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Larvicidal Activity of Solvent Extractions from some Selected Indigenous Plants Against the Mediterranean Fruit fly Larvae *Ceratitis Capitata* Identified From Coffee Berry (Diptera:Tephritidae) In Jimma Zone, Southwestern Ethiopia

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ABSTRACT

Background: The Mediterranean fruit fly is one of most devastating pest of coffee which reduces the quality and yield of coffee by destroying the organic mucilage with in coffee berry by its larvae. **Objective:** The basic objective of carrying out this study was to examine the larvicidal property of solvent extracts for Mediterranean fruit fly *Ceratitis capitata*, coffee pest. **Results:** All tested candidate botanical crude extracts have shown strong larvicidal activity against the larvae of Mediterranean fruit fly with *Lagera tomentossa* and *Ocimum lamiifolium* resulting the highest mortality of 96% and 97.5% respectively when extracted by petroleum ether. **Conclusion:** both polar and non-polar solvents can be complemented each other in extracting the active ingredients from the plant.

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INTRODUCTION

Coffee is a drink made from roasted and ground bean of coffee plant. It is a favorite hot drink in almost all country in the world. According to the legend, coffee was discovered in Ethiopia when goatherds noticed that their flocks stayed awake all night after feeding on coffee leaves and berries. Before its use as a beverage 700 years ago, coffee was used as food, wine and medicine (Mark, 1996; Bennett *et al*., 2002).

Coffee is the major cash crop in Ethiopia and economic sources of millions famers of the country and leading export commodity of the country. Indeed, coffee is the backbone of the Ethiopian economy, contributing 41 per cent of total foreign exchange earnings in 2005 (IMF, 2006) and the crop plays a central role in sustaining the livelihoods of more than one million coffee growing households and an estimated 15 million people in total (LMC, 2000). Furthermore, the bases for livelihood of million people in the country directly or indirectly depend on coffee production (Nicolas, 2007; LMC, 2003). Coffee production in different area is affected by different pests and disease that result in reduction of its quality and yield. Bacteria, fungus, nematodes and insect pests are some of the organisms posing serious problem. The pest Mediterranean fruit fly *Ceratitis capitata (*commonly known as med fly*)* is one of the pests that affect quality and yield of coffee. Its larvae severely affect berries of the coffee by eating organic compound in the berry. The Mediterranean fruit fly affects not only coffee, but also its impact goes almost 200 kinds of fruits and vegetables (Greenhalgh and Havis 2005).

Thus, different mechanisms have been being applied to control these pests since many years. It has been reported that by many workers conventional insecticides like malathm deazene, trichlorophon, and dimathoate are effective for the control of fruit fly (Farzana 2005). However, due to unwanted side effects of these insecticides on human beings, animals and environment, other possible alternatives are being solicited by scholars. One of the alternatives is use of crude extracts, compounds derived from botanicals. The advantage of using botanicals is not only measured from the point of its minimum effect on the environment, but also its availability in locality makes it more ideal option in search of alternative methods for insect pest management. In addition to this locally accessible botanicals can be easily cultivated on sustainable bases. The Idea of using insecticidal plants for pest control is not completely to replace the conventional insecticide, but rather to augment it with the existing tactics so that the impact of conventional chemicals

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would be as low as possible. Esayas, *et. al*.(2012), Araya,(2007) and Mulgeta (2005) all confirmed the insecticidal property of extracts and essential oils, from candidate plants (*Chenopodium ambrosioides* L(local name "Gime",)., *Lagera tomentosa*,(local name: "Ye chibbo zaf") *Ocimum lamiifolium (local name:"dama kesse")*, *Calpurnia , aurea(local name: "dagita")* and *Phytolacca decandra* (local name:"endod") against coffee berry borer, bruchid, and mosquito respectively, however, their activity against med fly is not addressed yet. In addition to these crude preparations, from *Calpurnia aurea*, and *Chenopodium ambrosioides* are commonly used in local communities around Jimma, for the purpose of dislodging ticks and repelling invasive ants, but these indigenous practices are not supported by scientific approach. Thus, the primary objective of this research was to examine the insecticidal property of the aforementioned botanical's extract against the larvae of med fly (*Ceratitis capitata*). Thus, Leaf, flower, and succulent parts of all the candidate plants (*Chenopodium ambrosioides, Lagera tomentosa, Ocimum lamiifolium, Calpurnea aurea and Phytolacca decandra*) were collected, dried, grind and extracted manually. Solvents were selected based on their dissolving property (polar, medium and non-polar) in order to extract all the possible active ingredients from candidate plants.

