Original Research



Potential of Malawi's medicinal plants in Covid-19 disease management: A review

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Abstract

The Coronavirus Disease 2019 (COVID-19) caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) has triggered an international pandemic that has led to significant public health problems. To date, limited evidence exists to suggest that drugs are effective against the disease. As possible treatments are being investigated, herbal medicines have shown potential for producing novel antiviral agents for the COVID-19 disease.

Aim

This review explored the potential of Malawi's traditional medicinal plants for the management of COVID-19.

Methods

The authors searched on PubMed and Google scholar for medicinal plants that are used in Malawi and published in openly available peer reviewed journals. Plants linked with antiviral treatment, anti-COVID-19 activity or COVID-19 symptoms management were targeted. These included activity against pneumonia, inflammation, cough, difficulty in breathing, pain/aches, fever, diarrhoea, rheumatism, fatigue, asthma, immunocompromised and cardiovascular diseases.

Results

11 studies were found with 306 plant species. 127 plant species had at least one COVID-19 related pharmacological activity. Of these plant species, the number of herbal entities used for each indication was: pain/aches (87), fever (2), pneumonia (9), breathing/asthma problems (5), coughing (11), diarrhoea (1), immunosuppression (8), blood issues (10), fatigue (2), heart problems (11), inflammation (8), rheumatism (10) and viral diseases (12). Thirty (30) species were used for more than one disease and *Azedarachta indica* topped the list (6 of the 13 COVID-19 related diseases). The majority of the species had phytochemicals known to have antiviral activity or mechanisms of actions linked to COVID-19 and consequent diseases' treatment pathways.

Conclusion

Medicinal plants are a promising source of compounds that can be used for drug development of COVID-19 related diseases. This review highlights potential targets for the World Health Organization and other research entities to explore in order to assist in controlling the pandemic.

Key Words: traditional medicine, herbal products, corona virus, drug development, screening

Introduction

Viruses are pathogens that cause communicable diseases like flu, AIDS and Ebola and increasing evidence shows that some viruses play a role in the disease mechanism of some non-communicable diseases like cancers, Alzheimer's disease and type 1 diabetes with high morbidity and mortality rates worldwide.1 Most of these diseases have proved hard to cure.²⁻⁵ Viruses cause epidemics that emerge and re-emerge and are easily transmitted to different locations due to increased global travel and rapid urbanization. Emergence of novel viruses and rapid mutation of old viruses make drug as well as vaccine development challenging and these are some of the major reasons why there has not been significant development of effective drugs or vaccines against many viruses. Notable viruses that have caused outbreaks with significant public health implications worldwide include dengue virus, influenza virus, measles virus, severe acute respiratory syndrome (SARS) virus, and West Nile virus and the recently discovered severe acute respiratory syndrome corona virus 2 (SARS-CoV-2).6-9 The SARS-CoV-2 is a novel

virus that was discovered in 2019 in Wuhan City of Hubei Province in China and has spread rapidly throughout the world, causing serious health care burden. The virus causes a disease called COVID-19 disease that affects all populations of people, but the elderly and those with underlying medical conditions are at a higher risk of morbidity and mortality. Being a novel disease caused by a novel virus, knowledge about the virus and the disease is limited and keeps on developing daily. 11

SARS-CoV-2 is a 60 nm to 140 nm diameter, enveloped, positive sense RNA virus (11) belonging to the Coronaviruses (CoVs) that are generally enveloped viruses with single-stranded RNA genome. CoVs have the largest genomes to date among RNA viruses that range from approximately 26 to 32 kilobases. They replicate by genes encoding for viral structural proteins such as nucleocapsids (N), membranes (M), spikes (S), and envelopes (E), which play significant roles in viral integrity. However, there are other commonly studied proteins that have been widely targeted

for drug development. These include papain-like protease (PLpro), 3c-like protease (3CLpro) and spike protein¹³⁻¹⁶.

Coronaviruses infections are well known for causing enteric, respiratory and central nervous system diseases in animals and humans.¹⁷ The nomenclature of coronaviruses originates from spike-like projections on its surface, which gives it a shape similar to a crown when viewed under an electron microscope.^{16,18} The gene sequence of SARS-CoV-2, the coronavirus responsible for COVID-19, suggests that its proteins are similar to those of South Asia Respiratory Syndrome (SARS) or Middle East Respiratory Syndrome (MERS).^{19,20} Hence, drugs, compounds and medicinal plants or extracts known to inhibit these proteins in SARS and MERS could be promising leads for COVID-19 drug development.

COVID-19 is transmitted by large water droplets released by infected people (symptomatic or asymptomatic) when they cough and sneeze, and they survive in these droplets that are spread on the surfaces or individual's bodies.²¹ Higher viral loads can be found in the nasal cavity than the throat.²² People are infected by touching their nose, eyes or mouth after touching surfaces contaminated with SARS-CoV-2.^{23,24} The virus enters the respiratory mucosa using angiotensin converting enzyme receptor 2 (ACE-2).²⁵ The virus can easily be killed by common disinfectants such as ethanol (preferably ≥ 80%), sodium hypochlorite or hydrogen peroxide.^{23,24}

COVID-19 patients can be symptomatic, pre-symptomatic, or asymptomatic.²⁶ Common clinical features are fever, dry cough, sore throat, fatigue, headache, conjunctivitis, myalgia and breathlessness as well as loss of taste or smell.²⁷⁻²⁹ Some patients also develop pneumonia and respiratory failure and may die within weeks. The latter scenario is associated with an extreme increase in inflammatory cytokines (cytokine storm), especially IL2, IL7, IL10, GCSF, IP10, MCP1, MIP1A, and TNFα.³⁰ The COVID-19 disease is also associated with complications such as acute lung injury, Acute Respiratory Distress Syndrome (ARDS), shock, and acute kidney injury. Currently, there are no approved treatment medicines in use

for COVID-19 disease. The disease is being managed by prevention of transmission (face masks and washing hands with soap and water or using hand sanitizer), maintaining hydration and nutrition, controlling fever and cough, provision of oxygen and renal replacement therapy. The use of these interventions varies by availability, access, location and disease severity. Therefore, there is a need to discover, design or develop novel efficacious and cost-effective antivirals as the search for effective vaccines continues.⁹

