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Effect of *Phoenix dactylifera* waste compost on the chemical compounds of *Trigonella foenum graecum*

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Abstract: The experiment was carried out in the Abu Al-Khasib district in 2023 and clay loam soil from the Al-Barjasiyah area was used to study the evaluation of date palm waste compost as an organic fertilizer for *Trigonella foenum graecum*. The results indicated that coarse date palm compost at 2.5% organic materials produced a fresh weight of plants was 6.5 g and a dry weight of 4.25 g, compared to control treatment which produced 2.5 g and 1.5 g fresh and dry weights. The findings demonstrated that the alcoholic extract of fenugreek (*T. foenum graecum*) leaves contained 57 different chemicals. The highest was found in diaziridine, 1,3,3-trimethyl, which was 15.3826 %, Ethyl. Alpha-d-glucopyranoside (7.9728%), Phytol (7.37%) and γ- -sitosterol (2.6745%). The results also revealed three chemical compounds were found associated with Trigonella extract treated with date palm in all treatments such as phytol, Bis (2-ethylhexyl) phthalate, and Bis (2-ethylhexyl) terephthalate. The *T. foenum graecum* treated with coarse compost date palm at a 2.5% concentration has 23 compounds. The compounds with the highest percentage were beta-d-mannofuranoside methyl (55.3652%). Beta -d-Mannofuranoside (51.5768) n-Hexadecanoic acid (4.2341%), and Phytol (12.1591%) are some of the 31 compounds that make up coarse compost with 0.5%. While the *T. foenum graecum* treated with fine compost date palm at a 2.5% concentration recorded 32 compounds, the higher percentage was beta-d-Mannofuranoside, methyl (35.852%). The fine compost 0.5% concentration has 15 compounds the highest was N-Serylserine which had a 58.8436% concentration.

Keywords: Compost; Date palm; Fenugreek; n-Hexadecanoic acid; Phytol; Sitosterol.

Introduction

Fenugreek (*T. foenum-graecum*) is a significant medicinal herb; it is cultivated in the Mediterranean Basin, Australia, China, Asia, North America, India, Turkey, Africa, and Egypt (Singh *et al*., 2022; Visuvanathan *et al*., 2022). Fenugreek belongs to the Leguminosae (Fabaceae family). It is accessible flavoring and spice that contains 50 different species (Kaviarasan *et al*., 2006; Parthasarathy *et al*., 2008; Hadi *et al*., 2018). *T. foenum graecum* 0.3–0.8 meters in height, upright, perfumed annual herb, the leaves are 20–25 mm in length, obovate, toothed, and gray green (Singh *et al*., c2022; Visuvanathan *et al*., 2022).

Trigonelline, the main bioactive component of *T. foenum-graecum*, is one of several bioactive chemicals found in the plant. The seeds contain 45–60% carbohydrates, lipids, fiber, and 25–30% protein, as well as protodioscin, trigoneoside, galactomannans, 4-hydroxyisoleucine, diosgenin, and yamogenin. Alkaloids (trigonelline, gentianine, carpaine), polyphenols, steroids, steroidal saponins, flavonoids, and terpenes. There are many different substances including polyphenol, mucilage, amino acids, and linoleic acid, palmitic acid, β-caryophyllene, camphor, β-Pinene, neryl acetate, phytol, and oleic acid (Zameer *et al.*, 2018; Akbari *et al.*, 2019; Singh *et al.*, 2022; Visuvanathan *et al.*, 2022). In addition, *T. foenum-graecum* contains essential oil (Naimi *et al.*, 2022). A study by Kumaravel *et al.,* (2017) identified 13 compounds in the alcoholic extract of *T. foenum-graecum*. Nalbantova *et al.* (2023) report palmitic acid and cubenol. As well as monocyclic sesquiterpenes such as α-bisabolol, carvacrol, eugenol, methyleugenol, thymol, and cubenol have been identified (Naimi *et al.*, 2022, Rajhi *et al.*, 2022; Nalbantova *et al.*, 2023).

