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Contaminated Air Force

Evaluation of Accumulation ability

Highlights

Activity of Eucalyptus Globules

Variability of Anibarosaeodora Oils

Discovering Thoughts, Inventing Future

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Determination of Phytochemical Constituents and Insecticidal Activity of Eucalyptus Globules Against Cactus Pests

By Yohannes Weldemariam & Shishay Welderufael
Adigrat University, Ethiopia

Abstract- Cactus pear is widely distributed in Tigray and South Amhara Regional state and is the integral part of the economy of the people. It is commonly used as a famine food, feed for livestock, bee forage, a source of cash income and short time occupation, soil and water conservation, live fences etc. However, cactus is been gradually destroyed. The peoples relied on cactus are suffering from the destruction. The effect of the insect *cochineal* has been an alarm around the region. The intention of this research was to find a solution to insects and pests on cactus. Insecticidal activity was done on *Eucalyptu* soil extracts and on three commercial pesticides. At all concentrations the oils terminate the cochineal insects of all ages. Especially, the male cochineals (adult and young) and young female were more sensitive to the oils respectively. Findings from spray test are promising with 80-90% inhibition in average.

Keywords: opnitiaficusindica, eucalyptus globulus, hydro distillation, essential oil, phytochemical screening, physicochemical constants, insecticidal activity.

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Yohannes Weldemariam [α] & Shishay Welderufael [σ]

Abstract- Cactus pear is widely distributed in Tigray and South Amhara Regional state and is the integral part of the economy of the people. It is commonly used as a famine food, feed for livestock, bee forage, a source of cash income and short time occupation, soil and water conservation, live fences etc. However, cactus is been gradually destroyed. The peoples relied on cactus are suffering from the destruction. The effect of the insect *cochineal* has been an alarm around the region. The intention of this research was to find a solution to insects and pests on cactus. Insecticidal activity was done on *Eucalyptu s*oil extracts and on three commercial pesticides. At all concentrations the oils terminate the cochineal insects of all ages. Especially, the male cochineals (adult and young) and young female were more sensitive to the oils respectively. Findings from spray test are promising with 80-90% inhibition in average.

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I. Introduction

Unlike those edible vegetable oils essential oil(ethereal oil) is a concentrated, hydrophobic liquid that contains hundreds of aromatic compounds, organic constituents, and other natural elements found in dried or fresh leaves, stems, flowers, bark, wood, roots or other elements of a plant(Buchbauer2010). Essential oils has been used for psychological and physical wellbeing since long timein China and Egypt. Yet, its medicinal potential was known only during the earlier part of the 20thCentury as discovered by French Chemist Rene-Maurice Gattefosse(Buchbauer2010,Taylor and Francis Group 2010,Cipolca2005, Celikel and Kavas 2008).

Essential oils can be used for treating burned skin or to heal wounds due to their anti-inflammatory properties (Derwich et al. 2010). They also bear role to play in the protection of crops against mould, mildew and wood root fungi and plants against various insects (Isman 2000). In addition, when applied in a vapor form, essential oil has potential to manage weeds, especially as its toxicity appears to be harmful to the insects. Since essential oils are a complex mixture of chemical components their synergetic effect is promising. Most of them work in the same way as:

- Repellents which drive the insects away from the plant by their smell or taste
- Anti- feed ants which cause insects feeding on the plants to reduce their food intake until they die from starvation
- Ovipositor deterrents which prevent insects from laying eggs
- Inhibitors which stop the development of different stages of the insect(Isman 2000, Hussain2009, Can Baser and Buchbauer 2010).

Globules oil *from Eucalyptus* genus can control aphids, Piercing-Sucking insect pests associated with Faba bean *Viciafaba by* reducing the population of leafhoppers and planthoppers (Mousa et al. 2013). Data from insecticidal activity of this plant indicates it is lethal to female Pediculushumanuscapitis De Geer insect (Yang et al. 2004).On another study it has lethal effect to Sternechus subsignatus, Rhyssomatussubtilis and Lutzomyialongipalpis, with significant mortality (contact toxicity (LD50 = 0.40 and 0.84 μL/cm^2 for S. pinguis and R. subtilis respectively) two important pest of soybean (Maciel et al.2010).

Cactus pear is widely distributed in Tigray Regional State and is the integral part of the economy of the people. Fruits are very sweet and have many essential components comparable to mostly used fruits and known in the countries over the entire world where cactus grows. Young cladodes are edible as fresh or cooked vegetable in the origin county Mexico and other countries. As reported in one study done on uses of cactus as livestock feed in Northern Ethiopia it revealed many uses such as famine food, feed for livestock, bee forage, a source of cash income and short time occupation, soil and water conservation, live fences etc (Gebretsadik2013). With regard to its medicinal application it is used to lower fever and relieves chest pains, as a healing pad in cases of rheumatic and asthmatic symptoms of the chest, liver trouble, earaches, against diabetes and neuro protective effects. However, here in Tigray its production and quality as compared to its potential is very low. One of

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the main reasons is damage of insect and disease. This fruit crop can be affected by disease such as Phyllosticta pad spot, Anthracnose, *Echinocereus, Pythium*, Sammons'virus, Bacterial necrosis and insects like *Scyphophorusacupunctatus*, Cochineal scale, Cactus longhorn beetle, Coccid scale etc. despite of this fact, there are no research reports on the control methods of these insects and diseases which hindering its production and quality (Buchbauer2010, Derwich et al. 2010, Isman 2000, Mousa et al. 2013).The aim of this research project was to extract essential oil from one eucalyptusspecies as an pesticide specifically with focus to Cochineal insect. This is the first project to try to eliminate cochineal insects in natural chemical pesticide.

II. Methodology

a) Materials and Methods

i. *Materials*

a. *Chemicals and Solvent*

Glacial acetic acid, acetic anhydride, ammonium solution, conc. hydrochloric acid, sodium hydroxide, potassium hydroxide, sodium mercuric chloride , potassium iodide , calcium hydroxide ($Ca(OH)_2$), iodine, potassium iodide, ferric chloride ($FeCl_3$), picric acid, concentrated sulphuric acid, dilute ammonia solution, n-hexane, diethyl ether, acetone, benzene, ethyl acetate, and ethanol.

b. *Instruments and Equipment*

Thermometer, distiller, pestle and mortal, vacuum pump, separatory funnel. pipettes, burettes, Clevenger apparatus, round bottom flask, fridge, electrode beam balance were the major instruments used in this work.

ii. *Methods*

a. *Extraction of Essential Oil*

Fresh collected samples were washed with tap water, to eliminate soil and other surface contaminants and shade dried at room temperature for 8 -10days.The dried sample was crashed to increase surface area using pestle and mortal(Saim et al. 2008).The essential oil was then extracted from samples of *Eucalyptus* using hydro distillation in Clevenger type apparatus through the following procedure; first 300g of the sample was measured using beam balance and put in to 5000 ml three-necked round bottom flask using spatula. Then ¾ of flask was filled with distilled water. The round bottom flask was then placed on heating mantle and using metal clamps it was connected with the Clevenger apparatus and condenser. Then the flask was heated for 3-4hours. While it was heating the oil and water evaporated as stem. The oil appears at the top of the water. The essential oil was obtained by removing the water until it riches the layer of the oil. The obtained essential oil was purified and stored under refrigerator for further use (Maciel et al. 2010, Saim et al. 2008, Fabiane et al. 2007).

The percent yields of essential oil extracted was calculated as;

Percent yields = weight of the oil/weight of the sample used(Fabiane et al. 2007,Tiwari et al 2011)

b. *Insecticidal activity*

In order to test the toxicity of essential oil on the insects of different age (young and adult). Ten adults were put into the 2500 ml glass jars. Essential oil was then applied on a filter-paper strip measuring 3 x 3 cm attached to the lower side of the jar's lid. Doses was calculated and assumed 100% volatilization of the oils in the exposure vessels. The same procedure was repeated with only difference in the number of treatment groups that 30 young insects were used in both male and female. The first insecticidal activity experiments was conducted at constant temperature (27 ± 1°C), photoperiod (14L: 10D) and relative humidity (60% ± 5) for 24 h. While for the sake of obtaining the exact death and time of paralysis the second experiment was done out of the incubator. In either case insects of both ages were exposed to essential oil vapors (100, 80, 60, 40, 20, 10, 5, 3, 1 μl/l air). A dose-mortality line was developed depending on the exposure time(s), and the lethal concentration of essential oil needed to kill 50% of the pest population (LC50) was also determined. Three replicates were set up for each dose and exposure time. In a small designed field containing six cladodes spraying was also done for three consecutive days with all the treatment groups at (100, 200, 300, 400, 500, 600 μl/l air). All replicates were run simultaneously during the experiments. A complete set of controls was also be maintained and replicated three times for each treatment (Mousa et al. 2013, Yang 2004 et al, Macielet al2010).

III. Result and Discussion

a) Essential oil yield

From fresh leaf samples of *Eucalyptus globulus* 1.56(%w/w) of oil was obtained.

b) Phytochemical screening findings

For a plant to have phytochemical constituents means that the plant is promising to be used in as herbal medicine. Some of those determined here have clear mechanism of action with respect to the strains. The phenols are expected to be toxic though they absent from the essential oil. Alkaloids are known to act in central nervous system of the insects while tannins complex with proteins through so-called nonspecific forces such as hydrogen bonding and hydrophobic effects, as well as by covalent bond formation. They inactivate microbial adhesions, enzymes, and cell envelope transport etc (Jeyachandran et al. 2009, Kashiwada1992, Paiva et al. 2003, Jagessarand Cox, 2010, Schulzet al. 2004)Condensed tannins act by

binding to cell walls of for instance ruminal bacteria resulting in declining growth weakened activity. In the case of insects tannins specifically those condensed ones are expected to act the same.

Table 1 : Phytochemical constituents of *Eucalyptus globulus and Eucalyptus camaldulensis* leaf and oil.

S/No	Phytochemicals	*Eucalyptus globulus(oil)*	*Eucalyptus globulus(leaf)*
1	Phenol	-	+
2	Alkaloids	++	-
3	Free anthraquinones	-	+
4	Flavonoids	-	-
5	Tannins	++	++
6	Steroids	++	++
7	Terpenoids	++	++
8	Saponins	ND	+
9	Cardiac glycosides	+	+
10	Volatile oil	++	++

Key: (++)=strong presence, (+)=presence,(-)= absence, (ND)=not determined

c) *Insecticide activity on cochineal insect*

In Cochineal insect taxonomy the female is about five times bigger than the male and it lacks wings. Equal sizes of both adult and young female as well as male were collected carefully in glass and plastic bottles from the most infected area near to the research laboratory. Since the insects are host specific that it is impossible to grow them from egg level. We tried to collect them along with the cactus cladode. Insecticidal tests were also done while the insects are in the cladode and in isolated manner. The problem is the females are fixed to the cladode attached by their mouth. For the first time cochineal female and male (young and adult) were also tested with the treatment groups in an incubator for 24 hours. The next day none of the insects survive in the jars containing them. But we were also interested at determining the exact time when the insects will die and follow how they behave towards the oil from the beginning. Thus, we tested the insects in open but protected environment in the laboratory. The recorded data are as follows.

i. *Eucalyptus globulus*

The oils of this specific species of eucalyptus tend to paralyze and kill the insects. At all concentrations the recorded activity was dose dependent. At the highest concentration(100μL/air) young cochineal male paralyzed and dead at 29±9 and 49±12 respectively while, the females are bigger and stronger than the males that they get paralyzed and killed at some longer time(58±19 and 89±18). In the same sex the adult tend to resist more than the young. Because of this 30 young cochineal was included in each jar. Even at this number, the oils paralyze and kill with less time compared to the adult insects. Table 2 and table 3 display this finding.

Table 2 : Paralysis and death time of *Eucalyptus globulus* essential oils over young cochineal insect male and female

S/No	Treatment groups	Concentration(μL)	Cochineal Male		Cochineal Female	
			Age(young)			
			Time(in minuets)			
			Paralysis	Death	Paralysis	Death
1	*Eucalyptus globulus*	100	29±9	49±12	58±19	89±18
		80	33±11	50±14	70±24	99±17
		60	39±10	58±11	87±20	107±21
		40	51±20	75±17	97±25	126±38
		20	60±7	87±20	100±18	124±34
		10	77±11	99±18	107±23	142±30
		5	94±8	108±21	144±54	157±33
		3	121±25	148±37	164±43	189±41
		1	140±22	166±41	191±48	217±55

- *Results on this biological study were reported as mean ± Standard deviation by formula. n= 30 in each group.*

Table 3 : Paralysis and death time of *Eucalyptus globulus* essential oils over adult cochineal insect male and female

S/No	Treatment groups	Concentration	Cochineal Male		Cochineal Female	
			Age(adult)			
			Time(in minuets)			
			Paralysis	Death	Paralysis	Death
1	*Eucalyptusglobulus*	100	38±11	69±17	68±21	200±55
		80	45±7	88±12	100±30	185±33
		60	45±8	100±16	122±40	199±34
		40	62±14	99±14	200±39	253±64
		20	66±13	107±19	220±33	308±56
		10	82±11	134±20	267±68	552±80
		5	91±8	158±38	388±84	608±88
		3	111±21	197±36	441±55	789±91
		1	139±18	254±31	710±98	920±105

- *Results on this biological study were reported as mean ± Standard deviation by formula. n= 10 in each group.*

ii. *Commercial pesticides*

In case of an emergency there is a habit in many people all around the world to use these pesticides to manage mainly infections at house level. The aim of this specific assay was not to compare and contrast the activity of the essential oils with these pesticides considering them as reference standards. Rather it is to show the effect of the pesticides to the insects as well as to the plants taking them as single individual treatment agent. The time they took for paralysis and death of the insects is lower but comparable to the essential oils. So, they can also be recommended to be used. The major side effect seen was the outer layer of the cladode turned yellow sometime after of the spray. Since they are all chemicals they leave residue this can then affect the plant time from time. The effect to the animals after eating those sprayed cladodes any time after the spray is another major concern. As shown in the table below, males are eliminated at less time before females. The inhibition was dose dependent that with increasing concentration paralysis and death decreased. Yong cochineal insect of both sex tend to be moresusceptible than corresponding adult.

