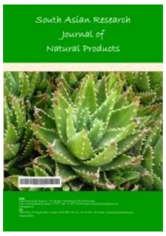

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Phytochemistry and Pharmacology of *Aframomum angustifolium* (Sonn.) K. Schum (*Zingiberaceae*): A Mini Review

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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

According to the World Health Organization (WHO), more than 80% of the population in Africa in general and in the Democratic Republic of the Congo (DRC) in particular, resorts to Traditional Medicine to solve the problem of primary health care. In this study we had reviewed the relevance of *A. angustifoolium* in phytochemical composition, traditional use and biological activities based on scientific results obtained from Google Scholar, PubMed, Sciencedirect, Web of Science, Scopus

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and Chemical Abstracts. Moreover, after compiling the research data of several authors, the results show that this plant is of great interest because it has a wide range of biological properties like antioxidant, antiageing, antiparasitic, anti-nociceptive activities. This wide range of biological properties of *A. angustifolium* would be much attributed to the essential oil compounds such as β-pinene and β-caryophyllene which are the major compounds in this plant. This review will therefore guide future research on the use of *A. angustifolium* β-caryophyllene rich-extract as anti-inflammatory medicine for the management of Sickle cell anemia.

Keywords: Aframomum angustifolium; phytochemistry; biological activities; medicinal plant; traditional medicine.

1. INTRODUCTION

The African flora constitutes an important reserve of medicinal plants which occupy an important place in the African pharmacopoeia [1-3]. Even today, they play a decisive role in the treatment of certain tropical diseases [4]. According to the World Health Organization (WHO), more than 80% of the population in Africa in general and in the Democratic Republic of Congo (DRC) in particular, uses Traditional Medicine to solve the primary health care problem [5,6]. The use of medicinal plants for various health problems is not only a choice, but is also reportedly linked to poverty and the high costs of modern medicines [7-10]. This reliance on plants is also justified by a strong attachment to traditional know-how and the availability of plant material through a large Congolese rainforest, comprising just over 10,000 species of angiosperms, of which approximately 3,000 are endemic [11].

Among the plants used by the population to treat various ailments is *A. angustifolium*. This herbaceous perennial plant is a tropical species that grows in Côte d'Ivoire, Cameroon, Gabon, DR Congo, Madagascar and is found mainly in undergrowth and rainforests [12]. Its ethnobotanical uses are well reported by several authors [13-16]. However, the analysis of *A. angustifolium* extracts revealed the presence of several essential oils [17], minerals, lipids, carbohydrates, proteins and fibers which is beneficial to human health in this plant species [13]. The presence of these compounds would justify the results of several authors who suggest that this plant is of great interest because it has a wide range of biological applications as antioxidant, antiageing, antiparasitic, anti-nociceptive and antimicrobial [12,18,19]. In addition, the objective of this study is to review the literature on the traditional use, phytochemistry, biological activities and toxicity. This review will therefore guide future research on the use of *A. angustifolium*.

2. METHODOLOGY

In this mini-review we will present the different data from articles, books, book chapters, PhD theses in French or English retrieved via a bibliographic search on the internet with the different scientific search sites such as Google Scholar, Pubmed, Sciencedirect, Web of Science, Online Library, Scopus and Chemical Abstracts. As a search strategy, the scientific name of this plant species was used as a keyword, along with the terms phytochemistry and pharmacology from these scientific engines to get searched data. After the first stage of research, we proceeded to the elimination of the duplicates and the ones that did not give the information about the plant. Then, we proceeded to the filtering of the full text. Finally, some articles are included for the editorial team of our journal. These different articles were characterized according to the activities of *A. angustifolium* as detailed in the selections of research results.

3. RESULTS AND DISCUSSION

In this mini-review, 102 scientific articles were downloaded and put in a folder, after this initial search step we proceeded to the elimination of duplicates and documents that do not give the information we were looking for. Subsequently, 59 articles were included for full text filtering. Finally, 49 articles providing information on the traditional use, phytochemical and pharmacological data of the plant were included for the editorial team of our journal. These different articles have been characterized according to the activities of *A. angustifolium* as detailed in the following selections.

3.1 Botanical Description

A. angustifolium is a perennial herbaceous plant, from 1,5 to 4 m high, resulting from extended rhizomes. It has large simple, alternate and deciduous leaves, of green color and flowers in the shape of trumpet, of yellow or pinkish color which are organized in ears. Grouped in inflorescences of 4 to 10 flowers appearing at the base of leafy shoots, the flowers have red petals, a yellow or pale orange labellum. Fruits are ovoid to subglobose, 7 to 9,5 cm long, including the persistent calyx, red at maturity. The stem is very rigid especially when its height reaches 1,50 m to 2 m. The plant has a fruity smell, with notes of apricot, spicy and sweet, slightly peppery. The seeds resemble those of pepper and cardamom in their spicy, pungent taste with a slightly acrid aftertaste [12].

3.2 Phytogeographic Distribution

A. angustifolium is a tropical plant that grows in Côte d'Ivoire, Cameroon, Gabon, DR Congo, Madagascar and is found mostly in undergrowth and rainforests [12]. In DR. Congo, it is widespread in the secondary forest and wet areas of the rainforest.