T. foenum graecum is a folk remedy utilized in Arabic, Chinese, and Indian cultures. It has several uses, including central nervous system stimulation, wound healing, antidiabetic, antioxidant, antipyretic, anticancer, and potential benefits for Alzheimer's patients (Kavararasan *et al.* (2006). The seeds also exhibit antimicrobial and neuroprotective properties (Visuvanathan *et al.*, 2022; Nalbantova *et al.*, 2023). People have used it to treat digestive issues, gout, diabetes, hyperlipidemia, anticarcinogenic, hepatoprotective, wound healing, and inflammation (Priya *et al.*, 2011; Syed *et al.* 2020.

Researchers and farmers are constantly search ing for organic fertilizers that are not found in their home ecosystems because the existing farming systems have been described by the large usage of chemical fertilization resulting leading to a decline in soil quality and agricultural product standards as well as agricultural products decline (Qader *et al.*, 2018; Al-Saadi *et al.*, 2017; Abd-Alrasoul *et al.,* 2022). Furthermore, excessive nutrients leaking from the overuse of this fertilizer's chemical without organic additions have the potential to pollute the ecosystem around them (Lim *et al.*, 2016). One potentially cost-effective and environmentally significant way to reduce *P. dactylifera* waste is by composting it. Research indicates that compost produced from 70% date palm waste has a moisture content level of 57.1% and a dry matter value of 891 g.kg^{-1}, which could make it a valuable fertilizer (Khiyami *et al.* ,2008).

P. dactylifera is the oldest fruit tree in the Arab world particularly in the (Southern Mediterranean regions). It is extensively cultivated for its sweet, edible fruit (Barreveld, 1993; Mahdi *et al.*, 2022; Gabash *et al.*, 2024). In Iraq, date palms are so ancient and have many of the names. Date palms produce several types of waste. *P. dactylifera* wastes are regarded as bioresources since they are inexpensive, have low pH, and have good water absorption (Barreveld, 1993; Rahbarian & Sardoei, 2014; Benabderrahim *et al.*, 2018). Samiei *et al.* (2005) examined the effect of date-palm substrate on the Aglaonema growth. Ali (2008) reported that composted *P. dactylifera* leaves improve plant development of four ornamental plants: *Zinnia elegans, Tagetes erecta, Dahlia variabilis*, and *Cosmos bipinnatus*. Date-palm peat' s impact on nutritional components and growth indicators tomatoes (Mohammadi-Ghehsareh *et al.*, 2011). their finding also revealed that the qualities of perlite and date-palm waste medium were similar and did not have a big effect on the quality or quantity of the cucumber fruit. *P. dactylifera* wastes are a strong contender for the position of culture material in systems for hydroponic plant growth (Mohammadi, 2013; Abd *et al.*, 2020; Al-Asadi *et al*., 2019). Rahbarian & Sardoei (2014) studied the effect of palm peat waste on the growth *F. benjamina*.

This study aims to evaluate the impact of *P. dactylifera* waste (coarse and fine compost waste) on *T. foenum graecum* growth metrics as well as the quantity and quality characteristics of chemical compounds by using clay loam soil.

Materials & Methods

Plant preparation

Trigonella foenum graecum seeds were collected from general garden locations throughout Basrah city and cleaned to prepare them for planting. An experiment was conducted using plastic pots (3 kg), filled with clay loam the soil from the Al-Barjasiyah area were used. The main attributes of these soil characteristics are shown in (Table 1). Soil was allowed to dry air and then adding coarse and fine date palm compost to the pots. On 15/2/2023 twenty seeds of *T. foenum graecum* were grown in each pot and irrigated to the field capacity. After two months, they were collected and dried (in an oven) at 35 ºC.

According to Page *et al*., (1982) and Black (1965), *P. dactylifera* waste was collected from several trees grown in Basrah city, this collected waste consisted of leaves, as well as leaves stems, The date palm waste was dried and ground, then sieved through a 4 mm sieve, the experiment was conducted (add a design) with three replicates, so that the number of experimental units (soil type * 2 concentration of coarse date palm compost (2.5%, 0.5%) concentrations and 2 concentration of fine date palm compost (2.5%, 0.5%) concentrations with 3 replicates.

Factorial experiments were used, according to the randomized complete block design of five culture substrate treatments were used to conduct the study. All data statistical analysis was performed using SPSS software with (ANOVA) analysis.

