Phytochemical Analysis and Broad Spectrum Antimicrobial Activity of *Cassia Occidentalis* L. (whole plant)

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ABSTRACT: *Cassia occidentalis* L. whole plant was extracted successively with hexane, ethylacetate and methanol. Another crude extract of aqueous methanol was also carried out. The extracts were tested *in vitro* for activity against standard strains microbes and clinical isolates. The zones of inhibition, minimum inhibitory concentration (MIC), minimum bactericidal concentration (MBC) and minimum fungicidal concentration (MFC) were determined. The *in vitro* antimicrobial screening revealed that the extract exhibited varying activity against different microbes with zones of inhibition ranging from 14-34mm, MIC ranging from 1.25 - 10mg/ml, and MBC/MFC of 2.5-20mg/ml for the sensitive organisms at the tested concentrations. The highest activity was an MIC of 1.25 mg/ml and MBC of 2.5mg/ml. The activities observed could be due to the presence of some of the secondary metabolites like, alkaloids, anthraquinones, sterols, glycosides, saponins, terpenes and flavonoids detected in the plant. [New York Science Journal 2010;3(10):74-81]. (ISSN: 1554-0200).

Key words: *Cassia occidentalis*, phytochemicals, antimicrobial activity, MIC, MBC, MFC.

INTRODUCTION

The development of resistance to current antibiotics by disease causing microbes has reinforced research for discovery of new ones. Current trends in drug development process are focused on natural sources, especially sources of plant origin due to some proven correlation between the folkloric medicinal uses of some of these plants to biological activity. Hence the use of plant materials to prevent and treat infectious diseases successfully over the years has continued to attract the attention of scientist worldwide (Osawa *et a*l, 1990; Kunle *et al*, 2003; Roopashree et al 2008; Kunle and Egharevba 2009; Begum *et al* 2002). *Cassia* species have been used as traditional medicine in rain forest and other tropical areas for centuries. The roots, leaves, flowers and seeds have been employed in herbal medicine around the world (Burkill, 1995). The *cassia* genus comprises of 600 species of trees, shrub, vines and herbs, with numerous species growing in the South American rainforest and tropics. Many species have been used as medicine, and these tropical plants have a rich history in natural medicine. Various Cassia plants have been known since the ninth or tenth centuries as a purgative and laxative e.g. *Cassia angustifolia* and *Cassia senna* (www.rain-tree.com/fedegosa.htm).

Cassia occidentalis Linn. belong to the family Caesalpiniaceae (Leguminosae**).** Synonyms include *Senna occidentalis, Cassia carolinian, Cassia ciliata, Cassia foetida, Cassia frutesceus, Cassia geminiflora* and *Cassia linearis***.** It is commonly called locally called *Akidi agbara (Igbo,) Abo rere (Yoruba) and Dora rai (Hausa).* The roots are considered as a diuretic, a tonic, dysmenorrhea (menstrual problem), tuberculosis, anemia, liver complaints and fever reducer. The leaf-sap is used in eye troubles in young and old as well as a febrifuge and laxative in The Gambia and Ijo area of Nigeria (Burkill 1995). The leaf is recognized as anti- neuralgic, purgative (in treatment of diaorhoea and dysentery) and vermifuge. The leaves and stems have been found to be hypertensive in dogs at Mexico. Ijo people in Nigeria use the leaves in treatment of malaria and body aches. In Yoruba land, the preparation with palm oil is used to cure convulsion in children. The root is believed to have depurative properties. Infusion or decoction is taking in Gabon to cleanse the blood and also used to clean body after parturition for Trinidad citizens (Burkill, 1995). Some of its ethno-use in various regions of the world is as highlighted below.