3.3 Ethno Medicinal Knowledge

Table 1 describes the data collected during our literature search. This information includes vernacular names, parts used, local uses and references for each country. Regarding this section on the traditional use of this plant, some information was collected and this data allowed us to see how this plant is used in the 12 African countries. All parts of this plant are used in the formulation of recipes by the population of the 12 African countries (Fig.2). The root is the most used part (33.3%), followed by the seeds or fruits and the use of the whole plant (20.8% each) and the stem (16.7%) respectively. Given that the root is an underground organ that serves for the nutrition of the plant through the absorption of water and mineral salts, it should be noted that any extensive use of roots represents a serious threat to the sustainable preservation of biodiversity [7,20] and this practice will lead to the extinction of this species. Figure on the mode of preparation of the recipes (Fig. 3) shows us that decoction is the most used mode of preparation (70.8%), followed by mastication (12.5%), maceration (8.33%), paste and instillation (4.1% each). This predominance of decoction as the most used mode in the preparation of recipes may be due to the fact that it has been reported that traditional healers believe that heat and steam remove toxic substances from plant materials [7]. Regarding the route of administration, three routes were recorded, namely the cutaneous, ocular and oral (Fig. 4). The results from this figure show us that the majority of the recipes are administered orally (75%), followed respectively by the cutaneous (20.8%) and ocular (4.17%).

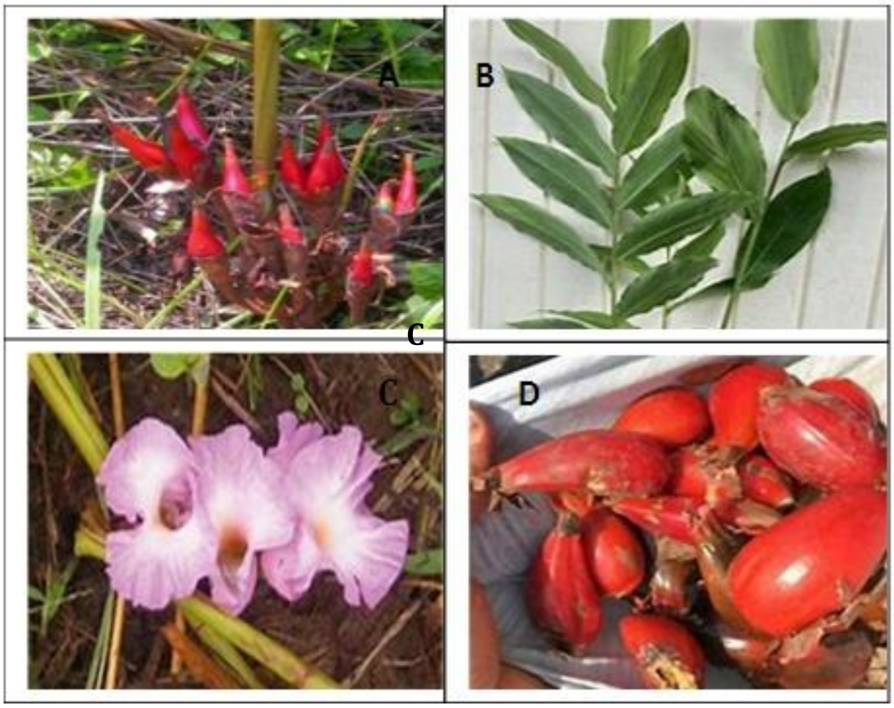


Fig.1. A *(Rhizomes and Seeds),* B (Leaves), C (Flower) and D (Seeds) of *A. angustifolium*

Table 1. Ethnomedicinal knowledge on different parts of *A. angustifolium*

Country	Vernacular names	Part uses	Formulation/method of administration	Local uses	Ref.
Burundi	Urutake (Kirundi)	Leaves	Decoction /oral	Against cough	[21]
Democratic Republic of the Congo	Mbembe, bebe and ngemoa (Pygmees) ntondolo (Mpama), tondolo (Kiyombe), matungulu (Kirega), bosombo Kitembo), mohombo (Lokonda), yolo, bulu (Ngwaka)	Fruits	Mastication/oral	Nutrition	[22]
		Stems and leaves	Instillation/ocular	Against conjunctivitis	[16]
		whole plant	Decoction/cutaneous	Against wounds and injuries	
		Fruits	Decoction /oral	Against ascites	
			Decoction /oral	Aigainst Splenomegaly	
		Leaves	The decoction/cutaneous by steam bath	Against diabetes	
		Roots	Decoction/oral	Against epilepsy	
		Leaves	Decoction /oral	Against Tachycardia	
			Paste/massage.	Against pneumonia	
			Maceration and decoction/cutaneous and oral	Against headaches, hyperthermia and joint pains	
		Stems	Decoction/oral	Against hemorrhoids	
		Stems	Decoction/cutaneous by steam bath	Against Psychosomatic disorders	
Central African Republic	bêle (Manja) kopea (Banda), gbagbili (Gbaya), Kokpo (Langwasi)	Leaves and roots	Decoction/oral	Elephantiasis	[23,24]
Angola	Gingenga da mata (Portugais), mansasa ma mfinda (Kikongo**)**	Roots	Decoction/oral	Against yellow fever	[25]
Ouganda	Matungulu (Luganda) amatehe (Rutooro)	Roots	Decoction /oral	It strengthens the immune system	[26]
		Stems	Maceration/oral	against diarrhea, cholera	[14]
		Fruits	Decoction/oral.	Against measles	[27]
Tanzania	mtuguu, mtuguu mke (swahili), wild cardamom (Anglais)	Not indicated	Not registered by the authors	Nutrition	[28]
Madagascar		Leaves and seeds	Decoction/oral	Against cough	[29,30]