Methodology:
Botanical Description:
Ocimum lamiifolium:

The genas *Ocimum* belongs to the family Lamiacae and is comprised of more than 50 species of herbs and sharps distributed in tropical regions. *Ocimum lamiifolium* wild. (Lamiacae) is perennial herb often densely and profusely branched up to 3m high with hairy opposite leaves. Flowers are small white sweet scented found in whorls in spikes active constituents may be phenol compounds. The plants are widely cultivated in home gardens and is common in shallow soils ever green bush land (Das *et al*., 2010).

A closely related species *Ocimum suavae* leaves and flowers are used as local medicine against headaches and skin problems and the sap against eye disease and typhus (Rajkumar and Jabanasan 2008). Materials from the leagues and succulent stems of *O.suavae* provide effective repellency against stored product insect pests (Rajkumar and Jabanasan 2008), however the solvent extract of *O. lamiifolium* were never evaluated for its bioactivity against fruit files.

Chenopodium ambrosioides (Epazote):

Chenopodium ambrosioides L. commonly known as Mexican tea is a herb native to central and south American and now distributed throughout the tropical parts of the world. It is an annual herb that grows to about 1 m in height. It has multi-branched, reddish stems covered with small, sharply toothed leaves. It bears numerous small yellow flowers in clusters along its stems. Following the flowers, it produces thousands of tiny black seeds in small fruit clusters. It is easily spread and re-grown from the numerous seeds it produces which is why some consider it an invasive weed. The whole plant gives off a strong and distinctive odor. The plant use for the treatment of intestinal parasites, stomachache and kill bacteria (Abebe *et al*., 2010).

Lagera tomentossa:

Lagera tomentossa family of Asteracae, is a perennial fragrant bushy herb endemic to Ethiopia. *Lagera tomentossa* and some other species of the genus have been used as repellent against ants, and to treat various diseases such as fever, pneumonia and skin tumors. The juice of the crushed plant is digested as a treatment for stomach ache it can also be used as a fumigant and for cleaning milk containers. However, the bioactivity of its extract against fruit flies has not been evaluated so far.

Phytolacca dodecandara:

*Phytolacca dodecandara (*Endod local name) is the soap berry perennial plant that grows in Ethiopia. It is a climbing plant with haring branches growing up to ten meter individual twice a year, December to February and then June to July. Endod is diocious plant the sexes being represented by separate plants. It has small berries which when clerked powdered and mixed with water yield teaming detergent solution that has been traditionally used in Ethiopia for washing clothes. Akllu Lamma (1965) discovered during a field work in northern Ethiopia the killing effect of the berries of "endod" with his observation to be " endod" a proven biological pesticide to control Schistosoma transmit snail. Because of its larvicidal effects it can be also used against larvae of mosquito, and other insects such as fruit fly (Mulgeta 2005).

Calpurnia aurea:

Calpurnea aurea or locally called is perennial herb branched opposite leaves it can grow with hairy steam and small yellow flowers the plant is widely grow in high land areas. *Calpurnia aurea*, a member of the subfamily Papilionoideae of the family Fabaceae (Coates 1983) is a plant commonly used in traditional medicine to treat diverse medical conditions and parasitic infestation, in humans and animals. It is a small, multi-branched tree, can grow up to 4 m tall, widespread in bush land and grassland in sub-Saharan Africa and India. In southwestern Ethiopia, it is called "digita". In western and south western Ethiopia, the juice of crushed leaves and bark is used for tick control (Regassa 2000). In southwestern Ethiopia, the leaves of *C. aurea*, mixed with other plant species, are crushed and squeezed to obtain a juice, which is applied through the auricular route for 2 days to treat earache in humans (Regassa

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2000). However, its insecticidal properties are not proved yet.