REGIONS	ETHNOMEDICINAL USE
Africa	Abscesses, bile complaints, birth control, bronchitis, bruises, cataracts, childbirth, constipation, dysentery, edema, erysipelas, eye infections, fainting, fever, gonorrhea, guinea worms, headache, hematuria, hemorrhages (pregnancy), hernia, increasing perspiration, inflammation, itch, jaundice, kidney infections, leprosy, malaria, pain (kidney), menstrual disorders, rheumatism, ringworms, scabies, skin diseases, skin parasites, sore throat, stomach ulcers, stomachache, swelling, syphilis, tetanus, worms, water retention, wounds
Amazonia	Abdominal pain, birth control, bile insufficiency, malaria
Brazil	Anemia, constipation, edema, fatigue, fever, gonorrhea, liver disorders, malaria, menstrual disorders, skin problems, tuberculosis, urinary disorders, water retention, weakness
Central America	Abortions, antifungal, athlete's foot, birth control, constipation, diarrhea, fungal infections, headache, menstrual disorders, menstrual pain, pain, respiratory infections, ringworm, spasms, uterine pain, urinary tract infections, urinary insufficiency, worms
Haiti	Acne, asthma, burns, colic, constipation, dropsy, eye infections, gonorrhea, headache, malaria, rheumatism, skin rashes and infections, and to increase perspiration
India	Abscesses, bites (scorpion), constipation, diabetes, edema, fever, inflammation, itch, liver diseases, liver support, rheumatism, ringworm, scabies, skin diseases, snakebite, wounds
Mexico	Chills, digestive sluggishness, dyspepsia, earache, eczema, edema, fatigue, fever, headache, inflammation (skin), laxative, leprosy, nausea, pain, rash, rheumatism, ringworms, skin problems, sores, stomachache, swelling, tumors, ulcers, venereal disease, water retention, worms, yellow fever
Panama	Colic, inflammation, spasms, stomach problems, worms, and as an antiseptic

Adapted from: www.rain-tree.com/fedegosa.htm

MATERIALS AND METHODS

All the solvents and reagent used in the study were of Analar grade and, unless otherwise stated, were sourced from Zayo-Sigma, Abuja, Nigeria.

Collection and Extraction of Plant Material

The plant was collected in April 2009 from Chaza Suleja, Nigeria and identified by the Taxonomist in the Department of Medicinal Plant Research and Traditional Medicine of the National Institute for Pharmaceutical Research and Development (NIPRD) Abuja, Nigeria. A voucher specimen was deposited at the herbarium of the department. The whole plant was rinsed with clean water and air-dried for two weeks, and then pulverized using a mechanical grinder. The pulverized plant was kept in an air-tight cellophane bag until used.

Phytochemical screening

The presence of some basic secondary metabolites in the pulverized plant material was determined using standard methods (Sofowora 2008; Evans 2002). Proximate analysis was also carried out to determine the moisture content, total ash value, acid insoluble ash value, and alcohol and water extractive values.

Preparation of extracts

Exactly 400g each of the pulverized plant was macerated successively in Hexane, ethylacetate and

98% methanol for 48hrs each. The mixtures were then filtered under vacuum and the filtrates concentrated using a rotary evaporator. The methanol concentrate was evaporated to dryness in a water bath. For aqueous methanolic extract, 70% methanol in water was used as extraction solvent and the concentrate was freeze-dried using a table-top freeze-dryer. The extracts were stored in an airtight sample bottles and kept in a desiccator until used.

Preparation of Extract Stock Concentration for Antimicrobial screening

A test stock concentration of 10mg/ml for aqueous methanol, methanol and ethylacetate extracts were prepared by dissolving 0.1g of each extract in 10mls of distilled water in separate test tubes. For the hexane extract a concentration of 20mg/ml was prepared by dispersing 0.2g in 10mls of distilled water. The positive control drugs were sparfloxacin (0.2mg/ml), erythromycin (0.5mg/ml) and flouconazole (0.5mg/ml), all of sigma chemicals UK obtained from Zayo-Sigma Abuja Nigeria.

Antimicrobial Screening

Organism Source

The organisms used include standard strains, *Staphylococcus aureus NCTC 6571, Bacilluc subtilis NCTC 8236, Eschericia coli NCTC 10418, Pseudomonas aeruginosa NCTC 6750, Salmonella typhimurium ATCC 9184, Klebsiella pneumonia ATCC 10031* and *Staphylococcuc aureus ATCC 13704,* and clinical isolates, *Staphylococcus aureus, Methicilin Resistant Staphylococcus aureus, Streptococcus pyogenes, Streptococcus faecalis, Corynebacterium ulcerans Listeria monocytogenes, Bacillus subtilis, Bacillus cereus, Escherichia coli, Klebsiella pneumonia, Klebsialla ozaenae, Proteus mirabilis, Proteus vulgaris, Pseudomonas aeruginosa, Pseudomonas flourescense, Salmonella typhimurium, Shigella dysenteriae, Aspergillus fumigates, candida albicans, Microsporum gypseum and Trichophyton rubrum.* The typed strains and clinical isolates were obtained from the department of medical Microbiology Ahmadu Bello University Teaching Hospital (ABUTH) and department of Pharmaceutical Microbiology, Ahmadu Bello University (ABU) Zaria, Nigeria, respectively. All the organisms were checked for purity and maintained at 4^oC in slants of nutrient agar and sabouraud dextrose agar (SDA) for bacteria and fungi respectively. Well diffusion method described by Hugo and Russel (1992) was used to determine the antimicrobial activities (zone of inhibition) of the extracts against the organisms.

