Acta entomologica serbica, 2019, 25(1): xx-xx

UDC:
DOI: 10.5281/zenodo.3660988

INSECTICIDAL AND ANTIOXIDANT ACTIVITIES OF AQUEOUS EXTRACTS OF TWO ALGERIAN MEDICINAL PLANTS

BILLAL NIA[1*], ADEL LEKBIR[2] and MOHAMED KAMEL BEN SALAH[1]

1 Center for Scientific and Technical Research on Arid Regions (CRSTRA), Mohamed Khider University Campus, 07000 Biskra, Algeria

2 Food Science Laboratory, Department of Food Technology, Institute of Veterinary and Agricultural Sciences, Hadj Lakhdar University of Batna, Algeria

*E-mail: nia.billal@crstra.dz / bilalniadz@gmail.com (corresponding author)

Abstract

In this work, we determined the insecticidal activity and antioxidant activity of aqueous extracts of *Nerium oleander* (Apocynaceae) leaves and *Peganum harmala* (Zygophyllaceae) seeds, two well-known Algerian medicinal plants. Four concentrations of each extract were applied in total randomization by spraying directly on the eggs and larvae of *Ectomyelois ceratoniae* (Zeller, 1879) (Lepidoptera: Pyralidae) under laboratory conditions. Our findings revealed that eggs hatching after four days were not affected by the aqueous extract, with a rate of 54% of hatching eggs in both control and treated eggs. Additionally, toxicity by contact on larvae was not evident and the mortality percentage did not exceed 8%, regardless of the extract plant and concentration. Phytochemical screening showed a slight presence of terpenes and saponins and an absence of alkaloids. However, polyphenols were present in medium concentrations in the aqueous extracts of both plants. The antioxidant activities of *N. oleander* and *P. harmala* extracts were found to be 71.80 and 72.94%, respectively. Total phenolic content (TPC) and total flavonoid content (TFC) of the studied extracts were 50.69 mg gallic acid equivalent (GAE)/100 g dry weight (DW) and 3.55 in terms of quercetin equivalent (QE)/100 g DW, respectively, in *N. oleander*. In *P. harmala*, the TPC and TFC were 52.30 mg GAE/100 g DW and 3.49 mg QE/100 g DW, respectively. Our study clearly shows the limited insecticidal effect of the aqueous extracts, although they showed an interesting antioxidant potential, which could help to decrease the incidence of oxidative stress-induced damage.

KEY WORDS: Aqueous extraction, medicinal plants, *Ectomyelois ceratoniae,* insecticidal property, antioxidant activity.

Introduction

Plants are an interesting source of natural substances. They constitute an essential component of Integrated Pest Management (IPM) strategies as alternatives to chemical pesticides. Indeed, multiple adverse effects on

humans and biodiversity as well as the emergence of resistant populations of pests are a result of the successive applications of chemical products (Peres, 2017). Moreover, in recent years, plant-derived antioxidants have fostered considerable interest among food scientists, manufactures and consumers (Lu *et al*., 2011).

According to Mokkadem (1999), there are approximately 600 medicinal and aromatic species in Algeria. These plants have been used for centuries, especially in phytotherapy (Reguieg, 2011).

The flowers and leaves of *Nerium oleander* are used in folk medicine for the treatment of a wide variety of diseases including infection, malaria, autoimmunity (Tayoub *et al*., 2014), and they have shown conspicuous efficiency as an antioxidant (Mohadjerani, 2012) and against some insect pests (Bagari *et al*., 2013; Nia *et al*., 2018). In addition, different parts of *Peganum harmala* are used in traditional medicine for the treatment of a variety of human ailments (Siddiqui *et al*., 1987). There are several reports in the literature indicating a great variety of pharmacological activities in the harmal plant, such as oxidase inhibition (Abolhasani *et al*., 2015), nematocidal activity (El Allagui *et al*., 2007) and insecticidal activity (Abbassi *et al*., 2005; Dehghani & Ahmadi, 2013).

Importantly, an interest in the use of "generally recognized as safe" (GRAS) solvents, such as carbon dioxide, water or ethanol, has grown in recent years (Camel, 2006). Several developments have been made recently to minimize or completely avoid the use of solvents in the extraction step in order to satisfy the requirements of green chemistry (Tobiszewski *et al*., 2009). In addition, the consumption of energy has been considerably reduced. Water is a "green solvent" and can be used not only for the extraction of polar compounds, but also for extracting slightly nonpolar compounds under the right conditions because of co-solubility issues and because the polarity of water decreases somewhat at high temperatures (Jones & Kinghorn, 2012).

