ISSN: 0975-833X

Available online at http://www.journalcra.com

International Journal of Current Research
Vol. 10, Issue, 05, pp.68908-68912, May, 2018

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

RESEARCH ARTICLE

THE INSECTICIDAL PROPERTIES OF CYMBOPOGON CITRATUS (D.C STAPF) AND MENTHA PIPERITA L.; EVALUATION STUDIES

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ARTICLE INFO

Article History:
Received 24th February, 2018
Received in revised form
08th March, 2018
Accepted 29th April, 2018
Published online 23rd May, 2018

Key words:
Cymbopogon citrates,
Mentha piperita,
Insecticide,
Mosquitoes, oil.

ABSTRACT

Many plant essential oils show a broad spectrum of activity against pests or insects. These oils have a long tradition of use in the production of stored products against pests or insects. Recent investigation indicates that some chemical constituents of these oils interfere with the octopaminergic nervous system in insects. Pure essential oils of Cymbopogon citratus and Mentha piperita have been investigated for their efficacy levels against mosquitoes (Anopheles). The two aerated jars labeled a and b, were place 40 mosquitoes each and the Cymbopogon citratus oil and Mentha piperita oil was sprayed inside them respectively. The mortality rate of both green insecticides was then recorded, with respect to time. The above procedure was thus repeated using varying doses of the green insecticide and their mortality rate were also recorded. Result showed that both Mentha piperita and Cymbopogon citratus oils have insecticidal properties, comparatively however, Mentha piperita oil achieved greater mortality (~2fold) compared to Cymbopogon citratus oils at the same dose application. It can be concluded that both Cymbopogon citratus oils and Mentha piperita oil are promising natural repellents due to its safety advantage over chemical repellents. Result gene optimum level of 1.0 ml and 1.3ml respectively for (PPO) Mentha piperita oil and (LPO) Lemon Plant oil were recorded, showing that at such concentration, the greatest killer of man can be checked.

Citation: Idibie C.A., Nwaokobia, K., Ogboru R.O. and Omoregie P.O., 2018. "The insecticidal properties of cymbopogon citratus (d.c stapf) and mentha piperita l.; evaluation studies", *International Journal of Current Research*, 10, (05), 68908-68912.

INTRODUCTION

Green insecticides are an important group of naturally occurring and, often slow acting crop protectants, usually safer to human and the environment than conventional insecticides. They are known to exhibit minimal residual effects, and since green insecticides contain mixtures of biologically active substances, no resistance has been known to develop in the insect and pathogen, hence the use of plant insecticides has been recommended ever more as a suitable alternative of plant protection with minimum negative risks (Pavela *et al.,* 2007). Insecticides just like Pesticides are recognized substances or mixture of substances that are majorly used in agriculture or in public health protection programs in order to protect plants from pests, weeds or diseases, and humans from vector-borne diseases, such as malaria, dengue fever, and schistosomiasis (Nicolopoulou-Stamati *et al.,* 2016). Suffice to note that green insecticides have long been a subject of research in an effort to develop alternatives to conventional insecticides. The use of insecticides has a long term tradition in Europe, where the first known written reference to the application of plant extracts against pest dated back as far as around 400 B.C in Rome (Sukumar, 1991). In recent years, increasing emphasis has been placed on reducing the number of synthetic insecticides that pose a number of problems, including killing beneficial bugs and adversely affecting human health and the environment (Nicolopoulou-Stamati *et al.,* 2016; Semchuk *et al.,* 1992). Numerous negative health effects associated with chemicals like these include, among other effects, dermatological, gastrointestinal, neurological, carcinogenic, respiratory, reproductive, and endocrine effects (Alewu and Nosiri, 2011; WHO, 1990 and Sanborn *et al.,* 2007).

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Furthermore, high occupational, accidental, or intentional exposure to pesticides can result in hospitalization and death (Alewu, and Nosiri, 2011). Many of the common insecticides such as chlorpyritos sold under the brand name dursban, chlordane sold under the brand name ortho and lindune are no longer sold for home and garden purposes because they did their job in the manner of killing both the pest and plants that are of economic importance. Most insecticides, both synthetic and natural, interfere with insect nerve transmission. DDT, indane and ortho cause insect neurons to fire randomly and thereby causing spasms and death. However, the general class of this organochlorine pesticides which the insecticide DDT belongs is known to be associated with health effects, such as endocrine disorders (Mnif *et al.,* 2011; Lemaire *et al*, 2004), effects on embryonic development (Tiemann, 2008), lipid metabolism (Karami-Mohajeri and Abdollahi, 2011), and hematological and hepatic alterations (Freire *et al.,* 2015). Although their carcinogenic potential has been questioned, but concerns about possible carcinogenic action is advised not be underestimated (Witczak and Abdel-Gawad, 2014; Chourasiya *et al.,* 2015; Calle *et al.,* 2002 and Robinson *et al.,* 2015).