Table 4 : Paralysis and death time of Drusban (48%), Malathion(48%), Ventazion /Diainon(60%) over young cochineal insect male and female

S/No	Treatment groups	Concentration(μL)	Cochineal Male		Cochineal Female	
			Age(young)			
			Time(in minuets)			
			Paralysis	Death	Paralysis	Death
1	Drusban (48%)	100	36±16	55±11	71±14	96±13
		80	52±13	68±9	88±15	104±22
		60	42±16	77±9	101±10	125±24
		40	72±17	88±16	98±8	108±14
		20	100±10	111±12	128±21	150±20
		10	99±24	124±22	167±17	188±35
		5	145±33	154±25	164±20	185±35
		3	148±17	166±31	174±41	201±16
		1	172±33	204±38	225±19	263±44
2	Malathion(48%)	100	56±23	77±10	84±21	89±25
		80	68±14	94±14	88±15	102±28
		60	75±17	89±15	103±32	124±18
		40	86±24	97±32	138±14	158±46
		20	94±25	107±34	118±23	157±34
		10	125±16	142±26	188±28	209±31
		5	144±39	175±28	195±35	244±33
		3	164±47	180±31	211±43	239±26

		1	177±21	186±23	208±51	254±46
3	Ventazion /Diainon(60%)	100	68±22	75±16	96±28	130±42
		80	81±32	98±16	116±26	129±27
		60	92±27	105±15	110±20	145±34
		40	118±26	149±22	141±32	156±27
		20	133±42	150±24	179±19	188±26
		10	166±29	187±37	208±44	238±46
		5	195±25	206±38	258±17	277±56
		3	222±24	228±33	219±25	286±46
		1	232±19	248±44	304±49	337±55

- *Results on this biological study were reported as mean ± Standard deviation by formula. n= 30 in each group.*

Table 5 : Paralysis and death time of Drusban (48%), Malathion(48%), Ventazion /Diainon(60%) over adult cochineal insect male and female

S/No	Treatment groups	Concentration(µL)	Cochineal Male		Cochineal Female	
			Age(adult)			
			Time(in minuets)			
			Paralysis	Death	Paralysis	Death
1	Drusban(48%)	100	71±17	86±28	99±24	119±18
		80	84±27	108±19	97±22	127±32
		60	83±16	101±29	121±11	142±22
		40	79±24	91±36	140±18	160±17
		20	84±14	98±18	109±30	148±33
		10	102±18	116±36	108±26	138±42
		5	97±23	122±20	147±20	164±46
		3	104±17	128±32	130±31	161±22
		1	134±44	158±42	178±37	211±48
2	M alathion(48%)	100	84±23	96±21	94±24	108±23
		80	98±21	99±24	102±18	144±27
		60	111±22	128±22	148±39	155±15
		40	126±24	136±41	138±27	162±19
		20	137±23	149±19	172±44	187±34
		10	156±19	169±28	200±36	257±54
		5	148±34	170±11	204±35	266±38
		3	199±53	239±42	259±33	277±32
		1	222±32	256±21	247±46	271±31
3	Ventazion /Diainon(60%)	100	102±34	118±19	109±28	134±33
		80	122±22	139±29	128±19	159±29
		60	124±31	138±22	142±17	168±37
		40	128±16	133±32	153±22	168±27
		20	161±50	174±36	201±11	241±18
		10	164±29	194±19	189±53	266±37
		5	184±42	193±28	184±52	246±29
		3	237±58	249±48	276±33	298±26
		1	258±29	269±39	296±56	328±38

- *Results on this biological study were reported as mean ± Standard deviation by formula. n= 10 in each group*

d) Lethal concentration of treatment groups

For the sake of complying with statistical validity of the data, lethal concentration at 50% inhibition (LC50) values were calculated from graph in Microsoft excel. The equations for these graphs are shown in (Table 12). When the equations are worked out for "X" value the results are correlated to LC50values. The R^2 values confirm the validity of the data in the graph. Because R^2 values > 0.7 are statically valid in such controlled experiments.

Table 6 : Lethal concentration of treatment groups needed to kill 50% of the insects

S/N	Agents	Cochineal insects		LC50	R^2	Equation
		Sex	Age			
1	Eucalyptus globulus	Male	Young	46.1	0.7299	y = -0.97x + 127.75
			Adult	40.97	0.6132	y = -1.268x + 178.95
		Female	Young	66.6	0.713	y = -0.975x + 173.44
			Adult	33.1	0.6706	y = -6.225x + 666.65
4	Drusban (48%))	Male	Young	47.32	0.788	y = -1.2096x + 159.21
			Adult	114.58!	0.4783	y = -0.417x + 126.78
		Female	Young	55.86	0.7182	y = -1.286x + 203.34
			Adult	184.39!	0.1847	y = -0.3144x + 163.4
5	Malathion(48%)	Male	Young	70.28	0.6997	y = -0.9894x + 162.51
			Adult	60.45	0.7167	y = -1.290x + 205.98
		Female	Young	65.02	0.8906	y = -1.627x + 232.79
			Adult	76.23	0.8787	y = -1.6545x + 261.6
6	Ventazion /Diainon(60%)	Male	Young	59.04	0.885	y = -1.5534x + 215.7
			Adult	72.03	0.6958	y = -1.204x + 221.23
		Female	Young	57.82	0.7633	y = -1.8349x + 274.6
			Adult	70.37	0.8284	y = -1.692x + 283.08

e) Present inhibition of cochineal insect on spray

Considering the loss of aroma of the oils in an open environment 100-600μl oils were sprayed to each of the experimental cladodes for three days. As shown in the figure below (Fig. 4.1.) the results of all treatment groups are promising. Compared to the laboratory findings the less effectiveness (taking the three days in to account) of the treatment groups can be explained in many ways. The female attaches to the cladodes by their moths and the oils may not effectively get their heads until they blown or diluted by the air. The cladodes contain more than 200 insects of all ages. During each spray all of the species may not receive the treatment. The oil is too much volatile. And probably the insects may die quickly when they are starved. In literature of the carmine die producing company it was revealed that they are environment sensitive (Weniger1991).The environment of the laboratory could have contribution to the effect here.

i. *Percent of inhibition*

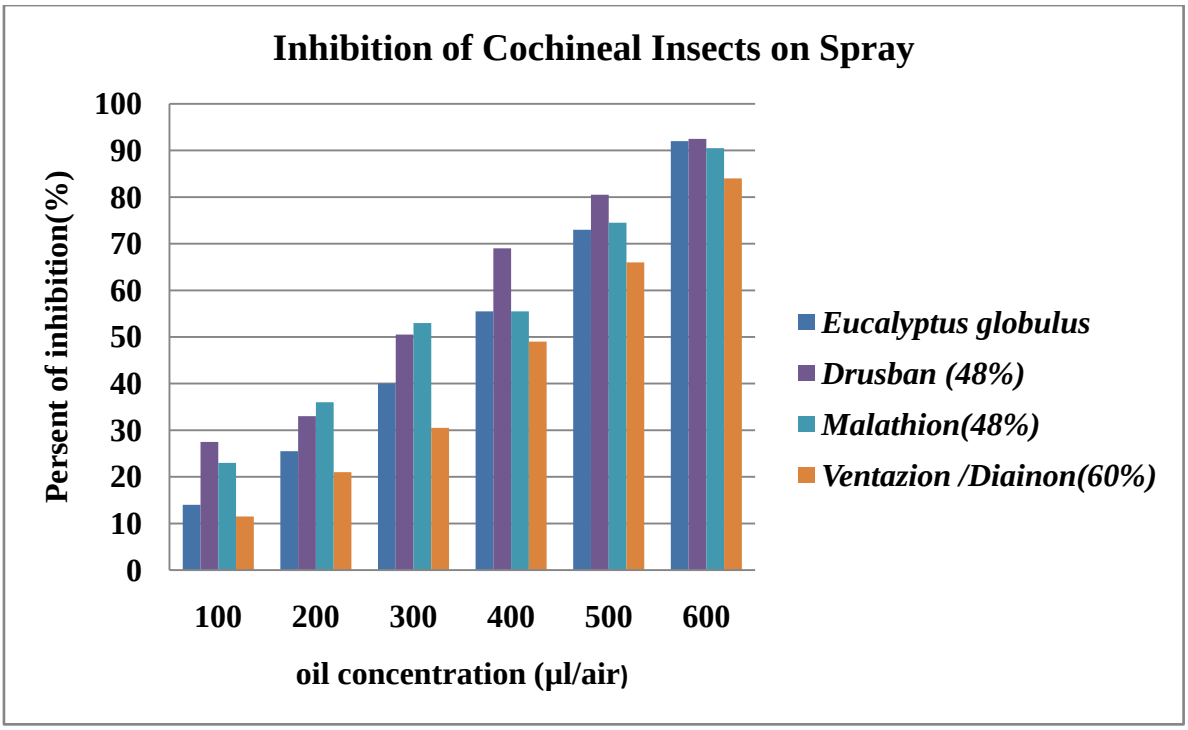

Fig. 1 : Inhibition of Cochineal Insects on Spray

ii. *Lethal concentration (LD50)*

Table 7 : Lethal concentration (LD50), Equation and R^2 values of treatment groups on spray

S/N	Treatment groups	LD50	R^2	Equation
1	*Eucalyptus globulus*	349.936	0.9932	y = 0.1566x - 4.8
4	Drusban (48%)	286.299	0.9852	y = 0.1389x + 10.233
5	Malathion(48%)	308.4804	0.9786	y = 0.1301x + 9.8667
6	Ventazion /Diainon(60%)	393.03	0.9814	y = 0.1474x - 7.9333

IV. Conclusion

If a plant possesses an essential oil it is believed by local peoples that it is medicinal plant. The aroma character of most of the plants used by traditional healers confirms this idea. Most insects are sensitive to plant aroma that they will be either attracted or repelled. Eucalyptus oils have strong aroma and irritating character capable of repelling the insects. The composite chemical nature of the oil is another big matter. The plants have many of these phytochemicals known for their inhibition towards microorganisms, insects and other foreign invaders. In addition, the oils tend to contain organic constituents, including hormones, vitamins and other natural elements with their own major role in the inhibition. This all could be the reason for the promising activity of the oils. In the in vitro assay in almost each jar the inhibition was dose dependent. Reasonable data was also recorded with respect to age and sex. A field test of course not in a big area as recommended by research works on insecticide was also done in six cladodes at six different concentrations. Elimination of the males both young and adult was very clear in three days of spray. Young female were also seen while getting dries out. However, the adult females are not mobile; their very small heads is mostly suck to the cladode that make it difficult to conclude whether or not they are lifeless. In general, it can be concluded that the oils from this variety of eucalyptus can repel and eliminate the cochineal insects. If the males of any age are eliminated the number of the colony will be too much decreased. There is no male insect means there is no way the insect will lay its 250 eggs in each cycle. There is no young female also means there is no adult female. Hence the adult female can be out of concern.

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Evaluation of Accumulation Ability for Pb, Cr, Ni, and Mn in Native Plants Growing on a Contaminated Air Force Shooting Range, Kaduna

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Abstract- The concentrations of Pb, Cr, Ni and Mn were determined in *Sida veronicifolia, Chrystanthelum americanum, Cassia rotundifolia* and *Borreria filifolia* samples using Atomic Absorption spectrophotometry at the Air Force shooting range, Kaduna. The heavy metals (Pb, Cr, Ni and Mn) concentrations in *Borreria filifolia* shoot were found to be (229.29 ± 0.03, 33.26 ± 0.00, 200 ± 0.01, and 142.51 ± 0.01 mg/kg respectively while those of *Sida veronicifolia* samples in shoot are 189.27 ± 0.04, 170.56 ± 0.03, 111.9 ± 0.04 and 158.71 ± 0.01 mg/kg respectively for Pb, Cr, Ni and Mn. In *chrystanthelum americanum* samples in shoot are found 112.31 for Pb, 41.14 ± 0.01 mg/kg for Cr, 176.64 ± 0.00 mg/kg of Ni and 228.80 ± 0.02 mg/kg of Mn. *Cassia rotundifolia* gave 112.23 ± 0.00 mg/kg for Pb, 41.09 ± 0.01 mg/kg for Cr, 176.56 ± 0.05 mg/kg for Ni while 228.71 ± 0.03 mg/kg in Mn. The translocation factor (TF) indicates that the plants accumulated these metals (Cr, Ni and Mn) more in the shoots than in the roots. *S. veronicifolia and B. filifolia* can be used to decontaminate soil contaminated with (Cr and Mn) studied because TF is greater than one (TF > 1) while other plants can only be used for decontamination of soil polluted with selected metals where (TF>1).

Keypoint: *heavy metals, shooting range, translocation factor and native plants.*

GJSFR-B Classification : *FOR Code: 259999*

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Evaluation of Accumulation Ability for Pb, Cr, Ni, and Mn in Native Plants Growing on a Contaminated Air Force Shooting Range, Kaduna

Nwaedozie, G., C. [α], Mohammed, Y. Faruruwa [σ], D. M Nwaedozie J. M. [ρ] & Esekhagbe, R., O [ω]

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Keypoint: heavy metals, shooting range, translocation factor and native plants.

I. Introduction

Heavy metals are currently of much environmental concern globally. They are harmful to humans, animals and plants. The threat that heavy metals pose to human and animal health is aggravated by their long-term persistence in the environment. They are introduced into the environment through mining and smelting of metal ores, industrial emissions and applications of insecticides and fertilizers (Alloway, 1994). Pb has been found to be responsible for quite a number of ailments in human such as chronic neurological problems (Awofolu, 2005) and mental retardation in children (Huge *et al*., 1980). Pb, Sb, As and Ni are common contaminants in areas adjacent to the impact bern of military shooting ranges (Robinson *et al*., 2007). High exposure to chromium can cause spinal joints degeneration, depressed immune system and lymphatic swelling (Roth, 2009). Long term exposure to Ni can cause decreased body weight, liver damage, lungs and nasal sinus cancers and skin irritation. Manganese effect occurs in the respiratory track and in brain. Symptoms of Mn poisoning are hallucination, forgetfulness and nerve damage (Abdullahi, 2006).

