



NIGERIAN MEDICINAL PLANTS WITH ANALGESIC AND ANTI-INFLAMMATORY POTENTIALS

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ABSTRACT

Medicinal plants with analgesic and anti-inflammatory potentials abound in Nigeria and yet inflammatory disorders, such as rheumatoid arthritis and haemorrhoids, continue to torment the populace in Nigeria and other developing countries. It is well documented that medicinal plants contain a vast array of bioactive compounds with different biological properties. Interestingly, studies underlying the biological effects of several medicinal plants in Nigeria have been elucidated. This report constitutes an updated review of 154 Nigerian medicinal plants, used locally and reported from the year 2000 to 2019, with analgesic and anti-inflammatory activities to motivate researchers towards exhaustive studies on them so that the active principles can be isolated and characterized. The chemical structures of some isolated active compounds have been given. The local names of each plant in the three Nigerian major languages have been included for easy identification by local users and researchers. The *in vitro* and *in vivo* study models for analgesic and anti-inflammatory activities used are also incorporated for critical evaluation and comparison.

KEYWORDS: Medicinal plants; Anti-inflammatory; Analgesic; Isolated compounds.

INTRODUCTION

Inflammation is the body's normal physiological response to tissue injury, some of which result from trauma, autoimmune response, microbial infection, and exposure to heat and toxic chemicals [1]. When tissue injury occurs, numerous substances are released by the injured tissues, which cause changes in the surrounding uninjured tissues. Some of the tissue products that cause the inflammatory reaction include histamine (which increases permeability, causes contraction of smooth muscle, and constriction of the bronchioles), serotonin, lipid mediators (prostaglandins, leukotrienes, and lipoxins and platelet-activator factor), bradykinin, products of the complement system, products of the blood clotting system and substances released by the sensitized lymphocytes (lymphokines). These

substances, collectively called autocoids, are the messengers of inflammation. The features of inflammation include redness (Latin *rubor*), heat (*calor*), swelling (*tumor*), and pain (*dolor*). An imbalance in the synthesis and release of the autocoids contributes significantly to pathological conditions such as inflammation, allergy, hypersensitivity and ischemia-reperfusion [2].

Chronic inflammatory diseases constitute one of the world's major health problems. Due to the involvement of inflammation in virtually all human and animal diseases, it has become the focus of global scientific research, more so, since the currently used anti-inflammatory agents both steroidal and non-steroidal are prone to evoking serious adverse reactions [3].

Nature has been a major source of drug for treating human and animal diseases from time immemorial.

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According to an estimate made by the World Health Organisation (WHO), around 80% of the world's populations in developing countries rely on traditional plant medicines for their primary health care needs, of which a major portion involves the use of plant extracts or their active principles [4]. The anti-inflammatory mechanism of some plant phytochemicals has been attributed to the inhibition of NF- κ B activation and down-regulation of the expression of inflammatory enzyme markers such as 5-LOX, COX-2, and MMP-9 [5]. Some authors have attempted similar reviews in the past but their reports are not as comprehensive, updated and specific to Nigeria as this. The aim of the current review is, therefore, to portray the analgesic and anti-inflammatory potentials of Nigerian medicinal plants and present an up-to-date report of scientific investigations carried out in that regard. This will stimulate research interest towards discovering new and safer drug leads from them, producing a possible synergy of activities and inventing new analgesic and anti-inflammatory herbal formulas.

DISCUSSION

Chronic inflammatory diseases constitute one of the world's major health problems. Due to the involvement of inflammation in virtually all human and animal diseases, it has become the focus of global scientific research, more so, since the currently used anti-inflammatory agents both steroidal and non-steroidal are prone to evoking serious adverse reactions [169,170].

Nature has been a major source of drug for treating human and animal diseases from time immemorial. According to an estimate made by the World Health Organisation (WHO), around 80% of the world's populations in developing countries rely on traditional plant medicines for their primary health care needs, of which a major portion involves the use of plant extracts or their active principles [171]. The folkloric uses of most of the plants reviewed correlate well with the pharmacological activities confirmed experimentally, lending credence to traditional medicinal practice in Nigeria as a valuable clue to drug discovery. Majority of the plant extracts were tested at a dose range of 50-200 mg/kg with the optimal and most effective dose ranging from 100-200 mg/kg. At doses higher than 200 mg/kg the activities tend to diminish. This could be attributed to increased toxicity at higher doses, for instance, gastric mucosal lesion which further releases mediators of pain and inflammation. Interestingly, many of the plants reviewed also have anti-ulcer

properties. This indicates that the mode of action of the phytoconstituents in these plants may not be by inhibition of the cytoprotective prostaglandins, or that the natural blend or synergy of the phytochemicals is cytoprotective. However, the fact that many of the plants tested also possess anti-diarrhoea property suggests involvement of prostaglandins which are implicated in both diarrhoea and inflammation. A thorough investigation of the structure, mode of action and synergy of activities is recommended and can be exploited for the formulation of herbal medicinal products.

Over 97% of the extracts tested are those of relatively polar solvents which include water, ethanol, methanol, acetone and ethyl acetate indicating that the phytochemicals responsible for the activities in the tested extracts are predominantly flavonoids, saponins, tannins and polar alkaloids and not steroids, terpenes and fatty acids. Figure 1 showed the chemical structures of some isolated compounds from medicinal plants with anti-inflammatory activity better than, or similar to, the standard drugs. The mechanism of anti-inflammatory activity for some plant phytochemicals has been reported in literature. One of such is through peripheral and central mechanisms, involving inhibition of release and/or actions of vasoactive substances and the inhibition of NF- κ B activation and down-regulation of the expression of inflammatory enzyme markers such as 5-LOX, COX-2, and MMP-9 [5, 172].