Preparation of the Inoculum

A loopful of the test organism was taken from their respective agar slants and sub-cultured into test-tubes containing nutrient broth for bacteria and sabouraud dextrose liquid for fungi. The test-tubes were incubated for 24hrs at 37^oC for bacteria and for 48hrs at 30^oC for the fungi. The obtained microorganisms in the broth were standardized using normal saline to obtain a population density of 10^8cfu/ml for the bacteria. For the fungi, fungal spores were harvested after 7 days old SDA slant culture was washed with 10ml normal saline in 2% Tween 80 with the aid of glass beads to help in dispersing the spores. The spores suspension were standardized to 10^5cfu/ml.

Preparation of Media

The medium was prepared according to manufacturer's instruction (Oxoids Limited Basingstoke, Hampshire, England). 40g of Blood Agar (52g of SDA) were weighed into a conical flask 1000ml of distilled water was added and capped with a cotton wool. The media were boiled to dissolution and then sterilized at 121^oC for 15mins. The media were allowed to cool to 45^oC and 20ml of the sterilized medium was poured into sterile Petri-dishes and allowed to cool and solidify. The plates were labeled with the test microorganism (each plate with a test microbe). The microbes were spread evenly over the surface of the medium with the aid of a glass spreader. The plates were dried at 37^oC for 30mins and divided into two sets to be used for the well diffusion method and the disc diffusion method respectively.

Zone of Inhibition - Well Diffusion Method

A standard cork borer of 5mm in diameter was used to cut well at the center of each inoculated plate and the agar removed from the well. 0.1ml of the text solution (extract) was then introduced into the well created at the center for each plate. The bacteria plates were incubated at 37^oC for 24hrs while the fungal plates were incubated at 30^oC for 1-7days, and observed for the zone of inhibition of growth. The zones were measured with a transparent ruler and the result recorded in millimeters. The screening was done in triplicates. Sterilized distilled water was used as negative control.

Minimum Inhibitory Concentration - Broth Dilution Method

MIC of the extracts was also carried out using broth dilution method as described in Ibekwe *et al*, 2001. The nutrient broth and sabouraud dextrose liquid were prepared according to the manufacturer's instruction (10ml of each broth was dispensed into separate test-tube and was sterilized at 121^oC for 15mins and then allowed to cool. Two-fold serial

dilution of the extract in the broth were made from the stock concentration of the extract to obtain 10, 5, 2.5, 1.25, 0.625mg/ml for aqueous methanol, methanol and ethylacetate extracts, and 20, 10, 5, 2.5, and 1.25mg/ml for the hexane extracts. 0.1ml of the standardized inoculums of the microbes were then inoculated into the different concentrations of the extracts in the broth. The test tubes of the broth were then incubated at 37^{o}C for 24hrs and 30^{o}C for 1-7days for bacteria and fungi respectively and observed for turbidity of growth. The lowest concentration which showed no turbidity in the test tube was recorded as the MIC.

Minimum Bactericidal/Fungicidal Concentration - Broth Dilution Method

Blood and sabouraud media were prepared, sterilized at 121^{o}C for 15mins and was poured into sterile Petri-dishes and left to cool and solidify. The contents of the MIC in the serial dilution were then sub-cultured onto the media and incubated at 37^{o}C for 24hrs and 30^{o}C for 1-7days for bacteria and fungi respectively, and observed for colony growth. The MBC/MFC was the plate with the lowest concentration of extract and without colony growth.

Determination of activity index

The activity index of the crude plant extract was calculated as

Activity index (A.I.) =Mean of zone of inhibition of the extract

Zone of inhibition obtained for standard antibiotic drug

Determination of proportion index

The proportion index was calculated as

Proportion index (P.I.) =Number of positive results obtained for extract

Total number of tests carried out for each extract

RESULTS

The results of phytochemical screening and proximate analysis are shown in tables 1 and 2, while the zone of inhibition and minimum inhibitory concentration / minimum bactericidal & fungicidal concentration are as shown in table 3 and 4below.