The date moth *Ectomyelois ceratoniae*, also known as the carob moth, is a major pest in all countries producing date palm (Idder *et al*., 2009). It seriously threatens date exports by reducing the quality of dates and because the presence of larvae inside the date is offensive. Therefore, in this study we aimed to assess the insecticidal activity of the aqueous extracts of two common plants in Algeria, *Nerium oleander* and *Peganum harmala*, against the eggs and larvae (3^{rd} and 4^{th} instar) of this insect pest by using different concentrations in order to find eco-friendly, safe and low-cost biopesticides.

Antioxidant properties were also studied in this work by testing the aqueous extracts of both plants by standard methods of 2,2-diphenyl1-1-picryl-hydrazyl (DPPH) free radical scavenging (Abolhasani *et al*., 2015).

Materials and methods

Biological material

Nerium oleander leaves were collected from Ain Touta (Batna), which is situated in the northeast of Algeria at N 35°17'48.29" and E 5°51'53.48" with an elevation of 729 m a.s.l. The leaves were picked in the morning and sent to the laboratory. Then they were dried in an oven at 50°C (Memmert UN110, Germany) for one week. *Peganum harmala* seeds were bought from a herbalist. Both leaves and seeds were transformed into powder using an electric mortar grinder (Retsch RM 200, Germany) and preserved in glass jars.

Individuals of *E. ceratoniae* used in this work were taken from infested dates provided by a farmer. The insects were reared in plastic boxes on an artificial diet based on wheat bran and yeast. The rearing conditions were: 25±1°C, 50±5% relative humidity (RH) and 16:8 light:dark regime.

Aqueous extract test

We took 50 g of the obtained powder to extract it by infusion in 500 ml of boiled distilled water, and after 24 h a double filtration was done with gauze. Four dilutions were made from a stock solution: 25, 50, 75 and 100%. To assess the toxicity of the aqueous extracts, 30 eggs and 10 larvae (3rd and 4th instar) were transferred separately to Petri dishes and sprayed with 100 µL of the prepared concentrations, with water as a control, with three replications. The experiment was carried out under laboratory conditions (25±1°C, 50±5% RH). The hatched eggs were counted after 4 days and the mortality of larvae and adults was determined after 24 h. When no leg or antennal movements were observed, the insects were considered to be dead.

DPPH free radical scavenging assay

The DPPH radical scavenging capacity was determined using the method described by Mansouri *et al*. (2005). From each aqueous extract, we took 25 µl that added to 975 µl of DPPH methanolic solution (6 x 10^{-5} M) and vortexed. The mixture was left in the dark for 30 min and the absorbance measured at 515 nm. DPPH radical scavenging capacity was estimated according to the following equation (Lu *et al*., 2011):

$$\text{DPPH radical scavenging capacity (\%)} = \left[{}^{(A_{DPPH} - A_{Ext})}/_{A_{DPPH}} \right] \times 100$$

where A_{DPPH} is the absorbance of the control solution (containing only DPPH) and A_{Ext} is absorbance in the presence of the aqueous extracts of each plant.

Phytochemical screening

The major constituents of both aqueous extracts were screened qualitatively as per standard procedures described by Benmehdi *et al*. (2012). Major constituents analyzed were alkaloids, terpenes, saponins and polyphenols.

Test for alkaloids

Five ml of each extract was warmed with 1.5 ml of 2% H_2SO_4 for 2 min. Then a few drops of Dragendorff's reagent (a solution of potassium bismuth iodide) were added. The presence of an orange/red precipitate indicated a positive alkaloid content.

Test for terpenes (Salkowski test)

Five ml of each extract was mixed in 2 ml of chloroform, and concentrated H_2S0_4 (3 ml) was carefully added to form a layer. The forming of a reddish-brown coloration of the interface indicated a positive result for the presence of terpenes.

Test for saponins

Five ml of each extract was shaken with 5 ml of distilled water, which was then heated to boiling point. Frothing (the appearance of a creamy mist of small bubbles) indicated the presence of saponins.