The 25 g of the ground samples were extracted using ethanol were placed in a 500 ml glass round- bottom flask, and 250 ml of ethanol alcohol was added. The chemical compounds were separated using gas chromatography-mass spectrometry (GC-MS) analysis.

Diagnosis of chemical compounds in *T. foenum graecum* leaves by GC-MS.

The chemical components of *T. foenum graecum* leaves were examined using the GC-MS Shimadzu 2010 equipment utilizing Agilent's 7890B GC in conjunction with a 5977A MSD from Agilent Technologies at the Nahran Omar/ Basrah Oil Company Labs, using helium gas has a flow rate of 22.3 cm/s and injection temperature of 250°C. The column temperature began at 40°C in five minutes and then increased by 10°C every minute to reach 300°C in twenty minutes. The Spectral Library identified the curves' spectra (NIST, 2005).

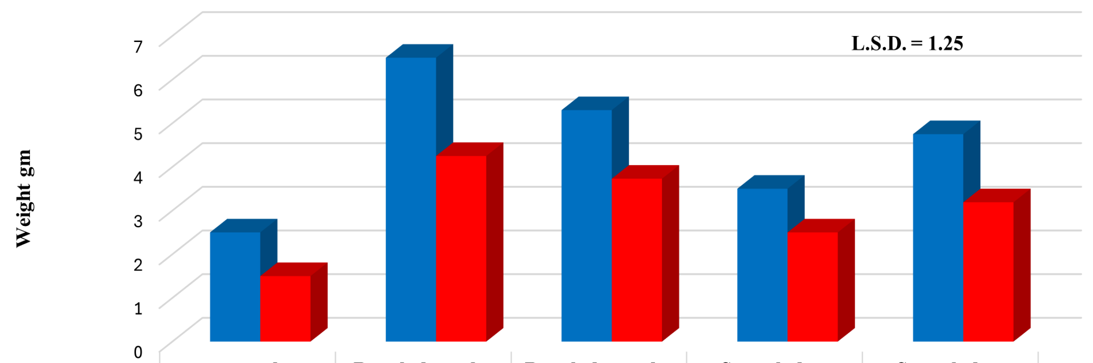
Table (1): The chemical and physical properties of the soil.

Texture	Clay	Silt	Sand	pH	Aval. N	Aval. P	Aval. K	ECe	CaCO3	OM
		g kg^{-1}				mg kg^{-1}		dS m^{-1}	g kg^{-1}	
Clay loam	379.8	419.2	201.0	7.58	16.5	12.2	110.1	4.5	372	5.62

Results & Discussion

Impact of date palm compost on fresh and dry weight of fenugreek.

In comparison to the control treatment, the use of composted date palm debris significantly enhanced the fresh and dry weight of the plant (Fig 1). The result showed that *T. foenum graecum* treated with 2.5% coarse date palm compost waste had higherfresh and dry weights of 6.5 gm and 4.25 gm respectively. The addition of fine date palm compost waste at 2.5% and 0.5% did not produce a significant effect on the fresh and dry weight, compared with the control treatment that had fresh and dry weights of 2.5 gm and 1.5 gm, respectively. Similar findings were observed in other studies, but with some changes that involved using compost (Abdou & Abdel-Fatah, 2021; Ghouili *et al.*, 2023). Samiei *et al.*, (2005) looked at how date palm waste could be used for *Aglaonema commutatum* growth; they found that date palm peat holds capacity water and acts to improve the growth of *A. commutatum*. So, *P. dactylifera*'s healing properties, like its improved porosity and water-retaining capacity, enhance the product's nutritional value and make it a viable alternative to peat, which is an expensive imported resource (Rahbarian & Sardoei, 2014). Benabderrahim *et al.*, (2018) reported that *P. dactylifera* compost is a very beneficial application for the field-grown plant, by improving the absorption of phosphorus, nitrogen, and potassium, producing larger and expanded much faster growing alfalfa leaves compared to the control.



	control	Rough dat palm +2.5%	Rough date palm + 0.5%	Smooth date palm + 2.5 %	Smooth date palm +0.5%
Fresh weight	2.5	6.5	5.3	3.5	4.75
Dry weight	1.5	4.25	3.73	2.5	3.19

Fig. (1): Impact of date palm compost on the fresh and dry weight of fenugreek.