CONCLUSION

Most plants with anti-inflammatory activity also possess analgesic potential. This is attributed to the involvement of the same mediators or autacoids in both processes. Pain, whether acute or chronic, peripheral or central, originates from inflammation and the inflammatory response. Nature endows Nigeria with abundant medicinal plants many of which possess analgesic and anti-inflammatory potentials. About 154 Nigerian medicinal plants have been investigated for and proved to exhibit anti-inflammatory and analgesic properties between the year 2000 and 2019. Currently, the analgesic and anti-inflammatory potentials of most of these plants have not been sufficiently studied or exploited for the health needs of man. The active principles of only a few of them have been elucidated. Numerous *in vitro* and *in vivo* (animal) models for analgesic and anti-inflammatory activities and various chromatographic and spectroscopic techniques are available at the disposal of researchers to unravel the mysteries surrounding the wonders of these natural resources

Table 1: Nigerian medicinal plants with analgesic and anti-inflammatory activities

S/N	Name of Plant, Plant part	Traditional Medicinal Uses	(Common name) Local names	Extract or Compound; Dose (mg/kg)	Anti-inflamm. Study Model	Analgesic Activity Model	Ref.
1	<i>Acacia karroo</i> Haine (Fabaceae) Stem bark	Wound healing, cold, eye treatment	(White-thorn, sweet torn tree)	Aqueous extract; 100-200	Carrageenan and histamine-induced oedema	Acetic acid induced writhing and tail immersion test	[6]
2	<i>Acacia modesta</i> (Mimosaceae) Wall. Leaves	Pain, wounds, dysentery, leprosy, ache	(Amritsar gum)	Methanol extract; 50,100,200	Carrageenan-induced oedema	Writhing, hot plate and formalin tests	[7]
3	<i>Acacia nilotica</i> (Fabaceae) Bark	Leprosy, fever, wounds, Inflammation, fungal infection insomnia, pain, emollient.	(Arabic gum) <i>Baani/Booni</i> ^Y , <i>Bagaruwa</i> ^H	Methanol; 50-100 g	Formalin-induced oedema	Acetic acid induced writhing test	[8]
4	<i>Acalypha wilkesiana</i> Col. (Euphorbiaceae) Leaves	Treatment of pain, fever, ulcers	(Fire dragon plant) <i>Aworoso</i> ^Y	Ethanol extract; 25, 50, 100	Carrageenan-induced oedema	Formalin and hot plate pain models	[9]
7	<i>Alafia barteri</i> Oliv. (Apocynaceae), Leaves	Treatment of painful and inflammatory conditions	(Guinea fowl's crest) <i>Ota nza</i> ^I , <i>Agbarietu</i> ^Y	96% ethanol; 50-200	Carrageenan and xylene induced oedema	Tail clip/ Immersion; writhing and formalin tests	[12]
12	<i>Alstonia boonei</i> De Wild. (Apocynaceae) Stem bark	Astringent, fevers, pains, rheumatism pain, hypertension, infection	(Stool wood) <i>Egbu/Egun</i> ^I , <i>Ahun, ahun</i> ^Y , <i>Ukpukunu</i> ^U	Methanol extract; 50-200	Carrageenan, adjuvant-arthritis; cotton pellet granuloma; vascular permeability.	Acetic acid and formalin-induced pain	[17]
17	<i>Anisopus mannii</i> N.E.Br. (Asclepiadaceae) Aerial parts	Diabetes, hypertension, Diarrhoea, pile	(Sweet killer) <i>KasheZak</i> ^H	Methanolic extract; 40	Carrageenan-induced oedema	Acetic acid writhing test	[22]
18	<i>Annona muricata</i> L. (Annonaceae) Unripe fruit	Neuralgia, rheumatism and arthritis	(Soursop) <i>Showashop</i> ^I	Lyophilized aqueous extract; 50-200	Carrageenan and xylene-induced oedema	Writhing, formalin and hot plate models	[23]
19	<i>Annona senegalensis</i> (Annonaceae) Pers. Stem bark	Helminth infection, snake bite, pain, diarrhea	<i>Gwandardaji</i> ^H <i>Uburuocha</i> ^I , <i>Abo</i> ^Y	Methanol extract; 100-200	Egg albumin edema; vascular permeability	Acetic acid writhing and hot plate tests	[24]

20	<i>Asparagus africanus</i> Baker. (Liliaceae)	Jaundice, headache, backache, stomach pain and as an aid in child birth malaria, syphilis and gonorrhoea	<i>Gi'efowru^F</i> <i>Shekan bera^H</i> <i>Aluki^Y</i>	Methanolic extract; 250, 500, 1000	Egg albumin induced oedema	Hot plate and tail-flick tests	[25]
21	<i>Asparagus pubescens</i> Bak. (Liliaceae) Root	Pain, family planning, gastrointestinal disorders	<i>Khayanbera^H</i>	Methanolic extract; 250-1500	Egg albumin induced oedema	Acetic acid, hot plate and formalin tests	[26]
22	<i>Aspilia Africana</i> Pers. (Asteraceae) Leaves	Gonorrhoea, tuberculosis, cough, rheumatic pains, stomach ache, bleeding	<i>Tozalin jamajina^H</i> , <i>Oranjila</i> or <i>aremejila^L</i> , <i>Akoyurinyun^Y</i>	Hexane, CH ₂ Cl ₂ , butanol and EtOAc fractions	Egg albumin-induced oedema	Tail immersion test	[27]
24	<i>Blepharis maderaspatensis</i> (L.) B. Heyne. (Acanthaceae) Whole plant	Swellings, oedema and Gout	(Creeping blepharis)	Absolute ethanol; 12.5-100	Carrageenan, histamine, serotonin and xylene tests	Acetic acid writhing; Haffner's tail clip test	[29]
25	<i>Breynia nivos</i> (Linn.) R. King & H. Robinson (Phyllanthaceae) Leaves	Headaches, toothaches and tooth infections	(Snow bush)	Ethanol, CH ₃ OH, CH ₂ Cl ₂ and EtOAc fractions; 50-200	Egg albumin-induced oedema.	Hot plate test.	[30]
26	<i>Bridelia Micrantha</i> (Hochst) Baill. (Euphorbiaceae) Leaves	Painful inflammatory conditions of the joints.	<i>Ogaofia^L</i> , <i>Edebe</i> , <i>Asa, araasa^Y</i>	Methanol extract; 100-400	Carrageenan, histamine and formalin tests; Cotton pellet	Acetic acid writhing and tail-flick tests	[31]
27	<i>Bridelia ferruginea</i> Benth. (Euphorbiaceae) Stem bark	Diabetes, purgative, vermifuge	<i>Kirni, Kizni^H</i> , <i>Maren^F</i> <i>Ola^L</i> , <i>Iralodan^Y</i>	Aqueous extract; 25-100	Croton oil, adjuvant arthritis, cyclophosphamide-induced haemorrhagic cystitis	Acetic acid-induced writhing test	[32]
28	<i>Bryophyllum pinnatum</i> (Lam.) (Crassulaceae) Leaves	Kidney stones gastric ulcers, skin disorders, menstrual pain	(Never die plant) <i>OdaaOpue^L</i> , <i>Abamoda^Y</i>	Ethanol extract; 50-200	Formalin-induced oedema	Acetic acid-induced writhing	[33]
29	<i>Buchholzia coriacea</i> Engl. (Capparidaceae) Seeds	Asthma, rheumatism and ulcer	(Musk tree) <i>Uworo^Y</i>	Ethanol extract; 50-200;	Carrageenan-induced oedema, cotton pellet	Formalin-induced paw licking and hot plate tests	[34]

