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THE BIOLOGICAL EFFECT OF TOTAL AND PARTIAL EXTRACTS OF LEAVES FOR TWO SPECIES OF POPLAR TREES ON *Chaitophorus Versicolor* NYMPHS

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ABSTRACT

This study included one type of forest insect in the Nineveh of northern Iraq, which is plant sap suckers that infect a group of forest trees, including *Populus Euphratica* and *P.deltoides*. The results showed a variation in the killing rate resulting from treating poplar leaf nymph aphids with phenols of the study tree species according to the type of tree, concentration, and insect phase. The phenols of the Euphratica poplar leaves excelled on average, with the killing rate of the American type being 62.01 and 56.49% at a concentration of 10%, respectively. For Alkaloids, it was 47.21 and 43.3% for *P.euphratica* and *P.deltoides*, respectively. Meanwhile, terpenes were 43.21 and 37.69%. The average percentage of expulsion reached 36.89% in the nymph phase of *P. euphratica* at a concentration of 10%. The study showed significant superiority of the Alkaloids of Euphratica poplar and the average expulsion percentage over the Alkaloids of the other types. The average percentage of expulsion was 32.69% in the nymph phase at a concentration of 10%. The Euphratica poplar Terpenes outperformed the average kill rate over the Terpenes of the other type, with an average expulsion ratio of 29.92% in the nymph phase at a concentration of 10%.

INTRODUCTION

The human need for forests and their products has increased with the development of humanity and civilizations due to the many benefits, such as productive, preventive, and tourism benefits, especially in countries with extensive forests. In ancient times, forests were essential for human livelihood, providing protection, food, housing, medicine, and fuel (FAO, 2015). As world-systems developed, these resources multiplied, focusing on fast-growing species with short-cutting cycles (Zsuffa *et al*., 1993) since natural forests could not meet the growing demands of the massive population explosion .

The genus Populus L., part of the family Salicaceae, includes 50 species that spread naturally in the northern hemisphere, from North Africa's forests to beyond the Arctic Circle in Asia and Europe. These trees, known as Poplar, Cottonwoods, and Aspens, are represented in Iraq by five natural species and cultured hybrids (Augul & Al-Saffar, 2019). In 1995, the area of poplar trees was estimated at over one million and 1.3 million hectares in Europe and China, respectively (FAO, 1997).

Poplar trees are used as decoration plants, stabilize riverbanks soil, provide animal fodder, and yield medical drugs from their bark (Browicz, 1977; Sharma & Ahmad, 1992). The studies confirm the economic importance of Poplar wood for

industries like paper, wood chips, sulfur sticks, fiberboards, particleboards, and handicrafts (Castro & Fragnelli, 2013). Due to their importance, nurseries were established by the local government in Nineveh and Dohuk provinces, and their cultivation spread to other regions in northern and central Iraq.

Poplar trees are susceptible to insects that cause significant damage, such as tree death, poor growth, and reduced commercial wood value (Habeck, 1963; Muhammad *et al*., 2022). and reduction in their importance as tourist areas (Alton,1999). These weakness trees become vulnerable to other insect groups like bark beetles and wood borers. Aphids are particularly problematic as they absorb plant sap and transmit plant pathogenic viruses (Komblas, 1972). The poplar aphid *Chaitophorus populialba* is economically significant worldwide, causing damage by sucking sap from leaves and soft branches and transmitting diseases and viruses (Basu, 1983; Ali & Kamal, 2018; Zhang, 1988). Pintera (1987) diagnosed 58 species of Chaetophorous insects across many regions, all feeding on Poplar and Salix trees. From this, it is clear that this genus is of great importance and that its many species cause signifcant damage to the trees of the family Salicaceae, where it is stated (Ripa *et al*.,1990).

In Iraq, *Chaitophorus Versicolor* is a significant pest, draining sap and weakening trees to the point where they become vulnerable to more dangerous pests like *Melanophia picta* Pall. or *Capnodis miliaris* Klug. (Al. Jubouri,2018; Bhardwaj & Sharma, 2022; Mustafa *et al*., 2014). Despite the importance of these trees and the damage caused by this pest, studies in Iraq are limited .

Due to the harmful effects of chemical pesticides, attention has been directed to using alternative, environmentally friendly methods, namely plant extracts. These are natural compounds extracted from plant parts (leaves, flowers, fruits) that contain active substances and are often water or alcoholic extracts. Many of these extracts contain toxic substances that can instantly kill insects. Plant extracts repel different insect stages from the treated leaves and other plant parts by affecting the insects' sensory and nervous systems. Additionally, some plant compounds impact the growth of larvae and adult insects, causing physiological disruptions that prevent their complete development and maturation. Target insects cannot develop resistance to these extracts, making them safe for humans, the environment, and pests' natural enemies. Due to natural factors, they decompose quickly in the soil and are cost-effective compared to chemical pesticides., The study aimed to Comparative biological evaluation of some chemical components of the leaves of the studied trees (phenols, alkaloids, terpenes) in terms of their fatal, attractive and repellent effect on insects.

MATERIALS AND METHODS

The research was conducted in the Nineveh Forest, located on Mosul's eastern side of the Tigris River. It is located at a latitude of 39.19 º north and a longitude of 43.09 º east during2020-2021, which included two types (*P. euphratica* and *P. deltoides*) homogeneous in age and size. The laboratory study was carried out in the laboratories of the Forestry Sciences Department.

