wolof-jamjam. Guinea: Pular-Sukunde or Mandeng-Kunjumborong; and Susu-Kinki. Guinea-Bissau: Mandyak-Becuape; Mankanya-Boukouf; Creole-Manduco de feticero. Liberia: Mano-a lah. Mali: Manding- kinkin. Sierra Leone: Susu-

Kinki; Mende-Pomamagbe; Gola-Zodo. Angola: kafuki, kavuki, kuvuiti[31]. Togo: kpatima[32].

The plant has several ethnobotanical, medical and pharmacological applications.

Ethnobotanical and ethnomedical uses

Given that many people use herbal medicines as their primary treatment when they are unwell, the identification and analysis of recorded plant species through phytochemical and pharmacological studies could provide evidence-based information on medicinal plants[33]. For example, Europeans use traditional medicine to varying degrees. Belgium's rate is 42%, the UK's is 90%, and the USA's is 42% among adults and 70% in Canada. In Africa, traditional medicine is used by between 60% and 90% of people, depending on the country. The highest rates of usage are 80% in Benin and 90% in Burundi and Ethiopia. The lowest rates of usage are 60% in Uganda and the United Republic of Tanzania, and 70% in Ghana and Rwanda[14]. Plant species are very important for human populations in sub-Saharan Africa due to their contribution to meeting needs relating to food, health, energy, money, and other parts of life[34,35]. They are also important in traditional disease treatments involving combinations of medicinal plants, as well as for their socio-cultural and cultural uses[36]. However, ethnobotanical studies also have several limitations that hinder the sustainability of local plant-based medicinal knowledge. It has been described that knowledge is mainly transmitted by relatives[37,38].

Originally from equatorial Africa, the *N. laevis* is a fast-growing plant in the Bignoniaceae family[39]. For many years, traditional medicine has used this plant[14]. It is called "tree of life" or "fertility tree" in Nigeria and is usually green, though the winter months do cause its leaves to turn a deep purple color. It appears that the stem and the leaf are the most used organs. This plant is very much in demand in the practices specifically reserved for the initiated. Thus, *N. laevis* is widely used in traditional rituals as the coronation traditional chief, the areas' or sites delimitation where deities are venerated, the exorcism of spaces where one believes defiled by negative spirits. Some respondents attribute the divine character to *N. laevis* and worship him as a "god". It is also reported that *N. laevis* has been identified as being used for various ceremonial activities throughout the Benin communities[8]. The leaves are cooked in palm oil and eaten by pregnant women to ease childbirth and promote a healthy milk supply. The ash from the leaves, mixed with salt, is used to treat chest pains. A decoction of the leaves combined with Psidium guajava leaves is used to treat diarrhoea and dysentery. Leaves are used to draw out venom after chewing or sucking them[17]. In Nigeria, *N. laevis* is used traditionally for rheumatic swellings, syphilis, piles, headache, convulsion, epilepsy, and manic disorders. A decoction of the roots of *Afraegle paniculatum* and the leaves of *N. laevis* is indicated (Southwestern Nigeria) for the treatment of hypertension, taken in the morning before eating, once a day for 8 days; leaves are too used to treat malaria[26, 29,40,41]. The root and leaves have been reported in the management of fever, headache, and CNS disorders[42]. The plant is effective against many ailments. It has been found to be an effective remedy for a variety of health issues, including elephantisis, earache, dysentery, sore feet, syphilis, chest pain, epilepsy, and convulsions in children[43].