Total phenolic content

The TPC of the aqueous extract of *N. oleander* was measured by the method described by Juntachote *et al*. (2007). To 0.5 ml of the extract we added 5 ml of distilled water, which was vortexed for 1 min using a vortex mixer (Janke & Kunkel IKA, Model: VF2, Germany). One ml of Folin and Ciocalteu's phenolic reagent was added and mixed well. After 5 min, 1 ml of saturated sodium carbonate solution was added and the mixture was vortexed again. The sample was left to develop a blue color for 1 h. The absorbance was measured at 640 nm using a spectrophotometer (UV-120-01; Shimadzu Co., Kyoto, Japan). A standard curve was prepared at the same time with gallic acid (Sigma-Aldrich GmbH, Steinheim, Germany) at concentrations ranging from 0 to 0.2 mg/ml. The TPC of extracts was expressed as mg of GAE/g DW.

Total flavonoid content

The TFC was estimated using the colorimetric assay according to Gursoy *et al*. (2009). One ml of 2% $AlCl_3$ solution was mixed with 1 ml of aqueous extract. Test tubes were incubated at room temperature for 10 min and the absorbance was determined at 415 nm. A standard curve was prepared with quercetin (Sigma-Aldrich GmbH, Steinheim, Germany) at concentrations ranging from 0 to 30 µg/ml. The TPC of extracts was expressed as mg of QE/g DW.

Statistical analysis

Experimental values are expressed as mean±standard error of mean (SEM). Comparison of the mean values between various treatments was performed by one-way analysis of variance (ANOVA) and means were separated according to Duncan's multiple range test (DMRT) at $p \leq 0.05$. The Shapiro-Wilk test of normality was used to test the assumption of normal data distribution. The statistical program SPSS statistical software ver. 20 (IBM company, NC) was used for statistical analysis.

Results and Discussion

The Shapiro-Wilk test confirmed the normality of our data. However, results did not show a significant effect of the aqueous extract of either plant on *E. ceratoniae* eggs hatching and larvae survival (Table I). Indeed, over 54% of the eggs hatched and larvae were able to emerge, regardless of the treatment, and the plant extracts showed no differences from the controls. Also, larvae mortality did not differ from the control and the overall mean did not exceed 8%. The phytochemical screening showed the lack of alkaloids and a slight presence of terpenes, two secondary metabolites families known for their insecticidal activity (Table II). Although these two plants are known for their insecticidal effects (Salari *et al*., 2012; Nia *et al*., 2018), their aqueous extracts revealed limited effects in this study. Cruz-Estrada *et al*. (2013) applied the aqueous extracts to *Bemisia tabaci* (Hemiptera: Aleyrodidae) nymphs, which were not affected by them. In fact, most secondary metabolites with insecticidal effects are extracted by nonpolar solvents (Djilani *et al*., 2006; Singh *et al*., 2014). According to Dhawan & Gupta (2016), various phytochemicals compounds are generally absent in distilled water extraction and this is may be due to the poor solubility of these phytochemicals in water.

Table I. Aqueous extract effects on *E. ceratoniae* eggs and larvae.

Plant species	Development Stage	Concentration (%)	Mean±SEM	Significance
N. oleander	Eggs	Control	54.44±1.11	F=0.93, p=0.48
		25	52.22±1.92	
		50	54.44±1.11	
		75	55.55±1.11	
		100	53.33±1.92	
	Larvae	Control	3.33±3.33	F=0.62, p=0.65
		25	00.00±0.53	
		50	3.33±3.33	
		75	6.66±3.33	
		100	3.33±3.33	
P. harmala	Eggs	Control	55.55±1.11	F=1.5, p=0.27
		25	54.44±1.11	
		50	52.22±1.11	
		75	54.44±1.11	
		100	55.55±1.11	
	Larvae	Control	6.66±3.33	F=0.5, p=0.74
		25	10.00±5.77	
		50	10.00±00.00	
		75	10.00±5.77	
		100	3.33±3.33	

The antioxidant activities of both extracts were high and similar (71.80 and 72.94%, respectively). Oleander possesses effective antioxidant activity, which includes free radical scavenging and reducing power, and it could be used as a natural source of potent antioxidants (Farooqui & Tyagi, 2018). Our results were close to those obtained by Vinayagam & Sudha (2017) who used a methanolic extract of leaves (72.8%), while Lakhmili *et al*. (2014) recorded over 90% of antioxidant activity with aqueous extract. The total level of antioxidant activity was higher in *N. oleander* leaf extract (72.8%) as compared to its flower extract (68%) (Farooqui & Tyagi, 2018).