Insect Farm

Twigs of the two types (*P. euphratica* and *P. deltoides*) infected with an insect of leaves were brought from the Nineveh Forest each separately to provide an insect

from the leaves of the poplar Chaitophorus Versicolor in its different phases. The branches were placed in pottery anvils filled with soil moistening daily and switching branches every 5-6 days to ensure the survival of insects and their continued growth and development to obtain insects in their different phases to conduct laboratory studies.

-Types of trees used.

-Populus euphratica.

-Populus deltoids.

Extraction partial extracts

Polyphenols were extracted from Poplar tree leaves through a two-step process. First, the leaves were placed in a Soxhlet apparatus for 3-4 days, defatted with petroleum ether at 60-80°C. The extracts were evaporated using a rotary evaporator. In the second step, the batch was macerated in 95% ethanol for 24 hours, followed by Soxhlet extraction for 6 hours, and evaporated (Al-Abbasy *et al*., 2020).

Alkaloids were extracted from Poplar tree leaves using the method described by (Djilani *et al*.,2006), which employing acidified water.

The method of Qureshi *et al*. (1992) was used in preparing the alcoholic extract by placing 10g of Poplar tree leaves in an extraction thimble to obtain the extracted materials sequentially by the Soxhlate device using 100ml of hexanol (99%) for (24 hours). Then, the extract was dried in the oven at 45°C .

Effect of plant extracts

Fatal Effect

The results of the Fatal biological effect were taken according to what was mentioned (Shaaban & Al-Mallah 1993).

Attractive and Repellent Effect

The results of the attractant and repellent effect were taken according to what was mentioned (Shaaban & Al-Mallah,1993).

HPLC Condition for Analyzed phenolic and Flavonoid compounds

Samples were analyzed by high-performance liquid chromatography (HPLC) model (SYKAM) Germany. The pump model is S 2100 Quaternary Gradient Pump, the autosampler model is S 5200, the Detector is U.V. (S 2340), and the Column Oven model is S 4115. The mobile phase was = (Methanol: D.W.: formic acid) (70: 25: 5), the column is C18-ODS (25 cm * 4.6 mm), and the detector is U.V.—280 nm at a flow rate of 1.0 ml /min.

RESULTS AND DISCUSSION

Total Extracts

The study's results showed that the total extracts of the types of trees studied with solvents and concentrations used did not have any fatal effect on the nymph phase Table (1). The results differ from the (Aref 2009), which found that the effect of extracts using different solvents (ethanol, acetone, diethyl ether, water) on the cotton leafworm Spodoptera littoralis B, as acetone gave the highest percentage of Mortality. Then, diethyl ether and ethanol were used simultaneously, while water was one of the weakest extracts in terms of its effect on the pest. It also disagrees with

(Adeniyi *et al*., 2010) as they found that ethanol extracts of plant leaves (Vernonia amygdalina, Ocimum gratissimum, Telfaria occidentalis, and Sida acuta) had a lethal effect against the (Acanthoscelides obtectus) and that the highest average homicide rate was on Vernonia amygdalina at 33.60%.

Partial Extracts

Phenols

The results shown in Table (1) show a variation in the Mortality rates resulting from the treatment of nymph aphids of Poplar leaves with phenols of the tree species under study, according to the tree type and concentration, as the results showed an increase in the killing rates according to the rise in the concentration used of phenols, and that the phenols of the Euphratica poplar leaves significantly outperformed the average killing rate on the other type, as the average killing rate was 62.01% in the nymph phase at a concentration of 10%. The statistical analysis results showed significant differences in the average killing rate at the probability level of 5%. This is consistent with several studies, including one (Rehill *et al*., 2005) that indicated that glycosidic phenols are important secondary compounds in trees of the genus Populus as well as other plant species of the willow family; these compounds make the plant resistant to insects. It was stated (Tsai *et al*., 2006) that glycosidic phenols are repellent to multiple types of herbivorous insects and protect the plant from pathogens. In a study (Vihakas *et al*., 2010), Phenols in the epidermis layer of birch leaves act as defense compounds against the larvae of the Epirrita autumnal L.

Table (1): The Fatal effect of leaf phenols for two poplar tree species in nymph aphids of poplar leaves *Chaitophorus versicolor*.

Species	Con. ٪					Means of species
	2	4	6	8	10	
P.euphratica	20.56 g	28.13 f	44.75 d	53.51 c	62.01 a	41.79 a
P. deltoides	5.83 h	28.05 f	39.23 e	45.14 d	56.49 b	37-34 b
Means of Con.	13.19 d	28.09 e	41.99 c	49.32 b	59.25 a	

*At the 0.05 probability level, different letters within a single column indicate a significant difference

Alkaloids

The results of Table (2) indicate a variation in the killing rate resulting from the treatment of Nymphs with Alkaloids of the tree species under study according to the type of tree, concentration, and insect phase. The results showed an increase in the killing rates according to the rise in the concentration used of alkaloids, and that the Alkaloids of the leaves of the Euphratica poplar significantly outperformed the average killing rate of the Alkaloids of the other type. The average killing rate was 45.10 % in the Nymph phase at a concentration of 10%.

The statistical analysis results also showed significant differences in the average killing rate at the level of probability of 5%. This is consistent with many studies that confirmed the toxicity of Alkaloids to insects, the importance of Alkaloids in preventing insects from attacking plants, and that the level of effectiveness of these Alkaloids is related to the type of plant and the concentration used and the type and phase of the insect used, including study (Badshah *et al*., 2005) as it indicated that extracts of alkaloids when applied to insects they cause a

malfunction in the nervous system, which leads to their death. (Shields *et al*., 2008) showed that herbal insects do not prefer Alkaloids, as they prevent insect feeding and are often poisonous. (Kirk *et al*., 2010) stated that alkaloids found in many plant hosts are toxic to herbal insects and play an essential role in resisting pathogens.

