International Research Journal on Advanced Engineering and Management
https://goldncloudpublications.com
https://doi.org/10.47392/IRJAEM.2024.0457
e ISSN: 2584-2854
Volume: 02
Issue: 10 October 2024
Page No: 3099-3103

Isolation, Identification and Evaluation of the Effective Phyto-Compounds for The Management of Groundnut Beetles Infesting Stored Groundnut (Arachis Hypogaea L.)

Lalit Chowdhury[1], Manoja Dash[2], Sarada Mohapatra[3], Debashis Mohanty[4], Prakash Kumar Sahoo[5], Niladri Debata[6], Sushree Chowdhury[7]
[1,2,3]GIET University, India.
[4,5,6]Department of Chemistry, Dhekanal Autonomous College, India.
[7]Gwinnett Technical College, Georgia, USA.
Emails: *lalit.chowdhury@giet.edu[1], hodbiotech@giet.edu[2], saradamohapatra121@gmail.com[3], maildebashismohanty@gmail.com[4], sushree.mohan@gmail.com[5], niladri.debata@gmail.com[6], prakashchemistry1989@gmail.com[7]*

Abstract
The effectiveness of various botanicals was tested against the Major Pest of shelled groundnuts, the red flour beetle, Tribolium castaneum (Herbst) (Coleoptera: Tenbebrionidae), under artificial infestation, in Laboratory conditions for one year. Essential Oils isolated by Clevengers Apparatus , @1%v/w of Pongamia glabra (Karanja Oil), Azadirachta indica (Neem Oil), Brassica campestris (Mustard Oil) , Crown oil (Resin of Shorea robusta) , Dalbergia sisso (Sisso Oil), Oryza sativa (Rice bran oil), Helianthus annus (Sunflower Oil) , Ricinus communis (Castor Oil), Aegle marmelos (Bael Oil), Sesamum indicum (Til Oil), etc were tested for their bioefficacy against the Major Pest, of shelled groundnuts, red flour beetle Tribolium castaneum, (Herbst) Tenebrionidae, Coleoptera, under artificial infestation, in Laboratory conditions for one year. Out of all these plant products only, Crown oil (Resin of Shorea robusta) gave 100 % pod/Kernel protection for one year. The LD 50 values were found out to be - 0.5% v/w. Spectroscopic GC MS analysis of, Crown oil (Resin of Shorea robusta) are identified as 2-Ethyl-oxetane (RT 2.223), as the major product It may be due to the strong aromatic nature of these phyto-product. Hence these phyto-product may be used as fumigants or insect repellants against Tribolium castaneum and can be included in the package of practices to save stored groundnut in storage.

Keywords: *Clevengers Apparatus, Tribolium castaneum, and LD_{50} etc.*

1. Introduction
Arachis hypogaea (L.), commonly known as groundnut or peanut, is an important oilseed crop grown in India [1-3]. Known as the "poor man's almond," groundnut kernels are higher in edible oil (48%) and readily digested protein (26%) than other oilseed crops. Tribolium castaneum (Herbst) (Coleoptera: Tenbebrionidae), also known as the red flour beetle, is a significant pest of groundnuts and their derivatives. It can also pose a significant risk to anthropogenic structures that handle and store groundnut products, such as flour mills, warehouses for the biscuit industry, and retail stores (Figure 1 & 2). Tribolium castaneum is present in all of the themes and is considered a significant pest of biscuits (Odeyemi et al. 2005), processed cereal products (Odeyemi et al. 2001), and shelled groundnuts (Odeyemi and Daramola, 2000). The adult T. castaneum has a length of 2-4 mm with a colour range of reddish brown to dark brown. The ideal life cycle is completed in around 28 days at 350 C and 75% relative humidity. The number of sticky eggs laid in the commodity by copulating females varies with temperature [4-7]. There could be 500 eggs laid. The average adult's lifespan is six months. Red-flour beetle damage to shelled groundnuts has been measured in terms of weight loss (about 4.5%) and germination loss (almost 73%). Additionally, as the groundnut oil's free fatty acid content rises, further quality degradation occurs (Apert, 1987). INDIA has a rich flora of economic importance especially

International Research Journal on Advanced Engineering and Management
https://goldncloudpublications.com
https://doi.org/10.47392/IRJAEM.2024.0457
e ISSN: 2584-2854
Volume: 02
Issue: 10 October 2024
Page No: 3099-3103

higher plants having pesticidal properties (Prakash and Rao, 1997; Prakash et al.,1986,89.) Certain plants have evolved the capacity to create compounds from their secondary metabolism that have particular anti-insect qualities in order to suppress their natural enemies [8]. (Isman, 2006). In certain regions of the world, using naturally available plant materials to shield agricultural products from various insect pests is a long-standing custom (Peter 1985). It has been demonstrated that plant extracts have insecticidal effects against a variety of insect pests (Golob et al., 1982; Delobel and Malonga, 1987). It has been observed that the bioactive components of almost 2000 different plant species exhibit biopesticidal qualities (Ahmed et al., 1984).