	Lingosa, Longonzo or Lingonza (betsimisaraka), Sintogno (Antakarana)	Stems	Not registered by the authors	Against wound (antiseptic), bloating, stomach ache	[31]
		Leaves	Not registered by the authors	Culinary service and as spoons Against stomach aches	[32]
		Young fruits	Not registered by the authors	Against pertussis	
		Fruits mu		Foods and confiture	
Liberia	not registered by the authors	Barks	Mastication/oral	Against orchitis due to gonorrhea	[33]
		Root	Not registered by the authors	Given to relieve post-partum pain	[34]
Cameroun	not registered by the authors	Stems	Mastication/oral	Against intestinal worms	[15]
Kenya	not registered by the authors	Seeds	Decoction /oral	Anthelmintic	[35]
Congo-B			Decoction/oral	Against oedema,	[36]
Nigeria		Stems Rhizomes		Beaten for use as a rope to tie up guinea-corn; As a spice	[13]

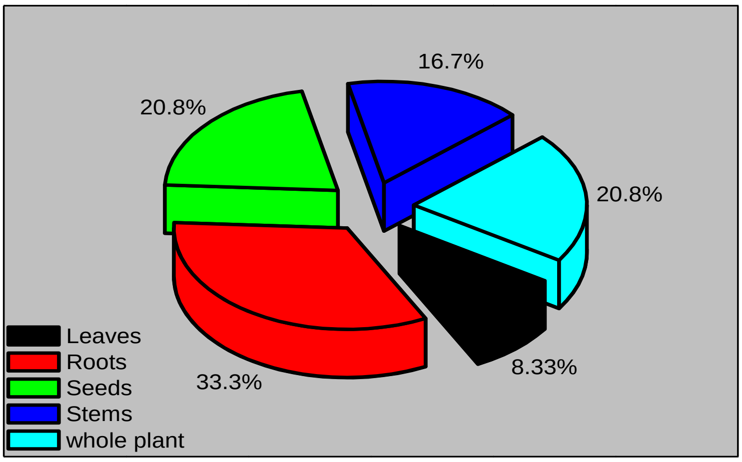


Fig. 2. Different parts of *A. angustifolium* used locally

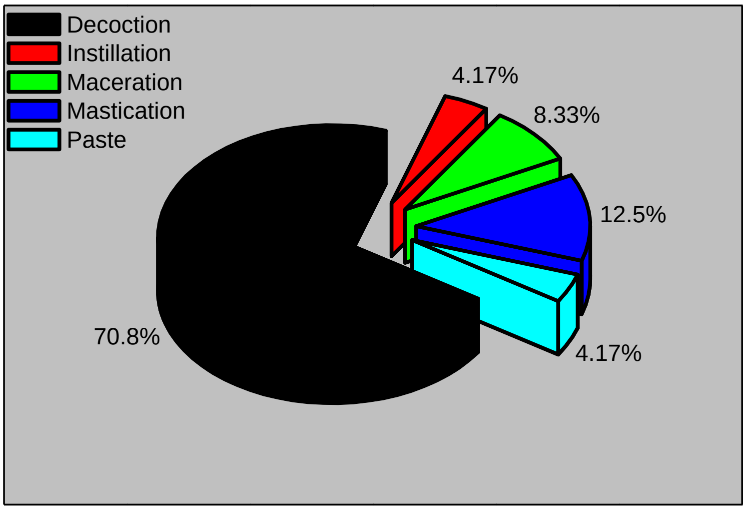


Fig. 3. Modes of preparation of recipes down from *A. angustifolium*

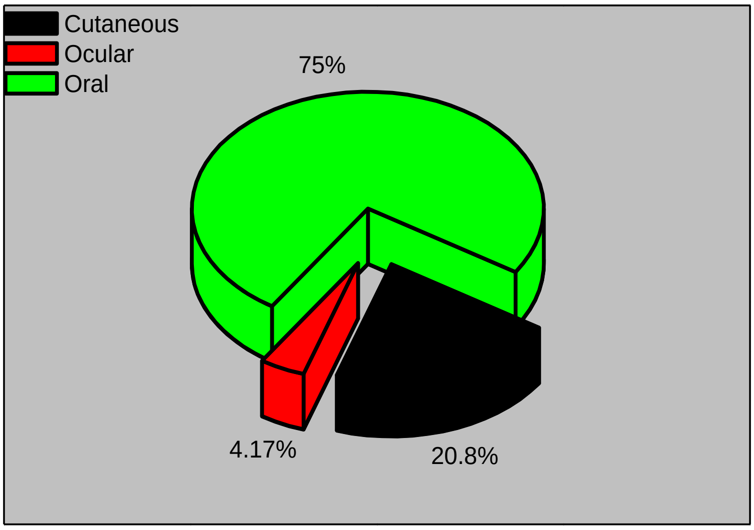


Fig. 4. Modes of administration of recipes

Table 1 gives ethnomedicinal knowledge on different parts of *A. angustifolium* in 12 Africa countries.