Mass Rearing of the insect:

Fresh ripen coffee berries were collected from Olme state farm of *Coffee Arabica* and brought to Jimma university research Laboratory of Biology Department. A 30X30X30 cm transparent plastic cage was taken with its cover removed from the center and replaced with Nylon mesh for aeration. Coffee berries collected from Olme state farm were introduced, the cage was kept in laboratory for a week until the last larval instar walk out from the ripen berry. The rearing room was maintained at 65-85% Rh and 24-27^{o}c (Carlos *et al*., 2012; Todd and Donald 2000).

Collection and Extraction of plant material:

This study was carried out in the research laboratory of Department of Biology of Jimma University. The study was conducted starting from October 2011-June 2012. Leaf, flower, succulent parts of all the candidate plants (*Chenopodium ambrosioides* L (local name "Gime",). *Lagera tomentosa*, (local name: "Ye chibbo zaf") *Ocimum lamiifolium (local name:"dama kesse"), Calpurnea, aurea (local name: "dagita")* and *Phytolacca dodecandra* (local name:"endod") were collected from, seka –Chekorsa wereda, Jimma Zone, South west Ethiopia.

Plant parts were dried and grind in to fine powder manually using a mortar and pestle and allowed to pass through a sieve of 0.25mm mesh size (Jembere *et al*., 2005).

All chemicals (Ptreleum ether, chloroform, methanol, and water used for this experiment were analytical grade and obtained from wise team plc, Ethiopia (national Laboratory chemicals supplier). 500g of the fine powder for each candidate botanical was taken, soaked into a bottle with one litter water, mixed gently and allowed to stand for 24 hrs at room temperature. The mixture was then filtered using filter paper. Water solvent from the supernatant was evaporated through vacuum rotary evaporator to obtain the crude extract in dry form. The residue left was again dried at room temperature and re-soaked with one liter of Chloroform and allowed to stand for 24 hrs. After 24 hrs the mixture was then filtered using filter paper. The supernatant was evaporated through vacuum rotary evaporator to obtain the dry form of crude extract. Finally the residue from chloroform mixture left at room temperature was allowed to dry and again soaked in to a bottle containing 1litter petroleum ether. The mixture was allowed to stand for 24 hrs. After 24 hrs the mixture was then filtered using filter paper. The supernatant was evaporated through vacuum rotary evaporator to obtain the dry form of crude extract. All the dried crude extracts were stored in -20 until usage (Das *et al*., 2010).

Bioassay of crude extracts:

Five, ten and twenty gram of each crude extracts were weighed using analytical balance and each dissolved in 100 ml of Methanol(100%) to be used as a stalk solution. One ml of crude extract was added to 250 ml size bottle and covered with screw cover. The bottle was then allowed to be coated with the extract solution by rolling on flat table surface for 5 minutes. Then the bottle was left open for 30 minutes to allow the solvent to evaporate. Twenty to twenty five larvae of Mediterranean fruit fly from the cage were added to each bottle and the bottle was left covered for 24 hrs. Mortality was recorded after 24 hrs. Each treatment was replicated five times. Concurrently 1 ml of methanol (100%) was added to two bottles each and bottles were coated with the solvent evenly for 5 minutes before they left open for 30 minutes to allow solvent evaporation and used as a control. Twenty to twenty five larvae of Mediterranean fruit fly from the cage were added to each bottle and the bottle was left covered for 24 hrs. Mortality was recorded after 24 hrs. The experiment was arranged in completely randomized design.

Method of data analysis:

The recorded data was entered in to excel and cleaned carefully. Analysis was made using SPSS software version 16.00. Percent mean mortality provoked by different plant extracts and the interaction between independent variable solvent and plant type was analyzed using two ways ANOVA. Duncan test was used to carry out the pair wise mean comparison of percent mean mortality among concentration and among botanicals. All results were considered at P-value < 0.05. Results were presented in tables.