The persistence of heavy metals in soils is a big environmental problem. This could have long-term implications for the biological, chemical and physical properties of agricultural and forest soil and its fertility as well as productivity (Nicholson *et al*., 2003). The heavy metals Cr, Cd, Pb, Ni, Cu and Zn take part in the biological turnover and their excess or lack of disturbance of the metabolism and inhibited vegetation (Adomaitis *et al.,*2000; Jaakkola, 1994). Metals may bioaccumulate in living organisms and be transferred into the food chain (Bogaert *et al*., 2000).

It is a confirmed fact that the major parts (75-80%) of heavy metals get into human organisms with vegetable diet when plants take it from the soil (Willaert *et al*., 1985).

Several technologies are available to remediate soils that are contaminated by heavy metals. However, many of these technologies are costly (e.g excavation of contaminated material and chemical/physical treatment) (Lorestani, *et al.,* 2011). The development of phytoremediation technologies for plant based cleanup of contaminated soil is therefore of significant interest (USEP, 2001). Phytoremediation is the use of plant to remove, detoxify or immobilize environmental contaminant in a growth matrix (soil, water or sediment) through the natural biological or chemical processes of plants (Curia *et al*., 2005). Several plants have been identified in the last two decades as highly effectively in absorbing and accumulating various toxic heavy metals. High heavy metal accumulating ability has been reported for cereal crops such as maize, sorghum and alfafa (*Medicago saliva L*) (Vijayarengan, 2005). Plants like Indian mustard, tobacco and spinach show high tolerance to heavy metals and are therefore used in phytoremediation studies (Schmidt, 2003, Tang *et al*., 2003).

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Military grounds are territories of specific purpose. Such areas have special stationary structures necessary for exercises, defence infrastructure; moreover exercises involving shooting real cartridges are held and heavy military war materials such as ammunitions and explosives are used there. Therefore soil in military grounds is very often polluted with heavy metals from spent bullets. These contaminations can create environmental and occupational health problems during range operation and maintenance.

Military training exercises lead to the release of heavy metals in the environment (Sanderson *et al.,* 2010, Johnson *et al*., 2005 and Robinson *et al*., 2008). It was reported that Air Force shooting range in Kaduna is contaminated with heavy metals as a result of shooting exercise (Nwaedozie *et al*., 2015). In this work therefore, some local plants (*Sida veronicifolia, Chrystanthalum americanum, Cassia rotundifolia and Borreria filifolia*) found growing in the shooting range were evaluated for their accumulation ability with a bid of using them as phytoremediators.

II. Materials and Method

a) Sampling

The plant samples used in this study were collected from the Nigerian Air Force shooting range located in Kaduna, Northern Western Nigeria. The entire area was divided into five (5) sections.

For sampling, four (4) different plants of each species, namely *S.veronicifolia, C. americanum*, *C. rotundifolia and B. filifolia* and three (3) samples of each plant species were collected at different points in a given section. Each plant sample was uprooted to include the roots and soil samples were also collected from the point of sampling. The samples were sorted according to species, collection points and labeled accordingly.

b) Plant Analysis

The plant samples were first separated into roots, stems and leaves, then washed with distilled water and oven dried at 70°C for 2hrs (Larry and Morgan, 1986). They were ground into fine powder sieved and stored in a labeled bottle until analysis. 0.5g of prepared plant samples were digested with 5.0cm^3 of concentrated $HN0_3$ and 5.0cm^3 of 70% $HCl0_3$ and placed on a hot plate for 5 minutes after which 20cm^3 of deionised water was added on cooling, the digest was filtered into 100.0cm^3 volumetric flask and made up to the mark with deionised water (Horwitz, 1980). Total concentrations of Pb, Cr, Ni and Mn in the prepared samples were determined by Shimadzu model Atomic Absorption spectrophotometer (AAS).

III. Results and Discussions

The Table 3.1 shows the mean total metal concentrations in plants in Air Force shooting range, Kaduna.

Table 3.1 : Heavy Metal Concentrations (mg/kg) in Plant Parts Collected at the Shooting Range of Air Force, Kaduna

Plant Species	Pb	Cr	Ni	Mn
S. veronicifolia$_{shoot}$	189.226±0.04	170.56±0.03	119.906±0.04	158.706±0.01
S. veronicifolia$_{root}$	52.422±0.04	137.358±0.04	129.692±0.04	57.818±0.04
C.rotundifolia$_{soot}$	112.226±0.00	41.086±0.01	176.562±0.05	228.71±0.03
C.rotundifolia$_{root}$	172.432±0.04	18.522±0.00	129.294±0.04	27.968±0.04
C.americanum$_{shoot}$	112.306±0.04	41.14±0.01	129.344±0.00	228.80±0.02
C.americanum$_{root}$	172.476±0.04	18.572±0.04	129.344±0.02	28.01±0.00
B. filifolia$_{shoot}$	229.29±0.03	33.26±0.00	200.00±0.01	142.51±0.01
B. filifolia$_{root}$	241.47±0.00	12.878±0.01	65.262±0.03	61.292±0.04
H. annus$_{shoot}$	500.31±0.06	25.11±0.01	41.28±0.03	423.12±0.02
H. annus$_{root}$	2213.85±0.04	21.01±0.04	16.15±0.00	103.385±0.04

Key: SV = S. veronicifolia, CR = C. rotundifolia, CA = C. americanum, HA = H. annus

The Table 3.1 showed that SV accumulated Pb, Cr and Mn more in the shoot than in the root while BF contained Cr, Ni and Mn higher in the shoot than in the root. The same pattern was observed in the case of CR and CA with more Ni and Mn in the shoot than in the root. This may imply that these metals absorbed by the plants are not stored in the root but fairly distributed to all parts of the plants. CA, CR and BF showed deviation in the accumulation of Pb where it is accumulated more in the roots than in the shoot. This implied that most of the Pb absorbed by CR, CA and BF from soil is stored in the roots and lesser percentage is transported to the shoot. This is same for absorbed Ni by SV. *H. annus* the control plant accumulated Pb, Cr, Ni and Mn more in the shoot than in the root. In 95% of the plant samples, the root Pb concentration were much greater than those of shoot Pb contents, indicating low mobility of Pb from the roots to the shoots and immobilization of heavy metals in the roots. This pattern was in agreement with observation of Yoon *et al*., 2006.

The results of translocation factor (TF) for all the heavy metals are reported in Table 3.2 below.

Table 3.2 : Translocation factor of SV, CR, CA and BF for Heavy Metals (Pb, Cr, Ni and Mn) in the native plants

Plant Species	Pb	Cr	Ni	Mn
S. veronicifolia	3.610	1.242	0.863	2.745
C. americanum	0.651	2.238	1.366	8.169
C. rotundifolia	0.651	2.218	1.365	9.178
B. filifolia	1.951	2.215	0.410	2.325
H.annus (Control)	1.678	1.195	2.500	4.077

The translocation factor values for heavy metals are presented on Table 3.2. The TF values for metals within the plants were calculated as the concentration of the metals in the shoot divided by the concentration in the root (Baker and Brooks, 1989). The TF highest for Pb was 3.61 for SV and lowest 0.651 for CA and CV. The TF values were greater than one for Pb in SV and BF; SV, CA, CR and BF for Mn. The control result (*H.annus*) shows TF greater than one for all the plants. A plants ability to translocate metals from the roots to the shoots is measured using the TF. TF greater than one represents that translocation of metals effectively was made to the shoot from the root (Baker and Brooks, 1989). The data presented indicate that metals (Cr and Mn) accumulated by plants species (SV, CA, and CR) were largely transported to the shoots from the roots as shown by general TF values which is greater than one (Table 3.2). Exceptions occurred in SV for Ni (TF<1), CA for Pb (TF<1) and BF for Ni (TF<1).

All the four plants studied have both TF greater than one for Cr and Mn. Therefore these plants can be used to remove these metals from the environment.

IV. Conclusion

Based on the results obtained in this study, it can be concluded that:

- All the plants studied (*S, veronicifolia, C. rotundifolia, C. amricanum and B. filifolia)* can be suitable phytoremediator for Cr and Mn.

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Chemical Variability of *Aniba rosaeodora* Oils

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Abstract- The scarcity of natural populations of *Anibarosaeodora* in Brazil is well known and it has been attributed to the over-exploitation for extraction of its trunk wood essential oil for perfumery industry. The leaves of cultivated trees of this species could be a new source for future sustainable exploitation for the same purpose. Leaf oils from 35 trees of *A. rosaeodora* ("pau-rosa") obtained by hydrodistillation were analyzed by gas chromatography/mass spectrometry. High variation in yields (1.15% to 4.21%) and in linalool content (38.48% to 71.05%) were observed. Additionally, leaf oils of *A. parviflora* ("macacaporanga"), commonly confused as *A. rosaeodora*were analized. Linalool was the major compound in *A. parviflora* essential oils, but in considerable smaller amount (21.30% and 12.64%) when compared to *A. rosaeodora*. *Anibaparviflora* oils were different from those of *A. rosaeodora*, showing a high amount of β-phellandrene (21.06% and 23.60%), and lacking the presence of α-, β- and γ-eudesmol, and 7-*epi*-α- and 10-*epi*-γ-eudesmol.

Keywords: aniba rosaeodora, a. parviflora, leaves, linalool, β-phellandrene.

GJSFR-B Classification : FOR Code: 030199

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Keywords: aniba rosaeodora, a. parviflora, leaves, linalool, β-phellandrene.

I. Introduction

Lauraceae comprises 52 genera and approximately 3,000 species, distributed throughout tropical and subtropical regions (Chanderbali et al., 2001). Twenty four genera and about 441 spp. of this family occur in Brazil, mostly in wet forests, sandbanks and "cerrado" (a tropical savanna ecoregion of Brazil) (Quinet et al., 2015). *Aniba rosaeodora* Ducke, popularly known as "pau-rosa" (rosewood), is endemic to Brazil, and occurs in the States of Amapá, Amazonas and Pará (Quinet et al., 2013). According to Marques (2001), besides *A. rosaeodora*, 12 other species belonging to the genus *Aniba* are known as "pau-rosa", including *A. parviflora*(Meisn.) Mez. *Aniba parviflora* is locally known as "macacaporanga" and is frequently confused with *A. rosaeodora* due to the similarities of their morphological aspects. An essential oil, dominated by linalool (3,7-dimethyl-1,6-octadien-3-ol) and known as rosewood oil, is extracted by steam distillation from the trunk wood of *A. rosaeodora*, Rosewood oil is widely used in fragrances for perfumery industry, mostly due to the fragrance of linalool. When populations of *A. rosaeodora*(Syn: *A. duckei* Kostermans) from French Guiana disappeared due to destructive exploitation, Brazilian populations of *A. rosaeodora* came to meet a high market demand. The search for another oil rich in linalool, but possessing a close bouquet of rosewood oil, prompted many researchers to study the leaf oil of *A. rosaeodora* from Brazil and French Guiana (Gottlieb and Mors, 1958; Araujo et al., 1971; Ohashi et al., 1997; Maia et al., 2007; Chantraine et al., 2009; Fidelis et al., 2012; Cunha, 2011). These studies showed that *A. rosaeodora* leaf oils also were dominated by linalool. Analysis of this oil using a two-dimensional (GC x GC) analytical technique was able to separate and identify more compounds when compared to gas chromatography (GC) (Fidelis et al., 2012). Very few studies were reported dealing with the volatiles of *A. parviflora* (Syn.: *Aniba fragrans* Ducke). Leaves and fine branches oils containing limonene, linalool and spathulenol as major compounds was reported (Maia et al., 2000). A study conducted by Tranchida et al. (2008) and focused on the use of a comprehensive 2D GC methodology, led to the identification of 84 compounds in the leaf essential oil, but unfortunately, the authors did not furnish the relative percentual contribution of each compound.

The aim of this paper was to analyze the chemical composition of 35 leaf essential oils obtained from *A. rosaeodora* cultivated trees in the State of Pará, in the North Brazil. Additionally, two samples of *A. parviflora* leaf oils were analyzed.

II. Experimental Botanical Material

Thirty five samples of *A. rosaeodora* leaves (AR) were collected for essential oil extraction. Numbering followed the collections numbers. Samples AR-3 and AR-4 were collected in a smallholder rural property, in the municipality of Tomé-Açu. Samples AR-36, AR-37 and AR-38 were collected in Curuá-Una, municipality of Santarém, from of an experimental plantation cultivated since 1974. Samples AR-5 to AR-35 were collected from an experimental 17 years old plantation in the research campus of Universidade Federal Rural da Amazônia (UFRA), in the city of Belém. All samples were collected in October, 2008. Both samples of *A. parviflora* (AP-2 and AP-21) were collected in the same place of samples AR-3 and AR-4. Botanical identification was carried out by comparison with the vouchers MG-53,318 (*A. rosaeodora*) and MG-30,053 (*A. parviflora*) deposited in the Herbarium MG of MuseuParaenseEmílioGoeldi

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(MPEG). The samples were dried for 7 days in an air-conditioned room (at low humidity) and then ground.

III. Extraction of Volatile Compounds

The dry plant material was hydrodistilled for 3 h, using a Clevenger-type apparatus with refrigeration water at 15°C. The oils obtained were centrifuged for 5 min (3,000 rpm), dried over Na_2SO_4, and centrifuged again in the same conditions. A hexane solution (1 mL) containing 2 μL of the oil was submitted to GC-MS analysis. The total oil yield was expressed in percentage (volume·mass^{-1}) on the basis of dried material. The amount of water was measured using infrared light on a Marte ID-50 device.

IV. Analysis of Volatile Compounds

The oils were analyzed using a Shimadzu GC/MS Model QP-2010 Plus, equipped with a Rtx-5MS (30 m × 0.25 mm; 0.25 µm film thickness) fused silica capillary column. Chromatographic conditions included helium as carrier gas at 1.2 mL·min^{-1}; splitless injection of 1 µL of hexane solution; injector and interface temperature at 250°C; oven temperature program 60-240°C at 3°C·min $^{-1}$. EIMS: electron energy, 70 eV; ion source temperature at 200°C. Identification of the compounds were made by comparison of their GC mass and retention data with those in NIST-05 library, and cited in the literature (Fidelis et al., 2018; Adams, 2007; Qiao et al., 2008). Retention indices were calculated using *n*-alkane standard solutions (C8-C26) available from Fluka S. A., in the same chromatographic conditions.