3.4 Phytochemistry Composition

It is found that the seed, pulp and peel of *A. angustifolium* can be considered as good source of minerals, lipids, carbohydrates, proteins, fibers and moisture, which is beneficial to human health [13]. Several phytochemicals like saponin, tannins, alkaloids, steroid, cardiacglycosides, flavonoids, and terpenoids have been identified in the seed extract of *Aframomum.* Similar phyochemicals have been detected in the pod extracts of *A. angustifolium* from this study [19]. Table 2 gives the proximate composition of the seed, pulp and peel of *A. angustifolium*.

Table 3 gives the essential oil composition of *A. angustifolium*.

As can be seen in this figure 5 that *A. angustifolium* is rich in essential oil. β-pinene (B :24.8) is the most abundant compound, followed by β-caryophyllene (D :17.8%), Cis-pinocarvyl acetate (G :11%), Myrtenyl acetate (H : 8.5%), Trans-pinocarvyl acetate (E:5.3%), Caryophyllene oxide (J:3.5%), α-pinene (A:3.3%), Sabinene (C:2.7%), α-humulene (F:2.9%) and α-terpineol (I:1.9%). These compounds constitute 81.7% of the essential oil composition of this plant, the other compounds constitute only 18.3%. The presence of these major compounds such as β-caryophyllene, β-pinene and α-pinene would be the basis of several biological properties such as anti-inflammatory, anti cancer [37,38].

Table 4 gives the summary of action mode of *A. angustifolium* compounds.

3.5 Pharmacological properties

Several pharmacological properties of some *A. angustifolium* have been identified from previous studies. Some examples are listed below.

3.5.1 Antimicrobial activities

It reported that ether and methanol extracts of the ripe pod of this species possess the antibacterial activity antibacterial activity against *Staphylococcus aureus* and *Escherichia coli* [19]. The MIC of the extracts was 125 mg/mL. The methanol extract showed the strongest antibacterial activity against *S. aureus* of 18.5 mm. Both the methanol and ether extracts tested positive for various phytochemicals especially flavonoids and terpenoids which are known to have antibacterial activity. The ether and methanol extracts of the ripe pod of *A. angustifolium* possess antibacterial activity, justifying the use of the fruit in ethnomedicine [19].

3.5.2 Antiageing activity

An assay based on image processing analysis demonstrated the antiwrinkle activity of a formulation containing *A. angustifolium* seed extract. The data obtained in the two centre study suggests that the cosmeceutical containing *A. angustifolium* seed extract produces a global rejuvenation effect in terms of redness, pigmentation and fine lines similar to that noted utilizing an intense pulse light source [47].

3.5.3 Antiparasitic activity

It was demonstrated by [12] that the hydoethanolic extract has no antiparasitic activity against *Culex quinque fasciatus*.

3.5.4 Antioxydante activity

Ebhohimen et *al.* [48] investigated the effect of heat treatment on the antioxidant capacity of aqueous and ethanolic extracts of *A. angustifolium* seeds in vitro by assessing metal chelating activity (MCA), ferric reduction capacity (FRA), hydroxyl radical (-OH) scavenging activity, nitric oxide (NO) scavenging activity and total antioxidant capacity (TAC) before and after heat treatment. The results of this study showed that the extracts of this plant have a significant antioxidant activity. Before treatment, the percentage of metal chelating activity of the extracts was comparable ($p > 0.05$) to that of ascorbic acid, while the percentage of metal chelating activity of the ethanol extract decreased significantly ($p < 0.05$) from 65.99% to 47.62% after 30 minutes heat treatment. Regarding, the hydroxyl radical scavenging of the aqueous extract the percentage was not affected ($p > 0.05$) by the heat treatment while the activity of the ethanol extract decreased. The ferric reduction capacity of the extracts decreased significantly after heat treatment, while the NO scavenging, activity increased with heat treatment. The total antioxidant capacity (TAC) of the extracts, measured in ascorbic acid equivalents, decreased but was not significantly affected by heat treatment.

3.5.5 Antibromate toxicity activity

The effect of ethanolic extract of *A. angustifolium* seeds was evaluated on renal and hepatic lesions induced by exposure to an acute dose of potassium bromate using appropriate biomarkers. In this study male Wistar rats were used as a biological model. The results obtained in this study suggest that the ethanolic extract of *A. angustifolium* seeds can accelerate the *in vivo* repair of bromate-induced liver and kidney toxicity in Wistar rats [18].