Several approaches are being implemented to tackle COVID-19, one of which is the repurposing of widely used conventional and herbal medicines.³¹ Antiviral drugs (ribavirin, lopinavir-ritonavir based on experience in SARS and MERS), combination therapy of oseltamivir, ganciclovir and lopinavir-ritonavir, and remdesivir (broad spectrum anti-RNA drug developed for Ebola) have been tested. Remdesivir, the only antiviral option showing benefit to date, has shown statistically significant improvements in time to recovery in hospitalized patients in comparison with placebo.³² Short term therapy with low-to-moderate dose corticosteroids (such as dexamethasone) in COVID-19 ARDS, intravenous immunoglobulin therapy, arbidol (antiviral drug), interferons, hydroxychloroquine and plasma of patients recovered from COVID-19 have been trialled. Despite preliminary reports showing that dexamethasone may decrease mortality rates

among critically ill patients, more evidence about its efficacy and safety, along with other agents, are needed before these treatment options are fully recommended for use. 30,33-39

Traditional medicines, especially Chinese herbs, have been tested for use in COVID-19.33 Aanouz et al., (2020) used computational techniques to evaluate the inhibition potential of compounds isolated from plants used in Morocco against COVID-19 virus. Sixty seven (67) compounds isolated from aromatic and medicinal plants were found and selected for molecular docking studies that used energy of interaction between the compound's functional groups and the corona virus (SARS-COV-2 spike protein) as one of the criteria for anti-corona virus effect. Chloroquine was used as a standard (interaction energy of -6 kcal/mol). Eleven (11) molecules showed a good interaction with the target, but the three greatest activities were for Crocin from Crocus sativus L. (-8.2kcal/mol), Digitoxigenin (Nerium oleander L., -7.2 kcal/mol) and β -Eudesmol (Laurus nobilis L., -7.1kcal/ mol). Experimental data also showed that they had antiviral activity. 40 For example, Crocin was found in vitro to be an inhibitor of the replication of Herpes Simplex Virus (HSV) before and after virion entry in Vero cells, and its plant/ herbal medicine source showed promise for use as an anti-HSV and anti-Human Immunodeficiency Virus (HIV) agent.41 Derivatives of Digitoxigenin are used as antiviral and anticancer inhibitors, while β-Eudesmol has substantial antibacterial and antiviral activity. 42-43

Zhang et al., (2020) executed a rational computer-based screening study aimed at identifying Chinese medical herbs and compounds with antiviral activity against respiratory infections and COVID-19. This computer-based study searched through literature for natural compounds and their respective traditional Chinese medicinal plants known to fight against MERS or SARS coronavirus. Docking studies were completed to analyse their potential for direct interaction with SARS-COV-2 protein, followed by biological activity search from literature. Thirteen (13) out of the 115 compounds found in the search of traditional Chinese medicines exhibited potential for anti-COVID-19 activity and 125 screened Chinese herbs contained 2 or more of the 13 compounds. A search for pharmacological activity showed that 26 of the 125 herbs had antiviral activity in respiratory infection, and that they regulated viral infection, immune/inflammation reactions and response to hypoxia.44

Hui et al., (2020) evaluated studies that tested the use of Chinese medicine (CM) as prophylaxis on people exposed to SARS and H1N1 influenza in clinical trials, cohort or other population studies. Results showed that the Chinese medicines performed well as prophylaxis, an effectiveness that has also been recorded in historical practice with CM.⁴⁵ During the COVID-19 epidemic, several CM products were also tested in humans for prevention of the epidemic effects and selection of the CM was based on historical use and previous experimental results in similar viral epidemics. The CM used in the studies included radix astragali (Astragalus propinquus Schischkin), radix glycyrrhizae (Glycyrrhiza uralensis Fisch. ex DC.), radix saposhnikoviae (Saposhnikovia divaricata (Turcz.) Schischk.), rhizoma atractylodis macrocephalae (Atractylodes macrocephala Koidz.), lonicerae japonicae flos (Lonicera japonica Thunb.) and fructus forsythia (Forsythia suspensa (Thunb.) Vahl.). This study revealed that historical use and previous use of the CM in similar epidemics provided clues for selection of CM use and efficacy in COVID-19.45,46

Plant extracts of *Lycoris radiata* (L'Hér.) Herb., *Artemisia annua* L., *Pyrrosia lingua* (Thunb.) Farw. and *Lindera aggregata* (Sims.) Kosterm. were also evaluated and found to have anti–SARS activity after a screening exercise of hundreds of CMs.⁴⁷

Apart from whole plant extracts, phytochemicals have been evaluated and shown potential for activity against COVID-19 disease, including Saikosaponins Types A, B2, C, and D (phytochemicals belonging to naturally occurring triterpene glycosides). For example, Saikosaponins from *Bupleurum* spp., *Heteromorpha* spp., *Scrophularia scorodonia* L. have showed antiviral activity against a human and bat corona virus HCoV-229E, that together with OC43, causes the common cold.^{34,47}

Furthermore, inhibitors of SARS enzymes (nsP13 helicase and 3CL protease) have also been isolated from plants. For example, myricetin is a flavonoid polyphenolic compound that has anti-oxidant properties.⁴⁸ Scutellarein, a flavono isolated from *Scutellaria lateriflora* L., has shown activity against SARS.^{35,49} Phenolic compounds isolated from *Isatis tinctoria* L., *Torreya nucifera* (L.) Siebold & Zucc. and a water extract of *Houttuynia cordata* Thunb. have also exhibited antiviral mechanisms against SARS.⁵⁰ These water extracts have been particularly known to inhibit viral 3CL protease as well as blocking viral RNA-dependent RNA-polymerase activity.⁵¹

Herbal-western medicine combination therapies of lopinavir/ritonavir (anti-HIV medicines), arbidol (broadspectrum antiviral) and CM Shufeng Jiedu capsule as well as lopinavir/ritonavir and CM Shufeng Jiedu capsule have also been tested clinically. Clinical observations for both herbal-western medicine combination therapies treated patients showed that the TCMs treatments were effective in a majority of the patients that were treated with them, which showed that the TCMs can play a role in treating COVID-19. The Herbal-western medicine combination therapies were very important in the treatment of the viral pneumonia. It was found that more studies were needed to produce conclusive results on the curing capability of the combination therapies on COVID-19.⁵²

In the search for chemotherapy for COVID-19, there are different sources of medicines, one of which is traditional medicines or medicinal plants. In the African region including Malawi, treatment options commonly stem from medicinal plants due to their abundance and untapped potential. 80% of the population in this region relies on medicinal plants as a primary health care option.⁵³

Several studies have already started exploring plants for COVID-19 cure. 32,54 There may be other unexplored plants that have potential for producing a cure for the disease or addressing mild to severe symptoms. Therefore, it is important to analyse the plants that have shown potential for COVID-19 activity and study plants with similar attributes. The following section explores the literature on studies that have evaluated the efficacy of medicinal plants on SARS-CoV-2 as well as searching for plants with similar antiviral potential in Malawi. For a plant or its isolated compounds to have potential for use in COVID-19, it should be able to kill or inactivate the virus or alleviate the symptoms and complications caused by coronavirus infection.