The advantages of composting on the properties of the soil could produce the soil's primary characteristics organic matter and the retention of water capacity saw a significant rise, while reducing the electrical conductivity. According to Rostami *et al.*, (2014), date palm culture medium improved stem length, leaf area, branch number, and chlorophyll index.

Lately, natural fibers have seen a sharp increase in attention, due to their properties such as light weight, low density, non-toxic, renewable resources (Grozdanov *et al*., 2009), and their availability and low cost (Mishra *et al*., 2009).

Date palm compost's effects on the chemical compound's fenugreek.

The biological activity of the presence of phytochemicals in *T. foenum graecum* treated with different date palm concentrations, and compost, and their relationships with macronutrients are displayed in (Table -2 and Fig 2-6). The findings revealed that *T. foenum graecum* leaf extract had 57 different chemical compounds. The highest was 15.3826 % found in diaziridine,1,3,3-trimethyl-, followed by phytol (15.3782%), ethyl alpha-d-glucopyranoside (10.9728%), Bis(2-ethylhexyl) phthalate (7.1304%), Bis(2-ethylhexyl) terephthalate (8.5908), cyclotetracosane (5.0673%), and gamma-sitosterol (3.6745%). We also discovered some compounds at low concentrations, including n-Hexadecanoic acid (2.4287%), linoelaidic acid 0.684% and 4(1H)-Pyrimidinone (4.6457%), The results also showed the chemical compounds were found associated with *Trigonella* extract treated with data palm in all treatments, phytol, bis (2-ethylhexyl) phthalate and bis (2-ethylhexyl) terephthalate (Table 1, Fig 2-6).

Trigonella treated with 2.5% coarse date palm compost has 23 compounds the higher percentage recorded for beta-d-Mannofuranoside, methyl (55.3652%), (Bis(2-ethylhexyl) terephthalate) (7.7896%), Thiophene, 3-methoxy-(5.0523%), diaziridine,1,3,3-trimethyl-(4.3878%), Bis(2-ethylhexyl) phthalate (4.095%) and Phytol (3.0096%). *Trigonella* treated with 0.5% of coarse date palm compost has 31 chemical compounds including beta-d-Mannofuranoside (51.5768), Diaziridine,1,3,3-trimethyl- (3.8286%), n-Hexadecanoic acid (4.2341%) Phytol (12.1591%), Bis (2 - ethylhexyl) phthalate (2.9235%) and Bis(2-ethylhexyl) terephthalate (2.6732%)

Trigonella treated with fine compost date palm at 2.5% concentration yielded 32 compounds. The higher percentage was beta.-d-Mannofuranoside, methyl (35.852%), 2-ethylhexyl) terephthalate (15.3694%), Phytol (4.9549%), Bis(2-ethylhexyl) phthalate (5.7025%), While the fine compost 0.5% concentration had 15 compounds with the highest was N-Serylserine (58.8436%), then diaziridine,1,3,3-trimethyl (9.6051%), bis(2-ethylhexyl) phthalate(4.6513%), 2-methoxy-thiophene(5.7122%) and phytol (5.8738).

Our results agreed with some research that reported that the bioactive component such as stigmasterol, c-Sitosterol and glycoside compounds in *T. foenum-graecum* (Gupta *et al.,* 2014; Ashraf *et al*., 2019; Visuvanathan *et al*., 2022). Ethanoic extract analysis of date palm on *T. foenum graecum* seeds revealed that the control treatment contained 57 chemical compounds, followed by fine compost with 32 chemical compounds, then 31 chemical compounds in coarse compost 0.5. The 2.5% coarse compost extract yielded 23 chemical compounds, while the fine compost date palm produced only 15 compounds. Several chemical compounds, such as lactose, beta-Sitosterol, N-Serylserine, 2-Methoxythiophenebeta-d-Mannofuranoside, methyl, 4(3H,5H)-Furandione, and 3-methyl were not found in the control treatment. However, beta-d-Mannofuranoside, methyl, was present in all treatments except control and 0.5 fine compost date palm. Researchers believed hexadecenoic acid to possess antibacterial and antioxidant properties (Al-Shammary *et al*., 2013; Abd-Alrasoul *et al*., 2022; Amran *et al*.,2023).