Table (2): The Fatal effect of the alkaloids of the leaves of the two types of poplar trees in nymph aphids of the leaves of the poplar *Chaitophorus versicolor*.

Species	Con. ٪					Means of species
	2	4	6	8	10	
P.euphratica	20.53 fg	24.43 def	28.55 cd	38.91 b	47.21 a	31.92. b
P. deltoides	17.56 g	21.25 efg	26.63 cde	31.14 c	43.3 ab	27.97 a
Means of Con.	19.05 d	22.84 d	27.59 c	35.02 b	45.10 a	

*At the 0.05 probability level, different letters within a single column indicate a significant difference

Terpenes

Table (3) shows a variation in the killing rate resulting from the treatment of nymphs with terpenes of the tree species under study, according to the tree type and the insect phase. The results showed an increase in the killing rates according to the rise in the concentration used of the terpenes and that the leaf terpenes of the types of Euphratica poplar trees significantly outperformed the average killing rates on the terpenes of the other kind. The statistical analysis results showed significant differences in the average killing rate at the probability level of 5%. This is consistent with many studies that have confirmed the importance of terpenes extracted from plants in their insect-killing effect, including a (Mustafa,2011) study of the results of the effect of terpenes extracted from sapwood and core of pine trees and eucalyptus, which found that they have a Fatal effect for the Microcerotermes diverse, as the average killing rate was 33.7%. It was stated that terpenes were the least effective in killing the Termite insects compared to alkaloids and phenols. (Alotaiba & Elsayed,2007) pointed out that Monoterpenes have shown importance in the defense against bark beetles .

Table (3): Shows the Fatal effect of leaf terpenes of two poplar trees in nymph aphids of poplar leaves *Chaitophorus versicolor*

Species	Con. ٪					Means of species
	2	4	6	8	10	
P.euphratica	20.73 f	26.23d	30.75c	37.51 b	43.21 a	31.69 a
P. deltoides	20.36 f	23.05 e	26.43d	30.74 c	37.69 b	27.65 b
Means of Con.	20.54 e	24.64d	28.59c	34.12 b	40.45 a	

*At the 0.05 probability level, different letters within a single column indicate a significant difference

Total Extract

From Table (4), it is clear that the averages of the percentage of attraction of nymph aphids of poplar leaves have varied according to the type and the type of solvent used in extraction and concentration. The statistical analysis results showed significant differences in the average percentage of attraction. The total ethanol extract for the *P.euphratica and P.deltoides* species showed a high average

percentage of attraction at a concentration of 10%, which amounted to 39.38, 30.98%. It is also shown from the same table that the average percentage of attraction to nymphs has increased with increasing concentration of extracts, while water extract has varied in its efficiency in attracting nymphs, and that the variation of leaf extracts of the two types of poplar trees in the degree of attraction may be due to the variation of these species in the quantity and quality of repellent

Compounds present in them. This is consistent with (Mustafa,2011), who found that the ethanolic extract of Poplar wood and Platanus wood showed an attractive effect in *Microcerotermes diversus* .

Table (4): Shows the effect of the type of trees used in the study and the type of solvent of the total extract and its concentrations on the average attraction rates of nymph aphids of *Chaitophorus versicolor* poplar leaves.

Species	Solvents	Con. ٪					Means of solvents
		2	4	6	8	10	
P.euphratica	Ethanol	12.02 k	19.43 h	27 d	29.27 c	39.38 a	25.42 a
	Water	8.72 m	14.51 j	19.82 h	24.09 f	25.81 e	18.59 c
P. deltoides	Ethanol	11.29	14.22 j	22.4 g	26.26 e	30.98 b	21.03 b
	Water	8.64 m	12.38 k	16.61 i	21.78 g	22.13 g	16.31 d
Means of Con.		10.32d	15.13c	21.45b	25.35 ab	29.57 a	

*At the 0.05 probability level, different letters within a single column indicate a significant difference

The study's results showed that the total extracts of the leaves of the two types of *P. euphratica* and P.deltoides with solvents and concentrations used did not show any repellent effect on nymph aphids of poplar leaves. Statistical analysis showed significant differences in the repellent ratios at a concentration of 10% of the solvents used in the study and significant differences in the general average of the percentage of expulsion between the solvents used in the study. From the above, it is found that the two types of trees contain attractions for nymph aphids of poplar leaves, which makes them susceptible to infection with nymphs. As for the balancing values of the proportions and expulsion of nymph aphids of poplar leaves and attraction, it is clear

From Table (5) that these values varied according to the type of tree, the kind of solvent, and the concentration used in the study. The statistical analysis results showed significant differences in the average values of the budget according to the previous variables. The total extract of ethanol showed a clear superiority in the balancing values of the ratios of the strength of attraction and expulsion of the total extract of ethanol at a concentration of 10%, which amounted to 31.42, 26.46 for the types of P.euphratica and P.deltoides while the total extract of water was 26. 98, 20.55. As can also be seen from the Table, the average balancing values were positive; they tend to attract. The statistical analysis of the values of the general average to balance the strength of attraction and expulsion of the total extracts of the leaves of the tree species used in the study showed significant differences at the level of probability of 5%.