Table 1: Phytochemical Analysis

METABOLITE	RESULT
Carbohydrate	+
Tannins	-
Saponins	+
Terpenes	+
Sterols	+
Flavonoids	+
Alkaloids	+
Phenols	-
Volatile Oil	-
Resin	+
Balsam	+
Cardiac glycoside	+
Phlobatannins	-
Anthraquinones	+

+ = present, - = not detected

Table 2: Proximate Analysis

Parameter	Values (%)
Moisture content	10.00
Water-soluble	15.10
extractive value	7.70
Alcohol-soluble	7.40
extractive value	5.30
Total ash value	
Acid-insoluble	
ash value	

Table 3: Zone of Inhibition

S/N	TEST ORGANISM	STRAINS	ZONE OF INHIBITION (mm)							ACTIVITY INDEX			
			C. occidentalis Extract				Control drugs						
			Am	m	e	h	Sp	Er	Fl	Am	m	e	h
1	*Staphylococcus aureus*	NCTC 6571	21	22	21	22	29	22	0	0.95	1.00	0.95	1.00
2	*Bacillus subtilis*	NCTC 8236	24	25	20	0	20	22	0	1.09	1.14	0.91	0.00
3	*Escherichia coli*	NCTC	25	27	24	22	22	24	0	1.04	1.13	1.00	0.92

		10418											
4	*Pseudomonas aeruginosa*	NCTC 6750	20	29	0	19	24	0	0	0.83	1.21	0.00	0.79
5	*Salmonella typhimurium*	ATCC 9184	24	27	0	0	25	27	0	0.89	1.00	0.00	0.00
6	*Klebsiella pneumoniae*	ATCC 10031	0	26	22	0	25	29	0	0.00	0.90	0.76	0.00
7	*Staphylococcus aureus*	ATCC 13704	21	24	27	21	20	27	0	0.78	0.89	1.00	0.78
8	*Candida albicans*	ATCC 10231	20	0	0	0	0	0	22	0.91	0.00	0.00	0.00
9	*Staphylococcus aureus*	Isolate	24	29	27	18	20	21	0	1.14	1.38	1.29	0.86
10	*Methicilin Resistant Staph. aureua*	Isolate	0	32	0	0	0	27	0	0.00	1.19	0.00	0.00
11	*Streptococcus pyogenes*	Isolate	23	34	0	14	20	26	0	0.88	1.31	0.00	0.54
12	*Streptococcus faecalis*	Isolate	20	34	0	0	24	29	0	0.69	1.17	0.00	0.00
13	*Corynebacterium ulcerans*	Isolate	24	32	25	0	25	30	0	0.80	1.07	0.83	0.00
14	*Listeria monocytogenes*	Isolate	20	32	26	0	25	24	0	0.83	1.33	1.08	0.00
15	*Bacillus subtilis*	Isolate	25	30	25	15	20	25	0	1.00	1.20	1.00	0.60
16	*Bacillus cereus*	Isolate	22	0	27	15	24	26	0	0.85	0.00	1.04	0.58
17	*Escherichia coli*	Isolate	24	0	25	0	27	20	0	1.20	0.00	1.25	0.00
18	*Klebsiella pneumoniae*	Isolate	20	27	0	0	26	19	0	1.05	1.42	0.00	0.00
19	*Klebsiella ozaenae*	Isolate	22	29	27	0	24	18	0	1.22	1.61	1.50	0.00
20	*Proteus mirabilis*	Isolate	0	0	27	0	22	20	0	0.00	0.00	1.35	0.00
21	*Proteus vulgaris*	Isolate	0	27	24	0	0	24	0	0.00	1.13	1.00	0.00
22	*Pseudomonas aeruginosa*	Isolate	0	29	0	0	19	22	0	0.00	1.32	0.00	0.00
23	*Pseudomonas flourescenses*	Isolate	0	32	0	14	0	24	0	0.00	1.33	0.00	0.58
24	*Salmonella typhimurium*	Isolate	24	31	22	0	20	22	0	1.09	1.41	1.00	0.00
25	*Shigella dysenteriae*	Isolate	22	29	27	14	20	20	0	1.10	1.45	1.35	0.70
26	*Aspergillus flavus*	Isolate	0	0	0	0	0	0	27	0.00	0.00	0.00	0.00
27	*Aspergillus fumigatus*	Isolate	0	0	0	0	0	0	23	0.00	0.00	0.00	0.00
28	*Candida albicans*	Isolate	0	19	14	0	0	0	24	0.00	0.79	0.58	0.00
29	*Microsporum gypseum*	Isolate	0	18	0	0	0	0	20	0.00	0.90	0.00	0.00
30	*Trichophyton rubrum*	Isolate	0	14	16	0	0	0	24	0.00	0.58	0.67	0.00

[1]Am = 70% aqueous methanol extract*;* m= *methanol* extract*; e= ethylacetate* extract*; h= hexane* extract Sp= Sparfloxacin; Er = Erythromycin; Fl = Flouconazole.