V. Results and Discussion

GC/MS analysis of the essential oils of *A. rosaeodora* obtained from the leaves of 35 trees led to the identification of a total of 48 different compounds, while 81 compounds were identified in two oils of *A. parviflora*. Tables 1 – 3 show the identified compounds in sequence of their retention indices together with the yields. Yields of *A. rosaeodora* essential oils ranged from 1.15% to 4.21%. The samples of *A. parviflora* furnished oils with 0.92% and 1.29% yields. High yields in oil of *A. rosaeodora* were obtained from the samples collected in Curuá-Una (AR-36: 3.85%, AR-37: 3.97% and AR-38: 4.21%), followed by samples taken in Tomé-Açu (AR-3 and AR-4: 2.92% and 2.69%, respectively). Comparison of the results with those reported by Chantraine et al. (2009) for the leaf oils of *A.rosaeodora* from French Guiana (0.18% to 0.55%) reveals a great difference. The trees cultivated in the campus of UFRA (AR-3 to AR-20 and AR-22 to AR-38), all of the same age (17 years old), provided yields that ranged from 1.15% to 3.05%. These results are in accordance with Chantraine et al. (2009) that obtained yields that were practically independent of the tree ages.

The content of linalool in the 35 *A. rosaeodora* oils ranged from 38.48% to 71.05%. Other compounds identified in the leaf oils of *A. rosaeodora* in amount ≥ 1% were α-pinene, *cis*-linalool furanoxide, *trans*-linalool furanoxide, α-copaene, β-elemene, β-cayophyllene, β-selinene, α-selinene, spathulenol, cayophyllene oxide, humulene epoxide II, selin-11-en-4α-ol and benzyl benzoate. Five linalool derivatives were found (dihydro-2,6,6-trimethyl-6-vinyl-2H-pyran-3(4H)-one, *cis*-linalool furanoxide, *trans*-linalool furanoxide, *cis*-linalool pyranoxide and *trans*-linalool pyranoxide). Pyranoxide derivatives of linalool were identified only in a small percentage (traces-0.29%). Benzyl benzoate was detected in *A. rosaeodora* and in *A. parviflora*, while benzyl salicylate was identified only in *A. parviflora*. Comparison of the present results to those previously reported by Maia et al. (2007) reveals some similarities in the chemical composition, but 1,8-cineole, β-chamigrene, α-muurolol and α-cadinol were not detected. In the same way, several compounds identified by Fidelis et al. (2012) in the leaf oil of *A. rosaeodora* by gas chromatography-quadrupole mass spectrometry, such as 1,8-cineole, hotrienol, myrcenol and ocimenol, were not detected in all 35 samples. No significant qualitative differences between individual chemical components of the samples of *A. rosaeodora* taken in Curuá-Una (Samples AR-36 – AR-38) and Tomé-Açu (AR-3 and AR-4) have been observed. However, considerable quantitative variation was noted in the linalool content (48.10% to 55.91%).

Linalool was present in leaf oils of *A. parviflora* in a smaller amount (21.30% and 12.64%) when compared to those encountered in *A. rosaeodora*. Besides linalool, AP-2 and AP-21 oils were characterized by a high amount of β-phellandrene (21.06% and 23.60%). The leaf and fine branch oil of *A. parviflora* (cited as *A.fragrans*), also collected in Curuá-Una, was reported by Maia et al. (2000) to contain linalool (32.40%), spathulenol (19.1%) and limonene (14.5%) as major compounds. Limonene was not detected in both analyzed samples; spathulenol was present in a small content, as well α- and β-eudesmol. Comparison of the chemical composition of the oils of *A. parviflora* with those previously reported by Tranchida et al.[13] reveals similarity on the presence of linalool as the major compound, but in both analyzed oils, β-phellandrene, instead of α-phellandrene, was detected in a high amount.

In order to investigate the chemical variability, all identified compounds in all studied oils were included in the multivariate analysis using Minitab 14 software for Hierarchical Component Analysis (HCA). HCA led to two-well defined clusters of essential oils: Cluster I, composed by the samples from *A. parviflora* characterized by the presence of linalool and β-phellandrene, and Cluster II, composed by the samples of *A. rosaeodora*, rich in linalool (Figure 1).

A study conducted by Chantraine et al. (2009) with the essential oil of *A. rosaeodora* trunk wood revealed that the age of the trees, season and phenological stages had no influence on the amount of linalool; but yield changes considerably. A large variation in the linalool content and in yields were observed, although the majority of the samples (Samples AR-3 to AR-20, and AR-22 to AR-38) were of the same age and they were collected in the same environment, date and Amazonian climate period (dry season);additionally, all trees were free from injuries caused by microorganisms. The chemical variability in *A. rosaeodora* is particularly important due to its potential to be used by perfumery industry.

VI. Conclusions

This study shows that the leaves of *A. rosaeodora* furnish essential oils with a high variation in linalool content and yield. It also shows that the chemical composition of essential oils could be an important tool in distinguishing *A. rosaeodora* and *A. parviflora*.

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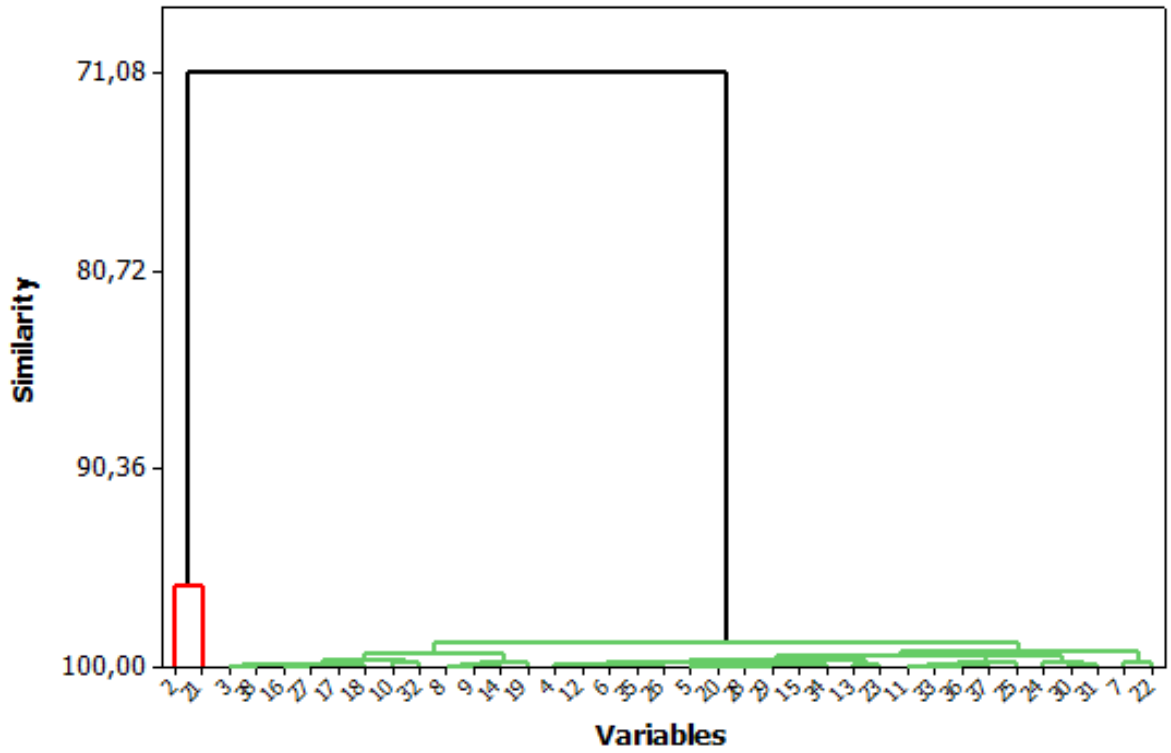

Figure 1 : Hierarchical Component Analysis (HCA) of *Aniba rosaeodora* and *A. parviflora* plants collected in the experimental plantation of Universidade Federal Rural da Amazônia, Belém, State of Pará, Brazil

Table 1 : Chemical constituents (%) identified in the essential oils of *Anibarosaeodora* leaves (AR).

Constituents/yields (%)	RI*	AR-3	AR-4	AR-5	AR-6	AR-7	AR-8	AR-9	AR-10	AR-11	AR-12	AR-13	AR-14
		2.92	2.69	2.39	2.19	1.15	1.81	1.55	2.17	2.06	1.68	2.39	2.05
(*Z*)-hexen-3-ol	857	tr	tr	tr	tr	tr	tr	-	tr	-	0.13	Tr	tr
hexanol	870	tr	tr	tr	tr	tr	tr	tr	tr	tr	0.74	Tr	tr
α-pinene	937	tr	0.87	-	tr	-	-	-	-	-	2.68	0.98	-
β-pinene	981	-	0.40	-	tr	-	-	-	-	-	0.80	0.38	-
myrcene	995	0.55	0.93	0.59	0.67	0.45	0.43	0.54	0.52	0.64	0.98	0.56	0.43
p-cymene	1027	-	-	-	-	-	-	-	-	-	-	Tr	tr
limonene	1031	0.63	0.63	tr	tr	tr	tr	tr	tr	tr	0.54	Tr	tr
(*Z*)-β-ocimene	1039	tr	-	tr	tr	tr	tr	tr	tr	tr	0.22	Tr	tr
(*E*)-β-ocimene	1050	0.31	0.42	0.27	0.31	tr	tr	0.25	tr	0.31	0.37	0.21	tr
cis-linaloolfuranoxide	1074	1.77	5.59	3.55	4.21	1.04	1.51	1.29	1.05	0.90	4.28	3.20	2.05
trans-linaloolfuranoxide	1091	1.42	4.43	2.70	3.30	0.80	1.12	0.93	0.79	0.64	2.94	2.48	1.53
linalool	1103	50.81	55.91	51.75	57.17	43.02	42.61	45.28	42.67	52.22	55.10	43.96	44.66
dihydro-2,2,6-trimethyl-6-vinyl-2H-pyran-3(4H)-one[a]	1113	0.59	0.84	0.85	0.76	0.40	0.45	0.54	tr	0.49	0.62	0.72	0.57
allo-ocimene	1131	-	tr	tr	tr	tr	tr	tr	tr	tr	tr	Tr	tr
borneol	1169	-	-	-	-	-	-	-	-	-	tr	-	-
cis-linaloolpyranoxide	1170	0.08	0.17	0.08	0.19	tr	tr	tr	tr	tr	tr	0.09	tr
trans-linaloolpyranoxide	1177	tr	0.29	0.14	0.33	0.01	0.06	tr	tr	tr	0.12	0.17	tr
α-terpineol	1194	0.24	0.3	0.15	0.18	0.12	0.16	0.16	0.15	0.14	0.47	0.21	tr

nerol	1231	tr	0.08	tr	tr	tr	tr	tr	tr	tr	0.08	Tr	tr
geraniol	1257	0.11	0.17	0.12	0.14	0.09	0.11	0.12	0.10	0.11	0.19	0.11	0.09
δ-elemene	1340	0.05	-	tr	-	-	tr	tr	0.06	tr	-	Tr	-
α-cubebene	1353	tr	-	tr	-	tr	tr	tr	-	tr	-	Tr	tr
α-copaene	1380	1.57	1.67	3.39	2.33	3.10	2.77	2.80	1.96	2.59	0.95	3.51	2.23
β-elemene	1395	1.68	0.32	0.41	0.29	0.50	1.06	0.78	1.52	1.07	0.20	0.60	0.79
β-caryophyllene	1424	0.75	tr	0.53	0.30	0.35	0.94	0.95	2.43	1.48	tr	0.35	0.42
α-guaiene	1443	0.19	0.08	0.09	0.12	0.14	0.21	0.22	0.38	0.15	0.08	0.17	0.13
α-humulene	1458	0.20	tr	0.11	tr	0.06	0.17	0.16	0.44	0.24	tr	0.08	0.11
allo-aromadendrene	1467	-	-	-	-	-	-	-	-	-	tr	-	-
4,5-di-*epi*-aristolochene	1474	0.17	0.11	0.15	0.11	0.24	0.21	0.21	0.19	0.13	0.11	0.22	0.23
γ-selinene[b]	1489	0.89	0.53	0.59	0.52	0.85	0.92	0.89	0.81	0.78	0.40	0.91	0.97
β-selinene	1492	4.35	3.43	3.79	3.37	5.84	5.23	5.11	4.88	4.24	3.34	5.25	5.40
α-selinene	1501	4.06	2.63	2.75	2.58	4.19	4.26	4.11	4.13	3.53	2.2	4.24	4.49
α-muurolene	1505	-	-	-	-	-	-	-	-	-	0.01	-	-
α-bulnesene	1510	0.23	-	tr	-	-	0.21	0.20	-	0.19	-	0.20	0.21
γ-cadinene	1519	tr	tr	tr	tr	tr	tr	tr	tr	tr	tr	tr	tr
7-*epi*-α-selinene	1522	0.14	0.09	0.09	0.09	0.16	0.16	0.15	0.14	0.12	0.08	0.16	0.17
δ-cadinene	1527	0.13	0.11	0.21	0.14	0.21	0.19	0.18	0.18	0.14	0.08	0.23	0.13
(*E*)-nerolidol	1563	0.28	0.20	0.31	0.34	0.28	0.49	0.42	0.42	0.26	tr	0.22	0.24
spathulenol	1580	4.46	2.67	3.82	3.92	4.46	3.32	3.01	7.20	1.48	4.25	3.51	1.33
caryophyllene oxide	1585	0.75	0.28	1.1	1.33	1.05	1.45	1.26	2.45	1.41	0.30	0.93	1.08
guaiol	1597	-	-	0.51	-	-	0.51	-	0.61	0.47	-	0.51	0.71
humuleneepoxide II	1611	0.86	0.56	0.84	0.66	0.87	0.96	0.92	1.02	0.75	0.53	0.86	0.91
selina-6-en-4-ol	1616	0.48	0.35	0.40	0.30	0.48	0.53	0.50	0.41	0.29	0.34	0.50	0.53
iso-spathulenol	1631	0.16	0.16	0.29	0.16	0.37	0.38	0.34	0.28	0.15	0.25	0.37	0.37
caryophylla-4(12),8(13)-dien-5-ol[c]	1641	0.53	0.13	0.38	0.40	0.46	0.55	0.48	0.87	0.32	0.18	0.42	0.27
selina-3,11-dien-6α-ol	1651	0.34	0.25	0.34	0.24	0.46	0.53	0.50	0.42	0.40	0.24	0.42	0.57
selin-11-en-4α-ol	1660	2.09	1.35	1.76	1.37	2.58	2.35	2.19	2.08	1.57	1.60	2.20	2.46
n.i.	1717	2.45	1.70	2.08	1.77	3.00	3.28	3.16	2.63	3.18	1.69	2.59	3.49
n.i.	1728	3.61	2.80	3.81	3.16	6.14	5.87	5.69	4.81	5.40	3.59	4.49	6.06
n.i.	1732	4.41	3.35	4.23	3.58	6.45	6.49	6.24	5.33	5.98	3.92	5.12	6.87
benzylbenzoate	1773	1.16	0.60	1.47	0.77	3.49	1.04	1.04	0.99	1.01	1.26	1.21	0.85

