Journal of Agripreneurship and Sustainable Development (JASD)
www.jasd.daee.atbu.edu.ng; Volume 6, Number 1, 2023
ISSN (Print): 2651-6144; ISSN (Online): 2651-6365

EVALUATION OF PHYTOCHEMICAL COMPOUNDS IN *Ficus polita* LEAVES POWDERS FOR INSECT PEST CONTROL

[1]Kashere, M. A., [2]Tijjani, A., [2]Sabo, M. U. and [2]Aliyu, M.
[1]Department of Agricultural Technology, Federal College of Horticulture P.M.B 108, DadinKowa, Gombe, Gombe State, Nigeria.
[2]Department of Crop Production, Faculty of Agriculture and Agricultural Technology, Abubakar Tafawa Balewa University P.M.B. 0248, Bauchi, Nigeria.
Corresponding Author's E-mail: mkashere@gmail.com **Tel.:** +2348142634896

ABSTRACT
Pesticidal plants, also referred to as botanical pesticides, have been used for centuries for pest management. The study objectives was to evaluate the phytochemical compounds in *F.polita* leaves powders and their insecticidal activity on *Callosobruchus subinnotatus* PIC in stored Bambara groundnut in Gombe through untargeted Gas Chromatography-Mass Spectrometry (GC-MS) using three different extraction solvents (ethanol, methanol and distilled water). Result of the study revealed the presence of various compounds. To mention but few, the ethanol extracts revealed the presence of 2-Methylchrysene ($C_{19}H_{14}$); Chrysene, 1-methyl- ($C_{19}H_{14}$); Ethyl.alpha.-d-glucopyranoside ($C_8H_{16}O_6$); 5,9-Undecadien-2-one, 6,10-dimethyl- ($C_{13}H_{22}O$). Methanol extracts showed Alloaromadendrene oxide-(2) ($C_{15}H_{24}O$); Methyl.beta.-d-galactopyranoside ($C_7H_{14}O_6$); Phytol ($C_{20}H_{40}O$); Ethyl .beta.-d-riboside ($C_7H_{14}O_5$). Distilled water extraction revealed Lupeol ($C_{30}H_{50}O$); 9,19-Cycloergost-24(28)-en-3-ol, 4,14-dimethyl-, acetate, (3.beta.,4.alpha.,5.alpha.)- ($C_{32}H_{52}O_2$); Lanosterol ($C_{30}H_{50}O$); [4-(4-Methoxymethylbenzyl) phenyl]methanol ($C_{16}H_{18}O_2$) as compounds with the highest percentage areas. Being cheap and readily available, resources-poor farmers perceive those natural products (botanical pesticides) possessed repellence, anti-feeding and ovipositional deterrence, fumigant or contact activity, growth inhibition etc. Hence, could serve as good alternatives to chemical insecticides.

Keywords: Evaluation, *Callosobruchus subinnotatus* PIC, Insect pest control, Pesticidal plants, Phytochemical.

INTRODUCTION
The fig tree, which is also referred to as *Ficus polita* and called Durumi in Hausa, Jammeiz alazrak in Shuwa Arabic and Gbanchi bokun in Nupe, all in northern Nigeria, belongs to the family *Moraceae* (Keays, 1989). *Ficus* is a large genus in the family Moraceae, is composed of over 1, 000 members of species of terrestrial woody trees, shrubs, vines, epiphytes and hemi epiphytes and is distributed in tropical and subtropical regions. Plants in this genus have occupied many ecological niches, and can be deciduous or evergreen trees, shrubs, herbs, climbers or creepers, and life forms can be free standing trees, epiphytes or semi-epiphytes in crevices, rheophytes or lithophytes (Yinxian *et al.,* 2018; Ronsted *et al.,* 2008 and Loutfy, *et al.,* 2005). *Ficus polita*, the heart-leaved fig, is a species of fig that is primarily native to tropical areas of East Asia and Africa, they are distributed throughout the world's tropics (van Noort and Rasplus, 2021; Encyclopedia Britannica, 2019). Approximately, 800 species are present in Tropical and Subtropical regions of the world (Adebayo *et al.,* 2009).