Table (5): Shows the effect of the type of trees used in the study and the type of solvent of the total extract and its concentrations on the balancing values of the force of attraction and expulsion of nymph aphids of the leaves of the poplar *Chaitophorus versicolor.*

Species	Solvents	Con. ٪					Means of solvents
		2	4	6	8	10	
P.euphratica	Ethanol	14.26i	18.33g	25.04d	27.41b	31.42 a	23.29 a
	Water	8.2 m	14.05 i	16.37h	21.81e	26.98c	17.48 b
P. deltoides	Ethanol	9.09 l	12.07 j	18.68g	21.77e	26.46 c	17.61 b
	Water	7.36 n	9.84 k	12.23 j	18.65g	20.55 f	13.72 c
Means of Con.		9.72 c	13.57c	18.08b	22.41ab	26.35a	

*At the 0.05 probability level, different letters within a single column indicate a significant difference

Partial Extracts

The statistical analysis results showed significant differences in the average percentage of attraction of *P.euphratica* at the concentrations used, followed by the partial extracts of *P.deltoides*. The table also shows the superiority of the phenols of P.*euphratica* over the other type in the average percentage of attraction, which reached 36.89 and 29.01% for *P.euphratica* and *P.deltoides* respectively at a concentration of 10%. While the average percentage of attraction for alkaloids for P.euphratica and P.deltoides was 32.69, 26. 90% respectively. The average percentage of attraction of nymphs by terpenes of the two previous species was 29. 92 25 ،. 18% respectively. The table also shows that the highest value of the overall average attraction was 30. 96% for Euphratica poplar phenols, while the rest of the averages showed variation in their general averages according to the partial extracts of the two species. This is consistent with some studies that confirmed that phenols compounds act as insect attractants (Chaudhary *et al*., (2011); Al-Mallah *et al*., 2008).

Table (6): Shows the effect of the types of trees used in the study, the types of partial extract and the concentration on the percentage of attraction of nymph aphids for the leaves of the poplar *Chaitophorus versicolor*.

Species	Solvents	Con. ٪					Means Species* extract
		2	4	6	8	10	
P.euphratica	Phenol	27.23 gh	29.15 e	29.83 d	31.68 c	36.89a	30.96 a
	Alkaloid	23.68 m	25.97 jk	26.86 hi	29.96 d	32.69b	27.83 b
	Terpene	20.43 p	23.78 m	26.54 ij	27.94 f	29.92d	25.72 c
P. deltoides	Phenol	21.18 o	24.8 l	25.87 k	27.55 fg	29.01e	25.68 c
	Alkaloid	20.99 op	22.17 n	23.78 m	26.46 ijk	26.9 hi	24.06 d
	Terpene	18.03 q	20.87 op	23.57 m	24.76 l	25.18 l	22.48 e
Means of Con.		21.92 b	24.45 b	26.07 ab	28.05 a	30.09 a	

*At the 0.05 probability level, different letters within a single column indicate a significant difference

As for the average expulsion ratios for nymph aphids of poplar leaves shown by partial extracts, it is clear from Table (7) that the expulsion ratios for nymphs have also varied according to the type, type of partial extract, and concentration. The results of the statistical analysis showed significant differences in the average expulsion ratio at the probability level of 5%, and that the expulsion ratios of partial

extracts of P.euphratica and P.deltoides were low at the concentrations used. As shown in the table also, the highest value of the general average of the expulsion ratios was for American poplar phenols, alkaloids, and terpenes, which amounted to 6.262%, 5.406%, and 5.227% respectively.

It appears from the above that the partial extracts of P.*euphratica* and *P.deltoides* species showed low expulsion rates. This is consistent with some studies that have confirmed that glycosidic phenols make plants more resistant to insects and pathogens (Rehill *et al*., 2005; Tsai *et al*., 2006; Vihakas *et al*., 2010) .

Table (7): Shows the effect of the types of trees used in the study, the types of partial extract and the concentration on the percentage of Repllent of nymph aphids for the leaves of the poplar *Chaitophorus versicolor*.

Species	Solvents	Con. ٪					Means Species* extract
		2	4	6	8	10	
P.euphratica	Phenol	5.82 e-j	6.23 b-h	6.09 b-h	6.46 a-d	6.68 ab	6.26 a
	Alkaloid	4.47 o	5.25 j-m	5.09 k-n	5.79 e-j	6.41 a-e	5.40 c
	Terpene	4.59 no	4.74 mno	4.91 mno	5.75 f-j	6.13 b-h	5.22 c
P. deltoides	Phenol	6.13 b-h	6.03 c-h	5.89 c-i	6.92 a	6.51 abc	6.30 a
	Alkaloid	5.29 i-m	5.69 g-k	5.61 h-l	6.37 a-f	6.26 b-g	5.84 b
	Terpene	5.02 l-o	5.26 i-m	5.23 j-m	5.85 d-j	5.99 c-h	5.47 c
Means of Con.		5.22 b	5.53 ab	5.47 ab	6.19 a	6.33 a	

*At the 0.05 probability level, different letters within a single column indicate a significant difference

In terms of the average balance values reflecting the percentage of attraction versus expulsion, Table (8) highlights that these values varied depending on the tree species, the type of partial extract, and the concentration used. At a concentration of 10%, the phenols extracted from *P. euphratica* and *P. deltoides* exhibited average values of 30.78% and 22.97%, respectively, while the alkaloids showed values of 27.00% and 21.23%, and the terpenes presented values of 24.43% and 19.63%. The statistical analysis revealed significant differences in the average balance values of attraction and expulsion ratios between *P. euphratica* and *P. deltoides*. Moreover, the overall analysis indicated that *P. euphratica* phenols had the highest balance value at 25.21%, whereas the American species had the lowest at 19.87%. This suggests that the balance of attraction was more pronounced in the species studied, particularly favoring attraction.