Significance of the Study on Medicinal plants with potential for use in COVID-19 in Malawi

The WHO recommends supportive care options such as the use of supplemental oxygen through ventilators but these interventions are too expensive for most low-income countries with under resourced healthcare systems. 55,56 Furthermore, there are gaps in trained health care providers for such interventions.⁵⁷ The majority of biomedical COVID-19 treatment options available lack data to support their effectiveness.⁵⁵ Options that are showing some clinical promise have soaring prices and frequent stock outs.58 Hence, medicinal plants may be alternatives for individuals in Malawi and other developing countries. Although there have been in-vitro studies that have shown activity for various aspects of COVID-19, there hasn't been a study completed in Malawi to assess the efficacy or toxicity of medicinal plants. Although various medicinal plants have been analysed abroad, these data cannot be extrapolated to the same species in Malawi since geographical differences have been identified in medicinal plants' composition and activity.⁵⁹ Hence, this study seeks to provide baseline data for use in the discussion of Malawi's medicinal plants use in COVID-19 treatment. Furthermore, it may confirm or refute widely-circulating arguments or fears concerning the use of medicinal plants against COVID-19. This will be achieved by the following specific objectives: To examine published ethnobotanical studies conducted in Malawi in order to identify the medicinal plants with demonstrated activity or potential for activity against COVID-19 disease. To evaluate the literature for reported pharmacological properties of medicinal plants found to have potential for use in COVID-19 disease.

Methods

The authors searched for studies on medicinal plants that are used in Malawi that met the following inclusion criteria: Published in peer reviewed journals that were openly available online between January 1994 and July 2020. Had medicinal plants reported to be found and used in Malawi by at least one ethnobotanical survey as well as being tested in a laboratory.

The plant had been linked with antiviral or anti-COVID-19 use or against the symptoms of COVID-19. The key words that were used on Google Scholar and PubMed were: Ethnobotany, ethnobotanical survey, Malawi, Malawi herbal medicine, Malawi herbalist, Malawi medicinal plant, Malawi phytochemical screening, Malawi herbals and traditional medicine. Eleven (11) studies met the inclusion criteria while over 93 studies were excluded because plants reported were not cited in the ethnobotanical surveys reported in Malawi. All plant extracts that had potential for use in COVID-19 were considered. That potential was shown by its local use on viral infections or antiviral activity (e.g., curative action against pneumonia and inflammation), COVID-19 symptoms (symptom management of cough, difficulty in breathing, pain/aches, fever, diarrhoea, rheumatism and fatigue) and risk factors (high risk comorbidities like asthma, immunocompromise and cardiovascular diseases).

For the plants that met the above criteria, further searches were conducted on Google Scholar and PubMed using key words: scientific or botanical name of the plant, phytochemicals, bioactivity and pharmacological activity to find out if there have been any laboratory studies in Malawi or any other country to evaluate their biological or pharmacological activity on COVID-19 and consequent diseases. Summaries of all the studies and plants were created using Microsoft Excel.

Results

The literature search found a total of 11 studies.⁶⁰⁻⁷⁰ Plant list extraction yielded 306 plant species thereafter removing species that were irrelevant or not identified by a botanist (Additional File 1: Table 1). Of these 306 medicinal plants, 127 plants were found to manage at least one of the symptoms related to COVID-19 or were found to be used for the management of viral infections (Additional File 2: Table 2). Table 3 shows a summary of the results shown in the Additional File 2.

This study revealed that 87 of 127 medicinal plants could be used for pain or aches management, and two of those for fever management (Azadirachta indica A. Juss. and Pyrenacantha kaurabassana Baill.). Pneumonia is another symptom associated with COVID-19. In this study, we found 9 medicinal plants that are used traditionally to manage pneumonia and 5 that have potential for use in managing breathing or asthma problems. Other diseases associated with COVID-19 for which we identified traditional medicines included coughing (11 plants), diarrhoea (1 plant), immunosuppression (8 plants), blood related issues (10 plants), fatigue (2 plants), heart problems (11 plants), inflammation (8 plants) and rheumatism (10 plants). COVID-19 is a viral infection and any medicinal plant used for viral diseases has potential of being tested on coronavirus. There were 12 plants found to have been used for viral infections or diseases.

Of the 127 medicinal plants with potential to manage COVID-19 related diseases or symptoms, 30 had more than one disease for which they could be used. Azedarachta indica topped the list with being used for 6 of the 13 COVID-19 related diseases, high risk comorbidities and symptoms followed by Moringa oleifera Lam. Pyrenacantha kaurabassana Baill. and Sclerocarya birrea (A. Rich.) Hochst. that could be used on 4 aspects of COVID-19. Analysis of these 30 plants revealed that they covered all types of the diseases except one; fatigue. Table 4 shows the 30 plant species and their associated benefits for COVID-19 management.

Pharmacological effects of the plants

The 30 plants with activity against one or more aspects of COVID-19 were considered more user-friendly since one entity can be used for multiple purposes. This may lead to a decreased incidence of toxicity and interactions. However, it should also be pointed out that the use of medicinal plants potentially leads to the administration of multiple active compounds (drug promiscuity), and is dangerous as it risks drug resistance and adverse events from unknown drug-drug interactions. Some of the components therein would be administered to the patient in suboptimal doses and others in overdoses, with chances of drug resistance and toxicity.⁷¹

On the other hand, documented evidence exists that suggests that the use of more than one medicinal plant (polyherbalism) improves the efficacy of the products as well as convenience for patients during administration (dose and frequency). Research also suggests that combining medicinal plants with more than one pharmacological effect can provide even greater benefit. Therefore, the 30 plants with multiple COVID-19 activities were evaluated further using literature review to determine if any studies had been completed to scientifically confirm their traditional ethnobotanical uses. Table 5 shows a summary of studies done so far on the plants. The table shows that the majority of the medicinal plants had phytochemicals linked to several

of their COVID-19 symptoms alleviation capabilities and had demonstrated some mechanism of action related to COVID-19 treatment pathways. A few medicinal plants had no studies conducted to confirm their use.