30	<i>Byrsocarpus coccineus</i> (Connaraceae) Schum. Leaves	Swellings, tumours, earache, pain, rheumatism	<i>Tsaamiyar-kasa</i> ^H , <i>Okeabolo</i> ^I , <i>Orikoten</i> ^Y	Aqueous extract; 50-400	Carrageenan, egg albumin, xylene and formalin tests	NA	[35]
31	<i>Calotropis procera</i> Ait. (Asclepeceae) Leaves	Wounds, skin problems, toothache, boil, pain, fever, asthma, rheumatism, bronchitis,	(Sodom apple) <i>Bom-ubomu</i> ^Y , <i>Tumifafiya</i> ^H	Ethanol extract; 100-400	Carrageenan-induced oedema	Writhing, tail-flick and formalin pain models	[36]
32	<i>Capparis thoningii</i> (Capparaceae) Schum. Roots	To alleviate painful and inflammatory conditions	(Caper bush) <i>Eka-nawodi</i> ^Y , <i>Ewonekir</i> ^H	Methanolic extract; 50-200	Carrageenan- and xylene-induced oedema	Writhing, formalin and hot plate models	[37]
33	<i>Caralluma dalzielii</i> N.E. Br (Asclepiadaceae) Whole plant	Antispasmodic and analgesic remedy	(Mosque reed) <i>Karan-masallaachi</i> ^H	Ethanol extract; 20-80	Carrageenan-induced oedema	Writhing; hot plate and formalin models	[38]
35	<i>Carissa edulis</i> Vahl. (Apocynaceae) Roots	Fever, oedema, toothache, ulcer, cough, hernia, anaemia	(Simple-spined Carissa) <i>Karen kafo</i> ^H ; <i>Behohi</i> ^F	Saponins; 37.5-150	Carrageenan-induced paw oedema	Formalin and writhing tests	[40]
37	<i>Cassia singueana</i> (Caesalpiniceae) Root bark	Pain, body ache, stomach spasm	<i>Runfu/Lomfu</i> ^H	N-hexane, chloroform and methanol	Formalin-induced oedema,	Formalin induced pain, acetic acid-induced writhing	[42]
38	<i>Ceiba pentandra</i> (Bombacaceae) Stem bark	Scabies, diarrhoea, coughs, fatigue, fevers, asthma, headaches stomach problems, gonorrhoea, oedema,	(Silk cotton tree) <i>Akpu-ogwu</i> ^I , <i>Rimi</i> ^H , <i>Ogun-gun</i> , <i>Araba</i> ^Y	Methanol 100-400	Xylene-induced ear oedema, egg albumin-induced rat paw oedema and vascular permeability tests	Acetic acid-induced writhing and tail flick latency tests	[43]
39	<i>Celosia isertii</i> (Amaranthaceae) Leaves	Diarrhoea, diabetes,	(Celosia) <i>Sokoyokoto</i> ^Y	Ethanol, aqueous; 250	Carrageenan-induced oedema	Acetic acid-induced writhing test	[44]
40	<i>Chasmanthera dependens</i> (Menispermaceae) Leaves	Venereal diseases, tonic fractures, sprains and muscular pains	(Chasmanthera) <i>Ogbo</i> ^I , <i>Àtó-oloriraun</i> ^Y	Methanolic extract; 100-400	Carrageenan, vascular permeability and cotton pellet tests	Acetic acid writhing and formalin-induced paw licking tests	[45]

41	<i>Chenopodium ambrosioides</i> (Chenopodiaceae) (L.) (Leaves)	Anti-tumour, anthelmintic, peptic ulcers, pains	(Epazote, Sweet pigweed) <i>Kafikashiwar</i> ^H , <i>Ewe imi</i> ^Y	Ascaridol, hexadec-12-enoic acid; 200	Egg albumin-induced oedema	Acetic acid-induced writhing; hot plate models	[46]
42	<i>Chromolaena odorata</i> (Asteraceae) Leaves	Bleeding, dysentery, toothache and malaria fever	(Siam weed) <i>Akamtoro</i> ^I , <i>Obiarakara</i> ^H , <i>Awolowo</i> ^Y	Aqueous/ethanolic extract; 50-200	Carrageenan, cotton-pellet granuloma and formalin tests	Hot plate and formalin-induced pain tests	[47]
43	<i>Chrysophyllum albidum</i> (Linn.) R. King (Sapotaceae) Seed cotyledons	Malaria, yellow fever, diarrhoea, stomach ache, inflammatory disorders	(White star apple) <i>Agwaliba</i> ^H , <i>Udara</i> ^I , <i>Agbalumo</i> ^Y	Eleagnin; an alkaloid; 5-20	Carrageenan, histamine and serotonin-induced oedema	Randall-Selitto test, tail flick, writhing and hot plate models	[48]
47	<i>Cnestis ferruginea</i> , (Connaraceae) Vahl ex DC. Roots	Periodontitis, headache, eye, migraine, toothache, sinusitis	<i>Furaamarya</i> ^H , <i>Amu` n̄kítā</i> , <i>òkpùnkítā</i> ^I , <i>Akarà-ojé</i> ^Y	Methanolic extract; 100-400	Carrageenan, egg albumin, formalin and xylene tests	Writhing, formalin, tail clip, and hot plate models	[52]
48	<i>Cochlospermum planchonii</i> (Cochlospermaaceae) Leaf	Pain, infertility, gonorrhoea, diabetes mellitus, jaundice, malaria diarrhoea and inflammatory disorders.	(Cochlospermum) <i>N' Dribala</i> ^F , <i>Rawaya</i> or <i>Kyamba</i> ^H , <i>Abanzi</i> ^I , <i>Gbehutu</i> or <i>Feru</i> ^Y .	N-hexane, ethyl-acetate and methanol 1500, 2000 and 2500	NA	Acetic acid induced abdominal writhing	[53]
49	<i>Cochlospermum tinctorium</i> A Rich (Cochlospermaaceae) Leaves, Roots	Pain and inflammatory conditions	<i>Rawaya</i> , <i>Kyamba</i> ^H , <i>Obazi</i> , <i>Abanzi</i> ^I , <i>Sewutu</i> ^Y	Aqueous methanol; 20-80	Carrageenan - induced oedema	Acetic acid writhing and hot plate tests	[54]
50	<i>Cocus nucifera</i> (L.) (Arecaceae) Fruits	To counteract drug overdose, boosts energy; diarrhoea, ulcer, dysentery	(Cocoanut) <i>kwakwa</i> ^H , <i>Akuoyibo</i> ^I , <i>Agbon</i> ^Y	Hydro methanol extract; 100-200	Carrageenan - induced rat paw oedema	Acetic acid and hot plate pain models	[55]
51	<i>Cola nitida</i> (Sterculiaceae) Seeds	As an aphrodisiac, fever, nausea, migraines, diarrhoea, inflammations and metabolic disorders	(Kola nut) <i>Goro</i> ^H , <i>Oji</i> ^I , <i>Obi</i> ^Y	Methanol 50, 100 and 200	Carrageenan-induced paw oedema	Acetic acid -induced writhing and formalin paw lick test.	[56]
52	<i>Combretum micranthum</i>	Swellings, fever, pains	<i>Gumumi</i> ^F , <i>Farargeéza</i> / ^I	Aqueous extract,	Formalin induced oedema	Acetic acid and	[57]