Focusing on the average values that balance the strength of attraction and expulsion of nymph aphids on poplar leaves, Table (9) reveals that these values were also influenced by the tree species, the type of partial extract, and its concentration. The results demonstrated significant variation, with a 10% concentration yielding average values for *P. euphratica* and *P. deltoides* phenols at 25.69% and 20.93%, respectively. Alkaloids produced values of 25.43% and 19.88%, while terpenes showed 23.44% and 17.97%. Statistical analysis of the general averages revealed significant differences in balancing the strength of attraction and expulsion across the partial extracts of the leaves from both types of poplar trees at a 5% probability level. Notably, the highest balance value was recorded for the phenols of *P. euphratica* at

23.76%, while the lowest was associated with the American poplar, with an average value of 19.85%.

Table (8): Shows the effect of tree type used in the study, partial extract type and concentration on the values of balancing the percentage of attraction and expulsion of nymph aphids of poplar leaves *Chaitophorus versicolor*.

Species	Solvents	Con. ٪					Means Species* extract
		2	4	6	8	10	
P.euphratica	Phenol	21.90 fg	23.54 e	24.20 d	25.63 c	30.78 a	25.21 a
	Alkaloid	19.6 jk	21.25 gh	21.83 fg	24.81 d	27.00 b	22.9 b
	Terpene	16.35 n	19.61 k	22.26 f	23.01 e	24.43 d	21.13 c
P. deltoides	Phenol	15.51 o	19.41 k	20.26 ij	21.21 gh	22.97 e	19.87 d
	Alkaloid	16.27 n	17.17 m	18.53 l	20.72 hi	21.23 gh	18.78 e
	Terpene	13.51 p	16.34 n	18.62 l	19.53 k	19.63 k	17.53 f
Means of Con.		17.19 b	19.55 b	20.95 ab	22.48 a	24.34 a	

*At the 0.05 probability level, different letters within a single column indicate a significant difference

Table (9): Shows the effect of tree type used in the study, partial extract type and concentration on the values of balancing the force of attraction and expulsion of nymph aphids of poplar leaves *Chaitophorus versicolor*.

Species	Solvents	Con. ٪					Means Species * extract
		2	4	6	8	10	
P.euphratica	Phenol	21.25 fgh	23.67 de	23.39 e	24.79 bc	25.69 a	23.76 a
	Alkaloid	21.02 ghi	21.8 f	21.85 f	24.85 bc	25.43 ab	22.99 b
	Terpene	20.00 jkl	20.33 ijk	21.52 fg	24.2 cd	23.44 e	21.9 c
P. deltoides	Phenol	18.56 m	19.41 l	19.74 kl	20.62 hij	20.93 ghi	19.85 d
	Alkaloid	17.97 mno	18.30 mn	18.63 m	19.64 kl	19.88 jkl	18.88 e
	Terpene	16.88 p	17.57 nop	17.25 op	17.78 no	17.97 mno	17.49 f
Means of Con.		19.32 b	20.18 b	20.39 ab	21.98 a	22.22 a	

*At the 0.05 probability level, different letters within a single column indicate a significant difference

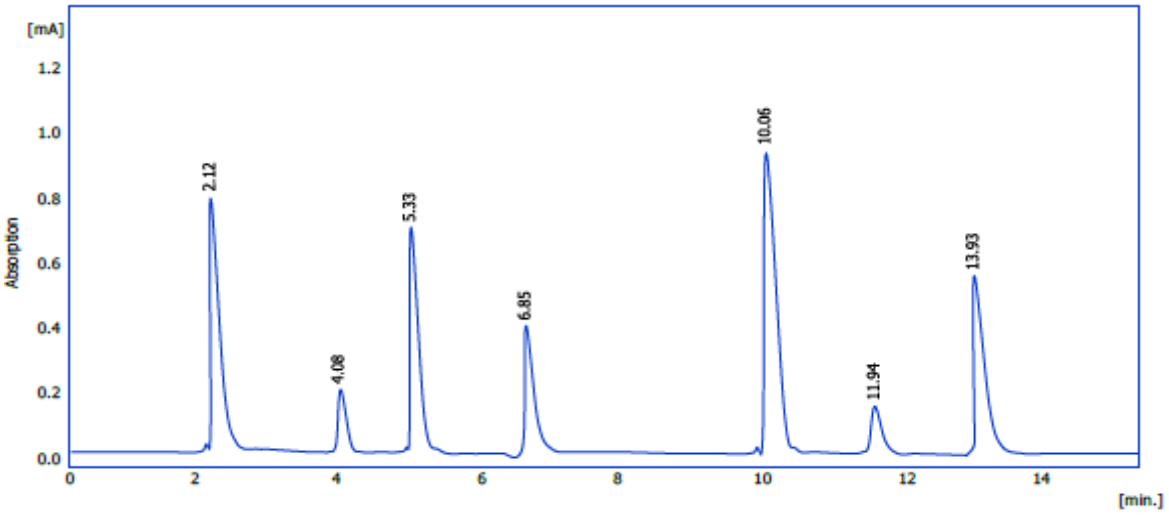
HPLC Condition for Analyzed phenolic and Flavonoid compounds

Sample were analyzed by high performance liquid chromatography HPLC model (SYKAM) Germany. Pump model: S 2100 Quaternary Gradient Pump, Auto sampler model: S 5200, Detector: UV (S 2340) and Column Oven model: S 4115. The mobile phase was = (Methanol: D.W: formic acid) (70 : 25 : 5), the column is C18-ODS (25 cm * 4.6 mm) and detector UV – 280 nm at flow rate 1.0 ml /min.