Figure 1 Neem Tree (Azadirachta Indica)


Figure 2 Eucalyptus Tree

The existing information on insecticidal, repellant and feeding deterrent properties of plant components was reviewed by Mc Indoo (1945), Jacobson (1958,1975). Only a small number of these ingredients are, in fact, utilised in crop protection today. In actuality, these were practically forgotten when new, potentially insecticidal synthetic agents emerged. There is a renewed interest in these naturally occurring compounds in plant materials due to the growing awareness and documentation of the issues surrounding the use of modern synthetic insecticides and the attendant issues of insect resistance, persistence of residues, effect on non-target organisms, biomagnification issues, human health hazards, and high application costs. In light of the fact that plant products are safer, more affordable, and environmentally friendly, research efforts are currently concentrated on the utilisation of plant powders, extracts, and oils (Adediran and Ajayi, 1996). According to Talukder & Howse (2000), botanical pesticides typically have a wide range of effects [9-11]. They are simple to use and process, safe, and have a rather particular mode of action (Sighamony et al., 1984; Rajapakse & Van Embden, 1997). There is a need to explore these plant products for their biopesticidal properties against the red flour beetle, Tribolium castaneum (Herbst) (Coleoptera: Tenbebrionidae). Hence the present study was set up to examine the bioefficacy of certain phyoproducts against the red flour beetle, Tribolium castaneum (Herbst) (Coleoptera: Tenbebrionidae) for their use in management of the losses caused by this serious pest on shelled groundnuts [12].

2. Materials and Methods

First the promising plants were screened against the red flour beetle, Tribolium castaneum (Herbst) (Coleoptera: Tenbebrionidae) and their bioefficacy was tested. The effectiveness of certain plant products (table) were tested against the red flour beetle, Tribolium castaneum (Herbst) (Coleoptera: Tenbebrionidae) under artificial infestation in laboratory conditions for nine months. Hundred grams of groundnut pods/Kernels were taken in glass bottles in three replicated sets for each test plant products [13-16]. Oil formulations extracted by

International Research Journal on Advanced Engineering and Management
https://goldncloudpublications.com
https://doi.org/10.47392/IRJAEM.2024.0457
e ISSN: 2584-2854
Volume: 02
Issue: 10 October 2024
Page No: 3099-3103

Clevenger's apparatus (Hydrodistillation method) were applied @ 0.1% v/w to the pods/Kernels (Figure 3). Ten pairs of freshly emerged live Tribolium castaneum of equal number of both sexes were released into each bottle 24 hours after treatment. The adult male & female population of the test insect was counted and recorded at intervals of 24h, 48h, 72h, 96h, 30 days, 60 days, 90 days, 120 days, 180 and 210 days of release. The final adult male and female population of test was recorded after 270 days of release. The percent reduction of beetle population over control has been calculated using the formula as follows –

$$\text{The \% Population Reduction} = \frac{\text{Population in Control} - \text{Population in Treatment}}{\text{Population in Control}} \times 100$$

The data thus recorded were analysed statistically and present in the following tables. That active ingredient of the most effective oil formulation can be further subjected to GC-MS to determine its chemical structure.