The aqueous extract of harmal could be used as a natural source of antioxidants (Kaskoos, 2014). Previous research results revealed that it has high antioxidant activity and is a rich source of antioxidant compounds (Abolhasani *et al*., 2015). Kanwal *et al*. (2016) recorded 56.71% of antioxidant activity, while Kaskoos (2014) recorded 86.37% and Abolhasani *et al*. (2015) 90%.

The antioxidant activity correlated with the amount of TPC present in the plant (Mohadjerani, 2012) and generally samples with a high level of phenolic content also contain flavonoids in great amounts (Sharififar *et al*., 2009). Indeed, the TPC and TFC found in oleander leaf aqueous extract were 50.69 mg GAE/100 g DW and 3.55 mg QE/100 g DW, respectively (Table II). Many researchers found high levels of both TPC and TFC in *N. oleander* aqueous extract, varying from 0.44 to 46 mg GAE/g and from 4.69 to 33.3 mg QE/g, respectively (Krishnaveni *et al*., 2013; Dixit *et al*., 2014; Akhtar *et al*., 2018).

Table II. Aqueous extracts phytochemical screening and total phenolic and flavonoid content.
(-): metabolite absent, (+): low concentration, (++): medium concentration, (+++): high concentration

Plant species	Alkaloids	Terpenes	Saponins	Polyphenols	TPC (mg/100 g DW)	TFC (mg/100 g DW)
N. oleander	-	+	+	++	50.69±1.88	3.55±0.07
P. harmala	-	+	+	++	52.3±0.48	3.49±0.00

In harmal seed aqueous extract, the TPC was 52.3 mg GAE/100 g DW and TFC 3.49 mg QE/ 100 g DW. In published researches, the TPC fluctuated from 24.3 to 348.82 GAE mg/g and TFC from 1.14 to 5.5 mg QE/g (Abolhasani *et al*., 2015; Khadr *et al*., 2017; Akhtar *et al*., 2018).

According to Esmaeili *et al*. (2015), a significant correlation was found between the antioxidant activities of extracts and their TPC and TFC, and these metabolites are often extracted in higher amounts in more polar solvents (Abarca-Vargas *et al*., 2016). Several studies have also shown that infusion is effective for polyphenol extraction (Rababah *et al*., 2010; Thouri *et al*., 2017).

Conclusion

Nerium oleander and *Peganum harmala* aqueous extracts could manifest themselves as a good potential natural source of antioxidants, which have a protective role in human health. On the other hand, these extracts revealed no insecticidal activity against *E. ceratoniae*. Nevertheless, further tests including antifeedant activity are recommended in the future.

Acknowledgements

The authors thank the Date Technology Laboratory team for its help in preparing extracts and tests.

References

Abarca-Vargas, R., Peña Malacara, C., & Petricevich, V. (2016). Characterization of chemical compounds with antioxidant and cytotoxic activities in Bougainvillea x buttiana Holttum and Standl, (var. Rose) extracts. *Antioxidants*, *5*(4), 45. http://doi.org/10.3390/antiox5040045.

Abbassi, K., Mergaoui, L., Atay-Kadiri, Z., Ghaout, S., & Stambouli, A. (2005). Biological activities of *Peganum harmala* (Zygophyllacea) leaves at floral stage on the mortality and reproductive activity of the desert locust. *Zoologica Baetica*, *16*, 31-46.

Abolhasani, L., Salehi, E. A., & Kenari, R. E. (2015). Study of antioxidant capacity and stability of phenolic compounds from the seeds of *Peganum harmala*. *Journal of Applied Environmental and Biological Sciences*, *4*(11s), 218-222.

Akhtar, Y., Yeoung, Y. R., & Isman, M. B. (2008). Comparative bioactivity of selected extracts from Meliaceae and some commercial botanical insecticides against two noctuid caterpillars, *Trichoplusia ni* and *Pseudaletia unipuncta*. *Phytochemistry Reviews*, *7*(1), 77-88. http://doi.org/10.1007/s11101-006-9048-7

Bagari, M., Bouhaimi, A., Ghaout, S., & Chihrane, J. (2013). The toxic effects of *Nerium oleander* on larvae of the desert locust *Schistocerca gregaria* (Forskål, 1775) (Ortoptera, Acrididae). *Zoologica Baetica*, *24*, 193-203.