The figures below show the analysis of a sample of plant extract from poplar trees using HPLC (High Performance Liquid Chromatography) technology For Ferulic acid, chlorogenicacid, gallic acid and caffeic acid compounds. As shown in the figures below 1 to 5.

Sample Info:

Sample ID	: sample	Amount	0
Sample	: sample	ISTD Amount	0
Inj. Volume [mL]	: 0.1	Dilution	1
Autostop	: 20.00 min	External Start	: Start - Restart, Down
Detector 1	: Detector 3	Range 1	: Bipolar, 2000 mAU, 10 Samp. per Sec.
Subtraction Chromatogram	: (None)	Matching	: No Change



Result chromatography Table (Uncal - F:\ sample)

No	Reten. Time [min]	Area [mAU.s]	Height [mAU]	Area [%]	Height [%]	W05 [min]	Compound Name
1	2.12	7952.00	800.80	19.00	19.00	0.10	
2	4.08	4965.01	202.55	10.00	10.00	0.05	
3	5.33	8045.98	719.80	15.00	15.00	0.10	
4	6.85	6325.08	403.65	12.00	12.00	0.08	
5	10.06	12441.48	914.58	24.00	24.00	0.20	
6	11.94	4569.32	185.99	8.00	8.00	0.05	
7	13.93	8522.00	530.80	12.00	12.00	0.10	
	Total	52820.19	3762.55	100.00	100.00		

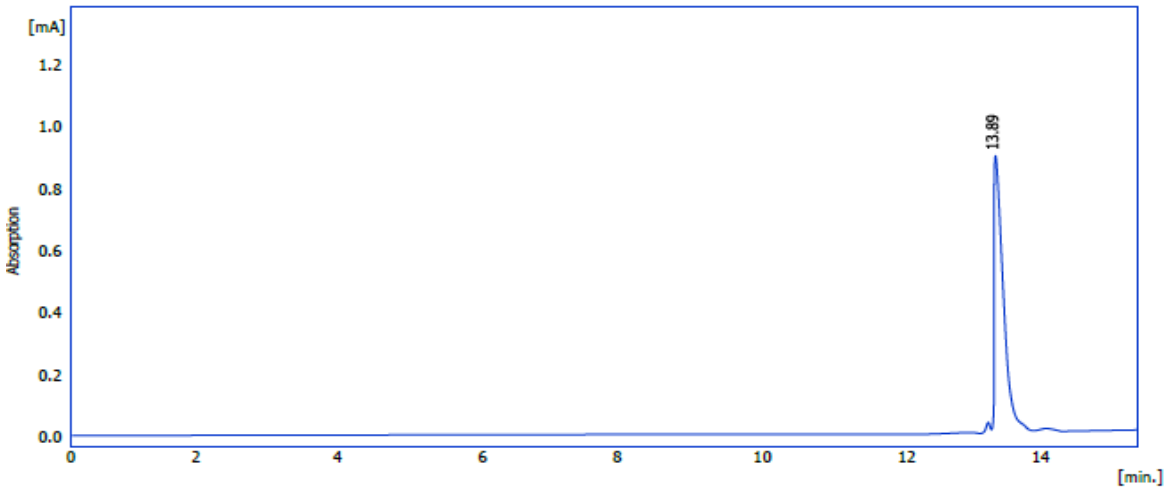
Figure (1): Alcoholic extract (7%) of Populus euphratica trees analyzed by HPLC device.

Given that the fatal results of the phenolic extract were better than the fatal results of alkaloids and terpenes, we decided to analyze them using the HPLC method to find out their main components.

Type of phenolic compound	Con (ppm)
Caffeic acid	125.98
Chlorogenic acid	65.28
Gallic acid	88.95
Ferulic acid	74.80

Sample Info:

Sample ID	: Ferulic acid 10 ppm	Amount	0
Sample	: Ferulic acid 10 ppm	ISTD Amount	0
Inj. Volume [mL]	: 0.1	Dilution	1
Autostop	: 20.00 min	External Start	: Start - Restart, Down
Detector 1	: Detector 3	Range 1	: Bipolar, 2000 mAU, 10 Samp. per Sec.
Subtraction Chromatogram	: (None)	Matching	: No Change



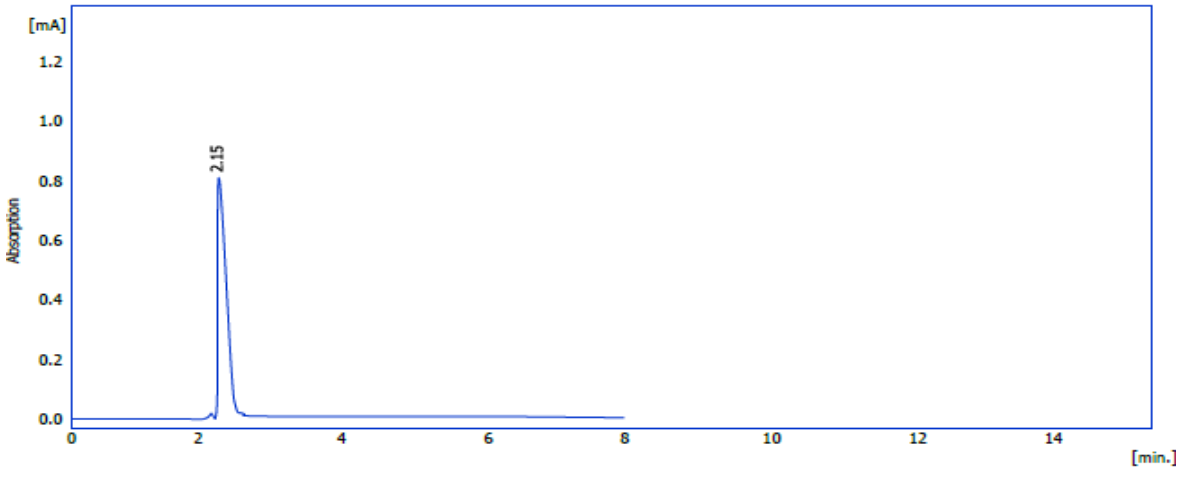
Result chromatography Table (Uncal - F:\ Ferulic acid 10 ppm)