Discussion

This study has demonstrated that there are multiple medicinal plants in Malawi that are being used for disease state management (Additional File 1: Table 1) and that several of these diseases are symptoms associated with COVID-19 (Additional File 2: Table 2). According to the World Health Organization (WHO), patients with mild COVID-19 are recommended to be treated with medicines that manage the presenting symptoms.⁵⁵

The WHO acknowledges that traditional medicines may be sources of new therapies in the search for potential treatments for COVID-19. This is based on the historical integration of medicinal plants into primary healthcare in many areas of the world and on phytochemicals serving as precursor molecules for several commonly used biomedical drugs.⁵⁵ This study was completed as a way of supplementing in the search for therapies for COVID-19 since initial selection of potential plant species for plant-derived lead compounds or medicines stems from ethnobotanical surveys. Since the disease is novel, we could not identify a novel medicinal entity with clinically significant SARS-COV-2 activity. However, plants targeting other viruses and associated symptoms might be repurposed in a similar fashion to various conventional medicines.⁷³ However, the WHO warns against the use of traditional medicines without evaluating them first for efficacy, toxicity, and safety. Although WHO recognizes that traditional, complementary and alternative medicines show beneficial effects, and that Africa has a long history of traditional medicine use, medicinal plants can also be toxic and medicinal plants' efficacy may vary due to differences in geographical locations. 55,59,73

The majority of the 30 medicinal plants identified contained known phytochemicals (Table 4 and 5). The review of the pharmacological effects of the plants confirms why they have potential for testing in the management of COVID-19 patient symptoms and eliminating the virus. The results, for example on Azadrachta indica, are consistent with the results reported by Roy and Bhattacharyya (2020), Shanmuga (2020), as well as Shanmuga et al., (2020) that also showed the potential of this plant in review, computational work, and clinical case study respectively.74-76 Furthermore, the study results are similar to those of Li et al who describe the Shufeng Jiedu Capsule/Granule (SFJD) containing eight medicinal herbs in China that is reported to have antiviral, antibacterial, antitumor, and anti-inflammatory activities, and have effective protection against lung injury and neuronal loss achieved through enhancement of autophagy and apoptosis reduction in rats with allergic rhinitis.⁷⁷ It is also reported to improve *Pseudomonas aeruginosa*-induced upper respiratory tract infection by acting on various targets, particularly ERK phosphorylation. When combined with oseltamivir treatment, SFJD reduced IAV-induced airway inflammation and pulmonary virus titres. This suggests that SFJD may be used for the prevention and treatment of infectious diseases by regulating various signal pathways.⁷⁷

This study can assist WHO's efforts to select traditional medicine products that can be investigated for clinical efficacy and safety in COVID-19. The WHO has historically supported clinical trials of traditional medicine products. https://dx.doi.org/10.4314/mmj.v33i2.4

Through these previous WHO trials, 89 products have been given market authorisation in 14 countries after meeting international and national requirements for registration. Furthermore, 43 products were included in national essential medicines lists for diseases including malaria, opportunistic infections related to HIV, diabetes, sickle cell disease and hypertension. ⁵⁵ This report recommends that the medicinal plants identified be evaluated as potential sources of COVID-19 management remedies and be prioritized for inclusion in clinical and analytical studies for antiviral activity or management of COVID-19 disease.

Conclusions

Coronaviruses have been in existence for decades and novel strains will continue to emerge. Efforts to find viable, safe and effective treatments in drug discovery pipelines are continuing and will adapt in response to evolving strains. From various community practices across the world, natural products have played a significant role in managing coronavirus related diseases to varying extents. As the aetiology of COVID-19 disease is studied further at the molecular and enzyme levels, a narrower selection can be made for potential hits and leads effective against the disease. Natural products, including plant products, are undoubtedly a promising source of compounds in drug development for possible drug leads and vaccines. It is recommended that multidisciplinary approaches are used to study active phytochemicals with regard to identifying suitable compounds that can be used as they are or developed into possible treatments against Covid-19 and other related coronavirus diseases.

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Table 1: List of Medicinal Plants that were included in the study

Abrus precatorius Acacia adenocalyx Acacia amythethophylla Acacia nilotica

Acacia sieberana

Acacia sp.

Acalypha chirindica Acalypha villicaulis

Adenia gummifera (Harv.) Harms Aeschynomene abyssinica Aframomum angustifolia

Afzelia quanzensis Welw.

Ageratum houstonia (compsitae)

Albizia harvevi

Albuca abyssinica Jacq.

Algae spp. Allium sativum

Allophylus chaunostachys

Aloe swynnertonii

Aloe vera

Ampelocissus africana

Ampelocissus obtusata (Welw. ex

Baker) Planch. Annona senegalensis Anthospermum spec. Apodytes dimidiata Aristolochia hockii Asparagus setaceus Azadrachta indica Azanza garckeana Azedaracht indica Bauhinia petersiana

Berberis holstii Bersama abvssinca Boophone disticha (L.f.) Borassus aethiopum

Bauhinia thonningii

Boscia salicifolia Oliv Brachystegia allenii Hutch. &

Burtt Davy

Breonadia microcephala (Del.) Bridelia cathartica G. Bertol. Byrsocarpus orientalis (Baill.)

Bak.

Calotropis procera Canthium glaucum ssp.

Carica papaya Cassia abbreviata Cassipourea mollis Cassytha filiformis L. Catunaregam spinosa

Cissus aristolochiifolia Planch

Cissus cornifolia Cissus faucicola Cissus integrifolia Cissus quadrangularis Cissus rubiginosa (Welw.ex

Baker) Planch Cissus sp.

Cissus zombensis Gilg and Brandt

Clerodendrum glabrum Cocculus hirsuitus Coffea swynnertonii

Colocasia esculenta (L.) Schott Combretum apiculatum

Combretum fragrans Combretum microphyllum Combretum mossambicense Commiphora mossambicensis

Cordyla africana

Crinum macowanii Baker Crossoptervx febrifuga Cryptolepis obtusa Cucumis hirsutus Sond.