**RI on HP-5MS; [a]Ref. 10; [b]Ref 14; [c]Correct isomer not characterized; tr = traces (< 0.01%); RI = 1717, m/z (rel. int.): 220 [M⁺](39), 202(27), 187(41), 173(12), 159(45), 145(81), 133(100), 119(61), 105(84), 93(93), 79(43), 67(30), 55(34), 41(46); RI = 1728, m/z (rel. int.): 220 [M⁺](21), 205(47), 202(42), 187(28), 177(13), 165(19), 159(52), 145(48), 133(53), 119(61), 105(90), 93(100), 79(70), 67(56), 55(50), 41(57); RI = 1732, m/z (rel. int.): 220 [M⁺](61), 205(23), 202(16), 187(32), 177(19), 159(47), 145(46), 133(50), 121(64), 107(81), 93(100), 81(88), 71(73), 55(55), 43(65).*

Table 2 : Chemical constituents (%) identified in the essential oils of Anibarosaeodora leaves (AR)

Constituents/yields (%)	IR	AR-15	AR-16	AR-17	AR-18	AR-19	AR-20	AR-22	AR-23	AR-24	AR-25	AR-26	AR-27
		2.25	2.85	1.63	3.04	2.72	2.04	1.22	2.47	2.34	2.20	2.90	3.52
(*Z*)-hexen-3-ol	857	tr	-	-	tr	tr	-	-	-	-	-	-	-
hexanol	870	tr	tr	-	0.55	0.23	-	tr	tr	-	tr	-	tr
α-pinene	937	1.71	-	-	-	-	-	-	1.57	0.82	1.11	0.38	-
β-pinene	981	0.85	-	-	-	-	-	-	0.68	0.54	0.51	0.24	-
myrcene	995	0.87	0.58	0.55	0.52	0.38	0.42	0.45	0.55	0.72	0.97	0.70	0.67
p-cymene	1027	-	-	-	-	-	-	-	-	-	-	tr	tr
limonene	1031	0.55	tr	tr	0.22	0.22	tr	tr	tr	0.62	0.69	0.45	tr
(*Z*)-β-ocimene	1039	0.21	tr	tr	0.13	0.11	tr	tr	-	-	tr	tr	tr
(*E*)-β-ocimene	1050	0.34	0.27	0.24	0.23	0.18	tr	tr	0.21	0.31	0.42	0.30	0.31
cis-linaloolfuranoxide	1074	4.79	1.21	1.90	2.96	1.09	2.84	2.66	3.68	1.15	2.43	2.86	1.73
trans-linaloolfuranoxide	1091	3.75	0.89	1.41	2.34	0.80	2.21	2.01	2.84	0.90	1.81	2.21	1.32
linalool	1103	56.29	52.72	46.90	49.24	38.48	47.49	45.41	45.99	57.22	64.26	52.68	49.93
dihydro-2,2,6-trimethyl-6-vinyl-2H-pyran-3(4H)-one[a]	1113	1.14	0.62	0.56	0.46	0.44	0.63	0.62	0.59	0.81	1.25	0.73	0.61
allo-ocimene	1131	tr	tr	tr	tr	tr	tr	tr	tr	tr	tr	-	tr
borneol	1169	tr	tr	-	-	-	-	-	tr	tr	tr	-	-
cis-linaloolpyranoxide	1170	0.14	tr	tr	0.09	0.02	0.10	0.09	0.13	tr	tr	0.09	0.06
trans-linaloolpyranoxide	1177	0.25	tr	tr	0.16	0.03	0.17	0.17	0.23	tr	0.07	0.14	tr
α-terpineol	1194	0.36	0.18	0.18	0.14	0.08	0.14	0.19	0.28	0.17	0.25	0.17	0.14
Nerol	1231	0.07	0.06	-	0.04	0.03	tr	tr	tr	tr	0.07	0.06	0.05
Geraniol	1257	0.17	0.16	0.15	0.10	0.07	0.12	0.10	0.12	0.10	0.16	0.12	0.13
δ-elemene	1340	-	-	-	0.01	0.01	-	0.01	-	-	-	-	-
α-cubebene	1353	-	tr	tr	0.03	0.03	tr	tr	tr	-	tr	tr	0.01
α-copaene	1380	3.37	2.46	2.26	3.45	2.21	3.20	3.65	5.06	5.48	3.27	1.51	2.64
β-elemene	1395	0.13	0.85	0.43	0.59	0.91	0.34	0.45	0.35	0.76	0.10	0.29	1.20
β-caryophyllene	1424	0.19	0.38	0.37	0.39	0.96	0.47	0.27	0.11	0.18	0.11	0.15	0.63
α-guaiene	1443	0.14	0.20	0.17	0.22	0.21	0.13	0.20	0.11	0.20	0.11	0.15	0.18
α-humulene	1458	tr	0.17	0.11	0.13	0.19	0.10	0.07	0.06	0.17	-	0.07	0.16
allo-aromadendrene	1464	tr	tr	tr	0.04	tr	tr	tr	tr	tr	tr	tr	tr
4,5-di-*epi*-aristolochene	1474	0.10	0.15	0.21	0.14	0.31	0.15	0.16	0.15	0.07	0.08	0.16	0.13
γ-selinene[b]	1480	0.55	0.80	0.86	0.72	1.24	0.69	0.64	0.70	0.52	0.49	0.75	0.71
β-selinene	1497	3.07	4.00	4.92	4.09	6.41	4.02	4.31	4.04	2.21	2.68	4.19	3.89
α-selinene	1501	2.39	3.69	4.07	3.44	5.58	3.10	3.10	3.17	2.27	2.11	3.46	3.19
α-muurolene	1505	-	-	-	0.07	tr	tr	tr	tr	tr	tr	tr	tr
α-bulnesene	1510	-	0.19	0.23	0.19	0.18	0.17	0.11	0.09	0.24	0.12	0.19	0.25
γ-cadinene	1519	tr	tr	tr	tr	tr	tr	0.08	tr	0.10	tr	tr	tr
7-*epi*-α-selinene	1522	0.08	0.13	0.16	0.13	0.23	0.11	0.13	0.11	0.09	0.06	0.12	0.12
δ-cadinene	1527	0.19	0.21	0.2	0.23	0.15	0.20	0.30	0.36	0.29	0.15	0.12	0.16
(*E*)-nerolidol	1563	0.12	0.33	0.22	0.23	0.45	0.37	0.28	0.30	0.14	0.12	0.23	0.46
spathulenol	1580	3.87	5.12	4.53	6.47	1.54	2.79	4.70	2.62	6.53	3.26	4.56	4.44
caryophyllene oxide	1585	0.22	0.55	0.84	0.94	1.59	1.26	0.59	0.36	0.35	0.19	0.39	0.88
guaiol	1597	0.11	0.71	0.58	0.33	0.24	0.47	0.39	0.34	0.44	0.11	0.47	0.61

humuleneepoxide II	1611	0.42	0.67	0.80	0.82	1.04	0.88	0.77	0.72	0.89	0.38	0.69	0.76
selina-6-en-4-ol	1616	0.26	0.41	0.52	0.39	0.63	0.42	0.46	0.41	0.23	0.23	0.25	0.34
iso-spathulenol	1631	0.13	0.24	0.33	0.26	0.32	0.26	0.39	0.34	0.20	0.08	0.22	0.25
caryophylla-4(12),8(13)-dien-5-ol[c]	1641	0.24	0.71	0.51	0.58	0.35	0.55	0.52	0.26	0.99	0.26	0.50	0.56
selina-3,11-dien-6α-ol	1651	0.16	0.33	0.41	0.36	0.56	0.45	0.40	0.40	0.25	0.14	0.33	0.40
selin-11-en-4α-ol	1660	1.21	2.07	2.33	1.51	2.59	1.90	1.94	1.84	0.80	1.15	1.99	1.64
n.i.	1717	1.24	2.43	2.74	2.21	3.84	2.97	2.10	2.51	1.54	1.12	2.26	2.73
n.i.	1728	2.18	3.87	4.88	3.40	5.66	5.23	4.37	4.40	2.43	2.04	3.77	4.67
n.i.	1732	2.57	4.51	5.40	4.32	7.12	5.53	4.69	5.10	2.81	2.34	4.54	5.39
benzylbenzoate	1773	2.61	1.91	2.30	0.88	0.85	1.58	6.25	1.96	1.59	2.38	0.96	1.36

**RI on HP-5MS; [a]Ref. 10; [b]Ref 14; [c]Correct isomer not characterized; tr = traces (< 0.01%); RI = 1717, m/z (rel. int.): 220 [M⁺](39), 202(27), 187(41), 173(12), 159(45), 145(81), 133(100), 119(61), 105(84), 93(93), 79(43), 67(30), 55(34), 41(46); RI = 1728, m/z (rel. int.): 220 [M⁺](21), 205(47), 202(42), 187(28), 177(13), 165(19), 159(52), 145(48), 133(53), 119(61), 105(90), 93(100), 79(70), 67(56), 55(50), 41(57); RI = 1732, m/z (rel. int.): 220 [M⁺](61), 205(23), 202(16), 187(32), 177(19), 159(47), 145(46), 133(50), 121(64), 107(81), 93(100), 81(88), 71(73), 55(55), 43(65).*

Table 3 : Chemical constituents (%) identified in the essential oils of Anibarosaeodora (AR) and A. parviflora (AP) leaves

Constituents/yields (%)	IR	AR-28	AR-29	AR-30	AR-31	AR-32	AR-33	AR-34	AR-35	AR-36	AR-37	AR-38	AP-2	AP-21
		1.78	2.77	1.85	2.19	3.05	2.23	1.96	2.71	3.85	3.97	4.21	0.92	1.29
(*Z*)-hexen-3-ol	857	-	-	-	-	-	tr	tr	-	-	-	-	-	-
hexanol	870	tr	-	tr	-	tr	tr	tr	tr	-	-	-	-	-
α-thujene	928	-	-	-	-	-	-	-	-	-	-	-	0.30	0.36
α-pinene	937	0.88	tr	2.61	1.37	-	-	1.74	-	-	-	-	2.53	1.61
camphene	951	-	-	-	-	-	-	-	-	-	-	-	1.95	0.90
β-pinene	981	0.35	0.23	1.39	0.74	-	-	0.81	-	-	-	-	1.54	0.76
myrcene	995	0.95	0.50	1.03	1.01	0.63	0.90	1.10	1.47	1.01	0.92	0.51	3.66	3.53
α-phellandrene	1009	-	-	-	-	-	-	-	-	-	-	-	7.25	2.26
α-terpinene	1020	-	-	-	-	-	-	-	-	-	-	-	0.02	0.25
p-cymene	1027	-	-	-	-	-	-	-	-	-	-	-	0.01	0.01
limonene	1031	0.60	tr	0.80	tr	tr	-	0.43	0.38	tr	0.68	tr	-	-
β-phellandrene	1033	-	-	-	-	-	-	-	-	-	-	-	21.06	23.60
(*Z*)-β-ocimene	1039	-	-	-	-	-	-	0.28	0.41	-	-	-	-	-
(*E*)-β-ocimene	1050	0.40	tr	0.36	tr	0.29	0.45	0.45	0.75	0.50	0.46	0.24	2.95	2.12
γ-terpinene	1061	-	-	-	-	-	-	-	-	-	-	-	0.75	0.78
cis-linaloolfuranoxide	1074	3.18	2.81	2.79	1.29	1.62	2.24	3.13	3.35	2.27	2.24	1.69	0.25	0.13
trans-linaloolfuranoxide	1091	2.29	2.21	2.14	1.06	1.32	1.66	2.38	2.60	1.91	1.71	1.35	-	-
terpinolene	1092	-	-	-	-	-	-	-	-	-	-	-	0.66	0.27
linalool	1103	51.87	54.36	71.05	70.3	43.66	50.32	48.39	61.96	55.09	55.93	48.10	21.30	12.64
dihydro-2,2,6-trimethyl-6-vinyl-2H-pyran-3(4H)-one	1113	0.95	0.83	1.10	0.57	tr	0.71	0.83	-	0.62	0.77	0.63	-	-
cis-p-menth-2-en-1-ol	1124	-	-	-	-	-	-	-	-	-	-	-	0.15	0.28
allo-ocimene	1131	tr	tr	tr	tr	tr	tr	tr	tr	tr	tr	tr	0.11	0.04
trans-p-menth-2-en-1-ol	1142	-	-	-	-	-	-	-	-	-	-	-	0.10	0.17
borneol	1169	-	-	-	-	-	-	-	-	-	-	-	0.84	0.21
cis-linaloolpyranoxide	1170	0.07	0.08	tr	tr	0.08	tr	0.08	0.09	tr	tr	0.05	-	-