Figure 3 Clevenger's Apparatus

Table 1 Concentration of Treatment

S.No	Treatment	Concentration of Treatment	Beetle population after 270 days			Mean Beetle population	% Reduction of beetle population over Control
			R1	R2	R3		
1.	Arachis hypogea (Groundnut Oil)	0.1% v/w	21	30	23	24.66	64.77
2.	Mentha spicata (Mint Oil)	0.1% v/w	27	17	19	21.0	70.00
3.	Pongamia glabra (Karanja Oil)	0.1% v/w	21	30	23	22.66	68.57
4.	Brassica campestris (Mustard Oil)	0.1% v/w	41	37	38	36.67	47.61
5.	Azadirachta indica (Neem Oil)	0.1% v/w	11	10	21	19.67	71.9
6.	Aegle marmelos (Bael Oil)	0.1% v/w	27	34	21	28	60.0
7.	Sesamum indicum (Tin Oil)	0.1% v/w	28	17	13	20.34	70.94
8.	Crown oil (Shorea robusta)	0.1% v/w	**NIL**	**NIL**	**NIL**	**NIL**	**100.00**
11.	Oryza sativa (Rice bran oil)	0.1% v/w	24	22	26	24	65.71
12.	Helianthus annus (Sunflower Oil)	0.1% v/w	45	47	41	40.34	42.37
13.	Ricinus communis (Castor Oil)	0.1% v/w	31	41	45	34.34	50.94
14.	Dalbergia sisso (Sisso Oil)	0.1% v/w	36	42	41	32.67	53.32
15.	Linum usitatissamum (Linseed Oil)	0.1% v/w	42	44	38	45.67	34.75
	Control		**72**	**68**	**70**	**70**	

Compound Label	Name	RT	Algorithm
Cpd 1: 2-Ethyl-oxetane; C5H10O; 2.223	2-Ethyl-oxetane	2.223	Find by Integration

Compound Chromatograms

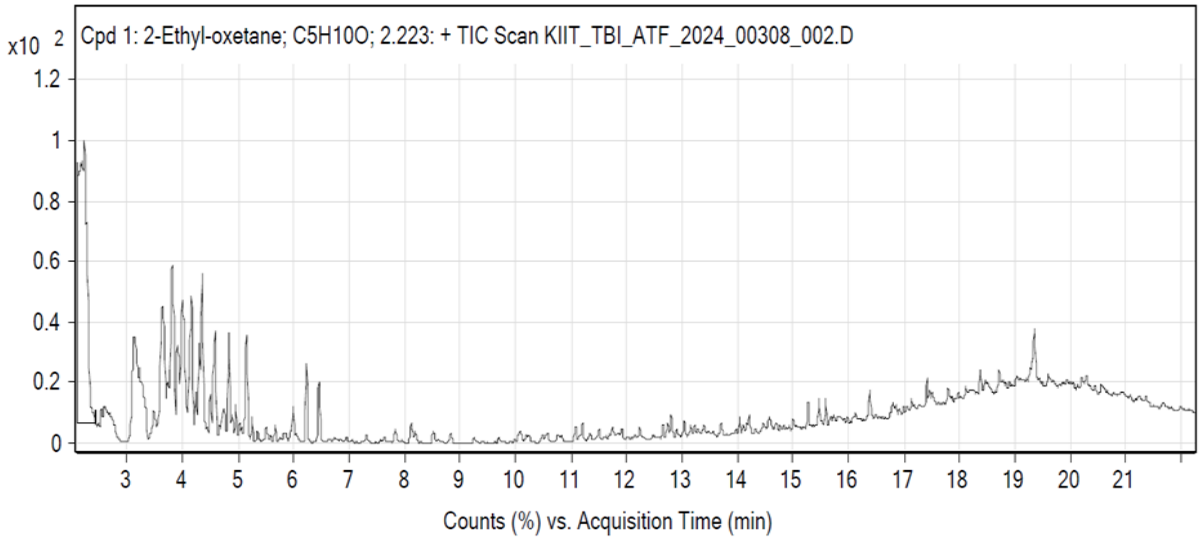
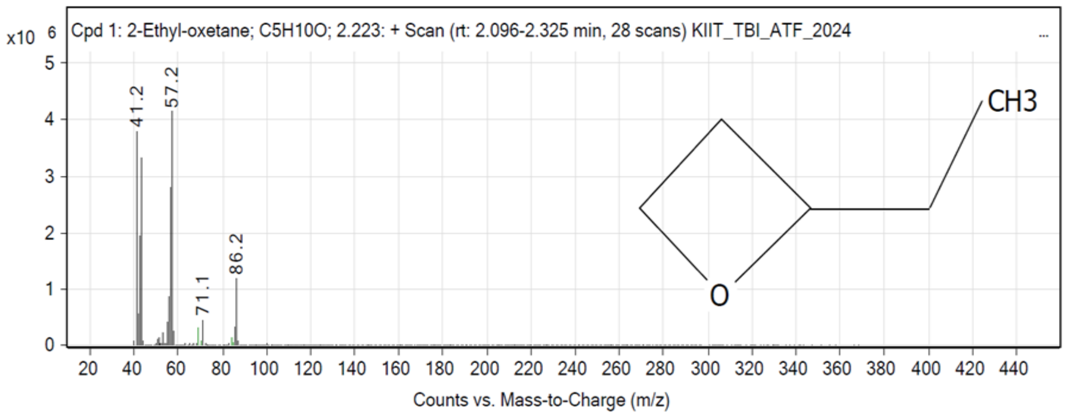