Phytochemical investigations of some *Ficus* species revealed the presence of phenolic compounds as their major components from different parts (leaves, stem wood, branches, stem bark, roots, root bark, fruits, and seeds) (Abdel-Hameed, 2009; Sultana and Anwar, 2008; Veberic *et al*., 2008; Basudan *et al*., 2005; Sheu *et al*., 2005; Salem, 2005; Lee *et al*., 2002). The presence of a cerebroside named politamide, sitosterol 3-O-b-D-glucopyranoside, betulinic acid, stigmasterol and lupeol have been reported in *F. polita,* (Kamga*et al*., 2010). Although synthetic pesticides can work very well, overuse and misuse of synthetic chemicals has led to considerable human and environmental health problems. Several studies have provided baseline information on many *Ficus* spp potential validity in the treatment and management of insect pests associated with stored grains. The leaves and stem of *F. sarmentosa* var. *henryi* have been reported to posessed insecticide activity (Wang *et al*., 2011). Liu *et al*., (2011) reported the leaf extract of *F. carica* showed the strongest nematicidal activity as 74.3, 96.2, and 98.4% mortality, respectively, within 72 hrs.

Kellouche A. (2005) tested the fecundity of female cowpea *C.maculatus* with powders from the leaves of the fig tree *Ficus carica* (Moraceae), *Eucalyptus globulus* (Myrtaceae), olive tree *Olea europaea* (Oleaceae), and *Citrus limon* (Rutaceae). The results showed that the effect of these powders slightly affects the fecundity of the females. Control of *C.subinnotaus* in Bamabara groundnut is largely depends and conducted using conventional synthetic insecticides in the study area, but resistance to organophosphates and other class of the synthetic insecticides has been observed by local farmers. The study was aimed to determine the phytochemical compounds in *F.polita* leaves powders found in Gombe State and their insecticidal potentials on *C.subinnotaus* in Bamabara groundnut.

MATERIALS AND METHODS

Experimental Site

The study was carried out at the Research Laboratory of Biological Sciences Department, the Federal University of Kashere (FUK), Gombe State, located at a GPS coordinate (DMS) 10° 16´ 44.9040" N and 11° 10´ 23.0160" E; Latitude 10.27914; Longitude 11.17306 and Altitude 454m, Gombe, Nigeria.

Collection and Athentication of Plant Materials

Fresh plant materials of *F.polita* leaves were locally collected in Gombe and suburb subsequently, identified at the herbarium of Biological Sciences Department (specimen voucher number 090), Faculty of Science, Federal University of Kashere (FUK), Gombe State, Nigeria.

Preparation of Plant Materials

All the plant materials collected from *F.polita* (leaves) were shade dried to a crispy dry condition and thereafter was grounded using pestle and mortar, blended with an electric blender and then sieved through a mesh size of 600µm to obtain fine powders.

Preparation of Crude Extracts of the Plant Materials

A weight of 1.8 kg was obtained from the powdered plant leaves. A 600g portions of the powdered leaves were soaked separately in 1.8 litres of 70% aqueous ethanol, 1.8 litres of 70% aqueous methanol and 1.8 litres of distilled water for 24 hours. After 24hours, the extract was sieved with a muslin cloth and this was stored in a refrigerator when not in use.

Phytochemical Screening of the Crude Extract

The processed crude extracts were aseptically carried using Laboratory sample bottles (to avoid contamination on transit) to the National Research Institute for Chemical Technology (NARICT) Basawa, Zaria, kaduna State where laboratory tests were conducted on the crude

extracts of the powdered specimens using standard procedures (Untargeted Gas Chromatography–Mass Spectrometry (GC-MS)).

GC - MS Experimental Conditions

The analysis was performed using Agilent Gas chromatography couple to the mass spectrometer system (model GC Agilent S/N 7890A and 5975A). HP 5ms 5% phenyl Methyl) siloxane Capillary Colum (30M x 250m) was used under the following conditions: Oven temperature 70^{o}C for 1 min, then increase to 280^{o}C by 10^{o}C/min for 10 min and Injector temperature of 260^{o}C. Helium gas was used as the carrier gas with flow rate of 1.9m/min, the volume of the injected sample was 1uL of diluted extract in ethanol, methanol and distilled water. Split injection techniques were used during sample injection with ionization energy 70ev in the electron ionization (EI) mode, ion source temperature 230^{o}C scan mass range of M/Z 50-500.