	(Combretaceae) G Don. Leaves		Ogànbule ^Y	50-200		formalin-induced pain	
53	<i>Combretum mucronatum</i> (Combretaceae) Root	Pains and inflammatory conditions	Ogan ^Y	Methanolic extract; 50-200	Carrageenan- and xylene-induced oedema	Acetic acid, formalin and hot plate models	[58]
54	<i>Combretum sericeum</i> , (Combretaceae) Root	Stomach disorders, conjunctivitis fever, diarrhoea	Taro ^H <i>Nyangbimsa</i> (<i>Jaba</i>)	Aqueous extract; 100-200	Carrageenan-induced oedema	Acetic acid writhing and hot plate tests	[59]
55	<i>Combretum sordidum</i> Exell (Combretaceae) Leaves	Conjunctivitis, abdominal disorders, backache, toothache, diabetes.	(Bushwillows) <i>Apoka pupa or funfun</i> ^Y	Acetone 100-400	Egg albumen – induced paw oedema and formalin paw lick test	Acetic acid-induced abdominal writhing test	[60]
59	<i>Crossopteryx febrifuga</i> Benth. (Rubiaceae) Stem	Cough, fever, malaria, pain, septic wounds, infections	(Crystal bark) <i>Ayeye</i> ^Y <i>Golomb</i> ^H	Methanolic extract; 25-100	Egg albumin oedema/ plethysmometer	Analgesy meter	[65]
63	<i>Dalbergia saxatilis</i> Hook. (Fabaceae) Leaf, Root	Cough, pains, bronchitis, toothache and fever	(Flat bean) <i>Runhunzaki</i> ^H <i>Ogundu</i> ^Y <i>Obunzizi</i> ^I	Distilled water, methanol extract; 250-1000	Carrageenan and dextran-induced rat paw edema	Acetic acid-induced writhing, tail flick, hot plate and formalin tests	[69,70]
64	<i>Dennettia tripetala</i> G. Baker (Annonaceae) Fruits	Fever, worm, convulsion, typhoid, cough, stomach ache	(Pepper fruit) <i>Igbere</i> ^Y , <i>Mmimi</i> ^I	Essential oils of fruit; 25-50	Carrageenan - induced oedema	Acetic acid, hot plate and formalin tests	[71]
65	<i>Desplatsia dewevrei</i> (Malvaceae) Leaves		(Bush okra) ila-erin ^Y	Water or methanol 10, 30, 100, 1000	Carrageenan-induced paw oedema; xylene-induced ear oedema	Mouse writhing test; hot-plate test	[72]
66	<i>Dichrostachys Cinerea</i> (Fabaceae) Leaves	Syphilis, body pains and toothaches	(Sickle bush) <i>Dundu</i> ^H <i>Kora</i> ^Y	Distilled water; 100-500 g	Carrageenan and dextran- induced-oedema	Mouse writhing and hot plate assay	[73]
67	<i>Dichrostachys glomerata</i> (Forssk.) Hutch (Fabaceae) Fruits	Rheumatism and snake bite.	(Sickle bush, Bell mimosa)	Aqueous extract; 25-200	Carrageenan and serotonin-induced rat paw oedema	Writhing, tail immersion, formalin	[74]

						and hot plate tests	
68	<i>Dorstenia barteri</i> Var. (Moraceae) Leaves and Twig	Arthritis, rheumatism, gout, stomach disorders, cough, headache	NA	Methanol/CH ₂ Cl ₂ ; 50-200	Carrageenan-pleurisy/oedema, pulmonary oedema	Writhing, hot plate, tail immersion and analgesiom eter	[75]
69	<i>Dryopteris filix-mas</i> (D. filix-mas) (L.) Schott, (Dryopteridaceae) Leaves.	Inflammation, rheumatoid arthritis, wounds and ulcers	(Male Fern) <i>Ihi' or'Erinji'</i> I	Ethanollic 200, 400	Egg-albumin induced paw edema, xylene-induced topical ear edema, formaldehyde-induced arthritis and ulcerogenic models.	NA	[76]
70	<i>Eleusine indica</i> L. Gaertn (Poaceae) Wholeplant	Malarial fever, pains, diuretic, amenorrhoea	(Goose grass, Crowsfoot)	Ethanollic extract; 200-600	Carrageenan, egg albumin and xylene-induced oedema	Acetic acid, formalin and hot plate tests	[77]
71	<i>Emilia sonchifolia</i> Linn. DC (Compositae) Leaves	Sore-throat, tonsillitis, wound healing, stomach ache, conjunctivitis	Hurahun Boka ^H <i>Odundun, odo</i> ^Y	Methanollic extract; 287.4, 574.8, 862.2	Carrageenan, egg albumin, capsaicin-induced oedema,	Formalin, acetic acid writhing and hot plate tests	[78]
72	<i>Entada Africana</i> (Fabaceae) Leaves	Malarial fever and pains	(French entada) <i>Ogurode</i> ^Y	Ethanol extract; 200	Inhibition of rat paw oedema	Acetic acid-induced writhing	[79]
73	<i>Eryngium foetidum</i> L. (Umbelliferae) Leaves	Perfumery and cosmetic, pain inflammatory disorders	(Spiny Coriander or Culantro)	Ethanol extract; 164, 329, 495	Egg albumin and xylene-induced oedema	Acetic acid-induced writhing	[80]
74	<i>Erythrina senegalensis</i> DC (Papilionaceae) Stem bark	Jaundice, anaemia, gonorrhoea and dysentery	(Coral tree) <i>Majiriya</i> ^H , <i>Echichi</i> ^I , <i>Ologbosere</i> ^Y	Aqueous extract; 50, 100	Egg albumin-induced oedema	Acetic acid-induced writhing test	[81]
75	<i>Faidherbia albida</i> Del. (Mimosaceae) Leaves/Stem bark	Diarrhoea, anti-emetic in fever; cough, kidney pain and madness	(Winter thorn) <i>Gawo</i> ^H	Aqueous extract; 250, 500	Kaolin-induced oedema	NA	[82]
76	<i>Feretia apodanthera</i> (Rubiaceae) Root bark	Erectile dysfunction of the penis, stomach upset, renal and urinary infections, nausea, syphilis	(Feretia or Red leaved medlar) <i>kuru-kuru</i> ^{H/F}	Distilled water, ethanol, diethyl ether and n-hexane; 400	Carrageenan induced hind paw	NA	[83]