Benmehdi, H., Hasnaoui, O., Benali, O., & Salhi, F. (2012). Phytochemical investigation of leaves and fruits extracts of *Chamaerops humilis* L. *Journal of Materials and Environmental Science*, *3*(2), 320-327.

Camel, V. (2014). Extraction Methodologies: General Introduction. In *Encyclopedia of Analytical Chemistry* (pp. 1-24). http://doi.org/10.1002/9780470027318.a9902

Cruz-Estrada, A., Gamboa-Angulo, M., Borges-Argáez, R., & Ruiz-Sánchez, E. (2013). Insecticidal effects of plant extracts on immature whitefly *Bemisia tabaci* Genn. (Hemiptera: Aleyroideae). *Electronic Journal of Biotechnology*, *16*(1), 1-10. http://doi.org/10.2225/vol16-issue1-fulltext-6

Dehghani, M., & Ahmadi, K. (2013). Influence of some plant extracts and commercial insecticides on the eggs of *Trialeurodes vaporariorum* Westwood (Homoptera: Aleyrodidae). *Archives Of Phytopathology And Plant Protection*, *46*(10), 1127-1135. http://doi.org/10.1080/03235408.2012.760261

Dhawan, D., & Gupta, J. (2016). Comparison of different solvents for phytochemical extraction potential from *Datura metel* plant leaves. *International Journal of Biological Chemistry*, *11*(1), 17-22. http://doi.org/10.3923/ijbc.2017.17.22

Dixit, A., Singh, H., Sharma, R. A., & Sharma, A. (2015). Estimation of antioxidant and antibacterial activity of crude extracts of *Thevetia peruviana* (Pers.) K. Schum. *International Journal of Pharmacy and Pharmaceutical Sciences*, *7*(2), 55-59.

Djilani, A., Legseir, B., Soulimani, R., Dickob, A., & Younos, C. (2011). New extraction technique for alkaloids. *Journal of the Brazilian Chemical Society*, *17*(3), 296-305. http://doi.org/10.1145/1966913.1966952

El Allagui, N., Tahrouch, S., Bourijate, M., & Hatimi, A. (2007). Action de différents extraits végétaux sur la mortalité des nématodes à galles du genre *Meloidogyne* ssp. *Acta Botanica Gallica 154*(4), 503-509. http://doi.org/10.1080/12538078.2007.10516076

Esmaeili, A. K., Taha, R. M., Mohajer, S., & Banisalam, B. (2015). Antioxidant activity and total phenolic and flavonoid content of various solvent extracts from in vivo and in vitro grown *Trifolium pratense* L. (Red Clover). *BioMed Research International*, 11. http://doi.org/10.1155/2015/643285

Farooqui, S., & Tyagi, T. (2018). *Nerium oleander*: It's application in basic and applied science: A review. *International Journal of Pharmacy and Pharmaceutical Sciences*, *10*(3), 1. http://doi.org/10.22159/ijpps.2018v10i3.22505

Gursoy, N., Sarikurkcu, C., Cengiz, M., & Solak, M. H. (2009). Antioxidant activities, metal contents, total phenolics and flavonoids of seven *Morchella* species. *Food and Chemical Toxicology*, *47*(9), 2381-2388. http://doi.org/10.1016/j.fct.2009.06.032

Idder, M. A., Idder-ighili, H., Saggou, H., & Pintureau, B. (2009). Taux d'infestation et morphologie de la pyrale des dattes *Ectomyelois ceratoniae* (Zeller) sur différentes variétés du palmier dattier *Phoenix dactylifera* (L.). *Cahiers Agricultures*, *18*(1), 63-71.

Jones, W. P., & Kinghorn, A. D. (2012). Extraction of plant secondary metabolites. In S. D. Sarker & L. Nahar (Eds.), *Natural Products Isolation* (Springer S, pp. 341-366). Humana Press. http://doi.org/10.1007/978-1-61779-624-1

Juntachote, T., Berghofer, E., Siebenhandl, S., & Bauer, F. (2007). Antioxidative effect of added dried Holy basil and its ethanolic extracts on susceptibility of cooked ground pork to lipid oxidation. *Food Chemistry*, *100*(1), 129-135. http://doi.org/10.1016/j.foodchem.2005.09.033

Kanwal, Z. G., Hafeez, A., Haq, I. U., Rehman, T. U., Aun, S., Shazadi, I., Fatima, N., Rehman, N. U. (2016). Antioxidant, antimicrobial and antileishmanial study of different parts of *Peganum harmala*. *International Journal of Biosciences*, *9*(1), 45-58. http://doi.org/10.12692/ijb/9.1.45-58

Kaskoos, R. A. (2014). Physico-chemical parameters, phytochemical screening and antioxidant activity of seeds of *Peganum harmala* collected from Iraq. *Asian Journal of Biomedical and Pharmaceutical Sciences, 4*(28), 20-24.