Identification of Constituents

The constituents of the plant material were identified base on the result obtained from the library search and mass spectra of most of the compound with data generated under identical experimental conditions by applying a search algorithm considering the retention index as well as mass spectra similar with those of authentic compounds available in NIST, 2011 and NIST, 2014 Library.

RESULTS AND DISCUSSION

The result presented in (Table 1) was limited to only first four compounds with the highest percentage area (peaks) and their chromatogram together with chemical structures (Figure 1 - 4) out of the numerous compounds screened in the various extracts. The Compounds names, Molecular Formula, Molecular Weight, Retention Time (Min), and Area (%) are presented in Table 1. The ethanol extracts of *F.polita* Leaves Powder revealed the presence of 2-Methylchrysene ($C_{19}H_{14}$) (29.41%); Chrysene, 1-methyl- ($C_{19}H_{14}$) (18.44%); Ethyl .alpha.-d-glucopyranoside ($C_8H_{16}O_6$) (9.37%) and 5,9-Undecadien-2-one, 6,10-dimethyl- ($C_{13}H_{22}O$) (5.62%) as compounds with the highest percentage area and their chromatogram together with chemical structures (Figure 1a – 4a).

Journal of Agripreneurship and Sustainable Development (JASD)
www.jasd.daee.atbu.edu.ng; Volume 6, Number 1, 2023
ISSN (Print): 2651-6144; ISSN (Online): 2651-6365

Table 1: GC-MS Analytical Report of Ethanol, Methanol and Distilled Water Extracts of *Ficus polita* Leaves

Extraction solvent	Peak	Compounds	Molecular Formula	Molecular Weight	Retention Time (Min)	Area (%)
Ethanol	1	2-Methylchrysene	$C_{19}H_{14}$	242	16.986	29.41
	2	Chrysene, 1-methyl-	$C_{19}H_{14}$	242	16.562	18.44
	3	Ethyl .alpha.-d-glucopyranoside	$C_8H_{16}O_6$	208	13.100	9.37
	4	5,9-Undecadien-2-one, 6,10-dimethyl-	$C_{13}H_{22}O$	194	20.430	5.62
Methanol	1	Alloaromadendrene oxide-(2)	$C_{15}H_{24}O$	220	16.917	32.28
	2	Methyl .beta.-d-galactopyranoside	$C_7H_{14}O_6$	194	13.095	14.07
	3	Phytol	$C_{20}H_{40}O$	296	14.657	8.20
	4	Ethyl .beta.-d-riboside	$C_7H_{14}O_5$	178	13.644	5.21
Distilled water	1	Lupeol	$C_{30}H_{50}O$	426	17.037	80.09
	2	9,19-Cycloergost-24(28)-en-3-ol, 4,14-dimethyl-,acetate,(3.beta.,4.alpha.,5.alpha.)-	$C_{32}H_{52}O_2$	468	19.091	7.87
	3	Lanosterol	$C_{30}H_{50}O$	426	20.407	6.35
	4	[4-(4-Methoxymethylbenzyl)phenyl]methanol	$C_{16}H_{18}O_2$	242	20.270	1.65

Journal of Agripreneurship and Sustainable Development (JASD)
www.jasd.daee.atbu.edu.ng; Volume 6, Number 1, 2023
ISSN (Print): 2651-6144; ISSN (Online): 2651-6365

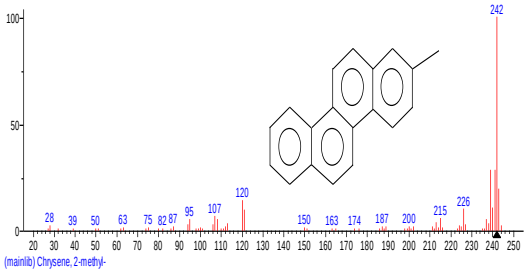

Figure 1a.

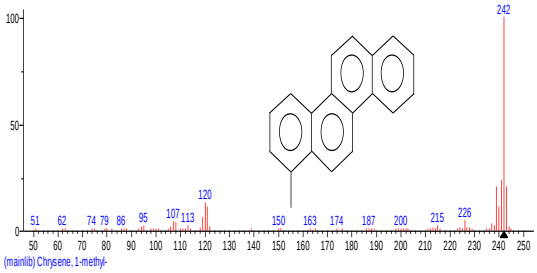

Figure 2a.