77	<i>Ficus ingens</i> Miq. (Moraceae) Leaves	Piles, diarrhoea, laxative, diuretic, leprosy, swellings	(Red-leaved fig); <i>Kawuri</i> or <i>Shirinya</i> ^H , <i>Nunahi</i> ^F	Methanol extract; 75, 150, 300	Carrageenan-induced oedema	Acetic acid-induced writhing and hot plate tests	[84]
80	<i>Ganoderma applanatum</i> (Ganodermataceae) Whole plant	Diabetes, tumors, stress relief	(Artist's bracket) <i>Eru agba</i> ¹	Ethanol extract; 150, 300, 600, 1200	Egg albumin-induced oedema	Thermal method	[87]
82	<i>Grewia crenata</i> (Malvaceae) Leaves	Fracture, wound healing, inflammatory conditions	<i>Kamomowa</i> ^H	Hexane, chloroform, EtOAc, butanol and aqueous fractions; 50-200	NA	Acetic acid-induced writhing and hot plate pain models	[89]
83	<i>Guiera senegalensis</i> Gmel. (Combretaceae) Leaves	Coughs, diarrhoea, impotence, leprosy, rheumatism	<i>Sabara, barbattaa, kurkure</i> ^H	Hexane; methanol, EtOAc fractions; 300-600	Egg albumin-induced oedema	Acetic acid writhing test	[90]
84	<i>Harungana madagascariensis</i> (Guttiferae.) Lam. ex Poiret. Stem bark	Anaemia, asthma, tuberculosis, fever, angina, syphilis, diarrhoea	(Dragon blood tree); <i>Asunje</i> ^Y , <i>Uturu</i> ¹ , <i>Alilibarraafi</i> ^H	Aqueous methanol extract; 50-200	Carrageenan, prostaglandin synthetase activity assay	Thermal method	[91]
85	<i>Hedranthera barteri</i> HB (Apocynaceae)	Inflammatory disorders, convulsion, gonorrhoea, ulcer, malarial and hiccups.	<i>Utu nkita</i> ¹ <i>Agboomode</i> ^Y <i>Ekiawa (Edo)</i>	Aqueous, methanol, chloroform, 25, 50, 100	Carrageenan - induced oedema	Acetic acid writhing and formalin tests	[92]
86	<i>Helianthus annuus</i> L. (Asteraceae) Leaves	Pyrexia, inflammation, diabetes mellitus and stomach problems	(Sunflower) <i>lyeye</i> ^Y , <i>Ijikara</i> ¹ <i>Tsadarlamarudu</i> ^H	Ethanol Methanol; 500-2000	formalin- and egg-albumin induced paw oedema	Hot plate, acetic acid-induced writhing and tail-flick test	[93,94]
88	<i>Hippocratea indica</i> Wild. (Celastraceae) Root bark	Guinea worm sores and respiratory disorders	<i>Ponjuowiw</i> ^Y	Methanolic extract; 125-500	Carrageenan-induced oedema	NA	[96]
89	<i>Hymenocardia acida</i> Tul. (Hymenocardia ceae) Leaves	Arthritis, rheumatic pain and toothache	<i>Gadingai (Gwari); Jan itace /Jan yaro</i> ^H ; <i>Orupa</i> ^Y	Aqueous extract; 50-200	Carrageenan and egg albumin paw oedema	Writhing and tail immersion tests	(97)