Results:

Larvicidal property of candidate plants:

All five candidate botanical extracts tested against the larvae of Mediterranean fruit fly have shown larvicidal property in our study under laboratory set up. The highest mean (61% and 60.2%) larval mortality was observed when petroleum ether extract of *Lagera tomentosa* and water extracts of *Phytolacca dodecandara* were used respectively (Table1). Petroleum ether and chloroform extraction of both *Lagera tomentosa* and *Ocimum lamiifolium* caused more than 50% larval mortality. Similarly Water extraction of *Chenopodium ambrosioides* and *Phytolacca dodecandara* caused more than 50% larval mortality. The least mean mortality (32.3%) was recorded for petroleum extract from *Calpurnia aurea.*

Table 1: Percent mean mortality ± SE after 24 hrs provoked by different botanical extract using three different solvents.

Plant	Solvent	Mean ±SE (%)	Confidence Interval

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			LB	UB
Lagera tomentossa	Petroleum Ether	61.0± 0.99^{i}	59.075	62.955
	Chloroform	50.6± 0.99^{g}	48.670	52.550
	Water	40.2± 0.99^{c}	38.245	42.125
Ocimum lamiifolium	Petroleum Ether	59.0± 0.99^{h}	57.063	60.944
	Chloroform	55.5± 0.99^{h}	53.535	57.415
	Water	39.1± 0.99^{c}	37.200	41.080
Chenopodium ambrosioides	Petroleum Ether	43.3± 0.99^{e}	41.318	45.199
	Chloroform	40.5± 0.99^{c}	38.595	42.475
	Water	56.5± 0.99^{h}	54.515	58.395
Calpurniaaurea	Petroleum Ether	32.3± 0.99^{b}	30.311	34.192
	Chloroform	40.3± 0.99^{c}	38.375	42.255
	Water	41.3± 0.99^{d}	39.350	43.230
Phytolacca dodecandara	Petroleum Ether	40.6± 0.99^{c}	38.663	42.544
	Chloroform	44.7± 0.99^{f}	42.725	46.605
	Water	60.2± 0.99^{i}	58.255	62.135
Control	Methanol	0.211±.474^{a}	0.000	1.145

Mean with in a column followed by the same letter (s) are not significantly different, P<0.001%, Duncan test.

Bioactivity of crude extracts using solvents with different degree of polarity:

Petroleum extracts of all plants at all three level of concentration caused significant mortality of med fly larvae compared to percent mortality recorded in control. Both *Lagera tomentossa* and *Ocimum lamiifolium* has provoked the highest (96.6% and 97.5%) recorded mortality when applied at the concentration of 0.2 gm/ml. *Calpurnia aurea* has produced the least (19.98 %) mortality with 0.05 mg/ml concentration (table 2).

Table 2: Percent Mortality (%) of Larvae of Mediterranean fruit fly due to petroleum Extracts of different concentrations of candidate botanicals after 24 hrs.

Plant	Conc. (mg/ml)	Mean ± SE (%)	95% confidence interval	
			LB	UB
Lagera tomentossa	0.05	63.0 ± 2.3^{h}	58.402	67.598
	0.1	84.4 ± 2.3^{j}	79.842	89.038
	0.2	96.6 ± 2.3^{k}	92.022	100.00
Ocimum lamiifolium	0.05	61.0 ± 2.3^{g}	56.402	65.598
	0.1	76.7 ± 2.3^{i}	72.102	81.298
	0.2	97.5 ± 2.3^{k}	92.882	100.00
Phytolacca dodecandara	0.05	35.7 ± 2.3^{c}	31.102	40.298
	0.1	61.0 ± 2.3^{g}	56.402	65.598
	0.2	64.9 ± 2.3^{h}	60.282	69.478
Chenopodium ambrosioides	0.05	49.0 ± 2.3^{d}	44.402	53.598
	0.1	60.8 ± 2.3^{g}	56.162	65.358
	0.2	62.4 ± 2.3^{g}	57.842	67.038
Calpurnia aurea	0.05	19.98 ± 2.^{b}	15.382	24.578
	0.1	52.6 ± 2.3^{e}	48.022	57.218
	0.2	55.7 ± 2.3^{f}	51.142	60.338
Control	0.00	0.63 ± 0.94^{a}	0.000	2.510
P-Value		0.000		