trans-linaloolpyranoxide	1177	0.13	0.13	0.09	tr	tr	tr	0.13	0.13	0.08	tr	0.10	-	-
terpinen-4-ol	1181	-	-	-	-	-	-	-	-	-	-	-	0.66	1.09
cryptone	1190	-	-	-	-	-	-	-	-	-	-	-	0.17	0.33
α-terpineol	1194	0.24	0.14	0.27	0.21	0.13	0.12	0.26	0.13	-	-	-	-	2.30
α-phellandreneepoxide (tent)	1205	-	-	-	-	-	-	-	-	-	-	-	0.17	0.12
trans-piperitol	1211	-	-	-	-	-	-	-	-	-	-	-	0.04	0.10
trans-carveol	1222	-	-	-	-	-	-	-	-	-	-	-	0.01	0.02
nerol	1231	0.07	tr	tr	tr	0.05	0.06	0.07	0.11	0.07	0.06	0.01	0.05	-
cuminaldehyde	1243	-	-	-	-	-	-	-	-	-	-	-	-	0.03
carvone	1248	-	-	-	-	-	-	-	-	-	-	-	-	0.02
geraniol	1257	0.16	-	0.10	0.11	0.11	0.14	0.16	0.22	0.13	0.13	0.08	0.05	-
piperitone	1258	-	-	-	-	-	-	-	-	-	-	-	-	0.10
phellandral	1279	-	-	-	-	-	-	-	-	-	-	-	0.04	0.07
δ-elemene	1340	tr	tr	tr	tr	0.06	-	tr	-	-	-	tr	1.62	0.76
α-cubebene	1353	tr	0.06	tr	tr	tr	-	-	tr	0.09	tr	0.04	0.07	0.03
α-ylangene	1376	-	-	-	-	-	-	-	-	-	-	-	0.08	-
isoledene	1377	-	-	-	-	-	-	-	-	-	-	-	-	0.24
α-copaene	1380	2.46	3.95	2.90	2.07	2.92	2.88	3.73	0.82	2.82	1.65	1.80	0.22	0.07
hexylhexanoate	1388	-	-	-	-	-	-	-	-	-	-	-	-	0.04
β-elemene	1395	0.28	0.38	0.10	0.20	1.10	1.66	0.27	0.43	0.74	0.37	1.24	0.64	0.52
methyleugenol	1408	-	-	-	-	-	-	-	-	-	-	-	0.02	-
α-gurjunene	1415	-	-	-	-	-	-	-	-	-	-	-	0.06	0.24
β-caryophyllene	1424	0.20	0.15	0.18	0.39	0.54	0.85	0.13	0.20	0.78	0.72	0.79	2.55	3.84
β-gurjunene	1433	-	-	-	-	-	-	-	-	-	-	-	-	0.27
β-copaene	1434	-	-	-	-	-	-	-	-	-	-	-	0.20	-
γ-elemene	1438	-	-	-	-	-	-	-	-	-	-	-	0.07	0.87
α-guaiene	1443	0.07	0.11	0.13	0.23	0.34	0.12	0.07	0.11	0.17	0.09	0.19	-	-
aromadendrene	1445	-	-		-	-	-	-	-	-	-	-	0.69	3.08
(Z)-β-farnesene	1447	-	-	-	-	-	-	-	-	-	-	-	0.23	-
α-humulene	1458	-	0.06	tr	0.14	0.26	0.18	-	tr	0.19	0.14	0.22	0.46	0.89
allo-aromadendrene	1467	-	-	-	-	-	-	-	-	-	-	-	-	0.53
4,5-di-*epi*-aristolochene	1474	0.16	0.15	-	-	0.28	0.14	0.13	0.10	0.16	0.13	0.19	0.03	-
γ-selinene	1480	0.63	0.68	0.27	0.46	1.23	0.74	0.52	0.52	0.89	0.68	0.97	-	0.01
γ-muurolene	1486	-	-	-	-	-	-	-	-	-	-	-	0.37	0.20
germacrene D	1487	-	-	-	-	-	-	-	-	-	-	-	1.08	-
β-selinene	1497	4.12	4.13	1.74	2.31	6.29	4.22	3.55	3.10	4.49	3.79	4.81	0.44	2.72
cis-β-guaiene	1497	-	-	-	-	-	-	-	-	-	-	-	0.08	-
δ-selinene	1497	-	-	-	-	-	-	-	-	-	-	-	-	0.24
α-selinene	1501	2.89	3.11	1.36	2.14	5.79	3.50	2.54	2.49	4.14	3.18	4.51	-	-
bicyclogermacrene	1504	-	-	-	-	-	-	-	-	-	-	-	4.31	3.42
α-muurolene	1505	tr	tr	tr	-	tr	tr	0.05	tr	tr	tr	tr	tr	tr
α-bulnesene	1510	-	-	-	0.19	0.28	0.01	-	0.18	0.20	-	0.24	-	-
(*E,E*)-α-farnesene	1511	-	-	-	-	-	-	-	-	-	-	-	0.63	-
α-curcumene	1515	-	-	-	-	-	-	-	-	-	-	-	-	0.33

γ-cadinene	1519	tr	tr	tr	tr	tr	tr	tr	tr	tr	tr	0.07	0.11	0.08
7-*epi*-α-selinene	1522	0.11	0.10	-	-	0.23	0.12	0.09	0.09	0.15	0.10	0.19	-	0.37
δ-cadinene	1527	0.15	0.20	0.13	0.13	0.24	0.17	0.25	0.08	0.15	0.09	0.17	0.32	0.35
selina-3,7(11)-diene	1546	-	-	-	-	-	-	-	-	-	-	-	0.44	0.19
elemol	1552	-	-	-	-	-	-	-	-	-	-	-	-	1.16
germacrene B	1561	-	-	-	-	-	-	-	-	-	-	-	0.04	0.32
(*E*)-nerolidol	1563	0.28	0.38	0.06	-	0.23	0.41	0.32	0.11	0.23	0.21	0.27	0.88	0.54
palustrol	1570	-	-	-	-	-	-	-	-	-	-	-	-	0.42
spathulenol	1580	2.63	2.36	3.73	6.2	6.18	0.56	3.15	3.75	1.99	0.55	4.62	3.75	4.73
caryophyllene oxide	1585	0.42	0.29	0.20	0.36	1.31	0.69	0.45	0.30	0.88	2.11	0.90	1.19	2.88
globulol	1594	-	-	-	-	-	-	-	-	-	-	-	0.26	0.79
guaiol	1597	-	-	-	0.21	0.70	0.36	0.10	0.01	0.39	0.42	0.33	0.26	1.37
rosifoliol	1602	-	-	-	-	-	-	-	-	-	-	-	0.09	0.94
humuleneepoxide II	1611	0.64	0.61	0.26	0.35	0.97	0.75	0.74	0.52	0.72	0.73	0.95	-	0.58
selina-6-en-4-ol	1616	0.43	0.33	0.12	0.15	0.55	0.35	0.42	0.29	0.33	0.36	-	-	-
10-*epi*-γ-eudesmol	1623	-	-	-	-	-	-	-	-	-	-	-	0.19	-
iso-spathulenol	1631	0.25	0.16	-	-	0.30	0.22	0.31	-	0.11	0.18	-	-	-
γ-eudesmol	1636	-	-	-	-	-	-	-	-	-	-	-	-	1.35
caryophylla-4(12),8(13)-dien-5-ol[c]	1641	0.28	0.24	0.26	0.76	0.72	0.18	0.28	0.26	0.24	0.21	0.62	-	-
selina-3,11-dien-6α-ol	1651	0.36	0.29	0.09	0.12	0.37	0.38	0.49	0.21	0.24	0.21	0.41	-	-
β-eudesmol	1657	-	-	-	-	-	-	-	-	-	-	-	0.71	2.05
α-eudesmol	1660	-	-	-	-	-	-	-	-	-	-	-	0.92	2.30
selin-11-en-4α-ol	1660	1.68	1.60	0.63	0.67	2.53	1.64	1.77	1.19	1.48	1.67	2.29	-	-
7-*epi*-α-eudesmol	1664	-	-	-	-	-	-	-	-	-	-	-	0.13	-
bulnesol	1674	-	-	-	-	-	-	-	-	-	-	-	0.23	1.07
(*Z*)-α-santalol	1678	-	-	-	-	-	-	-	-	-	-	-	0.22	0.48
eudesm-7(11)-en-4-ol	1705	-	-	-	-	-	-	-	-	-	-	-	-	0.08
n.i.	1717	2.17	2.24	0.65	0.80	2.47	2.98	2.30	1.55	2.42	2.66	2.90	-	-
n.i.	1728	4.21	4.16	1.24	1.34	3.98	5.04	4.68	2.57	3.39	4.10	4.32	-	-
n.i.	1732	4.75	4.70	1.45	1.63	4.88	5.65	5.19	2.99	4.43	5.11	5.23	-	-
benzylbenzoate	1773	1.6	2.35	1.15	0.49	0.85	0.90	1.38	0.83	0.62	0.79	0.50	0.48	0.66
benzylsalycilate	1878	-	-	-	-	-	-	-	-	-	-	-	0.06	-

**RI on HP-5MS; [a]Ref. 10; [b]Ref 14; [c]Correct isomer not characterized; tr = traces (< 0.01%); RI = 1717, m/z (rel. int.): 220 [M$^+$](39), 202(27), 187(41), 173(12), 159(45), 145(81), 133(100), 119(61), 105(84), 93(93), 79(43), 67(30), 55(34), 41(46); RI = 1728, m/z (rel. int.): 220 [M$^+$](21), 205(47), 202(42), 187(28), 177(13), 165(19), 159(52), 145(48), 133(53), 119(61), 105(90), 93(100), 79(70), 67(56), 55(50), 41(57); RI = 1732, m/z (rel. int.): 220 [M$^+$](61), 205(23), 202(16), 187(32), 177(19), 159(47), 145(46), 133(50), 121(64), 107(81), 93(100), 81(88), 71(73), 55(55), 43(65).*

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FARSS accrediting is an honor. It authenticates your research activities. After recognition as FARSB, you can add 'FARSS' title with your name as you use this recognition as additional suffix to your status. This will definitely enhance and add more value and repute to your name. You may use it on your professional Counseling Materials such as CV, Resume, and Visiting Card etc.

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We shall provide you intimation regarding launching of e-version of journal of your stream time to time.This may be utilized in your library for the enrichment of knowledge of your students as well as it can also be helpful for the concerned faculty members.

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As FARSS, you will be given a renowned, secure and free professional email address with 100 GB of space e.g. johnhall@globaljournals.org. This will include Webmail, Spam Assassin, Email Forwarders,Auto-Responders, Email Delivery Route tracing, etc.

The FARSS will be eligible for a free application of standardization of their researches. Standardization of research will be subject to acceptability within stipulated norms as the next step after publishing in a journal. We shall depute a team of specialized research professionals who will render their services for elevating your researches to next higher level, which is worldwide open standardization.

The FARSS member can apply for grading and certification of standards of their educational and Institutional Degrees to Open Association of Research, Society U.S.A.
Once you are designated as FARSS, you may send us a scanned copy of all of your credentials. OARS will verify, grade and certify them. This will be based on your academic records, quality of research papers published by you, and some more criteria. After certification of all your credentials by OARS, they will be published on your Fellow Profile link on website https://associationofresearch.org which will be helpful to upgrade the dignity.

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The FARSS is eligible to earn from sales proceeds of his/her researches/reference/review Books or literature, while publishing with Global Journals. The FARSS can decide whether he/she would like to publish his/her research in a closed manner. In this case, whenever readers purchase that individual research paper for reading, maximum 60% of its profit earned as royalty by Global Journals, will be credited to his/her bank account. The entire entitled amount will be credited to his/her bank account exceeding limit of minimum fixed balance. There is no minimum time limit for collection. The FARSS member can decide its price and we can help in making the right decision.

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The "MARSS" is a dignified ornament which is accorded to a person's name viz. Dr. John E. Hall, Ph.D., MARSS or William Walldroff, M.S., MARSS.

MARSS accrediting is an honor. It authenticates your research activities. After becoming MARSS, you can add 'MARSS' title with your name as you use this recognition as additional suffix to your status. This will definitely enhance and add more value and repute to your name. You may use it on your professional Counseling Materials such as CV, Resume, Visiting Card and Name Plate etc.

The following benefitscan be availed by you only for next three years from the date of certification.

MARSS designated members are entitled to avail a 25% discount while publishing their research papers (of a single author) in Global Journals Inc., if the same is accepted by our Editorial Board and Peer Reviewers. If you are a main author or co-author of a group of authors, you will get discount of 10%.

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We shall provide you intimation regarding launching of e-version of journal of your stream time to time.This may be utilized in your library for the enrichment of knowledge of your students as well as it can also be helpful for the concerned faculty members.

The MARSS member can apply for approval, grading and certification of standards of their educational and Institutional Degrees to Open Association of Research, Society U.S.A.

Once you are designated as MARSS, you may send us a scanned copy of all of your credentials. OARS will verify, grade and certify them. This will be based on your academic records, quality of research papers published by you, and some more criteria.

It is mandatory to read all terms and conditions carefully.

AUXILIARY MEMBERSHIPS

Institutional Fellow of Global Journals Incorporation (USA)-OARS (USA)

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The "FARSC" is a dignified title which is accorded to a person's name viz. Dr. John E. Hall, Ph.D., FARSC or William Walldroff, M.S., FARSC.

The IFOARS institution is entitled to form a Board comprised of one Chairperson and three to five board members preferably from different streams. The Board will be recognized as "Institutional Board of Open Association of Research Society"-(IBOARS).

The Institute will be entitled to following benefits:

The IBOARS can initially review research papers of their institute and recommend them to publish with respective journal of Global Journals. It can also review the papers of other institutions after obtaining our consent. The second review will be done by peer reviewer of Global Journals Incorporation (USA) The Board is at liberty to appoint a peer reviewer with the approval of chairperson after consulting us.

The author fees of such paper may be waived off up to 40%.

The Global Journals Incorporation (USA) at its discretion can also refer double blind peer reviewed paper at their end to the board for the verification and to get recommendation for final stage of acceptance of publication.

The IBOARS can organize symposium/seminar/conference in their country on behalf of Global Journals Incorporation (USA)-OARS (USA). The terms and conditions can be discussed separately.

The Board can also play vital role by exploring and giving valuable suggestions regarding the Standards of "Open Association of Research Society, U.S.A (OARS)" so that proper amendment can take place for the benefit of entire research community. We shall provide details of particular standard only on receipt of request from the Board.

The board members can also join us as Individual Fellow with 40% discount on total fees applicable to Individual Fellow. They will be entitled to avail all the benefits as declared. Please visit Individual Fellow-sub menu of GlobalJournals.org to have more relevant details.

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After nomination of your institution as "Institutional Fellow" and constantly functioning successfully for one year, we can consider giving recognition to your institute to function as Regional/Zonal office on our behalf.
The board can also take up the additional allied activities for betterment after our consultation.