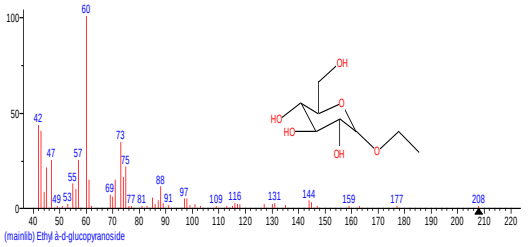

Figure 3a.

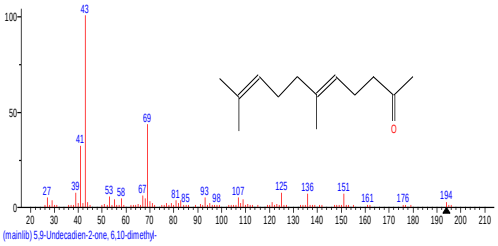

Figure 4a.

Figure 1 (1a – 4a): *GC-MS Chromatogram together with Chemical Structures of Ethanolic Extract of Ficus polita Leaves*

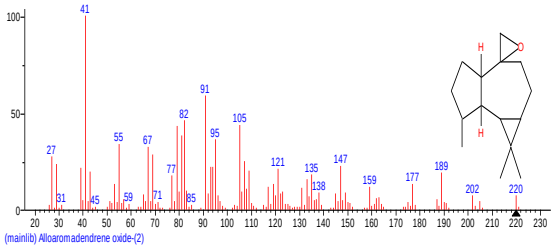

Figure 1b.

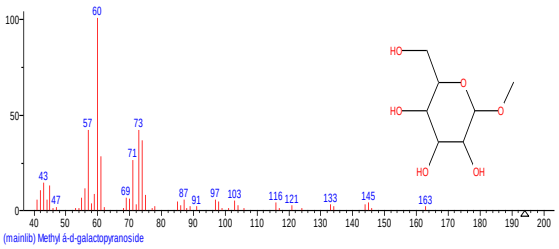

Figure 2b.

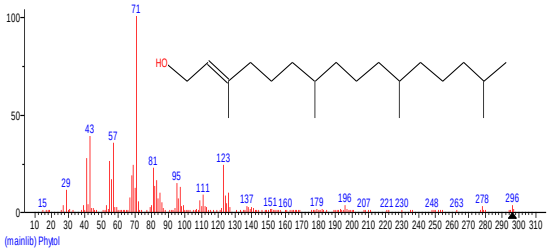

Figure 3b.

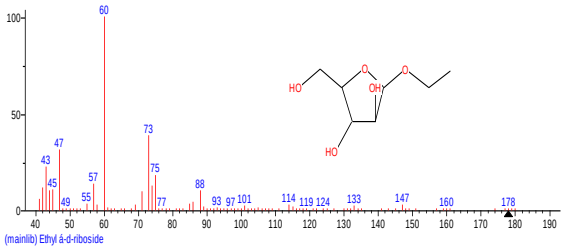

Figure 4b.

Figure 2 (1b – 4b): *GC-MS Chromatogram together with Chemical Structures of Methanolic Extract of Ficus polita Leaves*

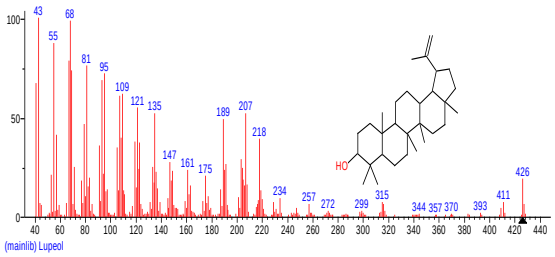

Figure 1c.

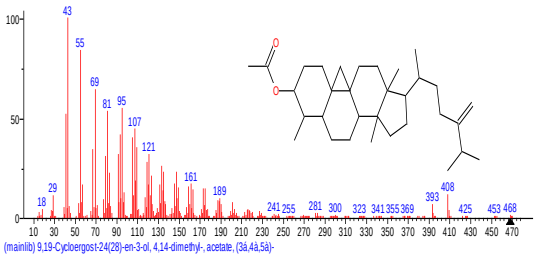

Figure 2c.