Khadhr, M., Bousta, D., Hajaji, H. El, Lachkar, M., Barkai, H., Ibnsouda-Koraichi, S., & Boukhchina, S. (2017). Phytochemical screening, total phenolics and biological activities of Tunisian *Peganum harmala* seed extracts. *Journal of Chemical and Pharmaceutical Research*, *9*(2), 32-39.

Krishnaveni, M., Madhaiyan, P., Durairaj, S., Amsavalli, L., & Chandrasekar, R. (2013). Antioxidant activity of plants at

Chinnatirupathi, Salem, Tamil Nadu, India. *International Journal of Pharmaceutical Sciences and Research*, *4*(10), 3917-3919. http://doi.org/10.13040/IJPSR.0975-8232.4(10).3917-19

Lakhmili, S., Obraim, S., Taourirte, M., Seddiqi, N., & Amraoui, H. (2014). Chemical analysis and antioxidant activity of "*Nerium oleander*" leaves. *OnLine Journal of Biological Sciences*, *14*(1), 1-7. http://doi.org/10.3844/ojbssp.2014.1.7

Lu, M., Yuan, B., Zeng, M., & Chen, J. (2011). Antioxidant capacity and major phenolic compounds of spices commonly consumed in China. *Food Research International*, *44*, 530-536. http://doi.org/10.1016/j.foodres.2010.10.055

Mansouri, A., Embarek, G., Kokkalou, E., & Kefalas, P. (2005). Phenolic profile and antioxidant activity of the Algerian ripe date palm fruit (*Phoenix dactylifera*). *Food Chemistry*, *89*(3), 411-420. http://doi.org/10.1016/j.foodchem.2004.02.051

Mohadjerani, M. (2012). Antioxidant activity and total phenolic content of *Nerium oleander* L. grown in North of Iran. *Iranian Journal of Pharmaceutical Research: IJPR*, *11*(4), 1121-6.

Mokkadem, A. (1999). Cause de Dégradation des plantes médicinales et aromatiques d'Algérie. *Revue Vie et Nature*, *7*, 24-26.

Nia, B., Frah, N., Lekbir, A., & Benhmed, K. (2018). Assessment of toxicity on the basis of total phenolic content in oleander leaves (*Nerium oleander* L.) against *Myzus persicae* (Sulzer, 1776) (Hemiptera: Aphididae). *Acta Agriculturae Slovenica*, *111*(2), 265-270. http://doi.org/10.14720/aas.2018.111.2.02.

Peres, L. L. S., Sobreiro, A. I., Couto, I. F. S., Silva, R. M., Pereira, F. F., Heredia-Vieira, S. C., Cardoso, C. A. L., Mauad, M., Scalon, S. P. Q., Verza, S. S., & Mussury, R. M. (2017). Chemical compounds and bioactivity of aqueous extracts of *Alibertia* spp. in the control of *Plutella xylostella* L. (Lepidoptera: Plutellidae). *Insects*, *8*(4). http://doi.org/10.3390/insects8040125.

Rababah, T. M., Banat, F., Rababah, A., Ereifej, K., & Yang, W. (2010). Optimization of extraction conditions of total phenolics, antioxidant activities, and anthocyanin of oregano, thyme, terebinth, and pomegranate. *Journal of Food Science*, *75*(7), 626-632. http://doi.org/10.1111/j.1750-3841.2010.01756.x.

Reguieg, L. (2011). Using medicinal plants in Algeria. *American Journal of Food and Nutrition*, *1*(3), 126-127. http://doi.org/10.5251/ajfn.2011.1.3.126.127.

Salari, E., Ahmadi, K., Dehyaghobi, R. Z., Purhematy, A., & Takalloozadeh, H. M. (2012). Toxic and repellent effect of harmal (*Peganum harmala* L.) acetonic extract on several aphids and *Tribolium castaneum* (Herbst). *Chilean Journal of Agricultural Research*, *72*(1), 147-151.