Cvphostema ssp. Cyphostemma junceum (Webb) Desc. ex Wild & R.B. Drumm. Cyphostemma setosum Cyphostemma zombense

Dalbergia melanoxylon Dalbergia nitidula Dalbergiella nyassae Dichrostachys cinerea

Dicoma amoena Dioscorea bulbifera L.

Dioscorea dumetorum (Kunth) Pax

Dioscorea esculenta (Lour.)

Burkill

Dioscorea odoratissima Pax Dioscorea sansibarensis Pax

Diospyros kirkii Diospyros zombensis

Diplorhynchus condylocarpon

Disa sp.

Dolichos kilimandscharicus Dolichos trinervatus Baker Dombeya acutangula Dychrostachys cincerea

Ehretia amoena Ehretia divaricata Ehretia obtusifolia

Ekebergia benguelensis Welw. ex

Elephantorrhiza goetzei

Elytaria lyrata

Eminia antennulifera (Baker) Taub Eriospermum abyssinicum Baker

Erythrophleum suaveolens

Euphorbia hirta

Euphorbia matabelensis *Ficus capensis* Thunb. Ficus kirkii Hutch. Ficus natalensis Ficus sycomorus Flacourtia indica Frueggea virosa

Gladiolus dalenii Van Geel Gloriosa superba L. goetzei

Grewia bicolor Grewia flavenscens *Grewia inaequilatera* Grewia micrantha Grewia stolzii

Habenaria sp.

Heteromorpha trifoliata Hibiscus cannabinu L. Hippocratea parviflora Holarrhena pubescens Hymenocardia acida Tul. Hymenodictyon floribundum Hymenodictyon parvifolium

Hypoxis villosa L.f. Indigofera emarginella Inula glomerata Jateorhiza bukobensis jatropha curcas Julbernardia globiflora

Kaempferia rosea Schweinf. ex

Baker

Khaya nyasica or Khaya

anthotheca Kigelia africana Kirkia acuminata Lagenaria sphaerica Lannea discolor Lannea edulis

Lecaniodiscus fraxinifolius Ledebouria cordifolia (Baker)

Stedje & Thulin

Ledebouria revolute (L.f.) Jessop

Leersia hexandra Leonotis nepetifolia Maerua parvifolia Mangifera indica

Manihot glaziovii Müll. Arg. Margaritaria discoidea or Phyllanthus discoideus Markhamia obtusifalia

Maunkhalamba

Maytenus heterophylla or Gymnosporia buxifolia *Maytenus senegalensis* or *G*.

senegalensis Melia azedarach

Momordica foetida Schumach &

Thonn. Mondia whitei Monodora junodii Molinga oleifera Mucuna poggei Taub. Multidentia crassa *Musa paradisiaca* L.

Neorautanenia mitis (A.Rich.)

Verdc.

Nidorella auricalata Nymphaea caerulea Savigny Terminalia kaiseriana

Table 1 Cont....

Cissus votundifolia	Gonatopus boivinii (Decne.) Engl.	Terminalia mollis
Ocimum americanum	Raphionacme welwitschii Schltr. &	Terminalia sericea
Olax dissitiflora	Rendle	Terminalia stenostachya
Olax obtusifolia	Rhus longipes	Tragia brevipes
Oldfieldia dactylophylla	Rhus natalensis	Tricalysia coriacea
Ormocarpum kirkii	Ricinus communis	Tricalysia spp.
Ozoroa reticulata	Rothmannia fischeri	Trichillia emetica
Paederia bojerana	Rytigynia adenodonta or Rytigynia	Trichodesma zeylanicum
Parinari excelsa	reticulata	Tricliceras longepedunculatum
Passiflora edulis	Rytigynia monantha	Turraea floribunda
Paulozia mixta	Sclerocarya birrea	Turraea nilotica
Pericopsis angolensis	Sclerocarya caffra	Tylosema fassoglensis (Kotschy ex
Phelinus gilvus	Searsia tenuinervis	Schweinf.) Torre & Hillc.
Philenoptera capassa	Securidaca longepedunculata	Vangueria infausta
Philenoptera violacea	Senna siamea or Cassia siamea	Vernonia adoensis
Phyllanthus ovalifolius	Smilax anceps	Vernonia colorata
Phyllanthus reticulatus	Solanum anguivii	Vigna radiata
Piliostigma thonningii	Solanum panduriforme	Vigna subterranean
Plectranthus esculentus N.E. Br	Sphaeranthes angolensis	Vitex doniana
Popowia obovata or Friesodielsia	Sphenostylis emarginata	Vitex mombassae
obovata	Steganotaenia araliacea	Vitex payos
Portulaca oleracea L.	Sterculia quinqueloba	Xeroderris stuhlmannii (Taub.)
Pouzolzia mixta	Stereospermum kunthianum	Mendonca & EP Sousa.
Protea petiolaris	Strophanthus kombe	Ximenia americana L.
Pseudarthria hookeri	Strychnos madagascariensis	Ximenia caffra
Pseudolachnostylis maprouneifolia	Stylochiton puberulus N.E.Br.	Zanha africana
Psidium guajava	Tabernaemontana elegans	Zingiber officinale
Psorospermum febrifugum	Tacca leontopetaloides	Ziziphus abyssinica
Pterocarpus angolesis	Tamarindus indica	
Pterocarpus brenanii	Tephrosia vogeli	
Pupalia lappacea		
Pyrenacantha kaurabassana		
	I.	I.

Table 2: List of Medicinal Plants that were evaluated further for Pharmacological and Physicochemical Properties

Abrus precatorious Acacia macrothyrsa Acalypha chirindica Aerva leucura

Aeschynomene abyssinica Aeschynomene nyassana Afzelia quanzensis

Ageratum houstonia (compsitae)

Albizia zimmermanii Albuca abyssinica Jacq.

Algae spp.
Allium sativum
Aloe spp.

Aloe swynnertonii

Aloe vera

Ampelocissus Africana (Lour.) Merr.

Annona senegalensis Azanza garckeana Azedarachta indica Bauhinia thonningii Berberis holstii

Boophone disticha (L.f.) Brachystegia utilis Breonadia microcephala Bridelia micrantha

Burkea africana Capsicum frutescens Carica papaya Carissa edulis Cassia abbreviata

Ceiba pentandra Cissampelos mucronata

Cissus quadrangularis Cissus rubiginosa (Welw.ex Baker) Planch. Cissus zombensis (Baker) Gilg & M. Brandt

Cissus zombensis (Bakei) (Combretum microphyllum Corchorus trilocularis Cordyla africana

Crinum macowanii Baker Croton megalobostrys Cussonia arborea Cyphostema spp.