Table 2. Proximate composition of the seed, pulp and peel of *A. angustifolium* fruit (%) [13]

Parameters	Seed	Pulp	Peel
Moisture	13.13±0.76	16.48±2.97	42.47±0.00
Ash	3.55±0.00	2.09±0.20	0.86±0.09
Crude lipids	2.59±0.00	65.30±0.00	41.06±0.00
Crude fibers	13.72±0.00	1.18±0.05	5.88±1.79
Crude proteins	23.05±1.54	1.57±0.05	1.80±0.05
Carbohydrates	43.96±0.86	13.38±2.77	7.93±1.65

Table 3. Essential oil identified from *A. angustifolium* [17]

N°	Molecules	Source	Part use	Identification method	%
01	α-pinene	Essential oil	Seeds	GS/MS	3.3
02	α-thujene	Essential oil	Seeds	GS/MS	0.2
03	Camphene	Essential oil	Seeds	GS/MS	0.1
04	β-pinene	Essential oil	Seeds	GS/MS	24.8
05	Sabinene	Essential oil	Seeds	GS/MS	2.7
06	Verbenene	Essential oil	Seeds	GS/MS	0.2
07	Myrcene	Essential oil	Seeds	GS/MS	0.5
08	α-terpinene	Essential oil	Seeds	GS/MS	0.2
09	Limonene	Essential oil	Seeds	GS/MS	1.6
10	1,8-cineole	Essential oil	Seeds	GS/MS	0.8
11	β-phellandrene	Essential oil	Seeds	GS/MS	0.3
12	(Z)-β-ocimene	Essential oil	Seeds	GS/MS	0.1
13	Ƴ-terpinene	Essential oil	Seeds	GS/MS	0.6
14	(E)-β-ocimene	Essential oil	Seeds	GS/MS	0.6
15	2-nonanol	Essential oil	Seeds	GS/MS	0.1
16	Camphor	Essential oil	Seeds	GS/MS	0.04
17	Linalool	Essential oil	Seeds	GS/MS	0.2
18	Isopinocamphone	Essential oil	Seeds	GS/MS	0.2
19	Pinocarvone	Essential oil	Seeds	GS/MS	0.2
20	Isocaryophyllene	Essential oil	Seeds	GS/MS	0.04
21	Bornyl acetate	Essential oil	Seeds	GS/MS	0.3
22	Isobornyl acetate	Essential oil	Seeds	GS/MS	0.05
23	β-elemene	Essential oil	Seeds	GS/MS	0.04
24	β-caryophyllene	Essential oil	Seeds	GS/MS	17.8
25	Myrtenal	Essential oil	Seeds	GS/MS	0.9
26	β-eudesmol	Essential oil	Seeds	GS/MS	0.05
27	α-eudesmol	Essential oil	Seeds	GS/MS	0.04
28	Trans-pinocarvyl acetate	Essential oil	Seeds	GS/MS	5.3
29	Trans-pinocarveol	Essential oil	Seeds	GS/MS	0.5
30	(Z)-β-farnesene	Essential oil	Seeds	GS/MS	0.1
32	Isoborneol	Essential oil	Seeds	GS/MS	0.1
33	α-humulene	Essential oil	Seeds	GS/MS	2.9
34	Cis-pinocarvyl acetate	Essential oil	Seeds	GS/MS	11.0
35	Myrtenyl acetate	Essential oil	Seeds	GS/MS	8.5
36	α-terpineol	Essential oil	Seeds	GS/MS	1.9
37	p-cymene	Essential oil	Seeds	GS/MS	1.1

N°	Molecules	Source	Part use	Identification method	%
38	Terpinolene	Essential oil	Seeds	GS/MS	0.3
39	Borneol	Essential oil	Seeds	GS/MS	0.3
40	δ-gualene	Essential oil	Seeds	GS/MS	0.2
41	Germacrene D	Essential oil	Seeds	GS/MS	0.04
42	Neryl acetate	Essential oil	Seeds	GS/MS	0.06
43	β-bisabolene	Essential oil	Seeds	GS/MS	1.5
44	Ƴ-cadinene	Essential oil	Seeds	GS/MS	0.1
45	Myrtenol	Essential oil	Seeds	GS/MS	0.6
46	p-cymen-8-ol	Essential oil	Seeds	GS/MS	0.04
47	Isocaryophyllene oxide	Essential oil	Seeds	GS/MS	0.3
48	Caryophyllene oxide	Essential oil	Seeds	GS/MS	3.5
49	(E)-nerolidol	Essential oil	Seeds	GS/MS	0.04
50	Humulene epoxide II	Essential oil	Seeds	GS/MS	0.4
51	Caryophylla-2(12),6(13)-dien-one	Essential oil	Seeds	GS/MS	0.4
52	Elemol	Essential oil	Seeds	GS/MS	0.2
53	Viridiflorol	Essential oil	Seeds	GS/MS	0.6
54	Caryophylla-2(12),6-dien-5-one	Essential oil	Seeds	GS/MS	0.1
55	β-bisabolol	Essential oil	Seeds	GS/MS	0.10
56	α-bisabolol	Essential oil	Seeds	GS/MS	0.3
57	Epi-α-bisabolol	Essential oil	Seeds	GS/MS	0.7
58	Caryophylla-2(12), 6(13)-dien-5β-ol	Essential oil	Seeds	GS/MS	0.1
59	Caryophylla-2(12), 6(13)-dien-5α-ol	Essential oil	Seeds	GS/MS	0.5
60	Caryophylla-2(12), 6-dien-5β-ol	Essential oil	Seeds	GS/MS	0.1
61	(E)-β-farnesene	Essential oil	Seeds	GS/MS	0.1