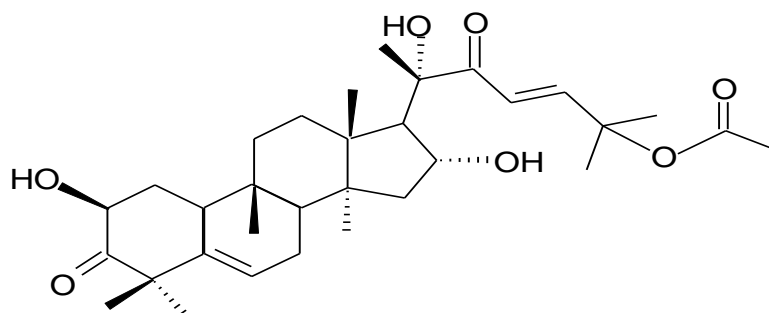
90	<i>Ipomoea asarifolia</i> Desr. (Convolvulaceae) Leaves	Inflammation and painful conditions	<i>Dúmánkadaá^H</i> , <i>Gbọ̀ọ̀rọ̀yaba^Y</i>	Aqueous extract; 37.5-150	Carrageenan-induced oedema	Acetic acid-induced writhing test	[98]
91	<i>Ipomoea involucreta</i> Var. (Convolvulaceae) Aerial parts	Pile, headache, toothache, rheumatism. Diarrhea	(Morning glory) <i>Dumankwaad^H</i> <i>Mgban'ala^I</i> <i>Alukere^Y</i>	Ethanol extract; 25- 100	Egg albumin induced oedema	Acetic acid writhing	[99]
92	<i>Jatropha curcas</i> L. (Euphorbiaceae) Leaves	Cancer, piles, snakes bites, paralysis, dropsy	(Physic nut) <i>Sabara^H</i> , <i>Boboloch^I</i> , <i>Bòtújẹ̀^Y</i>	Methanol extract; 10-80	Egg albumin-induced oedema	Acetic acid-induced writhing	[100]
93	<i>Kigelia africana</i> (Lam). Benth. (Bignoniaceae) Stem bark	Haemorrhage, rheumatism, boils, eczema, psoriasis, skin cancer, leprosy	(Sausage tree) <i>Rawuya^H</i> , <i>Uturukpa^I</i> , <i>Pandoro^Y</i>	Ethanol extract; 100-500	Carrageenan-induced oedema	Acetic acid-writhing and hot plate tests	[101]
94	<i>Lagenaria breviflora</i> (Benth.) Leaves (Cucurbitaceae)	Measles, digestive disorders, wound antiseptics	<i>Gojinjima^H</i> , <i>Anyummuo^I</i> , <i>Esogbegbe^Y</i>	Aqueous extract; 100, 200	Carrageenan, and histamine-induced oedema	Acetic acid writhing and formalin tests	[102]
95	<i>Landolphia owariensis</i> P. beauv. (Apocynaceae) Leaves	Malaria, purgative, gonorrhoea	(Vine rubber) <i>Ciwo^H</i> , <i>Eso/utu^I</i> , <i>Mba^Y</i>	Aqueous, Methanol, CHCl ₃ ; 100	Carrageenan-induced rat paw oedema	Writhing and tail immersion tests	[103]
97	<i>Loxostylis alata</i> A. spreng. Ex Rchb. (Anacardiaceae) Leaves	To aid childbirth and to stimulate immune system	(Wild Pepper Tree, Tarwood)	Acetone extract; 50-200	Egg albumin, histamine and prostaglandin E ₂ ; vascular permeability	Acetic acid writhing, formalin and hot plate tests	[105]
98	<i>Mallotus oppositifolius</i> (Geisel.) (Euphorbiaceae) Leaves	Infections, diuretic, pain killer, spasm, headache and swellings.	<i>Kafar Mutuwa^H</i> , <i>Nne Okpo Kirinya^I</i> , <i>Ija^Y</i>	Methanol extract; 50-200	Carrageenan, formalin and croton oil oedema; cotton pellet	Established Folkmedicinal potent analgesic	[106]
100	<i>Mangifera indica</i> L. (Anacardiaceae) Leaves	Malarial fever, dysentery, pain, inflammation	(Mango) <i>Mangwaro^H</i> <i>Mangoro^(IY)</i>	Ethanol; 2	Carrageenan-induced rat paw oedema	Acetic acid-induced writhing	[108]
103	<i>Melanthera scandens</i> (M. scandens) (Asteraceae) Leaves	Stomach ulcer, sores, malaria dysmenorrhoea diabetes	(Melanthera) <i>Abo-yunyun</i> , <i>Agbugbo^Y</i>	97% ethanol;	Carrageenan and egg albumin induced oedema	Acetic acid, formalin and thermally induced pain	[112]
105	<i>Nauclea latifolia</i> Smith. (Rubiaceae) Root bark	Malaria fever and pain; parasitic infections	<i>Marga/Tafashiya^H</i> <i>Uburuilu^I</i> <i>Egbesi^Y</i>	Aqueous extract; 50-200	Egg albumin-induced oedema	Acetic acid, hot plate and formalin pain tests	[114]

106	<i>Nelsonia canescens</i> (Acanthaceae) (Lam.) spreng Leaf	Treatment of fever, pain, chickenpox and ulcers	(Blue pussy leaf); <i>Tsamiyarkasa</i> ^H , <i>Manda Mbalaa</i> ^F	Ethanollic extract; 50-200	Carrageenan-induced oedema	Hot plate and formalin models	[115]
107	<i>Newbouldia laevis</i> P. Beauv. (Bignoniaceae) Flower	Diabetes, malaria, fever and pain	(Fertility tree) <i>Aduruku</i> ^H , <i>Ogiris</i> ^I , <i>Akoko</i> ^Y	Ethanollic extract; 25, 50, 100	Formalin-induced oedema	Acetic acid and formalin-induced pain	[116]
108	<i>Nothospondias staudtii</i> Engl. (Simaroubaceae) Leaves	Inflammation, headache and wound dressing	NA	Methanol, aqueous, CHCl ₃ ; 100	Carrageenan-induced rat paw oedema	Writhing test and tail immersion	[117]
109	<i>Ocimum basilicum</i> and <i>Ocimum L. gratissimum</i> (Lamiaceae) Leaves	Management of inflammatory disorders and dysentery; food spices	(Sweet basil; Clove basil; Wild basil) <i>Aidoya</i> ^H , <i>Nchuanwu</i> ^I , <i>Efinrin</i> ^Y	Distilled water, ethanol, terpenes, carboxylic acids; 50µg/ear	Xylene-induced ear oedema, egg albumin induced paw edema	NA	[118,119]
110	<i>Olox subscorpioidea</i> Oliv. (Olacaceae) Leaves	Pain, jaundice, yellow fever, rheumatoid arthritis and depression	(Olox, Stinkant forest) <i>Gwanokurm</i> ^H , <i>Aziza</i> ^I , <i>Ifon</i> ^Y	Ethanollic extract; 50-400	Xylene, carrageenan and Freund's adjuvant-induced arthritis	Writhing, tail immersion and formalin tests	[120]
111	<i>Parinari kerstingii</i> (Rosaceae) Leaves	Broncho pneumonia and feverish pains; serves as an emetic and purgative agent	<i>Kaika</i> ^H	Methanol 100, 200, 400	Egg albumin-induced paw oedema, leukocyte mobilization, and acetic acid-induced vascular permeability	NA	[121]
114	<i>Paullinia pinnata</i> (Linn.) (Sapindaceae) Leaves	Bleeding, ache, fever, arthritis, rheumatism, diarrhoea	<i>Rawaya</i> or <i>kyamba</i> ^H , <i>Obazi</i> ^I , <i>Sewuta</i> ^Y	Ethanollic extract; 100-400	Egg albumin-induced edema	Acetic acid-induced writhing; hot plate	[124]
115	<i>Pentaclethra macrophylla</i> Benth. (Leguminosae) Leaves; Seeds	Management of itching, pain and inflammation	(Oil bean tree) <i>Ugba</i> ^I , <i>Apara</i> ^Y , <i>Atawa</i> ^F	Aqueous extract; 30, 60	Leukocyte counts; pulmonary/ paw oedema	Tail flick, hot plate, acetic acid writhing	[125]
116	<i>Persea americana</i> Mill. (Lauraceae) Leaves	Hypertension stomach ache, bronchitis, diarrhoea, diabetes	(Avocado or alligator pear) <i>Ube bekee</i> ^I , <i>Igba/apoka</i> ^Y	Aqueous extract; 200-1600	Carrageenan-induced rat paw oedema	Writhing; formalin and hot plate tests	[126]
117	<i>Phragmanthera capitata</i> S. Balle	Fever and abdominal pains, diabetes, diarrhoea	(Mistletoe) <i>Kauc</i> ^H , <i>Owube</i> , <i>Eso</i> ^I	Aqueous extract; 100-300	NA	Writhing and formalin tests	[127]