Cyphostemma junceum (Webb)

Dalbergia nyassae, Swartzia madagascariensis

Dicoma anomala Sond.

Dicoma kirkii

Dioscorea bulbifera L.

Diplorhynchus condylocarpon Dolichos kilimandscharicus Dolichos trinervatus Baker Ectadiopsis oblongifolia Ehretia amoena klotzschi

Ehretia divaricata
Ehretia obtusifolia
Elephantorrhiza goetzei

Eriospermum abyssinicum Baker

Erythrophleum sauveolens

Fagara chalybea Ficus capensis Flacourtia indica

Flueggea virosa, Securinega virosa Gonatopus boivinii (Decne.) Engl.

Grewia micrantha

Heteromorpha arborescens Holarrhena pubescens Hymenocardia acida Hypoxis villosa L.f. Ipomoea tenuirostris Jatropha curcas

Kaempferia rosea Schweinf. ex Baker

Kigelia africana Lannea edulis Lotus sp.

Markhamia obtusifolia Melia azedarach

Momordica foetida Schumach & Thonn.

Moringa oleifera Mucuna poggei Taub. Multidentia crassa Musa paradisiaca

Neorautanenia mitis (A.Rich.) Verdc.

Nidorella auricalata Oldfieldia dactylophylla Parinari excelsa Sabine Pericopsis angolensis Phelinus gilvus

Phyllanthus reticulatus Piliostigma thonningii

Table 2 Cont....

Thunbergia spp.

Pseudolachnostylis maprouneifolia Dichrostachys cinerea Psorospermum febrifugum Tricalysia coriacea Pterocarpus angolensis Tricalysia spp. Trichillia emetica Pyrenacantha kaurabassana Baill. Rauvolfia caffra Trichodesma zeylanicum Rhus longipes Turraea floribunda Rothmannia fischeri Turraea nilotica Schrebera trichocloclada Tylosema fassoglensis (Kotschy ex Schweinf.) Sclerocarya birrea Torre & Hillc. Searsia tenuinervis Uapaca kirkiana Vernonia corolata Senna petersiana Senna sengueana Vigna radiata Sphaeranthes angolensis Vitex mombassae Steganotaenia araliacea Xeroderris stuhlmannii (Taub.) Mendonca & Strychnos innocua EP Sousa. Tabernaemontana elegans Ximenia americana Tacca leontopetaloides (L.) Kuntze Ximenia caffra Tephrosia vogeli Xylopia perviflora Terminalia sericea Zanha africana

Zingiber officinale

Table 3: Number of plants found to be used for each of the COVID-19 related diseases or symptoms

Variable	Frequency n=306	Percentage
Cough	11	3.59
Pneumonia	9	2.94
D 4/A 4		1.02
Breath/Asthma	5	1.63
Pain/Aches	87	28.43
Fever	2	0.65
Diarrhoea	1	0.33
Immunity	8	2.61
mmunity	8	2.61
Blood	10	3.27
Fatigue	2	0.65
Heart	11	3.95
Viral Activity	12	3.92
,		
Inflammation	8	2.61
Rheumatism	10	3.27

Table 4: Medicinal plants used on more than one COVID-19 related disease

r of				SIII																	
Number of	COVID-	related	diseases/	symptoms	9		2		2	7	3		ε				8	2		2	
Rheumatism													Yes (e)				Yes (e)	Yes (e)			
Inflammation													Yes (e)								
Viral					Yes (f)													Yes (e)			
Heart										Yes (g)											
Fatigue																					
Blood					Yes (f)								Yes (e)								
Immune	system	boosters			Yes (g)		Yes (c)														
Diarrhoea																				Yes (e)	
Fever					Yes (f)																
Pain/	,	Acnes			Yes (f)	Yes (k)	Yes (i)			Yes (i)	Yes (c)						Yes (e)			Yes (e)	
Breath/	,	Asthma																			
Pneumonia									Yes (b)		Yes (c)										
Cough					Yes (f)				Yes (b)		Yes (c)						Yes (e)				
Species name					Azadrachta indica A.	Juss.	Azanza garckeana	(F.Hoffm.) Exell & Hillc.	Berberis holstii Engl.	Carica papaya L.	Combretum	microphyllum Klotzsch		Cyphostemma junceum	(Baker) Desc. ex Wild &	R.B. Drumm.	Dicoma anomala Sond.	Dolichos	kilimandscharicus Taub.	Elephantorrhiza goetzei	(Harms) Harms

Table 4 Cont....

2		2		co	2		4			8	2		3			2		2		4	
																				Yes (e)	
																		ı			
Yes (e)							Yes (f)														
		Yes (g)		Yes (e)							Yes (e)										
Yes (e)					Yes (g)		Yes (f)	Yes (g)	Yes (g)	Yes (g)										Yes (e)	
																		ı			
																		Yes (c)	,		
				Yes (e)			Yes (g)														
				Y			Y														
																				Yes (e)	
		Yes (i)		Yes (e)	Yes (k)		Yes (f)				Yes (c)		Yes (d)			Yes (i)		Yes (g)		Yes (c)	
										Yes (e)						Yes (g)					
													(p)					ĺ			
										<u></u>			d) Yes (d)								
		یر								Yes (e)			a Yes (d)			s					
	aker	ica (Burm		a L.f.	па		era Lam.			ei Taub.	n mitis (A		ctylophylle	Oliv.) J		angolensis	wen	nningii	ie-Redh.		Baill.
Eriospermum	abyssinicum Baker	Flacourtia indica (Burm.	f.) Merr.	Hypoxis villosa L.f.	Kigelia africana	Lam.) Benth.	Moringa oleifera Lam.			Mucuna poggei Taub.	Neorautanenia mitis (A.	Rich.) Verdc.	Oldfieldia dactylophylla	(Welw. ex Oliv.) J.	Léonard	Pericopsis	(Baker) Meeuwen	Piliostigma thonningii	(Schum.) Milne-Redh.	Pyrenacantha	kaurabassana Baill.
Eric	aby.	Fla	f.) I	Hyp	Kig	Lan	Moi			Mu	Neo	Ric	Old	(We	Léo	Per	(Ba	Pili	(Scl	Pyr	kan

Table 4 Cont....