N. laevis leaves have been widely used to solve problems linked to sterility and childbirth in Africa[44]. Palnt regulates glucose and fat levels, making it a potential new diabetes and obesity treatment[45]. In Benin, researchers have reported the use of a decoction of the leafy stem of plant during difficult childbirth. This could help the woman to give birth in the best possible conditions. The plant is most commonly used to demarcate houses[19-23]. In southern Benin, its leaves are used alongside other plants, RNS, to treat salmonellosis. To treat haemorrhage, leaves are macerated with kaolin. The solution is taken orally by the patient[21,38]. In Ghana, Hyssop is used in combination with other plants to treat malaria. Various decoctions were indicated : 1) leaves or stem bark and dried *Mangifera indica* leaves - 2) *Psidium guajava* leaves with Hyssop leaves and *Citrus aurantiifolia* fruit juice - 3) leaves of *Periploca nigrescens*, *N. laevis*; leaves of *Cymbopogon citratus*, *Terminaliacatappa* and *Bombax buonopozense* - 4) stems and leaves of *Saccharum officinarum* with leaves of *N. laevis*. These different potions are taken orally by the patient[24]. In Togo, the pulverized foliage of plant is utilised in the treatment of hepatic ailments[32]. In Congo (DRC), *N. laevis* bark is macerated with kaolin to treat stomach upsets. The solution is taken orally by the patient. It has been suggested that the bark, leaves, aerial parts and underground parts of the plant can be used as a decoction, infusion or exudate to treat diseases of the digestive and circulatory systems[25-30]. In Guinea Bissau, the roots of *N. laevis*, RNS, are used to treat pregnancy, childbirth, breastfeeding and newborn diseases; fever, malaria, mental and neurological disorders, sexually transmitted diseases; eye diseases and rheumatism[46]. In Angola, Roots and leaves are used for a sitz bath, good for haemorrhoids ; the bark is recommended as a decoction on the skin to treat thrombosis, and to demarcate houses[31]. The various extracts used can be affected by different physico-chemical parameters such as the effect of temperature, electrostatic traction, pH, phytochemical constituents and various routes of administrations[47]. But isn't this ethnobotanical use dangerous for the population? To answer this question, we reviewed the literature. We found that the use of extracts can have harmful effects on the population. Some work has been carried out to determine whether and in what doses extracts should be used. For example, it has recently been observed that hydroethanol extract of *N. laevis* leaves is relatively non-toxic and safe when administered in low doses. However, sub-chronic administration of a sub-therapeutic dose of plant can cause anaemia in both sexes. In contrast, a supratherapeutic dose tends to cause infertility in both sexes, as well as liver damage in women and kidney damage in men[48,49].

These studies highlight the need for caution when using plant extracts long term, as well as the need for mechanistic laboratory studies. All these data have

enriched the current plant database and can be used in future studies.

Pharmacology

World Health Organization (WHO) reports that medicinal plants contain valuable, yet under-exploited, bioactive molecules whose pharmacological properties could benefit the majority of rural populations in Africa[50]. Traditional medicine practitioners observe their traditions and practices, thus valuing their diverse local knowledge[51]. Herbs find application in a plethora of fields, ranging from natural colouring to pest control, food, perfume, tea and beyond, not to mention their medicinal uses. Some countries' remedies for pest control include medical plants. Medicinal herbs are important for drug production[52]. An increasing amount of scientific research is investigating traditional medicine in order to shed light on people's knowledge of medicinal plants[53]. As reported in literature, natural products represented an important source of new active molecules, as more than half of clinically proven products are of natural origin[11]. Scientific studies presented then the braord area of pharmaceutical activity of the plant. Secondary metabolites of plants are known as phytochemicals, which often play a role in protecting plants against stresses of a biotic or abiotic nature. Humans use them in chemicals because they are valuable[54]. Research reports have included extracts from different organs of the plant.

Phytochemical evaluations were carried out for all the extracts using standard procedures to identify the constituents. Qualitative analysis of the crude extracts were carried out as described by researchers[55,56], to identify the presence of the classes of secondary metabolites. *N. laevis* (P. Beauv.) is a tropical vegetation from the rainforest that has been used to treat malaria, coughs, joint pain, stomach aches, oedema and inflammation. According to the literature, several authors have studied the phytochemistry of plant organs. Phytochemical screening showed polyphenols, alkaloids, tannins, saponins, terpenes, flavonoids, and cardiac glycosides, anthraquinones, steroids, phenol, volatile oils etc in differents extracts from organs of *N. laevis*[57-59]. Previous chemical studies proved that *N. leavis* had saponins, flavonoids, phenolics, terpenes, cardiac glycosides, tannins, and alkaloids[43,55,60,61]. Both, Tuo and Ayoola et collaborators, in their research on phytochemical screening of raw extracts and active fractions revealed the presence of a sterols and polyterpenes, polyphenols, flavonoids, anthocyanins, lecoanthocyanins, gallic tannins, catechic tannins, quinones, carotenoid, oxalate, cyanide,alkaloids, trypsin inhibitor, coumarins, cardiotonic glycosides and saponosins ; however, he noted the absence of steroids[62,63], and anthraquinones[64], and reducing sugars[65,66]. Fatunla *et al*., also found some secondary metaboliteswhen they worked in the qualitative screening of the methanolic extract of *N. laevis*[67]. Ushie *et al*., showed in their study that several extracts of *N. laevis* using several solvents such as ethyl acetate, acetone, hexane and methanol revealed the presence of major families active constituents. But, all their extracts lacked phlobatannins and tannins, and the acetone extract contained steroids[15]. Both the methanolic and aqueous extracts revealed phenols, flavonoids, glycosides, tannins, oxalates, terpenoids, anthraquinolones and alkaloids[68]. In another study, Dermane *et al*., found that high-performance liquid chromatography can determine withasomnine, newbouldine, lapachol derivatives, and other bioactive compounds in *N. leavis*[69]. These results vary from researchers according to the nature of the organ, the solvent used and the extraction method employed. This shows that various factors, such as the extraction method (decoction, maceration or infusion), the solvent (water, ethanol, a water ethanol mixture or organic solvents) and the type and age of the plant organ used, influence the research results. These important research parameters could explain the observed variation in results.