Nature or green insecticides such as pyrethrum work in a similar way, but they break down quickly upon exposure to sunlight, which limits their agricultural effectiveness. In low doses, they often repel rather than kill insects. Synthetic insecticides work the opposite way by inhibiting the enzyme cholinesterase that allows nerves return to their resting states. Consequently, nerves stay leads to paralysis of the insect and causing death (Mnif *et al.,* 2011). Many of the never green insecticides have a unique mode of action that targets and block a key neurotransmitter receptor site. Nevertheless all insecticides gradually lose effectiveness as their target mutate and build up resistance. But because they degrade more rapidly, natural insecticides have longer useful life in the field. In order to encourage the development of alternative pest management the U.S environmental protection Agency (EPA) in 1996 created the biopesticide division and the minimum risk pesticide category. Nowadays, before a pesticide or insecticide can be marketed and use, the EPA conducts a full evaluation to ensure that it will not pose any risk of harm to human health or the environment (Haley, 1995). The neurotransmitter in insect is called octopamine, it is basically the insects version of adrenaline. The botanical blocks the octopamine resulting in a shutdown of the insect nervous system. Since only insects have this receptor, there is no harm to mammals, birth or fish. Human come in contact with dangerous insecticides on food, in water and in the air near farms and homes. Insecticidal drift occur when insecticides dust and spray travel by wind to places unexposed to the insecticides such as DDT thereby wrecking havoc on birds, fish and even people (Curson and Rechael, 1992, Semchuk *et al.,* 1992).

Many plants species produce substances that protect them by killing or repelling the insects that feed on them. For example, Elm tree produces oil that alters the hormones of bugs so that they cannot fly, breed or eat (Natural Academy of Science, 1992). It is possible to create effective, natural insecticides from these substances to protect crops. Natural insecticide has many advantages over synthetic once which includes; cost-effectiveness as they are cheaper, they are biodegradable and barely leaves residues in the soil and are less likely to harm human and animals, and more accessible in less developed countries (Mittal, 2005). This works focuses on evaluating the insecticidal properties of Cymbopogon citratus and Mentha piperita found in the environment, by isolating the oils in these plants and testing their abilities to repel or kill insects.

MATERIALS AND METHODS

Materials for extraction of Cymbopogon citratus oil (cymbopogon) include

Cymbopogon citratus (500gm) (Cymbopogon citratus was collected in Auchi), 750ml olive oil, a glass bowl, a small saucepan, dark mason jar, Jelly bag.

Method of extraction of Cymbopogon citratus oil

Cymbopogon citratus was chopped and placed in a glass bowl that sits above a saucepan with boiling water and was stirred briefly. The glass bowl was covered and the content was allowed to simmer for 2 to 3 hours. Thereafter the bowl was removed from heat source and allowed to cool. The next stage was to pour the content of the glass bowl into a jelly bag where the oil was squeezed and drained out. At the end of draining the oil, the Cymbopogon citratus residue inside the jelly bag was thrown away. Into a dark mason jar the Cymbopogon citratus oil extract also referred to as lemon oil was poured, sealed tightly and set aside.

Materials for extraction of Mentha piperita oil (M. Balsamea)

Fresh leaves of Mentha piperita (Mentha piperita leaves were collected in Benin, Edo State), Gracin alcohol or vodka, coffee filters, tunnel, mosquitoes.

Method of Extraction of Mentha piperita oil

The leaves of Mentha piperita was first chopped into pieces and mashed. The chopped and mashed mint leaves were packed into a sealable jar, leaving about ½ inches or 1.25cm of space for a stronger tincture. Alcohol was introduced into the jar to completely cover the leaves. The lid was then closed and the jar fastened tightly. The jar was allowed to sit for several weeks (4 weeks), and was accompanied with occasional shaking to speed up the dissolving process. The jar was however, stored in a dark place, since sunlight could lower the tinctures shelf life. The liquid was later strained into a brown glass container, and poured through a coffee filter to remove leaves and sediments. The tincture was stored in a brown glass container to protect it from sunlight and in order to keep its shelf life intact.