[2]A.I. used Erythromycin primarily, unless where there was no activity, in which case sparfloxacin or flouconazole were used.

[3]**Proportion Index: Am=0.63; m=0.80; e=0.60; h=0.33**

Table 4: MIC and MBC/MFC

S/N	TEST ORGANISM	STRAINS	*C. occidentalis* Extracts							
			MIC				MBC//MFC			
			Am	m	e	h	Am	m	e	h
1	*Staphylococcus aureus*	NCTC 6571	2.5	2.5	2.5	5	10	10	10	20
2	*Bacillus subtilis*	NCTC 8236	2.5	2.5	2.5	-	10	5	10	-
3	*Escherichia coli*	NCTC 10418	2.5	2.5	2.5	5	5	5	10	20
4	*Pseudomonas aeruginosa*	NCTC 6750	2.5	2.5	-	10	10	5	-	20

5	*Salmonella typhimurium*	ATCC 9184	2.5	2.5	-	-	5	10	-	-
6	*Klebsiella pneumoniae*	ATCC 10031	-	2.5	5	-	-	10	10	-
7	*Staphylococcus aureus*	ATCC 13704	2.5	2.5	2.5	5	10	10	5	20
8	*Candida albicans*	ATCC 10231	2.5	-	-	-	10	-	-	-
9	*Staphylococcus aureus*	Isolate	2.5	2.5	2.5	10	10	5	5	20
10	*Methicilin Resistant Staph. aureus*	Isolate	-	1.25	-	-	-	2.5	-	
11	*Streptococcus pyogenes*	Isolate	2.5	1.25	-	10	10	2.5	-	20
12	*Streptococcus faecalis*	Isolate	2.5	1.25	-	-	10	2.5	-	-
13	*Corynebacterium ulcerans*	Isolate	2.5	1.25	2.5	-	10	2.5	5	-
14	*Listeria monocytogenes*	Isolate	2.5	1.25	2.5	-	10	2.5	5	-
15	*Bacillus subtilis*	Isolate	2.5	1.25	2.5	10	5	2.5	5	20
16	*Bacillus cereus*	Isolate	2.5	-	2.5	10	10	-	5	20
17	*Escherichia coli*	Isolate	2.5	-	2.5	-	10	-	5	-
18	*Klebsiella pneumoniae*	Isolate	2.5	2.5	-	-	10	5	-	-
19	*Klebsiella ozaenae*	Isolate	2.5	2.5	2.5	-	10	5	5	-
20	*Proteus mirabilis*	Isolate	-	-	2.5	-	-	-	5	-
21	*Proteus vulgaris*	Isolate	-	2.5	2.5	-	-	5	10	-
22	*Pseudomonas aeruginosa*	Isolate	-	2.5	-	-	-	5	-	-
23	*Pseudomonas flourescenses*	Isolate	-	1.25	-	10	-	2.5	-	20
24	*Salmonella typhimurium*	Isolate	2.5	1.25	2.5	-	10	2.5	10	-
25	*Shigella dysenteriae*	Isolate	2.5	2.5	2.5	10	10	5	5	20
26	*Aspergillus flavus*	Isolate	-	-	-	-	-	-	-	-
27	*Aspergillus fumigatus*	Isolate	-	-	-	-	-	-	-	-
28	*Candida albicans*	Isolate	-	5	5	-	-	10	10	-
29	*Microsporum gypseum*	Isolate	-	5	-	-	-	10	-	-
30	*Trichophyton rubrum*	Isolate	-	5	5	-	-	10	10	-

[1]Am = 70% aqueous methanol extract*;* m= *methanol* extract; *e= ethylacetate* extract*; h= hexane* extract

DISCUSSION

The extracts were selectively activite against food pathogens like the *Staphylococcus aureus* and enteric organisms like *Streptococcus faecalis, Shigella dysenteriae* and *Bacillus species.* The methanolic and ethylacetate extract showed some activity against *Candida, Microsporum* and *Trichophyton*. The observed activity may be due to the presence of some metabolites like alkaloid, saponins, flavonoids and terpenes. The activity also suggests that the plant extracts could be good food preservative and also good as an antibiotic for the management of gastrointestinal and respiratory troubles.