Figure 4 Gas Chromatography (GC)

MS Zoomed Spectrum



MS Spectrum Peak List

m/z	z	Abund
41.1		558325.19
41.2		3797176.5
42.1		561802.56
42.2		1940921.38
43.2	1	3326820
56.1		854645.94
56.2		2786702.5
57.2	1	4141422.25
71.1		449990.34
86.2	1	1188088.13

Figure 5 Mass Spectrometry Data (MS)

Results and Conclusion

Spectroscopic GC MS analysis of active component of Crown oil (Shorea robusta) of are identified as 2-Ethyl-oxetane as the major product. It may be due to the strong aromatic nature of these photoproduct. Hence this photoproduct may be used as fumigant or insect repellent against Tribolium castaneum and can be included in the package of practices to save stored shelled groundnut in storage.

References

[1]. Ahmed, S., M. Grainge, J. W. Hylin, W. C. Mitchell and J. A. Litsinger. 1984. Some promising plant species for use as pest control agents under traditional farming system, pp. 565-580. /n.' H. Schmutterer and K. R. S. Ascher (eds.). Proc. 2nd Int. Neem Conf. (Rauischholzhausen, Germany, 1983). GTZ, Eschborn, Germany.

[2]. Apert, J. (1987). The Storage of food grains and seeds. CTA. Macmillan Press. Pp 146.

[3]. Delobel A. and P. Malanga (1987) Insecticidal properties of six plant materials against Caryedon serratus (01.). J. stored Prod. Res. 23, 173-176.

[4]. Golob, P., & Hodges, R. (1982). Study of an outbreak of Prostephanus truncatus (Horn) in Tanzania. Report of the Tropical Products Institute (G164).

[5]. Isman, M. (2006). Botanical insecticides, deterrents, and repellents in modern agriculture and an increasingly regulated world. Annu. Rev. Entomol. 51, 45–66.

[6]. Jacobson, M (1958). Insecticides from plants. A review of literature. USDA Agric. Hand, govt. Printing office, Washington, DC, p-219.

[7]. Mclndoo, N.E.1945. Plants of possible insecticidal value: A review of literature up to 1941. E-661. Agricultural Research Administration, Bureau of Entomology and Plant Quarantine, US Department of Agriculture, Washington DC, USA.

[8]. Odeyemi, O.O. and Daramola, A.M. (2000). Storage Practices in the tropics. Volume1: Food Storage and Pest problems. First Edition, Dave Collins Publications, Nigeria.

[9]. Odeyemi, O.O.; Oyedare, B.M. and Ashamo, M.O. (2005). Resistance of Seven Biscuit types to Infestation by Tribolium castaneum (Herbst) (Coleoptera: Tenebrionidae). Zoological Research; 26 (3): 300-304.

[10]. Odeyemi, O. O., A. C. Adeniyi and A.O. Ojo (2001). Susceptibility of Processed Cereal Products to infestation by Sitophilus oryzae Motsch and Tribolium castaneum Herbst. Applied Tropical Agriculture; 6(2): 85-91.

[11]. Peter, D.S. (1985): An introduction of insect pest and their control. Macmillan press Ltd pp1-73.

[12]. Prakash, A., Pasalu IC and mathur KC (1982). Evaluation of plant products as grain protectants in paddy storage. International Journal of Entomology1(1), 75-77.

[13]. Prakash, A. and J.Rao. 1997. Botanical Pesticides in Agriculture, 1st Edn. CRC Pess Inc., Baton Rouge, Florida Pages: 461.

[14]. Rajapakse, R and Van Emden,H.F., Potential of four vegetable oils and ten botanical powders for reducing infestation of cowpeas by Callosobruchus maculatus, C. chinesis and C. rhodesianus,Journal of Stored Products Research,Volume 33, Issue 1,1997,Pages 59-68,ISSN 0022-474X,

[15]. Sighamony, S.I.A., Chandrakala, T.S. & Osmani, Z.1984. Natural products as repellents for Tribolium castaneum Herbst. Int. Pest. Contr. 26: 156-157.

[16]. Talukder, F.A. and Howse, P.E. “Isolation of secondary plant compounds from Aphanamixis polystachya as feding deterrents against adult Tribolium castaneum (Coleopteran: Tenebrionidae)”. Journal of Stored Prod. Res., Vol. No.5, pp-395-402, 2000.