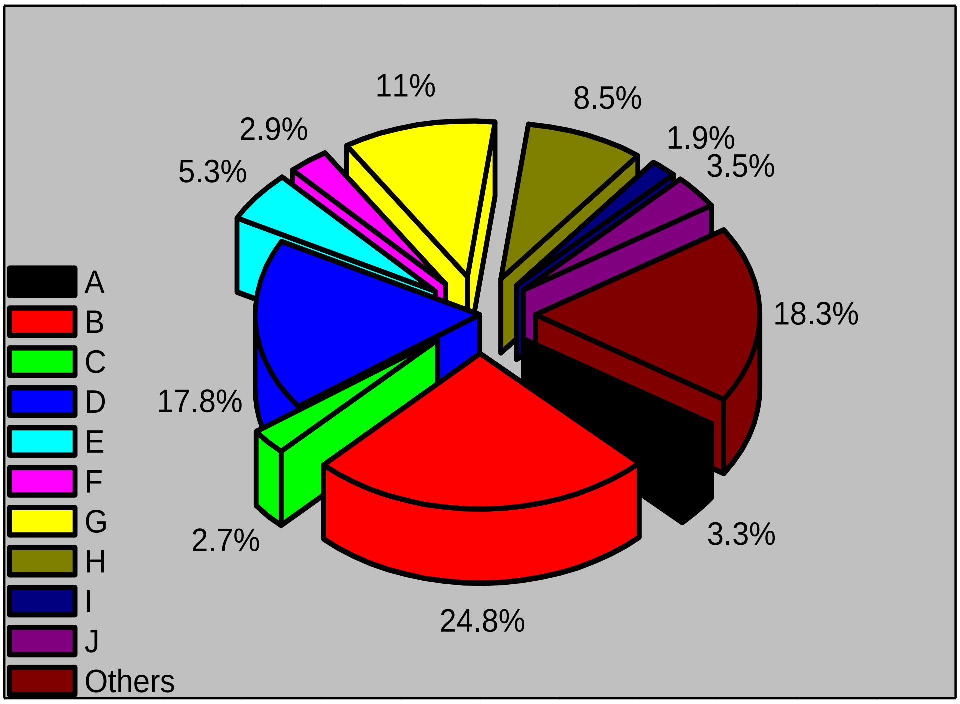
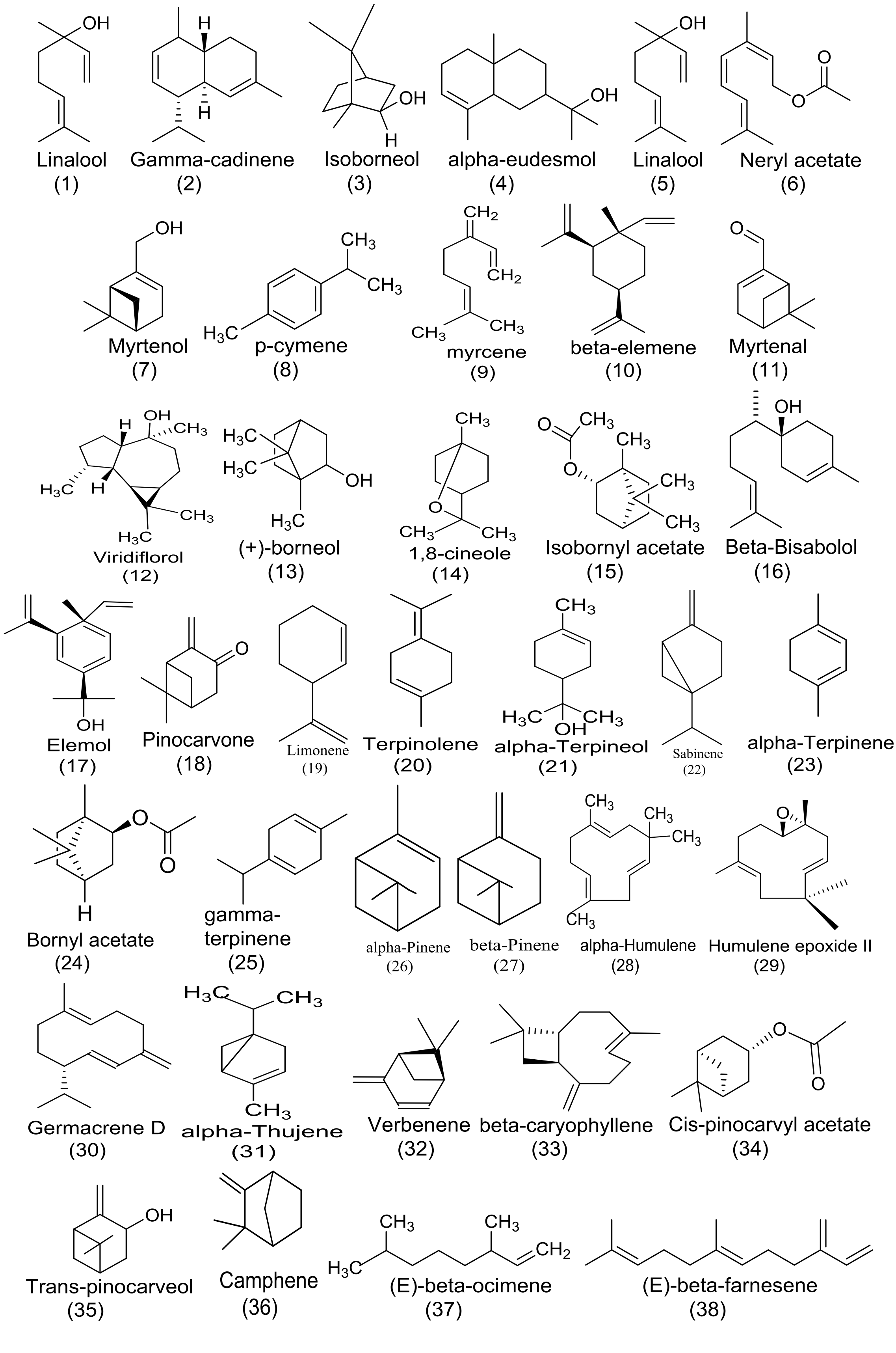