The result of the phytochemical screening indicates the presence of carbohydrates, saponins, sterols, flavonoids, resins, alkaloids, terpenes, anthraquinones, glycoside and balsam. The presence of these metabolites suggests great potential for the plant as a source of useful phytomedicines. For instance, the presence of flavonoids and resins might be responsible for its use as anti-inflammatory recipe in Chinese folkloric medicine as some flavonoids has anti-inflammatory effect on both acute and chronic-inflammation (Kunle and Egharevba 2009; Sadique *et al*., 1987). Some plants that possess alkaloids are known for decreasing blood pressure and balancing the nervous system in case of mental illness. The presence of tannins could also shows that it is an astringent, help in wound healing and anti-parasitic. The presence of terpenes suggests its possible use as anti-tumor and anti-viral agent as some terpenes are known to be cytotoxic to tumor cells. Some to eudesmane sesquiterpenes has been reported to exhibit antibacterial properties. Alkaloids are known to

possess anti-malaria property, hence the plant may be a good source of antimalaria for which it is traditionally uses in locally (Ronan *et al*., 2009). Also the use of *C. occidentalis* as genital stimulant may be attributed to the presence of alkaloids. Plant containing saponins are believed to have antioxidant, anti-cancer, anti-inflammatory, and anti-viral properties.

The anthraquinones, emodin and chrysophanone have been isolated from the plant. Emodin has been reported to exhibit activity against *Bacillus subtilis* and *staphylococcus aureus* while chrysophanol has been reported to have some wound healing properties (Chukwujekwu *et al*., 2006; Sheeba *et al*., 2009). Hence the activity of exhibited in this study may have been due to the presence of these anthraquinones. Other compounds reported in literature include, 1,8-dihydroxyl-2-methyl anthraquinone, 1,4,5-trihydroxy-3-methyl-7-methoxy anthraquinone, cassiaoccidentalin A, B & C, which are C-glycosides, achrosine, anthrones, apigenin, aurantiobtusin, campesterol, cassiollin, chryso-obtusin, chrysophanic acid, chrysarobin, chrysoeriol, essential oils, funiculosin, galactopyranosyl, helminthosporin, islandicin, kaempferol, lignoceric acid, linoleic acid, linolenic acid, mannitol, mannopyranosyl, matteucinol, obtusifolin, obtusin, oleic acid, physcion, quercetin, rhamnosides, rhein, rubrofusarin, sitosterols, and xanthorin. (Jawahar and Gupta, 1974; Tsutomu *et al*., 1999; www.rain-tree.com/fedegosa.htm).

Pharmacognistic analysis showed moisture content of 10%, this shows that the dry plant has little chance of microbial attack and the total ash value of 7.4% suggests that the amount of inorganic substance in the plant is not too high. Acid insoluble ash value was 5.3% which suggests that the soluble inorganic component is quite small and this may portray the plant as a poor source of dietary inorganic salts. The alcohol and water extractive values of 7.7% and 15.1% respectively show that water is a better solvent of bulk extraction than alcohol.

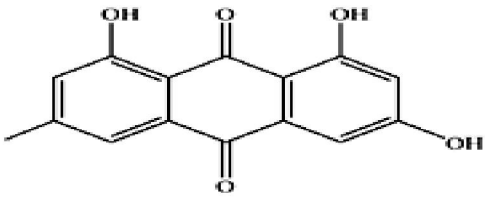

Figure 1: Molecular Structure of Chrysophanic acid

Synonym: Chrysophanol; 1,8-Dihydroxy-3-methylanthraquinone

Molecular Formula: $C_{15}H_{10}O_4$

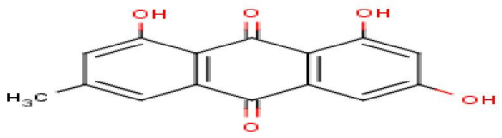

Figure 2: Molecular Structure of Emodin

Synonym: 6-methyl-1,3,8-trihydroxyanthraquinone

Molecular formula: $C_{15}H_{10}O_5$

CONCLUSION

This study supports the traditional use of *Cassia occidentalis* for the treatment of various infectious diseases in different regions of the world. The study also shows that the plant may be good as an antibacterial recipe but may not be very useful as an antifungus. More work is ongoing to isolate the bioactive components in the plant.

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