Journal of Agripreneurship and Sustainable Development (JASD)
www.jasd.daee.atbu.edu.ng; Volume 6, Number 1, 2023
ISSN (Print): 2651-6144; ISSN (Online): 2651-6365

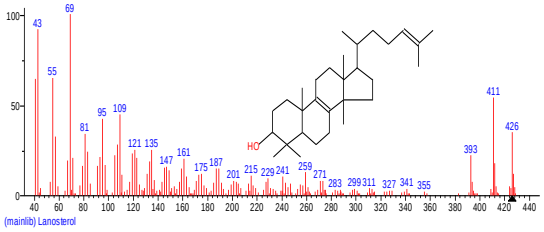

Figure 3c.

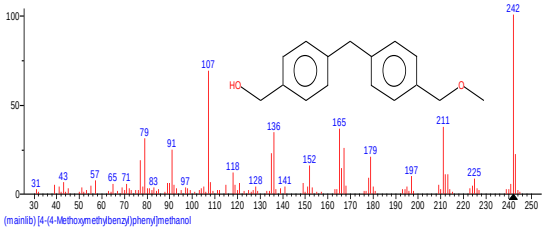

Figure 4c.

Figure 3 (1c – 4c): *GC-MS Chromatogram together with Chemical Structures of Distilled Water Extract of Ficus polita Leaves*

In a similar study, Hossam *et al*. (2019) found that the ethanolic and ethyl acetate extracts of leaves of *Ficus sycomorus* have higher concentrations of total phenols, flavonoids, tannins, alkaloids and anthocyanin than the fruit extracts. The results are in agreement with Mudi *et al.*, (2015) who found that the phytochemical analysis of *Ficus sycomorus* revealed the presence of alkaloids, tannins, saponins, flavanoids and steroids in both the aqueous extracts of the leaves and the fruits. Result of the methanol extracts of *F.polita* Leaves Powder presented in Table 1, revealed Alloaromadendrene oxide-(2) ($C_{15}H_{24}O$) (32.28%); Methyl .beta.-d-galactopyranoside ($C_7H_{14}O_6$) (14.07%); Phytol ($C_{20}H_{40}O$) (8.20%) and Ethyl .beta.-d-riboside ($C_7H_{14}O_5$) (5.21%) as compounds with the highest percentage area (peaks) and their chromatogram together with chemical structures (Figure 1b – 4b). In a different study, a GC-MS analyses conducted on *Ficus capensis* Thunb by Aboaba *et al*. (2010), afforded the identification of 27 compounds in the leaf essential oil, 17 in the stem bark and 14 in the root. The leaf oil composition comprised of 32.3% monoterpenoid which are 21.0% monoterpene hydrocarbon and 11.3% oxygenated monoterpene. The sesquiterpenoid fraction (39.7%) was identified as 21.5% sesquiterpene hydrocarbons and 18.2% oxygenated sesquiterpenes. Other constituents were characterized as 3.1% diterpene, 6.9% fatty acids and 8.4% simple aliphatic. The distilled water extracts of *F.polita* Leaves Powder (Table 1) revealed Lupeol ($C_{30}H_{50}O$) (80.09%); 9,19-Cycloergost-24(28)-en-3-ol, 4,14-dimethyl-,acetate,(3.beta.,4.alpha.,5.alpha.)-($C_{32}H_{52}O_2$) (7.87%); Lanosterol ($C_{30}H_{50}O$) (6.35%) and [4-(4-Methoxymethylbenzyl)phenyl]methanol ($C_{16}H_{18}O_2$) (1.65%) as compounds with the highest percentage areas (peaks) and their chromatogram together with chemical structures (Figure 1c – 4c). In a related study, a group of Terpenoids and Sterols; Lupeol, lupeol acetate, lupenone, lupeol hexanoate and betulinic acid with different substituents were found in *F. benghalensis, F. carica, Ficus cordata, F. glumosa, F. microcarpa, F. nervosa, F. ovata, F. polita, F. racemosa, F. religiosa* and *F.thonningii* as reported by Gbonjubola (2015). Pesticidal plants, also referred to as botanical pesticides, have been used for centuries for pest management. Result obtained from a study shows that the application of leaves and bark extracts of *F. exasperata* was effective in the control of insect pest infestation when compared with control (Alamu, 2018). The Leaves and stem of *F. sarmentosa* var. *henryi* have been reported to posessed insecticide activity (Wang *et al*., 2011). Result obtained from a study shows that the application of leaves and bark extracts of *F. exasperata* was effective in the control of insect pest infestation when compared with control (Alamu, 2018). Diouf *et al*. (2016) shown that the extracts with the cyclohexane and methanolic of *Ficus thonnigii* are more effective on *Callosobruchus maculatus*. Thus, the methanolic extract (EM) of *Ficus thonningii* reduces considerably the number of insects emerged in the short run on *Callosobruchus maculatus*.