Means within the same column followed by the same letter are not significantly different, p<0.001%, HSD

Similarly Chloroform extracts were tested for their larvicidal activity and the results showed higher morality record. Both *Lagera tomentossa* and *Ocimum lamiifolium* extracts have produced strong bioactivity with the 83.9% and 87.0% mortality respectively against the Med fly larvae. However, its bioactivity has induced less mortality when compared to the extracts from petroleum ether. *Calpurnia aurea* has shown weak larvicidal activity (Table 3).

Table 3: Percent Mortality (%) of Larvae of Mediterranean fruit fly due to Chloroform Extracts of different concentrations of candidate botanicals after 24 hrs.

Plant	Conc. (mg/ml)	Mean ± SE (%)	95% confidence interval	
			LB	UB
Lagera tomentossa	0.05	53.48 ±2.05 ^{c}	49.41	57.55
	0.1	65.04 ± 2.05^{de}	60.97	69.11
	0.2	83.92 ± 2.05^{fg}	79.85	87.99
Ocimum lamiifolium	0.05	59.82 ± 2.05^{c}	55.75	63.89
	0.1	75.08 ± 2.05^{f}	71.01	79.15
	0.2	87.00 ± 2.05^{g}	82.93	91.01
Chenopodium ambrosioides	0.05	36.24 ± 2.05^{b}	32.17	40.31
	0.1	59.02 ± 2.05^{c}	54.95	63.09

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	0.2	66.880 ± 2.05^{ef}	62.81	70.95
Calpurnia aurea	0.05	36.32 ± 2.05^{b}	32.25	40.39
	0.1	59.58 ± 2.05^{c}	55.51	63.65
	0.2	65.36 ± 2.05^{de}	61.29	69.43
Phytolacca dodecandara	0.05	52.48 ± 2.05$_{c}$	48.41	56.55
	0.1	63.92 ± 2.05^{cd}	59.85	67.99
	0.2	62.26 ± 2.05^{cd}	58.19	66.33
Control	0.00	0.00^{a}		
P-Value		0.000		

Means within the same column followed by the same letter are not significantly different, p<0.001%, HSD

Water extracts of *Phytolacca dodecandara* and *Chenopodium ambrosioides* have shown increased mortality where as all the rest *Calpurnia aurea, Lagera tomentossa and Ocimum lamiifolium* have induced lower mortality. The highest larval mortality (98%) was recorded when 0.2 gm/ml of *p. dodecandara* was applied and the least mortality (41.06%) was recorded by extractions of *Calpurnia aurea* (table 3).

Table 3: Percent Mortality (%) of Larvae of Mediterranean fruit fly due to water Extracts of different concentrations of candidate botanicals after 24 hrs.

Candidate_Botanical	Conc.(g/ml)	Mean ± SE	95% Confidence Interval	
			LB	UB
Lagera tomentossa	0.05 Mg/ml	51.16 ± 1.62^{c}	47.95	54.37
	0.1 mg/ml	50.08 ± 1.62^{c}	46.87	53.29
	0.2 gm/ml	59.50 ± 1.62^{cd}	56.29	62.71
Ocimum lamiifolium	0.05 Mg/ml	51.52 ± 1.62^{c}	48.31	54.73
	0.1 mg/ml	52.08 ± 1.62^{c}	48.87	55.29
	0.2 gm/ml	52.96 ± 1.62^{c}	49.75	56.17
Chenopodium ambrosioides	0.05 Mg/ml	54.74 ± 1.62^{c}	51.53	57.95
	0.1 mg/ml	73.80 ± 1.62^{f}	70.59	77.01
	0.2 gm/ml	97.28 ± 1.62^{g}	94.07	100.00
Calpurnia aurea	0.05 Mg/ml	41.06 ± 1.62^{b}	37.85	44.27
	0.1 mg/ml	60.62 ± 1.6^{2d}	57.41	63.83
	0.2 gm/ml	63.48 ± 1.62^{de}	60.27	66.69
Phytolacca dodecandara	0.05 Mg/ml	54.56 ± 1.62^{c}	51.35	57.77
	0.1 mg/ml	88.18 ± 1.62^{g}	84.97	91.39
	0.2 gm/ml	98.04 ± 1.62^{gh}	94.83	100.00
Control	0.00 gm/ml	0.000^{a}		
P-Value		0.000		

Means within the same column followed by the same letter are not significantly different, p<0.001%, HSD

Table 4: Median Lethal concentration of different candidate botanical extracts using three different solvents after 24 hrs.