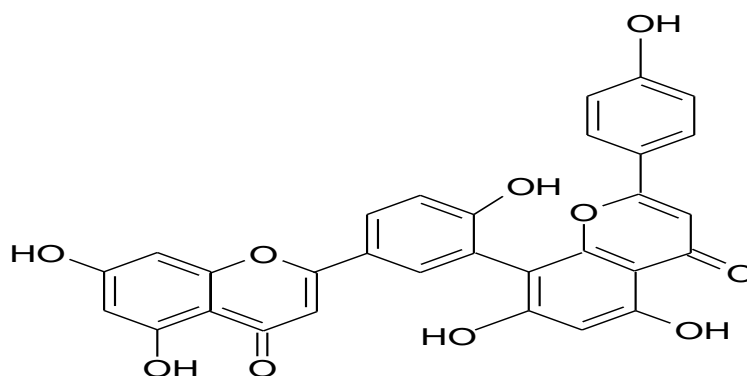
	(Loranthaceae) Whole plant						
118	<i>Phyllanthus amarus</i> Schum. (Euphorbiaceae) Leaves	Arthritis, asthma, malaria, inflammatory disorders	(Gulf leaf flower) <i>Arunjeran</i> , <i>Eguezza</i> , <i>Oguezie</i> ^l	Soft drink extract; 100,200	Carrageenan and histamine-induced rat paw oedema	Writhing and formalin tests	[128]
120	<i>Physalis angulata</i> Linn. (Solanaceae) Leaves	Asthma, urinary problems, rheumatism and tumor, sore throat and abdominal pain	(Cut-leaf ground cherry) <i>Saadi Biri</i> ^H	Methanol 200-400	Carrageenan-induced paw oedema	Acetic acid induced writhing	[130]
121	<i>Piliostigma thonningii</i> (Schum.) (Caesalpinioideae) Leaves	Cough, diuretic toothache, fever, ulcers, rheumatism, anthelmintic	(Carmel's foot) <i>Kalgo</i> ^H , <i>Okpoatu</i> ^l , <i>Abefe</i> ^Y	Aqueous extract; 200, 400	Xylene-induced ear oedema	Writhing and tail immersion tests	[131]
122	<i>Piper guineense</i> Schumach & Thonn, (Piperaceae) Leaves	Respiratory infections, infertility and low sperm count in male, relieve flatulence, rheumatism, and syphilis	(Ashanti pepper) <i>Uziza</i> ^l , <i>Iyere</i> ^Y	Ethanol 250, 500, 1000	Carrageenan – induced rat paw oedema	Hot plate, tail immersion, analgesiom eter and acetic acid induced writhing tests	[132]
127	<i>Psidium guajava</i> Linn. (Myrtaceae) Stem bark; Leaves	Diarrhoea, dysentery, sore throat, haemorrhages, diabetes, vomiting	(Guava) <i>Guafa</i> , <i>Goba</i> ^H , <i>Gova</i> ^l	Aqueous extract; 50-800	Egg-albumin-induced oedema	Hot plate and acetic acid-induced pain	[137]
128	<i>Rothmannia longiflora</i> (Rubiaceae) Leaves	Applied internally or externally as lotions, washes and baths; used to treat bowel complaints.	(Rothmannia) <i>Uri</i> or <i>Uli</i> ^l , <i>Kerebuje</i> ^Y , <i>Katambiri</i> ^H	Methanol 250, 500, 1000	Carrageenan-induced paw oedema	Acetic acid-induced writhing, hot plate and formalin tests.	[138]
131	<i>Schwenckia Americana</i> Linn. (Solanaceae) Roots	Swellings, rheumatism, arthritis, hernia, stomach ache	<i>Dandan</i> ^H , <i>Dandana</i> ^F	Methanolic extract; 25, 50, 100	Formaldehyde-induced oedema	Acetic acid and formalin-induced pain	[141]
133	<i>Securinega virosa</i> Roxb. (Ex Wild) Baill (Euphorbiaceae) Root bark	Management of painful and inflammatory conditions	<i>Tsuwaawun karee / gussu</i> ^H , <i>Njisinta</i> ^l , <i>Iranje</i> ^Y	Methanolic extract; 6.25- 25	Carrageenan-induced oedema	Acetic acid and hot plate tests	[143]
137	<i>Spathodea campanulata</i> . (Bignoniaceae) Linn. Leaves	Malaria fever and painful inflammatory conditions	<i>Imiewu</i> , ^l <i>Oruru</i> , ^Y <i>Okuekue</i> (Edo)	Ethanol extract; 250-1000	Carrageenan-induced oedema	Acetic acid writhing; tail flick; hot plate tests	[147]