Fig. 5. Distribution of essential oil compounds of *A. angustifolium*

Table 4. Summary of action mode of *A. angustifolium* compounds

Compoups	Action mode of compounds	Ref.
α-pinene	Modulates antibiotic resistance, decreases the minimum inhibitory concentration of antibiotics (ciprofloxacin, erythromycin, triclosan), inhibits microbial efflux pumps, impairs membrane integrity and microbial metabolism. α -pinene stimulates stimulated apoptosis which is due to early disruption of mitochondrial npotential, ROS formation, increased caspase-3 activity, deposition of heterochromatin DNA fragmentation and exposure of phosphatidylserine on the cell surface.	[37]
β-caryophyllene	β-caryophyllene exerts anti-inflammatory action via inhibiting the main inflammatory mediators, such as inducible nitric oxide synthase (iNOS), Interleukin 1 beta (IL-1β), Interleukin-6 (IL-6), tumor necrosis factor-alfa (TNF-α), nuclear factor kapp a-light-chain-enhancer of activated B cells (NF-κB), cyclooxygenase 1 (COX-1), cyclooxygenase 2 (COX-2). Peroxisome proliferator-activated receptors alpha (PPAR-α) effects are also mediated by the activation of PPAR-α and PPAR-γ receptors.	[38]
Limonene	Limonene induces apoptosis via mitochondrial death and suppression of cell mediators.	[39]
β-bisabolene	β-bisabolene reduc the growth of mammary tumours	[40]
β-pinene	Initsprotonated(undissociated)form, β-pinene lisready todiffuseagainacrossthecytoplasmic membrane and dissociates, releasing the proton into the cytoplasm.	[41]
Sabinene	Sabinene acts as a reversible competitive inhibitor occupying the center of the hydrophobic active site of acetylcholinesterase	[42]
Trans-pinocarvyl acetate	Trans-pinocarvyl acetate acts by affecting multiple targets thus more effectively disrupting cellular activity	[42]
Cis-pinocarvyl acetate	Trans-pinocarvyl acetate acts by affecting multiple targets thus more effectively disrupting cellular activity	[42]
Myrtenyl acetate	Myrtenyl acetate intervenes at the level of the nervous system on the processes responsible for the spasms (involuntary contractions of the smooth or striated muscles) at the thoraco-abdominal level by a sympatholytic action: i.e. it inhibits the sympathetic nervous system responsible for the preparation to the action of the body	[43]
α-terpineol	This compound stimulation of defense mechanisms (cytoprotective effect) is the suggested mechanism of drug action showing gastroprotective activity. According to other results it was demonstrated that the vasorelaxant activity of α-Terpineol is endothelium-dependent and that α-T blocks Ca+2 entry through voltage-dependent Ca+2 channels, which is involved in the mechanism by which relaxation can be produced. Further results indicated that α-Terpineol was able to inhibit contractions induced by the cumulative addition of phenylephrine without endothelium preparations suggesting that α-T could exert its activity on vascular smooth muscle contractile machinery [5].	[44]
p-cymene	revealed to inhibit β-secretase	[45]
Caryophyllene oxide	Caryophyllene oxide have the central analgesic action who be mediated via inhibition of central pain receptors, while the peripheral analgesic effect be mediated through inhibition of cyclooxygenase and/or lipoxygenase (and other inflammatory mediators).	[46]