Treatments		LC50 (mg/ml)	95% confidence interval	
Solvent	Botanical		Lower	Upper
Petroleum ether	*L. tomentossa*	0.55	0.05	1.53
	O. lamiifolium	0.64	0.01	1.74
	C. ambrosioides	1.60	0.30	4.59
	C. aurea	3.07	0.84	10.04
	P. dodecandara	1.7	0.04	4.72
Chloroform	*L. tomentossa*	1.85	0.00	5.65
	O. lamiifolium	1.90	0.00	5.87
	C. ambrosioides	3.24	0.00	9.84
	C. aurea	3.77	0.00	12.09
	P. dodecandara	3.02	0.00	9.59
Water	*L. tomentossa*	6.42	3.67	12.91
	O. lamiifolium	7.37	3.32	18.23
	C. ambrosioides	2.47	2.02	2.96
	C. aurea	4.49	3.29	6.70
	P. dodecandara	2.20	1.78	2.60

Determination of LC_{50} for the candidate Botanical extracts at Different concentrations:

The results of Probit analysis for the determination of Median Lethal Concentration, (LC50) and their 95% fiducial limits after 24 hrs for mortality of larvae of Mediterranean fruit fly were presented in table 4. Petroleum extracts of *Lagera tomentossa* was found to be the most bioactive candidate extract with LC50 value of 0.55 gm/ml and water extracts of the same plant has provoked the least bioactivity with LC50 value of 6.42 mg/ml.

Discussion:

Crude preparations, from *Calpurnia aurea*, and *Chenopodium ambrosioides* are commonly used in local communities around Jimma, and throughout the

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country for the purpose of dislodging ticks and repelling invasive ants, but these indigenous practices are not supported by scientific approach. Moreover, it was not confirmed yet weather the insecticidal properties observed in ticks dislodgment are also active against fruit pests such as med fly. Thus, the primary objective of this research was to evaluate the larvicidal effect of some selected indigenous plants against Mediterranean fruit fly, *Ceratitis capitata* larvae. Crude solvent extracts from *Lagera tomentosa, Ocimum lamiifolium, Chenopodium ambrosioides, Calpurnia aurea* and *Phytolacca dodecandara* were prepared following standard procedure. In our effort to search for natural products against the larvae of Tephritid fruit flies we have found that crude extracts from the above plants were found to be potent against the larvae of Med fly. We also tried to compare the larvicidal property of the candidate plants with using various solvents, polar, medium and non-polar solvents.

The result from comparison of crude extracts of different botanicals has shown different degree of mortality. The highest (61% and 60.2%) mean larval mortality was observed when petroleum ether extract of *Lagera tomentosa* and water extracts of *Phytolaca dodecandara* were used (Table1). Similarly Water extraction of *Chenopodium ambrosioides* and *Phytolaca dodecandara* caused more than 50% larval mortality. The least mean mortality (32.3%) was recorded for petroleum extract from *Calpurnia aurea.* Similarly Adusu *et al*., (2013) from Jimma Zone, south western Ethiopia has reported the potency of water crude extracts of *Chenopodium ambrosioides* and other botanicals against *Macrotermes* species at different concentrations(10, 20, 30 and 35 (W/V)). Similarly a filter paper bioassay conducted in upper Awash Agro-Industry Enterprise, eastern Ethiopia against the larvae of Mediterranean fruit fly using solvent extracts of Jatropha, eucalyptus and Black cumin has resulted 85% mortality when 0.1ml of the active ingredient is used (Mekuria, 2013 Personal communication) (http://acp-edulink.eu/content/mekuria-tadesse).