4	7	8	2	7	(C)	2	2	5	
	Yes (c)	Yes (e)							9
Yes (f)			Yes (f)			Yes (c)			9
Yes (f)		Yes (e)	Yes (f)						∞
								Yes (g)	∞
Yes (f)					Yes (f)	Yes (c)			9
								Yes (g)	vo
									1
									2
Yes (f)	Yes(c)	Yes (e)		Yes (i)	Yes (f)		Yes (c)		22
				Yes (g)			Yes (g)		4
					Yes (f)				4
									9
Sclerocarya birrea (A. Rich.) Hochst.	Tabernaemontana elegans Stapf	Tacca leontopetaloides (L.) Kuntze	Tephrosia vogelii Hook. f.	Terminalia sericea Burc. ex DC.	Trichilia emetica Vahl	Xeroderris stuhlmannii (Taub.) Mendonca & Sousa	Zanha africana (Radlk.) Exell	ber officinale	
Sclero Rich.)	Taber	Tacca leonto (L.) Kuntze	Tephra f.	Terminc ex DC.	Trichi	Xerode (Taub.) Sousa	Zanha Exell	Zingiber Roscoe	Total

Table 5: Literature Reported Pharmacological properties of medicinal plants with potential for use in COVID-19 disease

Plant species	Cited Uses in	Lab study	Phytochemicals available	Mechanism studies of the plants studied	COVID-19
	Ethnobotanical	done in			related
	survey(indicated in	Malawi on the			# 70/ T
	the excel sheet)	plant			rests/Studies
Andrabata indian	Count moin/nother	_	Alfoloide flavonoide tritamanoide nhanolio	Outh ashma antitinal activity antidiarchaal anti	_
Azaarachia indica A.	Cougn, pain/acnes,	None	Alkaloids, flavonoids, tricrpenoids, pnenone	Cough, asthma, andviral activity, anddiarrheal, and-	Case report,
Juss.	fever, blood,		compounds, carotenoids, steroids and	inflammatory, antipain, immunity response, fever.	Domicon
	immunity, viral		ketones.	Suppression of viral replication; anti-oxidant activity;	Neview,
	infections.			induce a cell-mediated and humoral immune response;	Computational
				maintaining normal immune homeostasis by upregulating	study. ⁷⁴⁻⁷⁶
			Glycosides, Reducing Sugar, Tannins,	type 1 response; Th1 type immune responses; antibody	
			Saponins, Polysaccharides, Phytosterols,	production against viruses; increases CD4+ cell levels;	
			Phenols Azadirachtin.78-79	induce dendritic cell maturation; macrophage-mediated	
				antigen presentation. ^{74,80-84}	
Azanza garckeana	Protect from illness.	Antimalarial	Amino acids, alkaloids, ascorbic acid,	Antibacterial antifungal, antihyperglycemic, antimalarial,	
(F.Hoffin.) Exell &		Activity.85	carotenoids, flavonoids, glucosides, phenols,	anti-oxidant and iron absorption activities.86	N 1 W.
Hille.			lipids, tannins and saponins.86		None.
		Nutritional			
		value. ⁶³			

Table 5 Cont....

None.	None.	None.	None.	None.
Antidiabetic activity, antioxidants, antimicrobial, nanalgesic, anti-inflammatory, anti-arthritic and wound healing. 87.89	Anti-inflammatory, immunomodulatory, analgesic, Nephroprotective, hepatoprotective, hypoglycaemic, hypolipidemic, antisickling membrane-stabilizing properties and protect blood cells against stress-induced destruction. ⁹⁰⁻⁹⁴	Anti-oxidant, antimutagenic, anti-oxidant, antiplatelet, anticoagulant, antinecrotic, antitumour, antinephrotoxic, anti-inflammatory, anti-nociceptive, anticholinesterase, antidiabetic, anti-asthmatic, antimicrobial and anti-insecticidal activities.	None.	Anthelmintic, anticancer, antihyperglycemic, anti- inflammatory, antimicrobial, antioxidant, antiplasmodial and hepatoprotective activities. ⁹⁸
Total phenols, tannins, flavonoid, saponins, alkaloids. ⁸⁷⁻⁸⁸	Flavonoids, other phenolic compounds polysaccharides, glycosides, enzymes, flavonoids, lectins, saponins, vitamins, steroids.	Triterpenes, flavonoids, lignans, amino acids, alkaloids. 95.96	None.	Acatylenic compounds, phenols, flavonoids, phytosterols, saponins, sesquiterpenes, tannins and triterpenes. ⁹⁸
None.	None.	None.	None.	None.
Cough, pneumonia.	Pain/aches, heart problems.	Pain/aches.	Blood, inflammation, rheumatism.	Headache, cough, Pains in Stomach, fever, Rheumatism.
Berberis holstii Engl.	Carica papaya L.	Combretum microphyllum Klotzsch	Cyphostemma junceum (Baker) Desc. ex Wild & R.B. Drumm.	Dicoma anomala Sond.

Table 5 Cont....

Dolichos	Shingles,	None.	None.	None.	None.
kilimandscharicus	rheumatism, new				
Taub.	castle disease in				
	chicken and				
	rheumatism.				
Elephantorrhiza goetzei	Pain/aches	None.	Phenolic	Antibacterial, antifungal,	None.
(Harms) Harms	,		compounds, coumarins, flavonoids, saponins,	antiviral, anthelmintic, antioxidant.86	
	Латноеа.		stilbenoids, tannins and triterpenoids.86		
Eriospermum	Heart,	None.	None	None.	None.
abyssinicum Baker	Inflammation.				
Flacourtia indica	Pain/aches,	None.	Flavonoids Saponins Tannins Terpenoids	Antimicrobial, antiviral, antifungal properties, anti-oxidant,	None.
(Burm. f.) Merr.	Wirol infantions		Phenols Alkaloids Steroids Pholabatannins	anti-inflammatory. ⁹⁹	
	viidi illiecuolis.		Anthroqinones Cardiac glycosides Coumerins		
			Reducing sugars. 99		
Hypoxis villosa L.f.	Pain/aches,	None.	None.	None.	None.
	Immunity,				
	Viral infections.				

Table 5 Cont....