Testing for the reagents produced

Both the lemon and mint oils produced were tested to know their effectiveness against insects particularly mosquitoes. Mosquitoes were captured and put into a glass jar and the jar was covered with a very tiny net to aid free flow of oxygen into the jar, to avoid death of the specimen from suffocation and heat. The glass jars were labeled a and b, respectively. For Jar a, which contains 40 mosquitoes, 0.2 ml of lemon oil was added and it was observed after 2 minutes and four mosquito were found dead. Increasing the concentration to 0.3 ml of the lemon oil, and at the time interval of twenty minutes, it was discovered that eight mosquitoes were dead, and 0.4 ml of the oil at eighteen minutes resulted into death of nine mosquitoes.

RESULTS AND DISCUSSION

Table 1a. Activities of lemon oil on mosquitoes

Conc. (ml)	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4
Time (min)	22	20	18	16	14	12	10	8	6	4	2	<1	<1
No. of dead	4	8	12	12	14	16	18	20	22	24	32	40	40

Table 1b. Activities of peppermint oil on mosquitoes

Conc. (ml)	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.5
Time (min)	14	12	10	8	6	4	2	1	<1	<1	<1	<1	<1
No. of dead	6	10	12	16	22	24	26	34	40	40	40	40	40

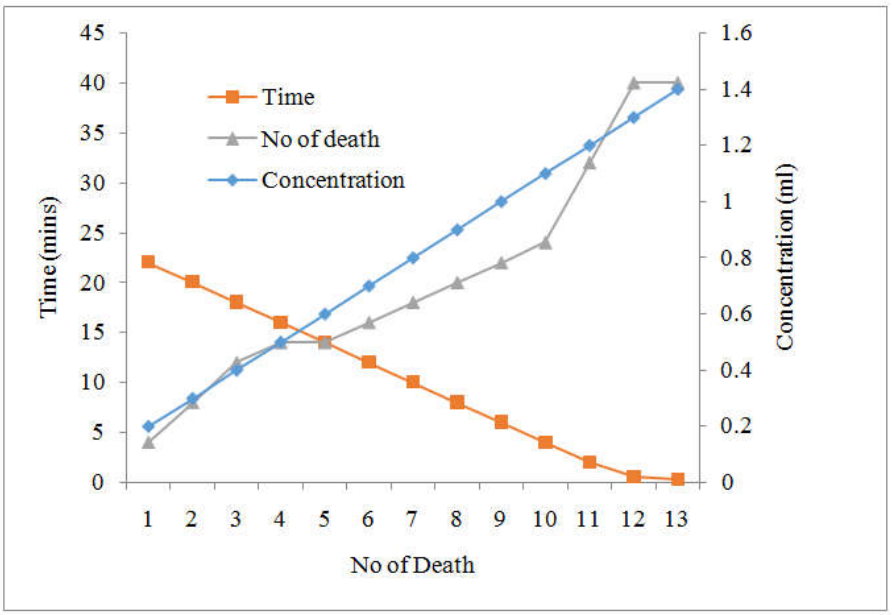

Figure 1. Effect of lemon oil on mosquitoes

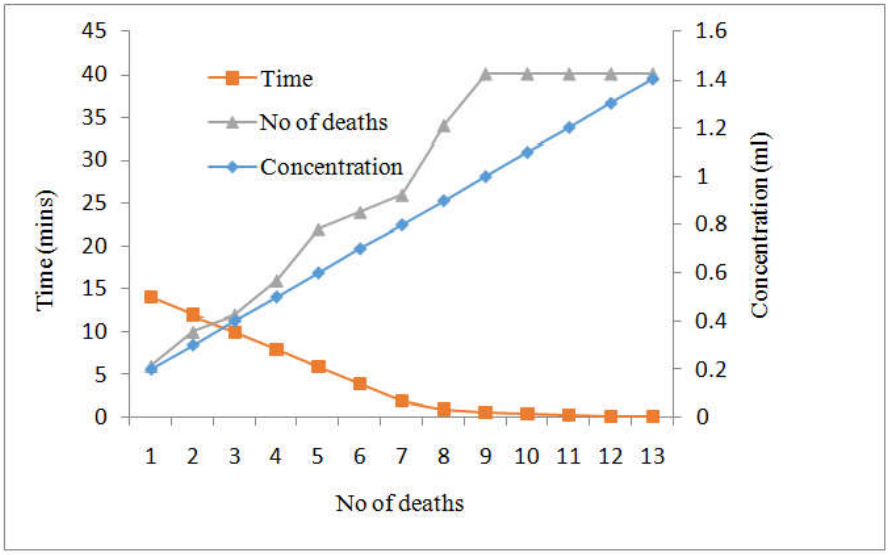

Figure 2. Effect of peppermint oil on mosquitoes

Same trend was observed with increasing lemon oil concentrations, where 0.5 ml at ten minutes achieved ten dead mosquitoes, 0.6ml at fifteen minutes resulted in the death of fourteen mosquitos and, finally 0.7 ml in 12 minutes resulted in the death of eighteen mosquitos. In glass jar b which also contains 40 mosquitoes, 0.2 ml of peppermint oil was added at fifteen minutes and six mosquitoes were dead, 0.3 ml at twelve minutes resulted into the death of ten mosquitoes. Additional 0.3 ml and at ten minutes, twelve mosquitoes were found dead, 0.5ml in eight minutes, sixteen mosquitoes died, 0.6 ml at six minutes, twenty-two died and, finally 0.7 ml at four minutes, twenty-four died, leaving the rest fourteen weaken and inactive. But addition of 1.0 ml, all mosquitoes died instantly. Beyond this concentration, no further potency was observed as it all leveled out.

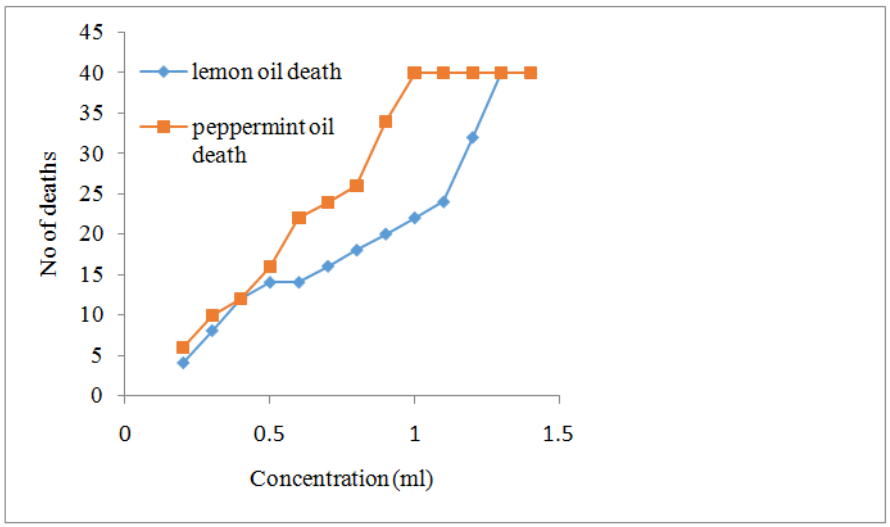

Figure 3. Mortality trend of insecticides between lemon and peppermint oils

DISCUSSION