CONCLUSION AND RECOMMENDATIONS

The present study suggest an enormous biological potential of *F.poita* leaves. It could be concluded that, the study have provided baseline information on several phytoconstituents found in *F.poita* leaves extracts and many information on *Ficus* spp potential and validity in the treatment and management of insect pests associated with stored grains. Further investigations on the bio insecticidal activity of these compounds and spectrum of activity of *F.poita* leaves against other stored products insects, as well as the optimal level of application necessary to afford complete protection of stored grain, is highly advocated.

REFERENCES

Abdel-Hameed, E-S. S. *(*2009). Total phenolic contents and free radical scavenging activity of certain Egyptian Ficus species leaf samples. *Journal of Food Chemistry,* **114:** 1271.

Aboaba, S. A., Oladosu, I. A. and Ekundayo, O. (2010) Chemical composition, acetyl cholinesterase inhibitory properties and brine shrimp toxicity of essential oils from *Ficus capensis* Thunb from Nigeria. *International Journal of Biol. Chem. Sci.,* **4**(5): 1494-1500. Available online at http://ajol.info/index.php/ijbcs.

Adebayo, E. A., Ishola, O. R., Taiwo, O. S., Majolagbe, O. N. and Adekeye, B. T. (2009) Evaluations of the Methanol Extract of *Ficus Exasperata* Stem Bark, Leaf and Root for Phytochemical Analysis and Antimicrobial Activities. *African Journal of Plant Science,* **3** (12): 283-287.

Alamu, L.O.A. (2018) Use of Bark Leaf Extracts of *Ficus Exasperata* L. as an Environmental Friendly Organic Insecticide in the Control of Insects in Eggplant. *International Journal of Forestry and Horticulture (IJFH),* **4**(2):*38-44 DOI: http://dx.doi.org/10.20431/2454-9487.0402005 www.arcjournals.org.*

Basudan, O. A., Ilyas, M., Parveen, M., Muhisen, H. M. and Kumar, R. (2005). A new chromone from *Ficus lyrata*. *J. Asian Natural Prod. Res.*, **7**:81–85.

Diouf, E. H. G., Diop, M., Sene, A., Samb, A. and Gueye, S. (2016) Comparison of the Insecticidal Activities of Three Plants against Two Devastating Insects: Callosobruchus maculatus and Sitophilus zeamais. *Open Access Library Journal,* **3:**29-66. http://dx.doi.org/10.4236/oalib.1102966.

Encyclopedia Britannica, (2019). "Ficus". https://www.britannica.com/plant/Ficus. Accessed 9 January, 2022.

Gautam, P., Vaidya, D. N. and Mehta, P. K. (2000). Evaluation of some edible plant products against pulse beetle, *Callosobruchus analis* (Fabr.) infesting green gram. *Pest. Manage. Econ. Zool*., **8**: 145-150.

Gbonjubola, V. A. (2015) Phytochemical Analyses and Biological Activities of Four South African *Ficus* Species (Moraceae). A PhD Thesis. University of Kwazulu-Natal, South Africa.

Hossam, S. E., Heba, I. M., Abdelrahman, S.A., Reem, Y., and Gehan, S. (2019) GC-MS Analysis, Antioxidant, Antimicrobial and Anticancer Activities of Extracts from Ficus sycomorus Fruits and Leaves. *Notulae Botanicae Horti Agrobotanici Cluj-Napoca*, **47**(2):493-505. DOI:10.15835/nbha47211405.