Linalool (1)
Gamma-cadinene (2)
Isoborneol (3)
alpha-eudesmol (4)
Linalool (5)
Neryl acetate (6)
Myrtenol (7)
p-cymene (8)
myrcene (9)
beta-elemene (10)
Myrtenal (11)
Viridiflorol (12)
(+)-borneol (13)
1,8-cineole (14)
Isobornyl acetate (15)
Beta-Bisabolol (16)
Elemol (17)
Pinocarvone (18)
Limonene (19)
Terpinolene (20)
alpha-Terpineol (21)
Sabinene (22)
alpha-Terpinene (23)
Bornyl acetate (24)
gamma-terpinene (25)
alpha-Pinene (26)
beta-Pinene (27)
alpha-Humulene (28)
Humulene epoxide II (29)
Germacrene D (30)
alpha-Thujene (31)
Verbenene (32)
beta-caryophyllene (33)
Cis-pinocarvyl acetate (34)
Trans-pinocarveol (35)
Camphene (36)
(E)-beta-ocimene (37)
(E)-beta-farnesene (38)

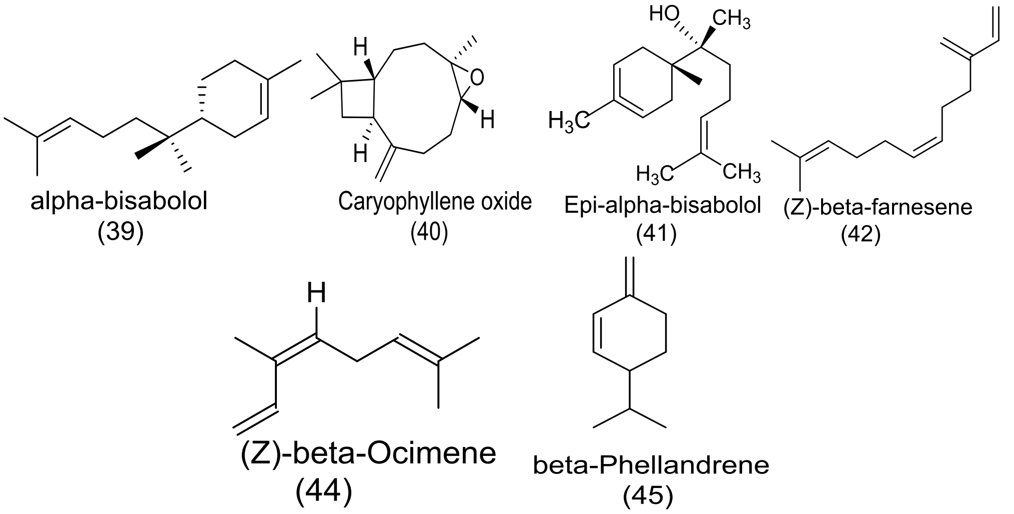


Fig. 6. Chemical structure of compounds identified from the essential oils of *A. angustifolium*

Table 5. Several pharmacological properties of some *A. angustifolium*

Parts	Solvent or extract	Model system	Methods	Activities	Ref.
Ripe pod		*Staphylococcus aureus, Escherichia coli*	serial dilution method	Antimicrobial activity	[19]
Seeds				Antiageing activity	[47]
Seeds	Ethanol extract	Male Wistar rats	Appropriate biomarkers and spectrophotometric methods	Bromate toxicity	[18]
Seeds	Hydroethanol extract	Culex		Antiparasitic activity	[12]
Seeds	Aquous and ethanoloc extracts		Spectrophotometric methods	Antioxydant activity	[48]

3.6 Toxicology

It has been reported that the fruits of *A. angustifolium* would contain toxic principles that could belong to two chemical groups, namely leucoanthocyanins and anthraquinones [12]. The study of the toxicological activity of *A. angustifolium* fruit extracts showed that the hydoethanolic extract is toxic on mice [12]. In plants, it can have an inhibitory activity on the germination of seeds of Monocotyledons and Dicotyledons, so it acts on the growth of the epicotyl and hypocotyl of young seedlings either by inhibiting it or stimulating it, depending on the species tested [12]. Recent findings revealed that the anthraquinones can induce genotoxicity and mutagenicity in mouse lymphoma L5178Y [49].

4. CONCLUSION AND SUGGESTIONS

In this present study, the objective was to review the literature on the traditional use, phytochemistry, biological activities and toxicity of *A. angustifolium* in order to therefore guide future research on the use of this vegetal species used in traditional African medicine as a nutraceutical. The several bibliographical data obtained in this study show that:

- Traditionally *A. angustifolium* is used in most African customs;
- The root is the most used part (33.3%) of this plant and extensive use of roots represents a serious threat to the sustainable preservation of biodiversity;

- The decoction (70.8%) is the most used mode of preparation and the majority of the recipes are administered orally (75%);
- *A. angustifolium* is good source of minerals, lipids, carbohydrates, proteins and fibers which is beneficial to human health;
- It is rich in essential oil compounds such as β-pinene and β-caryophyllene which are the major compounds;
- The presence of phyto-compounds, like essentials oils, phenolic acids and anthocyanin, would justify its, anti-oxidant, antimicrobial, antiageing and parasitic demonstrated by the researches of several authors.

To our knowledge, the anti-inflammatory activity of this plant has not been yet evaluated despite the fact that one of its major compounds, the natural bicyclic sesquiterpene β-Caryophyllene, is known to display such activity. Thus, *Aframomun angustifolium* could display such activity according to chimiotaxonomic approach. It is in this perspective that we wish to evaluate the *in vitro* and *in vivo* anti-inflammatory activity of this plant as well as its genotoxic activity.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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