The following entitlements are applicable to individual Fellows:

Open Association of Research Society, U.S.A (OARS) By-laws states that an individual Fellow may use the designations as applicable, or the corresponding initials. The Credentials of individual Fellow and Associate designations signify that the individual has gained knowledge of the fundamental concepts. One is magnanimous and proficient in an expertise course covering the professional code of conduct, and follows recognized standards of practice.

Open Association of Research Society (US)/ Global Journals Incorporation (USA), as described in Corporate Statements, are educational, research publishing and professional membership organizations. Achieving our individual Fellow or Associate status is based mainly on meeting stated educational research requirements.

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- The professional accredited with Fellow honor, is entitled to various benefits viz. name, fame, honor, regular flow of income, secured bright future, social status etc.

- In addition to above, if one is single author, then entitled to 40% discount on publishing research paper and can get 10%discount if one is co-author or main author among group of authors.
- The Fellow can organize symposium/seminar/conference on behalf of Global Journals Incorporation (USA) and he/she can also attend the same organized by other institutes on behalf of Global Journals.
- The Fellow can become member of Editorial Board Member after completing 3yrs.
- The Fellow can earn 60% of sales proceeds from the sale of reference/review books/literature/publishing of research paper.
- Fellow can also join as paid peer reviewer and earn 15% remuneration of author charges and can also get an opportunity to join as member of the Editorial Board of Global Journals Incorporation (USA)
- • This individual has learned the basic methods of applying those concepts and techniques to common challenging situations. This individual has further demonstrated an in–depth understanding of the application of suitable techniques to a particular area of research practice.

Note :

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- In future, if the board feels the necessity to change any board member, the same can be done with the consent of the chairperson along with anyone board member without our approval.
- In case, the chairperson needs to be replaced then consent of 2/3rd board members are required and they are also required to jointly pass the resolution copy of which should be sent to us. In such case, it will be compulsory to obtain our approval before replacement.
- In case of "Difference of Opinion [if any]" among the Board members, our decision will be final and binding to everyone.

"

Process of submission of Research Paper

The Area or field of specialization may or may not be of any category as mentioned in 'Scope of Journal' menu of the GlobalJournals.org website. There are 37 Research Journal categorized with Six parental Journals GJCST, GJMR, GJRE, GJMBR, GJSFR, GJHSS. For Authors should prefer the mentioned categories. There are three widely used systems UDC, DDC and LCC. The details are available as 'Knowledge Abstract' at Home page. The major advantage of this coding is that, the research work will be exposed to and shared with all over the world as we are being abstracted and indexed worldwide.

The paper should be in proper format. The format can be downloaded from first page of 'Author Guideline' Menu. The Author is expected to follow the general rules as mentioned in this menu. The paper should be written in MS-Word Format (*.DOC,*.DOCX).

The Author can submit the paper either online or offline. The authors should prefer online submission.Online Submission: There are three ways to submit your paper:

(A) (I) First, register yourself using top right corner of Home page then Login. If you are already registered, then login using your username and password.

(II) Choose corresponding Journal.

(III) Click 'Submit Manuscript'. Fill required information and Upload the paper.

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- Font type of all text should be Swis 721 Lt BT.
- Paper Title should be of Font Size 24 with one Column section.
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- Numbering of First Main Headings (Heading 1) must be in Roman Letters, Capital Letter, and Font Size of 10.
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You can use your own standard format also.
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1. General,

2. Ethical Guidelines,

3. Submission of Manuscripts,

4. Manuscript's Category,

5. Structure and Format of Manuscript,

6. After Acceptance.

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2) Drafting the paper and revising it critically regarding important academic content.

3) Final approval of the version of the paper to be published.

All authors should have been credited according to their appropriate contribution in research activity and preparing paper. Contributors who do not match the criteria as authors may be mentioned under Acknowledgement.

Acknowledgements: Contributors to the research other than authors credited should be mentioned under acknowledgement. The specifications of the source of funding for the research if appropriate can be included. Suppliers of resources may be mentioned along with address.

Appeal of Decision: The Editorial Board's decision on publication of the paper is final and cannot be appealed elsewhere.

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Manuscript submission is a systematic procedure and little preparation is required beyond having all parts of your manuscript in a given format and a computer with an Internet connection and a Web browser. Full help and instructions are provided on-screen. As an author, you will be prompted for login and manuscript details as Field of Paper and then to upload your manuscript file(s) according to the instructions.

To avoid postal delays, all transaction is preferred by e-mail. A finished manuscript submission is confirmed by e-mail immediately and your paper enters the editorial process with no postal delays. When a conclusion is made about the publication of your paper by our Editorial Board, revisions can be submitted online with the same procedure, with an occasion to view and respond to all comments.

Complete support for both authors and co-author is provided.

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Based on potential and nature, the manuscript can be categorized under the following heads:

Original research paper: Such papers are reports of high-level significant original research work.

Review papers: These are concise, significant but helpful and decisive topics for young researchers.

Research articles: These are handled with small investigation and applications

Research letters: The letters are small and concise comments on previously published matters.

5.STRUCTURE AND FORMAT OF MANUSCRIPT

The recommended size of original research paper is less than seven thousand words, review papers fewer than seven thousands words also.Preparation of research paper or how to write research paper, are major hurdle, while writing manuscript. The research articles and research letters should be fewer than three thousand words, the structure original research paper; sometime review paper should be as follows:

Papers: These are reports of significant research (typically less than 7000 words equivalent, including tables, figures, references), and comprise:

(a)Title should be relevant and commensurate with the theme of the paper.

(b) A brief Summary, "Abstract" (less than 150 words) containing the major results and conclusions.

(c) Up to ten keywords, that precisely identifies the paper's subject, purpose, and focus.

(d) An Introduction, giving necessary background excluding subheadings; objectives must be clearly declared.

(e) Resources and techniques with sufficient complete experimental details (wherever possible by reference) to permit repetition; sources of information must be given and numerical methods must be specified by reference, unless non-standard.

(f) Results should be presented concisely, by well-designed tables and/or figures; the same data may not be used in both; suitable statistical data should be given. All data must be obtained with attention to numerical detail in the planning stage. As reproduced design has been recognized to be important to experiments for a considerable time, the Editor has decided that any paper that appears not to have adequate numerical treatments of the data will be returned un-refereed;

(g) Discussion should cover the implications and consequences, not just recapitulating the results; conclusions should be summarizing.

(h) Brief Acknowledgements.

(i) References in the proper form.

Authors should very cautiously consider the preparation of papers to ensure that they communicate efficiently. Papers are much more likely to be accepted, if they are cautiously designed and laid out, contain few or no errors, are summarizing, and be conventional to the approach and instructions. They will in addition, be published with much less delays than those that require much technical and editorial correction.

The Editorial Board reserves the right to make literary corrections and to make suggestions to improve briefness.

It is vital, that authors take care in submitting a manuscript that is written in simple language and adheres to published guidelines.

Format

Language: The language of publication is UK English. Authors, for whom English is a second language, must have their manuscript efficiently edited by an English-speaking person before submission to make sure that, the English is of high excellence. It is preferable, that manuscripts should be professionally edited.

Standard Usage, Abbreviations, and Units: Spelling and hyphenation should be conventional to The Concise Oxford English Dictionary. Statistics and measurements should at all times be given in figures, e.g. 16 min, except for when the number begins a sentence. When the number does not refer to a unit of measurement it should be spelt in full unless, it is 160 or greater.

Abbreviations supposed to be used carefully. The abbreviated name or expression is supposed to be cited in full at first usage, followed by the conventional abbreviation in parentheses.

Metric SI units are supposed to generally be used excluding where they conflict with current practice or are confusing. For illustration, 1.4 l rather than 1.4 × 10-3 m3, or 4 mm somewhat than 4 × 10-3 m. Chemical formula and solutions must identify the form used, e.g. anhydrous or hydrated, and the concentration must be in clearly defined units. Common species names should be followed by underlines at the first mention. For following use the generic name should be constricted to a single letter, if it is clear.

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All manuscripts submitted to Global Journals Inc. (US), ought to include:

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Optimizing Abstract for Search Engines

Many researchers searching for information online will use search engines such as Google, Yahoo or similar. By optimizing your paper for search engines, you will amplify the chance of someone finding it. This in turn will make it more likely to be viewed and/or cited in a further work. Global Journals Inc. (US) have compiled these guidelines to facilitate you to maximize the web-friendliness of the most public part of your paper.

Key Words

A major linchpin in research work for the writing research paper is the keyword search, which one will employ to find both library and Internet resources.

One must be persistent and creative in using keywords. An effective keyword search requires a strategy and planning a list of possible keywords and phrases to try.

Search engines for most searches, use Boolean searching, which is somewhat different from Internet searches. The Boolean search uses "operators," words (and, or, not, and near) that enable you to expand or narrow your affords. Tips for research paper while preparing research paper are very helpful guideline of research paper.

Choice of key words is first tool of tips to write research paper. Research paper writing is an art.A few tips for deciding as strategically as possible about keyword search:

- One should start brainstorming lists of possible keywords before even begin searching. Think about the most important concepts related to research work. Ask, "What words would a source have to include to be truly valuable in research paper?" Then consider synonyms for the important words.
- It may take the discovery of only one relevant paper to let steer in the right keyword direction because in most databases, the keywords under which a research paper is abstracted are listed with the paper.
- One should avoid outdated words.

Keywords are the key that opens a door to research work sources. Keyword searching is an art in which researcher's skills are bound to improve with experience and time.

Numerical Methods: Numerical methods used should be clear and, where appropriate, supported by references.

Acknowledgements: Please make these as concise as possible.

References

References follow the Harvard scheme of referencing. References in the text should cite the authors' names followed by the time of their publication, unless there are three or more authors when simply the first author's name is quoted followed by et al. unpublished work has to only be cited where necessary, and only in the text. Copies of references in press in other journals have to be supplied with submitted typescripts. It is necessary that all citations and references be carefully checked before submission, as mistakes or omissions will cause delays.

References to information on the World Wide Web can be given, but only if the information is available without charge to readers on an official site. Wikipedia and Similar websites are not allowed where anyone can change the information. Authors will be asked to make available electronic copies of the cited information for inclusion on the Global Journals Inc. (US) homepage at the judgment of the Editorial Board.

The Editorial Board and Global Journals Inc. (US) recommend that, citation of online-published papers and other material should be done via a DOI (digital object identifier). If an author cites anything, which does not have a DOI, they run the risk of the cited material not being noticeable.

The Editorial Board and Global Journals Inc. (US) recommend the use of a tool such as Reference Manager for reference management and formatting.

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Tables: Tables should be few in number, cautiously designed, uncrowned, and include only essential data. Each must have an Arabic number, e.g. Table 4, a self-explanatory caption and be on a separate sheet. Vertical lines should not be used.

Figures: Figures are supposed to be submitted as separate files. Always take in a citation in the text for each figure using Arabic numbers, e.g. Fig. 4. Artwork must be submitted online in electronic form by e-mailing them.

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Even though low quality images are sufficient for review purposes, print publication requires high quality images to prevent the final product being blurred or fuzzy. Submit (or e-mail) EPS (line art) or TIFF (halftone/photographs) files only. MS PowerPoint and Word Graphics are unsuitable for printed pictures. Do not use pixel-oriented software. Scans (TIFF only) should have a resolution of at least 350 dpi (halftone) or 700 to 1100 dpi (line drawings) in relation to the imitation size. Please give the data for figures in black and white or submit a Color Work Agreement Form. EPS files must be saved with fonts embedded (and with a TIFF preview, if possible).

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6. AFTER ACCEPTANCE

Upon approval of a paper for publication, the manuscript will be forwarded to the dean, who is responsible for the publication of the Global Journals Inc. (US).

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Proofs must be returned to the dean at dean@globaljournals.org within three days of receipt.

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Before start writing a good quality Computer Science Research Paper, let us first understand what is Computer Science Research Paper? So, Computer Science Research Paper is the paper which is written by professionals or scientists who are associated to Computer Science and Information Technology, or doing research study in these areas. If you are novel to this field then you can consult about this field from your supervisor or guide.

TECHNIQUES FOR WRITING A GOOD QUALITY RESEARCH PAPER:

1. Choosing the topic: In most cases, the topic is searched by the interest of author but it can be also suggested by the guides. You can have several topics and then you can judge that in which topic or subject you are finding yourself most comfortable. This can be done by asking several questions to yourself, like Will I be able to carry our search in this area? Will I find all necessary recourses to accomplish the search? Will I be able to find all information in this field area? If the answer of these types of questions will be "Yes" then you can choose that topic. In most of the cases, you may have to conduct the surveys and have to visit several places because this field is related to Computer Science and Information Technology. Also, you may have to do a lot of work to find all rise and falls regarding the various data of that subject. Sometimes, detailed information plays a vital role, instead of short information.

2. Evaluators are human: First thing to remember that evaluators are also human being. They are not only meant for rejecting a paper. They are here to evaluate your paper. So, present your Best.

3. Think Like Evaluators: If you are in a confusion or getting demotivated that your paper will be accepted by evaluators or not, then think and try to evaluate your paper like an Evaluator. Try to understand that what an evaluator wants in your research paper and automatically you will have your answer.

4. Make blueprints of paper: The outline is the plan or framework that will help you to arrange your thoughts. It will make your paper logical. But remember that all points of your outline must be related to the topic you have chosen.

5. Ask your Guides: If you are having any difficulty in your research, then do not hesitate to share your difficulty to your guide (if you have any). They will surely help you out and resolve your doubts. If you can't clarify what exactly you require for your work then ask the supervisor to help you with the alternative. He might also provide you the list of essential readings.

6. Use of computer is recommended: As you are doing research in the field of Computer Science, then this point is quite obvious.

7. Use right software: Always use good quality software packages. If you are not capable to judge good software then you can lose quality of your paper unknowingly. There are various software programs available to help you, which you can get through Internet.

8. Use the Internet for help: An excellent start for your paper can be by using the Google. It is an excellent search engine, where you can have your doubts resolved. You may also read some answers for the frequent question how to write my research paper or find model research paper. From the internet library you can download books. If you have all required books make important reading selecting and analyzing the specified information. Then put together research paper sketch out.

9. Use and get big pictures: Always use encyclopedias, Wikipedia to get pictures so that you can go into the depth.

10. Bookmarks are useful: When you read any book or magazine, you generally use bookmarks, right! It is a good habit, which helps to not to lose your continuity. You should always use bookmarks while searching on Internet also, which will make your search easier.