Comparison of mortality records based on solvent chemical property among non-polar (petroleum ether, less non-polar (Chloroform) and polar (water) has shown the difference in bioactivity among candidate botanicals. Both *Lagera tomentossa* and *Ocimum lamiifolium* has resulted higher mortality (96% and 97.5% respectively) when extracted by Petroleum ether and produced 83% and 87% mortality respectively when extracted by chloroform solvent (table 2,3). On the other hand both *Chenopodium ambrosioides* and *Phytolacca dodecandara* have produced higher mortality (97% and 98%) respectively when water is used as solvent.

Previous works directly related to our works (*Ceratitis Capitata*) larvae are missing with our literature search key words however; the bioactivity of candidate botanicals has been compared using related results. A study carried out by Abebe *et al.,*(2010) on adult Mediterranean fruit fly in Addis Ababa University has proved the insecticidal property of oils extracted from *L.tomentossa*, *C.ambrisiodes*, and *O.suavae*. Addisu *et al*., (2013) from south western Ethiopia has reported 98% mortality of tested termites when water extracts of *Chenopodium ambrosioides* were applied. Yugi *et al*., (2014) applied different concentrations of ethanol extracts of *Phytolacca dodecandara* on model wall surfaces painted of mud, cow dung, cement and plywood and exposed adult *An gambiae* which resulted in 90% mortality. Nure *et al*., (2012) from Gondor, north western Ethiopia has reported 100% mortality of larvae of Culex mosquitoes when applied with water and methanol extracts of *Phytolacca dodecandara*. Similarly Araya, (Araya 2007) on stored grain pests such as Bruchids revealed that the oils derived from leaves and inflorescence part of *Chenopodium ambrosioides* has shown insecticidal activity against coleopteran insect pests causing significant level of mortality. The study carried out elsewhere in India using methanolic extracts of *Chenopodium ambrosiodes* on Culex mosquito by Rajkumar and Jebanesan (2008) has shown the perfect insecticidal property of the plant, provoking 100% mortality when used by 25mg/l preparation. The application of *Phytolacca dodecandara* and *Calpurnia aurea* extracts against the larvae of Mediterranean fruit flies is the first attempt in Ethiopia and provided promising results causing significant mortality even though its concentration needs further optimization for statistical significance. This result will help us in order to decide which plant would be most effective when used a specific type of solvents. In some plants the active ingredient may be extracted by polar solvents, as proved from the above result and in others the active ingredient may be best extracted when non-polar solvents are used.

The results of Probit analysis for the determination of Median Lethal Concentration, (LC50) and their 95% fiducial limits after 24 hrs for mortality of larvae of Mediterranean fruit fly were presented in table 4. Petroleum extracts of Lagera tomentossa was found to be the most bioactive candidate extract with LC50 value of 0.55 gm/ml and water extracts of the same plant has provoked the least bioactivity with LC50 value of 6.42 mg/ml. Similarly Karunamorthi *et al*., (2008) has conducted toxicity test for on larvae of mayflies (aquatic macro-invertebrates) using water extracts of *Phytolacca dodecandara* and reported LC50 of 181.94mg/L.

In general the insecticidal activity of *Lagera tomentosa* and *Osmium lamiifolium* was found to be relatively most promising compared to the rest three candidate plant extracts. Both of them caused average 50% mortality when all the records are pooled across concentrations. The comparison of three solvents with ranging chemical property (polar,

semi-polar and non-polar) has revealed significant mortality differences among candidate botanicals, for instance, extracts from *Chenopodium* and *Phytolacca* are effective when extracted by polar solvents such as water where as extracts from *Lagera tomentossa* and *Osmium lamiifolium* best kill when extracted by petroleum ether.

Conclusion:

The petroleum ether extracts from plants *Lagera tomentosa* and *Ocimum lamiifolium* cased significant mortality where as extracts from *Chenopodium ambrosioides* and *Phytolacca dodecandara* caused more mortality when water is used as solvent suggesting that both polar and non-polar solvents can be complemented each other in extracting the active ingredients from the plant.

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