Sharififar, F., Dehghn-Nudeh, G., & Mirtajaldini, M. (2009). Major flavonoids with antioxidant activity from *Teucrium polium* L. *Food Chemistry*, *112*, 885-888. http://doi.org/10.1016/j.foodchem.2008.06.064

Siddiqui, S., Khan, O. Y., Siddiqui, B. S., & Faizi, S. (1987). Analyse de la composition de l'huile de *Peganum harmala* L. (Zygophyllaceae). *Phytochemistry*, *26*(5), 1548-1550. http://doi.org/10.1016/S0031-9422(00)81861-0

Singh, P., Jayaramaiah, R. H., Sarate, P., Thulasiram, H. V., Kulkarni, M. J., & Giri, A. P. (2014). Insecticidal potential of defense metabolites from *Ocimum kilimandscharicum* against *Helicoverpa armigera*. *PLoS ONE*, *9*(8). http://doi.org/10.1371/journal.pone.0104377

Tayoub, G., Tayoub, G., Sulaiman, H., Alorfi, M., & Author, C. (2014). Analysis of oleandrin in oleander extract (*Nerium oleander*) by HPLC. *Journal of Natural Products*, *7*, 73-78.

Thouri, A., Chahdoura, H., El Arem, A., Omri Hichri, A., Ben Hassin, R., & Achour, L. (2017). Effect of solvents extraction on phytochemical components and biological activities of Tunisian date seeds (var. Korkobbi and Arechti). *BMC Complementary and Alternative Medicine*, *17*(1), 1-10. http://doi.org/10.1186/s12906-017-1751-y

Tobiszewski, M., Tsakovski, S., Simeonov, V., & Namieśnika, J. (2013). Application of multivariate statistics in assessment of green analytical chemistry parameters of analytical methodologies. *Green Chem*, *15*, 1615-1623. http://doi.org/10.1039/C3GC36976E

Vinayagam, A., & Sudha, P. N. (2011). Antioxidant activity of methanolic extracts of leaves and flowers of *Nerium indicum*. *International journal of pharmaceutical sciencse and research, 2*(6), 1548-1553.

ИНСЕКТИЦИДНА И АНТИОКСИДАТИВНА АКТИВНОСТ ВОДЕНИХ ЕКСТРАКАТА ДВЕЈУ ЛЕКОВИТИХ БИЉАКА ИЗ АЛЖИРА

БИЛАЛ НИА, АДЕЛ ЛЕКБИР и МОХАМЕД КАМЕЛ БЕН САЛАХ

Извод

У овом раду утврдили смо инсектицидну активност и антиоксидативну активност водених екстраката листова врсте *Nerium oleander* (Apocynaceae) и семенки *Peganum harmala* (Zygophyllaceae), две добро познате алжирске лековите биљке. Четири концентрације сваког екстракта примењене су по принципу случајности прскањем директно на јаја и ларве врсте *Ectomyelois ceratoniae* (Zeller, 1879) (Lepidoptera: Pyralidae) у лабораторијским условима. Наши налази потврдили су да на излегање јаја после четири дана није утицао водени екстракт, са стопом 54% излегања јаја како у контролним тако и у третираним јајима. Поред тога, токсичност контакта са ларвама није била евидентна и проценат смртности није прелазио 8%, без обзира на биљку и концентрацију екстракта. Фитохемијски скрининг показао је незнатно присуство терпена и сапонина и изостанак алкалоида. Међутим, полифеноли су били присутни у средњим концентрацијама у воденим екстрактима обе биљке. Нађено је да антиоксидативна активност екстракта *N. oleander* и *P. harmala* износи 71,80 односно 72,94%. Укупни фенолни садржај (TPC) и укупни садржај флавоноида (TFC) у испитиваним екстрактима били су 50,69 mg еквивалента галне киселине (GAE)/100 g суве тежине (DW) и 3,55 у односу на кверцетин еквивалент (QE)/100 g DW, респективно, за *N. oleander*. За врсту *P. harmala*, TPC и TFC су били 52,30 mg GAE/100 g DW, односно 3,49 mg QE/100 g DW, респективно. Наше истраживање јасно показује ограничено инсектицидно дејство водених екстраката, мада су показали интересантан антиоксидативни потенцијал, који би могао да помогне да се смањи учесталост оштећења изазваних оксидативним стресом.

Received: 11th September, 2019
Accepted: 10th January, 2020