Kamga, J., Sandjo, L.P., Poumale, H.M.P., Ngameni, B., Shiono, Y., Yemloul, M., Rincheval, V., Ngadjui, B.T. and Kirsch, G. (2010). Politamide, a new constituent from the stem bark of *Ficus polita* Vahl (Moraceae). *Arkivoc*, **2**:323–329.

Keays, R. W. J. (1989). Trees of Nigeria. Clarendon Press Oxford, 476Pp.

Kellouche, A. (2005) Etude de la bruche du poichiche, *Callosobruchus muculatus* (*Coleoptera: bruchidae*): Biologie, physiologie, reproduction et lutte, Thèse. Doc d'état. Univ. Tizi-Ouzou. 154.

Lee, B. H., Lee, S. E., Annis, P. C., Pratt, S. J., Park, B. S., Tumaalii, F. (2002). Fumigant toxicity of essential oils and monoterpenes against the red flour beetle, Tribolium castaneum Herbst. *J. Asia Pac. Entomol*, **5** (2): 237–240.

Liu, F., Yang, Z., Zheng, X. M., Luo, S., Zhang, K. and Li, G. (2011) "Nematicidal coumarin from*F. carica* L," *Journal of Asia-Pacific Entomology*, **14(**1): 79–81.

Loutfy, M. H. A., Karakish, E.A.K., Khalifa, S. F. and Mira, E. R. A. (2005). Numerical taxonomic evaluation of leaf architecture of some species of genus Ficus L. *International Journal of Agriculture and Biology*, **7**: 352–357.

Mishra, D., Shukla, A. K., Tripathi, K. K., Singh, A., Dixit, A. K. and Singh, K. (2007). Efficacy of Application of vegetable seed oils as grain protectant against infestation by *Callosobruchus chinensis* and its effect on milling fractions and apparent degree of dehusking of legume-pulses. *J. Oleo. Sci*., **56**: 1-7.

Mudi, S.Y., Muhammad, A., Musa, J. and Datti, Y. (2015). Phytochemical screening and antimicrobial activity of leaves and fruits extract of *Ficus sycomorus*. *ChemSearch Journal* **6**(1):62-67.

Mulatu, B. and Gebremedhin, T. (2000) Oviposition-deterrent and toxic effects of various botanicals on the Adzuki bean beetle, Callosobruchus chinensis L. *Insect Science and its Application*, **20**(1):33–38.

Ronsted, N., Weiblen, G.D., Savolainen, V., Cook, J.M., (2008). Phylogeny, biogeography, and ecology of Ficus section Malvanthera (Moraceae). *Molecular Phylogenetics and Evolution* **48**: 12–22.

Salem, M.Z.M. (2005). Evaluation of wood, bark and leaves extracts and their influence on the growth of some pathogenic bacteria. *Alexandria J. Agric. Res.* MSc. Abstract, **50**(1):243.

Sheu, Y.W., Chiang, L.C., Chen, I.S., Chen, Y.C., and Tsai, I.L. (2005). Cytotoxic flavonoids and new chromenes from *Ficus formosana*. *Planta Medica* **71**:1165–1177.

Sultana, B. and Anwar, F. (2008). Flavonols (kaempeferol, quercetin, myricetin) contents of selected fruits, vegetables and medicinal plants. *Food Chemistry* **108**:879–884.

Van Noort, S. and Rasplus, J.Y. (2021). Figweb: figs and fig wasps of the world. URL: www.figweb.org. Copyright 2004-2021 Iziko Museums of South Africa.

Veberic R, Colaric M, Stampar F (2008). Phenolic acids and flavonoids of fig fruit (*Ficus carica* L.) in the northern Mediterranean region. *Food Chemistry* **106**:153–157.

Wang, X., Wei, X., Huang, X., Shen, L., Tian, Y. and Xu, H. (2011) Insecticidal constructure and bioactivities of compounds from *Ficus sarmentosa* var. henryi. *Agric. Sci. China.* **10**(9): 1402-1409.

Yinxian, Shi, Aye Mya Mon, Yu Zhang, Yao Fu, Chen Wang, Xuefei Yang and Yuhua Wang, (2018). The genus *Ficus* (Moracea) used in diet: Its plant diversity, distribution, traditional uses and ethnopharmacological importance, *Journal of Ethnopharmacology*, https://doi.org/10.1016/j.jep.07.027