Kigelia africana (Pain/aches,	None.	Iridoids, flavonoids, kigelinone, isopinnatal,	Antiprotozoal, antibacterial, antifungal, analgesic, anti-	me.
Lam.) Benth.	Heart		dehydro-α-lapachol, p-coumaric acid,	inflammatory, antidiarhoea, andidiabetic, antiprotozoal,	
	116411.		kigelinone, isopinnatal, iridoids, ferulic acid,	anti-inflammatory, analgesic, anticancer, antidiarrhoeal,	
			palmitic acid and verminoside. 100	anti-ulcer. 101	
	,	,		-	
Moringa oleifera Lam.	Pain/aches,	None	Alkaloids (moringine and moringinine),	Anesthetic, antinociceptive, antispasmodic, diuretic, anti-	me.
			pterygospermin, triterpenoids, saponins and	urolithiatic, anti-ulcer, hypotensive, cardioprotective,	
	Immunity, neart,		tannins. 102,103	antihelmentic, hypolipidemic, anti-atherosclerotic,	
	Inflammation.			hepatoprotective, wound healing, antifungal, antibacterial,	
				antitrypanosomal, hypoglycemic, and anti-AIDS	
				outcomes. 102,103	
Mucuna poggei Taub.	Cough, Heart.	None.	Balsams, tannins, triterpenoids, saponins,	Anti-inflammatory and anticancer properties. ¹⁰⁴ None.	me.
			alkaloids, terpenoids, carbohydrates. 104		
	Breathe/asthma.				
Neorautanenia mitis	Pain.	None.	Saponin glycosides, flavonoids, tannins and	Acaricidal and insecticidal activities, cytotoxicity,	
(A. Rich.) Verdc.			alkaloids. ¹⁰⁵	antimicrobial and antinociceptive activities,	
				antidiarrheal. ¹⁰⁶	
Oldfieldia	Pneumonia,	None.	None.	None. None.	me.
dactylophylla (Welw.	coughing, pain.				
ex Oliv.) J. Léonard					
Pericopsis angolensis	Breathe/asthma,	None.	None.	None. None.	ne.
(Baker) Meeuwen					

Table 5 Cont....

	Pain.				
	Nose bleeds, (fever, respiratory ailments,	None.	Flavonoids, tannins, kaurane diterpenes, alkaloids, carbohydrates, saponins, terpenes,	Antilipidemic, antibacterial, antihelminthic, anti- inflammatory, anthelmintic, analgesic, antipyretic,	None.
	Malaria.		and volatile oils. ¹⁰⁷	antidiabetic, anti-oxidant and antilipidemic activities. ¹⁰⁷	
	Breathe/asthma	None.	Xanthose. ¹⁰⁸	Anti-HIV.108	None.
	Fever, Heart,				
	Rheumatism.				
Sclerocarya birrea (A.		None.	Polyphenols, tannins, coumarins, fl avonoids,	Antidiarrhoeal, antidiabetic, anti-inflammatory,	None.
			triterpenoids, phytosterols. 109-110	antimicrobial, antiplasmodial, antihypertensive,	
				anticonvulsant, antinociceptive and anti-oxidant,	
				astringent, antihyperglycemic, anti-atherogenic,	
				antiviral. ¹⁰⁹⁻¹¹⁰	
	backache and	None.	Alkaloids.111	Antibacterial activity. ¹¹¹	None.
	rheumatism.				
Tacca leontopetaloides	Yellow fever,	None.	Flavonoids, steroids, and tannins,	Anticancer, anti-oxidant.112	None.
	stomachache,		taccalonolide, flavones, isoflavones,		
	rheumastism.		anthocyanins, coumarins, catechins, and		
			carotenoids. 112		

Table 5 Cont....

None.		nti- None.	anti- idant	anti- ivity,		lial, None.	ive,	anti-		None.			ory, None.	iral,	
Anti-oxidant, antimicrobial, antivirus, and anticancer. 114		Antibacterial, anti-HIV, antifungal, lipolytic activity, anti-	inflammatory activity, hypoglycemic activity, anti-mutagenic activity, acetyl-cholinesterase effect, antioxidant	activity, wound healing, anticancer, anti-neurodegenerative, anti-parasitic activity,	antidiabetic. ^{44,115,116,117}	Anti-inflammatory, antischistosomal, antiplasmodial,	anticonvulsant, antitrypanosomal, antitussive,	antimutagenic and hepatoprotective properties, a	oxidant, antidiarrheal. ^{118,119}	None.			Anti-atherogenic, anti-oxidative, anti-inflammatory,	anticancer properties, antibacterial, antifungal, antiviral,	antidiabetic, insecticidal, antitrypanosomal. ¹²⁰
Rotenoids, flavones, flavonones, tephrosin, rotenone, dequelin	terpenoids, flavonoids, tannins, saponins, and phlobatannins. 113.114	Saponins, lignin, steroids, glycosides,	phenolic acids, amino acids, terpenoids, tannins, flavonoids, lignans, phenols and	glycosides and anthraquinones. 44.115.116.117		Total phenolics, total tannins,	total flavonoids, total flavonols and	sterols/terpenes. ¹¹⁸		None.			Anthocyanins, courmarins, saponins, steroids,	triterpenoids, tannins and volatile oils. 120	
None.		None.				None				None.			None.		
Viral,	Inflammation.	Breathe/asthma,	Pain/aches.			Pneumonia,	Dain/aches	ram actics,	Blood.	Continuous	menstruation.		Painkiller, headache.		
Tephrosia vogelii Hook. f.		Terminalia sericea	Burc. ex DC.			Trichilia emetica Vahl				Xeroderris stuhlmannii	(Taub.) Mendonca &	Sousa	Zanha africana (Radlk.)	Exell	

Table 5 Cont....

None.								
antinausea,	ascular effects,							
anti-inflammatory,	; cardiovascular, cardiova	antidiabetic, anti-asthmatic, antiviral. 121-123						
Antioxidant,	anticarcinogenic	antidiabetic, anti						
[4]-gingerol, [6]-gingerol, [8]-gingerol, [10]-	gingerol, [6]-paradol, [14]-shogaol, [6]- anticarcinogenic, cardiovascular, cardiovascular effects,	shogaol, 1-dehydro-[10]-gingerdione, [10]-	gingerdione, hexahydrocurcumin,	tetrahydrocurcumin, gingerenone A, 1,7-bis-	(4' hydroxyl-3' methoxyphenyl)-5-	methoxyhepthan-3-one, and methoxy-[10]-	gingerol. 121-123	
None.								
Immunity,		neart.						
Zingiber officinale Immunity,								
Zingiber	Roscoe							