No	Reten. Time [min]	Area [mAU.s]	Height [mAU]	Area [%]	Height [%]	W05 [min]	Compound Name
1	13.89	3258.74	840.11	100.00	100.00	0.25	
	Total	3258.74	840.11	100.00	100.00		

Figure (2): Ferulic acid phenolic extract at a concentration of 10ppm and analyzed by HPLC device.

Sample Info:

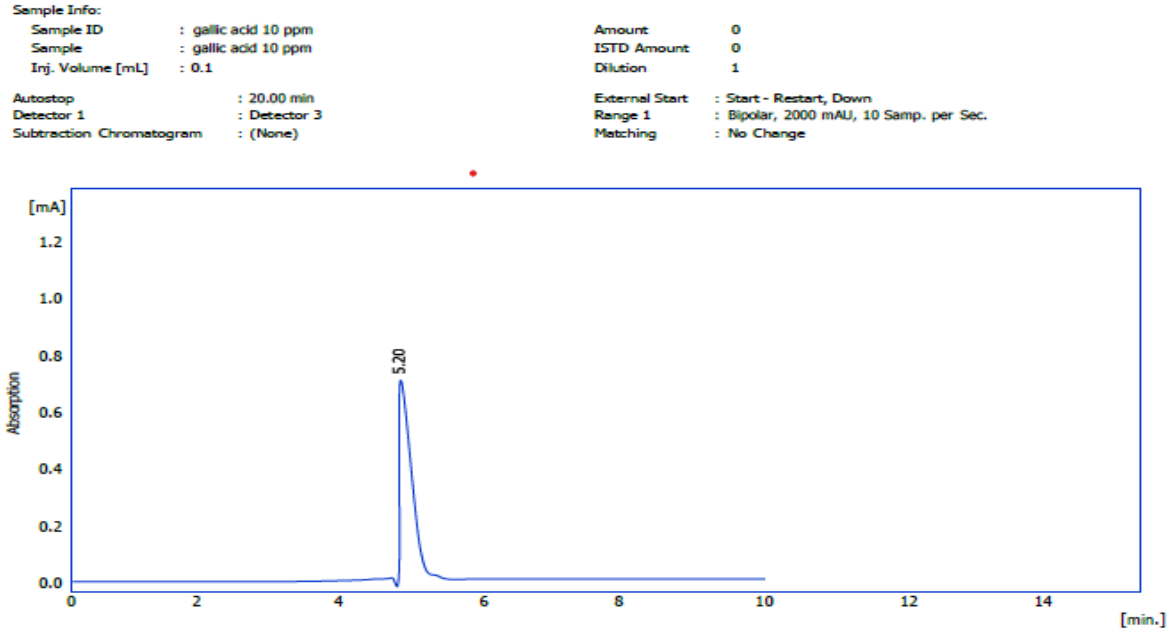
Sample ID	: chlorogenic acid 10 ppm	Amount	0
Sample	: chlorogenic acid 10 ppm	ISTD Amount	0
Inj. Volume [mL]	: 0.1	Dilution	1
Autostop	: 20.00 min	External Start	: Start - Restart, Down
Detector 1	: Detector 3	Range 1	: Bipolar, 2000 mAU, 10 Samp. per Sec.
Subtraction Chromatogram	: (None)	Matching	: No Change



Result chromatography Table (Uncal - F:\ chlorogenic acid 10 ppm)

No	Reten. Time [min]	Area [mAU.s]	Height [mAU]	Area [%]	Height [%]	W05 [min]	Compound Name
1	2.15	2145.80	811.45	100.00	100.00	0.25	
	Total	2145.80	811.45	100.00	100.00		