Results revealed the presence of phytol in both the control and all treatments, a finding that aligns with the outcomes of (Nalbantova *et al*., 2023). Our finding agreed with Farag *et al*., (2014) who identified linoleic acid. Also, Nalbantova *et al*., (2023) and Abbood *et al*., (2023) noted, methyl ester, octadecenoic acid, and hexadecanoic acid, palmitic acid, hexadecanoic acid, and Octadecadienoic acid TMS derivative, á-Sitosterol, à-L-Galactopyranoside recorded by (Alamri *et al*.,2024).

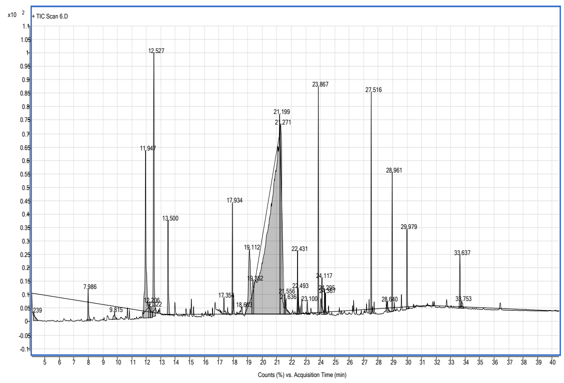


Fig. (2): The *T. foenum-graecum* Chromatogram of control.

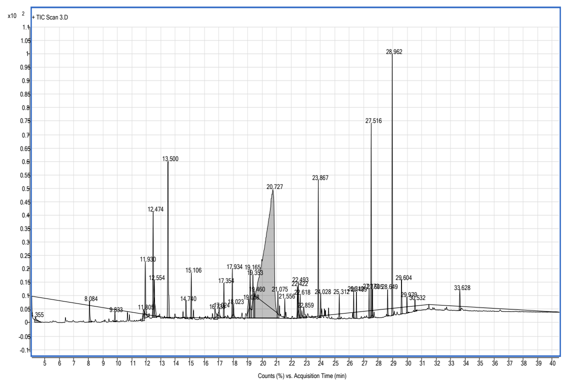


Fig. (3): Chromatogram of *T. foenum-graecum* treated with 2.5% concentration coarse date palm compost.

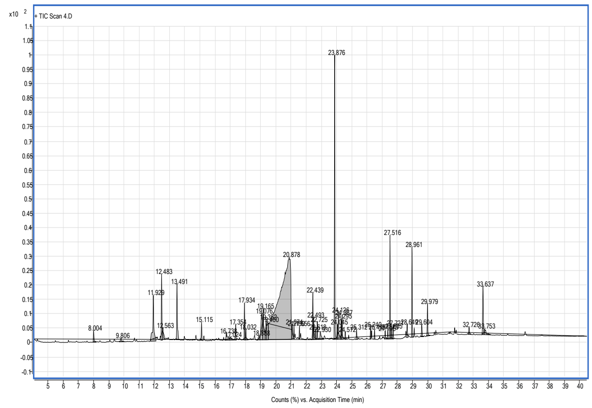


Fig. (4): Chromatogram of *T. foenum-graecum* treated with 0.5% concentration coarse date palm compost.

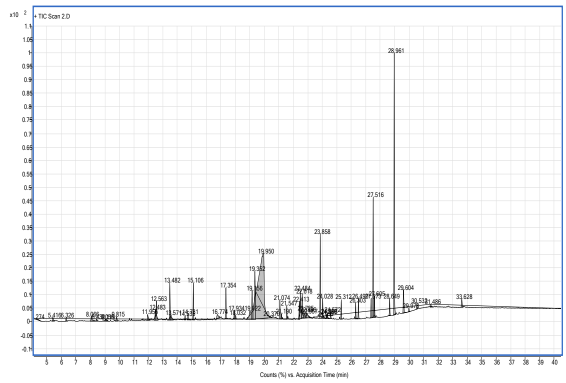


Fig. (5): Chromatogram of *T. foenum-graecum* treated with 2.5% concentration fine date palm compost.