138	<i>Sphaeranthus senegalensis</i> Vaill. (Asteraceae) Whole plant	Skin diseases, sedative, rheumatic pains	<i>Dodoya, burki</i> ^H	Aqueous extract; 50-200	Egg albumin-induced oedema	Acetic acid; hot plate; formalin-induced pain	[148]
139	<i>Stephania dinklagei</i> (Engl.) (Menispermaceae) Roots	Dysentery, wounds, asthma hyperglycemia, cancer, fever, sleep disorders inflammation	<i>Gbejedi</i> ^Y <i>Ebewaki</i> (Edo)	Hexane, chloroform, EtOAc, methanol extracts; 100, 300	Carrageenan, kaolin-carrageenan and formalin-induced oedema	Established folk medicinal use as an analgesic	[149]
140	<i>Stereospermum kunthianum</i> (Cham, S. Petit) (Bignoniaceae) Stem bark	Rheumatoid arthritis, malaria, diarrhea	(Pink jacaranda) <i>Jiri</i> ^H , <i>Ajade</i> ^Y , <i>Golombi</i> ^K	Stereostin, Stereospermin, Stereospermiside; 20	Carrageenan-induced rat paw oedema	Randall-Selitto and formalin-induced pain tests	[150]
141	<i>Strophanthus sarmentosus</i> (Apocynaceae) P.Dc. Root	Oligospermia, fever, peptic ulcers, inflammation	(Poison arrow) <i>Gama sagere</i> ^H , <i>Uta nta</i> ^L , <i>Isage aganolugbo</i> ^Y	Ethanol extract; 50-200	Carrageenan and xylene induced oedema tests	Acetic acid induced writhing and hot plate tests	[151]
143	<i>Syzygium aromaticum</i> L. (Myrtaceae) Flower buds	Antiseptic, antibacterial, antifungal, antidiarrheal	(Clove) <i>Kanumfari</i> ^H <i>Osasagbogbo</i> ^L <i>Kanafuru</i> ^Y	Ethanol extract; 50-200	Formalin-induced oedema	Acetic acid writhing test	[153]
144	<i>Syzygium guineense</i> , (Myrtaceae) Leaves	Stomach-ache, diarrhoea, sprain, tonic, ophthalmia, dysentery	<i>Malmo</i> ^H <i>Adere</i> ^Y <i>Asurahi</i> (Fulani)	Ethanol extract; 200-1000	Egg albumin-induced oedema	Acetic acid writhing and hot plate tests	[154]
145	<i>Tamarindus indica</i> (Fabaceae) Seeds, Leaves	Diarrhoea, dysentery, asthma, bronchitis, leprosy, diabetes, wounds, ulcers	(Tamarind) <i>Tsamiya</i> ^H <i>Icheku</i> ^L , <i>Ajagbon</i> ^Y	Aqueous extract; 100-400	Carrageenan-induced oedema	Writhing; hot plate and tail immersion tests	[155,156]
146	<i>Tithonia diversifolia</i> (Compositae) Leaves	Menstrual pain, inflammatory conditions, diarrhoea, diabetes	(Tree marigold)	Methanolic extract; 50-200	Carrageenan - induced oedema, cotton pellet granuloma test	Hot plate and formalin-induced paw licking tests	[157]
149	<i>Viola betonicifolia</i> (Violaceae) Whole plant	Antipyretic, astringent, Anticancer	(Arrowhead violet)	N-hexane extract; 100-300	Carrageenan and histamine-induced oedema	Acetic acid-induced writhing	[160]
150	<i>Vitex doniana</i> (Verbenaceae) Leaves	Stomach and rheumatic pains, dysentery, diarrhoea and inflammatory disorders	(Black plum) <i>Dinya</i> , <i>Tinya</i> , <i>Tunci</i> ^F	Methanol extract; 500, 1000	Agar injection, prostaglandin synthase and phospholipase A ₂ models	hot plate method	[161]

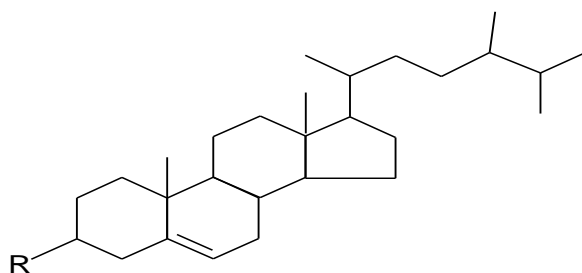
152	<i>Zea mays</i> (Poaceae) Husks	Pains, arthritis, immunological disorders	(Maize /corn) <i>Masara</i> ^H , <i>Oka</i> ^I ; <i>Agbad</i> ^Y	Aqueous extract; 25-200	Carrageenan oedema; cotton pellet granuloma test	Hot plate and formalin- induced pain	[163]
154	<i>Zizyphus spina-christi</i> (Rhamnaceae) Roots	Fever, ulcers, inflammatory- related ailments, asthma, diarrhoea, meningitis and wounds infection.	(Christ's thorn) <i>Kurna</i> ^H <i>Kurnah</i> ^F <i>Eakannase-adie</i> ^Y	Ethyl-acetate, n-butanol and ethanol 300, 500	Egg albumin induced hind paw oedema	NA	[165]



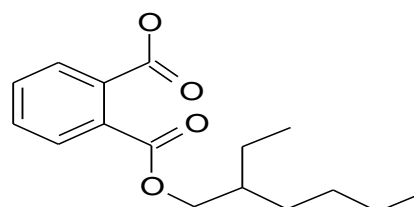
1A: Chemical structure of cucurbitacin E isolated from *Citrullus lanatus* [166].



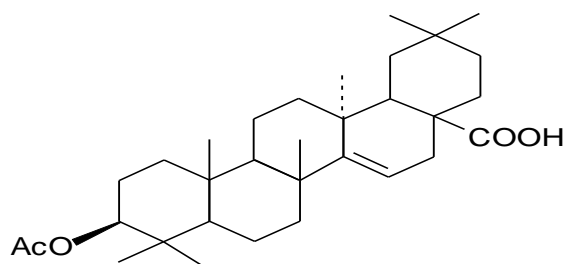
1B: Chemical structure of amentoflavone isolated from the root extract of *Cnestis ferruginea* [167].



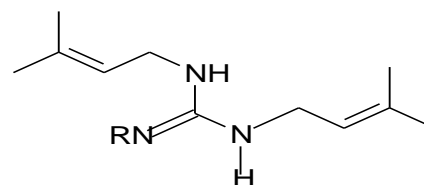
1. R=H Beta sitosterol
2. R=Glucose Daucosterol



3. Di- (2-ethylhexyl) phthalate



4. Acetyl aleuritolic acid



5. R = H Diisopentenyl guanidine
6. R = Isoprene Triisopentenyl guanidine

1C: Chemical structure of sitosterol (1), daucosterol (2), DEHP (di-(2-ethylhexyl) phthalate) (3), acetyl aleuritolic acid (4), diisopentenyl guanidine (5) and triisopentenyl guanidine (6) isolated from leaves and root bark of *Alchornea cordifolia* [168].

Figure 1: Some anti-inflammatory compounds isolated from medicinal plants.

and harness them for maximum health benefit of humanity.

CONFLICTS OF INTEREST

The authors do not have any conflicts of interest regarding the present work.

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