The plant has several medicinal uses. It can help with problems related to high blood sugar, protect the heart, and reduce blood pressure. It can also help with weight loss, reduce inflammation, prevent blood clots, protect the liver, and fight off parasites and bacteria[6,49]. Hyssop contains antimicrobial properties[67]. The plant's extracts had the required properties for treating these diseases in Nigerian traditional medicine[70]. Leaf extract improved the antioxidant status of rats, showing significant free radical scavenging potential. Researchers reported that plant leaf may exhibit its anti-hyperglycemic effect by inhibiting α-glucosidase. In their study, they showed that methanol extract of *N. leavis* leaf was able to normalize blood glucose, increase insulin sensitivity and secretion as well as reduce insulin resistance[71].

In an other research in mercury chloride-induced toxicity in wistar rats, it was noted that the ethanolic extract of *N.* offers significant hepatoprotection[72]. In cytogenotoxicity study of aqueous extract of Hyssop leaves, authors indicated the mutagenic effect in the Ames test, while the SOS chromotest showed good complementation, using prokaryotic (Ames *Salmonella fluctuation* test using TA100 and TA98 strains of *Salmonella typhimurium*) and eukaryotic (*Allium cepa* root cells) models. The plant extract was cytotoxic, significantly ($p < 0.05$) inhibiting root growth at 5-50% concentrations. At 50% it completely inhibited *A. cepa* cell division, while exposing onions at 5-20% increased chromosomal aberrations significantly ($p<0.05$)[44].

In their study, Osigwe and collaborators suggested that *N. laevis* leaf extract and fractions have anti-hyperglycemic properties and could be used to treat diabetes[58]. In a diabetes-based study, researchers concluded that *N. laevis* leaf methanolic extract acted significantly. In their research, they showed that both this extract and glibenclamide exerted an interesting effect on type 2 diabetes rats. *N. laevis* was also able to prevent insulin resistance, as well as enhance beta cell function. *In silico* study revealed that plant leaf may exhibit its anti-hyperglycemic effect by inhibiting α-glucosidase[58,71]. Some research reported that compelling evidence that oxidative stress is one of the causes of diabetes mellitus because it can lead to impairment of beta cells in pancreas, which would inevitably impede insulin production. Ethanol extract