There are four ways a natural insecticide can kill an insect, by injection, through contact, as deterrent and by disrupting development process. Injection is when the insect consumes the pesticide and are poisoned. Contact poisoning is when the solution kills the insect through the skin or other tissue. A deterrent is when the insecticide prevents the insect from feeding and starve to death. From the results in Table 1, figures showed that at the same concentration, peppermint oil killed higher numbers of mosquitoes at reduced time compared to lemon oil. Same trend is found in Figure 1 – 3. For example, using 0.2 ml, while lemon oil was only able to kill 4 mosquitoes at a prolonged time of 22 minutes, peppermint oil killed 6 mosquitoes at a short time of just 14 minutes. On increasing the concentration, using 0.9 ml, while lemon oil killed 20 mosquitoes at a prolonged time of 8 minutes, mint oil killed almost all the mosquitoes (34 out of 40) in the jar. And at the optimum concentration of 1.0 ml, while mint oil killed all the mosquitoes in just one minutes, lemon oil could only kill about half of the mosquitoes (22 out of 40) in 6 minutes. The mortality trend shown in Figure 3 reveals that the peppermint oil kills more mosquitoes than the lemon oil, although both oils have insecticidal properties. Therefore the peppermint oil is a superior insecticidal agent than the lemon oil since the efficacy of the mint oil against insect is higher than that of the lemon oil which Figures 1-3 clearly corroborated.

Conclusion

From the study, the efficacy level of lemon grass oil and peppermint oil was established using the repelling activity and their mortality rate on mosquitoes (Anopheles). The results showed that both peppermint and lemon oils exhibited insecticidal properties, however peppermint oil is more efficient than lemon grass oil as an insecticide. To put it simply that the lemon grass oil exhibited more of repellant property as seen in this study. The efficiency level of both green insecticides reduced with time due to the diffusion of the vapour phase in the local elimination of their active agent from the vicinity, leading to the reduced death or mortality rate of mosquito after a long term (several hours). However, optimum level of 1.0 ml and 1.3 ml respectively were observed for Mentha piperita oil and Lemon Plant oil.

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