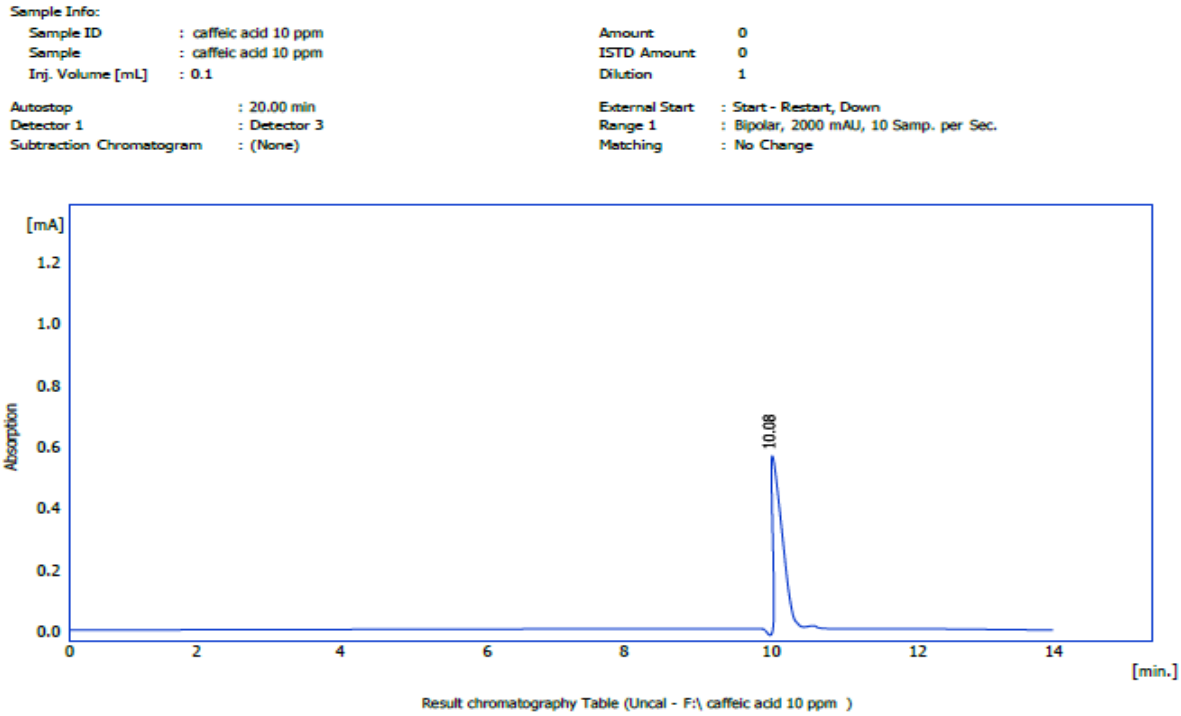
Figure (3): Chlorogenic acid phenolic extract at a concentration of 10ppm and analyzed by HPLC device



Result chromatography Table (Uncal - F:\ gallic acid 10 ppm)

No	Reten. Time [min]	Area [mAU.s]	Height [mAU]	Area [%]	Height [%]	W05 [min]	Compound Name
1	5.20	1854.08	784.44	100.00	100.00	0.25	
	Total	1854.08	784.44	100.00	100.00		

Figure (4) Gallic acid phenolic extract at a concentration of 10 ppm and analyzed by HPLC device.



Result chromatography Table (Uncal - F:\ caffeic acid 10 ppm)

No	Reten. Time [min]	Area [mAU.s]	Height [mAU]	Area [%]	Height [%]	W05 [min]	Compound Name
1	10.08	2105.12	600.14	100.00	100.00	0.25	
	Total	2105.12	600.14	100.00	100.00		

Figure (5) Caffeic acid phenolic extract at a concentration of 10 ppm and analyzed by HPLC device.

CONCLUSIONS

The study results indicated variations in the levels of phenols, alkaloids, and terpenes in the leaves of two tree species, which influenced the killing, repelling, and attracting rates of poplar leaf aphid nymphs depending on species and concentration. The nymphal stage exhibited a strong response to partial extracts, with *P. euphratica* leaves containing higher levels of phenols, alkaloids, and terpenes compared to other species, affecting the rates of killing, attraction, and repulsion. Phenolic compounds were the most toxic and repellent to nymphs, followed by alkaloids and terpenes. The results revealed variations in mortality rates after treating poplar leaf aphid nymphs with phenols from the tree species under study. Additionally, the total extracts of the tree species using the solvents and concentrations applied did not have a lethal effect on the nymphal stage. However, the total ethanol extract of *P. euphratica* and *P. deltoides* exhibited a high average attraction percentage at a 10% concentration, amounting to 39.38% and 30.98%, respectively.

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CONFLICT OF INTEREST

The authors state that there are no conflicts of interest with the publication of this work.

التأثير الحيوي للمستخلصات الكلية والجزئية لأوراق نوعين من اشجار الحور في حوريات مَنْ اوراق الحور *chaitophorus versicolor*

سامر امير حنا [1]، حنان غانم سعدالله [2]
قسم علوم الغابات / كلية الزراعة والغابات / جامعة الموصل / الموصل / العراق [1،2]

الخلاصة

تضمنت هذه الدراسة أحد أنواع حشرات الغابات والتي هي ماصات العصارة النباتية التي تصيب مجموعة من أشجار الغابات ومنها أشجار الحور الفراتي *Populus euphratica* والحور الأمريكي *P. deltoids* الموجودة في غابة نينوى. فيما يخص التأثير القاتل والجاذب والطارد للمستخلصات الجزئية فقد أظهرت النتائج وجود تباين في نسبة القتل الناتجة عن معاملة حوريات مَنّ أوراق الحور بفينولات أنواع أشجار الدراسة تبعاً لنوع الشجرة والتركيز والطور الحشري وأن فينولات أوراق الحور الفراتي تفوقت في متوسط نسبة القتل على النوع الامريكي اذ بلغت 62.01 و56.49 % عند التركيز 10 % وعلى التوالي اما بالنسبة للقلويدات فكانت 47.21 و43.3 % للفراتي والامريكي على التوالي، اما بالنسبة للتربينات فكانت 43.21 و37.69 %. اما بالنسبة لمتوسط نسبة الطرد فقد بلغت 36.89 % لطور الحورية في النوع الفراتي عند التركيز 10 ٪

واظهرت الدراسة تفوقاً معنوياً لقلويدات الحور الفراتي أيضاً في متوسط نسبة الطرد على قلويدات النوع الاخر، إذ بلغت متوسط نسبة الطرد 32.69 ٪ في طور الحورية عند التركيز 10 ٪، وكذلك الحال فيما يخص تربينات الحور الفراتي التي تفوقت في متوسط نسبة القتل على تربينات النوع الاخر، إذ بلغ متوسط نسبة الجذب 29.92٪ في طور الحورية عند التركيز 10 ٪.

الكلمات المفتاحية: حور، فراتي، امريكي، مَنْ.

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