11. Revise what you wrote: When you write anything, always read it, summarize it and then finalize it.

12. Make all efforts: Make all efforts to mention what you are going to write in your paper. That means always have a good start. Try to mention everything in introduction, that what is the need of a particular research paper. Polish your work by good skill of writing and always give an evaluator, what he wants.

13. Have backups: When you are going to do any important thing like making research paper, you should always have backup copies of it either in your computer or in paper. This will help you to not to lose any of your important.

14. Produce good diagrams of your own: Always try to include good charts or diagrams in your paper to improve quality. Using several and unnecessary diagrams will degrade the quality of your paper by creating "hotchpotch." So always, try to make and include those diagrams, which are made by your own to improve readability and understandability of your paper.

15. Use of direct quotes: When you do research relevant to literature, history or current affairs then use of quotes become essential but if study is relevant to science then use of quotes is not preferable.

16. Use proper verb tense: Use proper verb tenses in your paper. Use past tense, to present those events that happened. Use present tense to indicate events that are going on. Use future tense to indicate future happening events. Use of improper and wrong tenses will confuse the evaluator. Avoid the sentences that are incomplete.

17. Never use online paper: If you are getting any paper on Internet, then never use it as your research paper because it might be possible that evaluator has already seen it or maybe it is outdated version.

18. Pick a good study spot: To do your research studies always try to pick a spot, which is quiet. Every spot is not for studies. Spot that suits you choose it and proceed further.

19. Know what you know: Always try to know, what you know by making objectives. Else, you will be confused and cannot achieve your target.

20. Use good quality grammar: Always use a good quality grammar and use words that will throw positive impact on evaluator. Use of good quality grammar does not mean to use tough words, that for each word the evaluator has to go through dictionary. Do not start sentence with a conjunction. Do not fragment sentences. Eliminate one-word sentences. Ignore passive voice. Do not ever use a big word when a diminutive one would suffice. Verbs have to be in agreement with their subjects. Prepositions are not expressions to finish sentences with. It is incorrect to ever divide an infinitive. Avoid clichés like the disease. Also, always shun irritating alliteration. Use language that is simple and straight forward. put together a neat summary.

21. Arrangement of information: Each section of the main body should start with an opening sentence and there should be a changeover at the end of the section. Give only valid and powerful arguments to your topic. You may also maintain your arguments with records.

22. Never start in last minute: Always start at right time and give enough time to research work. Leaving everything to the last minute will degrade your paper and spoil your work.

23. Multitasking in research is not good: Doing several things at the same time proves bad habit in case of research activity. Research is an area, where everything has a particular time slot. Divide your research work in parts and do particular part in particular time slot.

24. Never copy others' work: Never copy others' work and give it your name because if evaluator has seen it anywhere you will be in trouble.

25. Take proper rest and food: No matter how many hours you spend for your research activity, if you are not taking care of your health then all your efforts will be in vain. For a quality research, study is must, and this can be done by taking proper rest and food.

26. Go for seminars: Attend seminars if the topic is relevant to your research area. Utilize all your resources.

27. Refresh your mind after intervals: Try to give rest to your mind by listening to soft music or by sleeping in intervals. This will also improve your memory.

28. Make colleagues: Always try to make colleagues. No matter how sharper or intelligent you are, if you make colleagues you can have several ideas, which will be helpful for your research.

29. Think technically: Always think technically. If anything happens, then search its reasons, its benefits, and demerits.

30. Think and then print: When you will go to print your paper, notice that tables are not be split, headings are not detached from their descriptions, and page sequence is maintained.

31. Adding unnecessary information: Do not add unnecessary information, like, I have used MS Excel to draw graph. Do not add irrelevant and inappropriate material. These all will create superfluous. Foreign terminology and phrases are not apropos. One should NEVER take a broad view. Analogy in script is like feathers on a snake. Not at all use a large word when a very small one would be sufficient. Use words properly, regardless of how others use them. Remove quotations. Puns are for kids, not grunt readers. Amplification is a billion times of inferior quality than sarcasm.

32. Never oversimplify everything: To add material in your research paper, never go for oversimplification. This will definitely irritate the evaluator. Be more or less specific. Also too, by no means, ever use rhythmic redundancies. Contractions aren't essential and shouldn't be there used. Comparisons are as terrible as clichés. Give up ampersands and abbreviations, and so on. Remove commas, that are, not necessary. Parenthetical words however should be together with this in commas. Understatement is all the time the complete best way to put onward earth-shaking thoughts. Give a detailed literary review.

33. Report concluded results: Use concluded results. From raw data, filter the results and then conclude your studies based on measurements and observations taken. Significant figures and appropriate number of decimal places should be used. Parenthetical remarks are prohibitive. Proofread carefully at final stage. In the end give outline to your arguments. Spot out perspectives of further study of this subject. Justify your conclusion by at the bottom of them with sufficient justifications and examples.

34. After conclusion: Once you have concluded your research, the next most important step is to present your findings. Presentation is extremely important as it is the definite medium though which your research is going to be in print to the rest of the crowd. Care should be taken to categorize your thoughts well and present them in a logical and neat manner. A good quality research paper format is essential because it serves to highlight your research paper and bring to light all necessary aspects in your research.

Informal Guidelines of Research Paper Writing

Key points to remember:

- Submit all work in its final form.
- Write your paper in the form, which is presented in the guidelines using the template.
- Please note the criterion for grading the final paper by peer-reviewers.

Final Points:

A purpose of organizing a research paper is to let people to interpret your effort selectively. The journal requires the following sections, submitted in the order listed, each section to start on a new page.

The introduction will be compiled from reference matter and will reflect the design processes or outline of basis that direct you to make study. As you will carry out the process of study, the method and process section will be constructed as like that. The result segment will show related statistics in nearly sequential order and will direct the reviewers next to the similar intellectual paths throughout the data that you took to carry out your study. The discussion section will provide understanding of the data and projections as to the implication of the results. The use of good quality references all through the paper will give the effort trustworthiness by representing an alertness of prior workings.

Writing a research paper is not an easy job no matter how trouble-free the actual research or concept. Practice, excellent preparation, and controlled record keeping are the only means to make straightforward the progression.

General style:

Specific editorial column necessities for compliance of a manuscript will always take over from directions in these general guidelines.

To make a paper clear

· Adhere to recommended page limits

Mistakes to evade

- Insertion a title at the foot of a page with the subsequent text on the next page
- Separating a table/chart or figure - impound each figure/table to a single page
- Submitting a manuscript with pages out of sequence

In every sections of your document

· Use standard writing style including articles ("a", "the," etc.)

· Keep on paying attention on the research topic of the paper

· Use paragraphs to split each significant point (excluding for the abstract)

· Align the primary line of each section

· Present your points in sound order

· Use present tense to report well accepted

· Use past tense to describe specific results

· Shun familiar wording, don't address the reviewer directly, and don't use slang, slang language, or superlatives

· Shun use of extra pictures - include only those figures essential to presenting results

Title Page:

Choose a revealing title. It should be short. It should not have non-standard acronyms or abbreviations. It should not exceed two printed lines. It should include the name(s) and address (es) of all authors.

Abstract:

The summary should be two hundred words or less. It should briefly and clearly explain the key findings reported in the manuscript--must have precise statistics. It should not have abnormal acronyms or abbreviations. It should be logical in itself. Shun citing references at this point.

An abstract is a brief distinct paragraph summary of finished work or work in development. In a minute or less a reviewer can be taught the foundation behind the study, common approach to the problem, relevant results, and significant conclusions or new questions.

Write your summary when your paper is completed because how can you write the summary of anything which is not yet written? Wealth of terminology is very essential in abstract. Yet, use comprehensive sentences and do not let go readability for briefness. You can maintain it succinct by phrasing sentences so that they provide more than lone rationale. The author can at this moment go straight to shortening the outcome. Sum up the study, with the subsequent elements in any summary. Try to maintain the initial two items to no more than one ruling each.

- Reason of the study - theory, overall issue, purpose
- Fundamental goal
- To the point depiction of the research
- Consequences, including definite statistics - if the consequences are quantitative in nature, account quantitative data; results of any numerical analysis should be reported
- Significant conclusions or questions that track from the research(es)

Approach:

- Single section, and succinct
- As a outline of job done, it is always written in past tense
- A conceptual should situate on its own, and not submit to any other part of the paper such as a form or table
- Center on shortening results - bound background information to a verdict or two, if completely necessary
- What you account in an conceptual must be regular with what you reported in the manuscript
- Exact spelling, clearness of sentences and phrases, and appropriate reporting of quantities (proper units, important statistics) are just as significant in an abstract as they are anywhere else

Introduction:

The **Introduction** should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable to comprehend and calculate the purpose of your study without having to submit to other works. The basis for the study should be offered. Give most important references but shun difficult to make a comprehensive appraisal of the topic. In the introduction, describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will have no attention in your result. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here. Following approach can create a valuable beginning:

- Explain the value (significance) of the study
- Shield the model - why did you employ this particular system or method? What is its compensation? You strength remark on its appropriateness from a abstract point of vision as well as point out sensible reasons for using it.
- Present a justification. Status your particular theory (es) or aim(s), and describe the logic that led you to choose them.
- Very for a short time explain the tentative propose and how it skilled the declared objectives.

Approach:

- Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done.
- Sort out your thoughts; manufacture one key point with every section. If you make the four points listed above, you will need a least of four paragraphs.

- Present surroundings information only as desirable in order hold up a situation. The reviewer does not desire to read the whole thing you know about a topic.
- Shape the theory/purpose specifically - do not take a broad view.
- As always, give awareness to spelling, simplicity and correctness of sentences and phrases.

Procedures (Methods and Materials):

This part is supposed to be the easiest to carve if you have good skills. A sound written Procedures segment allows a capable scientist to replacement your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt for the least amount of information that would permit another capable scientist to spare your outcome but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section. When a technique is used that has been well described in another object, mention the specific item describing a way but draw the basic principle while stating the situation. The purpose is to text all particular resources and broad procedures, so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step by step report of the whole thing you did, nor is a methods section a set of orders.

Materials:

- Explain materials individually only if the study is so complex that it saves liberty this way.
- Embrace particular materials, and any tools or provisions that are not frequently found in laboratories.
- Do not take in frequently found.
- If use of a definite type of tools.
- Materials may be reported in a part section or else they may be recognized along with your measures.

Methods:

- Report the method (not particulars of each process that engaged the same methodology)
- Describe the method entirely
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures
- Simplify - details how procedures were completed not how they were exclusively performed on a particular day.
- If well known procedures were used, account the procedure by name, possibly with reference, and that's all.

Approach:

- It is embarrassed or not possible to use vigorous voice when documenting methods with no using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result when script up the methods most authors use third person passive voice.
- Use standard style in this and in every other part of the paper - avoid familiar lists, and use full sentences.

What to keep away from

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings - save it for the argument.
- Leave out information that is immaterial to a third party.

Results:

The principle of a results segment is to present and demonstrate your conclusion. Create this part a entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Carry on to be to the point, by means of statistics and tables, if suitable, to present consequences most efficiently.You must obviously differentiate material that would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matter should not be submitted at all except requested by the instructor.

Content

- Sum up your conclusion in text and demonstrate them, if suitable, with figures and tables.
- In manuscript, explain each of your consequences, point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation an exacting study.
- Explain results of control experiments and comprise remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or in manuscript form.

What to stay away from

- Do not discuss or infer your outcome, report surroundings information, or try to explain anything.
- Not at all, take in raw data or intermediate calculations in a research manuscript.
- Do not present the similar data more than once.
- Manuscript should complement any figures or tables, not duplicate the identical information.
- Never confuse figures with tables - there is a difference.

Approach

- As forever, use past tense when you submit to your results, and put the whole thing in a reasonable order.
- Put figures and tables, appropriately numbered, in order at the end of the report
- If you desire, you may place your figures and tables properly within the text of your results part.

Figures and tables

- If you put figures and tables at the end of the details, make certain that they are visibly distinguished from any attach appendix materials, such as raw facts
- Despite of position, each figure must be numbered one after the other and complete with subtitle
- In spite of position, each table must be titled, numbered one after the other and complete with heading
- All figure and table must be adequately complete that it could situate on its own, divide from text

Discussion:

The Discussion is expected the trickiest segment to write and describe. A lot of papers submitted for journal are discarded based on problems with the Discussion. There is no head of state for how long a argument should be. Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implication of the study. The purpose here is to offer an understanding of your results and hold up for all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of result should be visibly described. Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved with prospect, and let it drop at that.

- Make a decision if each premise is supported, discarded, or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."
- Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work
- You may propose future guidelines, such as how the experiment might be personalized to accomplish a new idea.
- Give details all of your remarks as much as possible, focus on mechanisms.
- Make a decision if the tentative design sufficiently addressed the theory, and whether or not it was correctly restricted.
- Try to present substitute explanations if sensible alternatives be present.
- One research will not counter an overall question, so maintain the large picture in mind, where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

- When you refer to information, differentiate data generated by your own studies from available information
- Submit to work done by specific persons (including you) in past tense.
- Submit to generally acknowledged facts and main beliefs in present tense.

Please carefully note down following rules and regulation before submitting your Research Paper to Global Journals Inc. (US):

Segment Draft and Final Research Paper: You have to strictly follow the template of research paper. If it is not done your paper may get rejected.

- The **major constraint** is that you must independently make all content, tables, graphs, and facts that are offered in the paper. You must write each part of the paper wholly on your own. The Peer-reviewers need to identify your own perceptive of the concepts in your own terms. NEVER extract straight from any foundation, and never rephrase someone else's analysis.

- Do not give permission to anyone else to "PROOFREAD" your manuscript.

- Methods to avoid Plagiarism is applied by us on every paper, if found guilty, you will be blacklisted by all of our collaborated research groups, your institution will be informed for this and strict legal actions will be taken immediately.)
- To guard yourself and others from possible illegal use please do not permit anyone right to use to your paper and files.

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Topics	Grades		
	A-B	**C-D**	**E-F**
Abstract	Clear and concise with appropriate content, Correct format. 200 words or below	Unclear summary and no specific data, Incorrect form Above 200 words	No specific data with ambiguous information Above 250 words
Introduction	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

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