of plant leaf reduced spontaneous motor activity, showing the extract's neuroprotective and neuro-rescue properties. This decline in action is intimately connected to sedation resulting from a deterioration in the central nervous system. This research provides insights into Parkinson's disease and its causes. It also highlights neurodegeneration[73]. *N. laevis* extract reduced blood glucose levels after sucrose intake in both rats with and without diabetes. It does this by blocking two important enzymes[74]. Another research showed that the methanol fraction was the most effective painkiller, while the ethylacetate fraction was the least[61,75]. On several extracts study, it noted that some extracts showed antipyretic properties, but no effect on body temperature. It was pretty much the same as the effect of paracetamol[12]. Other studies have revealed that *N. laevis* leaves contain crude proteins. Nehete *et al*., pointed out that, of all the nutrients, proteins are the most important for the human body because they help to build and repair cells and tissues. A protein-rich diet is recommended for those looking to build muscle. The molecular tools of biotechnology mean that many versatile plant proteins can be produced and used as medicinal agents[76]. Presence of these compounds in *N. laevis* leaves could potentially be useful in the treatment of inflammation, given that saponins have the ability to cause red blood cells to clump together and form lumps. This finding is said to be due to the fact that saponins have certain characteristics that enable them to form olutions that contain foam and exhibit hemolytic, cholesterol-binding and bitterness characteristics[77]. Saponins, natural compounds with antiseptic properties, appear to play a role in defending plants against pathogens in their natural environment[78]. It has been demonstrated by earlier research that steroids present in plants have the capacity to provide pain relief and influence the functioning of the central nervous system[79]. The bark of the *N. laevis* plant was found to have pain-killing properties. It was also discovered to demonstrate peripheral analgesic characteristics[40]. The crude extract presented significant *in vivo* and *in vitro* anticoagulant activity, especially at high concentrations[80]. Crude extract of *Newbouldia* was anti-parasitic against all models, dose-dependently. The fractions exhibited anti-malaria properties, with the ethyl acetate fraction proving the strongest and comparable to the standard drug. The results show that the leaves of the *N. laevis* plant contain substances that can fight malaria. These substances could be used to make new drugs to treat malaria[81]. Leaves of hyssop were extracted with water and ethanol and tested on isolated rat uterus. These extracts increased spontaneous contractions ($p<0.05$) with little effect on amplitude. Bafor and Sanni found that the extracts and acetylcholine directly stimulated the uterus[28]. The leaf extract of *N. laevis* is known to possess antioxidant properties and scavenge free radicals. Recent reports have revealed the DPPH radical-scavenging potential of *N. laevis*[60]. Previous work involved carrying out chromatographic studies on plant extracts. Gas chromatography revealed around twenty molecules in the methanolic extract. These include : 1,7-Dioxaspiro [5.5] undec-2-ene ; Propyl - phosphonic acid ; di(2-methylpentyl) ester ; 4-((1E)-3-Hydroxy-1-propenyl)-2-methoxyphen; Gingerol ; 8,11-Octadecadienoic acid, methyl ester ; 2,5-dimethoxy-benzenepropanoic acid ; Acarbose (Alpha glucosidase inhibitor) ; Carinol ; 5,10-Diethoxy-2,3,7,8-tetrahydro-1H,6H-dipyrr; 2-hydroxy-1-(hydroxymethyl)hexadec anoic acid ; N,N'-dibutyl-idene-hydrazine. These bioactive molecules presented significative pharma-cological properties[71].In other work, the fractions from root bark extracts of *N. leavis* led to isolated moleculessuch as lapachol, 2-acetyl-naphtho [2,3-b]furan-4,9-dione, and 2-(1-hydroxy-ethyl)-2-acetyl-naphtho[2,3-b]furan-4,9-dione which were screened against *Onchocerca ochengi* parasites. Among them, lapachol and 2-(1-hydroxyethyl)-2-acetyl-naphtho[2,3-b]furan-4,9-dione showed 100% inhibition at a concentration of 5 µg/mL after 5 days[82]. Bark extract of the *N. laevis* plant is antimalarial, which explained its long-used role in herbal remedies[83].

New studies are carried out and new publications are released every day throughout the world. We do not claim to cover all aspects of the research projects conducted over the last ten years. However, we believe that we have covered the essential points and have attempted to summarise them. The available data shows that *N. laevis* exhibits a variety of pharmacological activities, which justifies its use in traditional medicine. However, rigorous clinical studies and long-term toxicity assessments are essential to validate its safety and efficacy in humans.

CONCLUSIONS

N. laevis has significant therapeutic potential that deserves further exploration through in-depth studies. Available ethnobotanical and pharmacological results confirm its antimicrobial, anti-inflammatory, analgesic, antioxidant and anti-diabetic properties, among others. These properties are derived from extracts and compounds of various *N. laevis* organs, which supports its traditional use. However, despite these promising results, there are still a number of gaps, particularly with regard to the standardisation of extracts, the precise mechanisms of action, and clinical studies in humans that are in line with modern scientific standards. Such an approach would validate its efficacy and safety, and encourage its integration into conventional medicine.

ACKNOWLEDGEMENTS

Authors thank Professor Joachim GBENOU, Professor Eléonore YAYI and everyone who contributed to this review.

AUTHOR'S CONTRIBUTION

NOUDAMADJO A: investigation, methodology, writing original draft. **KPADONOU-KPOVIESSI B:** methodology, formal analysis, writing – original draft. **GLINMA B:** conceptualization, formal analysis, writing original draft, validation, supervision. **GOUETI B:** investigation, methodology. **MEDEGAN**

FAGLA S: investigation, methodology. **AGNIMONHAN H:** methodology, visualization. **TOKLO PM:** investigation, methodology. **LOKO LEY:** investigation, methodology. **GBAGUIDI FA:** laboratory and research unit manager. **KPOVIESSI SDS:** resources, visualization. Final manuscript was checked and approved by the both authors.

DATA AVAILABILITY

Data will be made available on request.

CONFLICT OF INTEREST

None to declare.

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