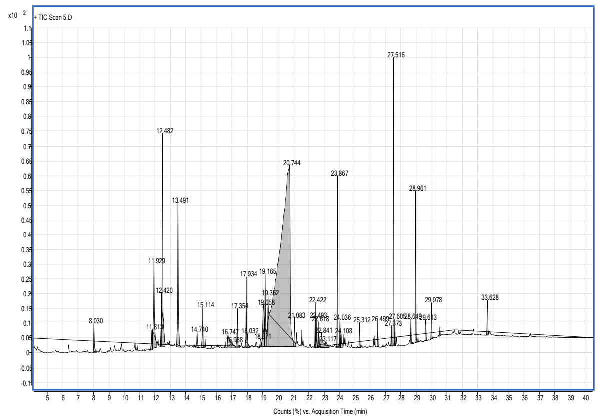


Fig. (6): Chromatogram of *T. foenum-graecum* treated with 0.5% concentration fine date palm compost.

Table (2): Compounds identified by GC-MS analysis of *T. foenum-graecum*.

	Chemical compounds	Control	Coarse compost %		Fine compost%	
			2.5	0.5	2.5	0.5
1	Pyridine	0.4188	0.5542	-	-	-
2	2-Hexanol, 2-methyl-	0.2238	-	-	0.3018	-
3	Morpholine, 2,6-dimethyl-	0.1556	-	-	-	-
4	2-Acetylamino-3-cyano-propionic acid	1.6533	-	-	-	-
5	1H-Pyrazole, 1-ethyl-3,5-dimethyl-	0.2639	-	-	-	-
6	Ethanone, 1-[4-[4-(2-hydroxyethyl)-1-piperazinylsulfonyl]phenyl]-	0.3233	-	-	-	-
7	5-Fluoro-m-xylene	0.2256	-	-	0.2264	-
8	3-Fluoro-o-xylene	0.4672	-	-	-	-
9	2-Cyclopenten-1-one, 3,4,4-trimethyl-	0.3167	-	-	-	-
10	p-Cresidine	0.2131	-	-	-	-
11	1-Butanol, 3-methyl-, acetate	0.7304	-	-	-	-
12	1,4-Pentanediamine	0.4353	-	-	-	-
13	Diaziridine,1,3,3-trimethyl-	15.3826	4.3878	3.8286	-	9.6051
14	4(1H)-Pyrimidinone	4.6457	-	-	-	-
15	3-Amino dimethyl-2(5H)-furanone	0.8796	-	-	-	-
16	Pentadecafluorooctanoic acid, undecyl ester	0.4067	-	-	-	-
17	2-Methoxy-4-vinylphenol	0.2883	-	-	-	-
18	Butanal, ethylhydrazone	0.3766	-	-	-	-
19	Cyclobutanone, 2-ethyl-	0.2185	-	-	-	-
20	Heptane, 3-ethyl-2-methyl-	0.2732	-	-	-	-
21	2-Methylpyrrolidine	0.208	-	-	-	-
22	1H-Indene, 1-methyl-	0.1595	-	-	-	-
23	4-Methoxy-2-methyl-2,3-dihydroazete	0.3594	-	-	-	-
24	Butan-2-one, 4-[pyrrolidin-2-one-5-yl]-	1.0293	-	-	-	-
25	5,6-Dihydro-4-methoxy-2H-pyran	0.2177	-	-	-	-
26	3-Penten-2-one, 4-methoxy-	3.7436	1.1896	-	-	3.7314
27	2-(Cyanomethylamino)pentanedinitrile	0.8329	-	-	-	-
28	.beta.-l-Arabinopyranoside, methyl	1.1819	-	-	-	-
29	Ethyl . alpha.-d-glucopyranoside	10.9728	0.8681	-	-	-
30	d-Mannose	0.5348	-	-	-	-
31	1,2- Benzenedicarboxylic acid, bis (2-methylpropyl) ester	0.4627	-	0.3517	0.6431	-
32	Oxirane, decyl-	0.4413	-	-	-	-
33	n-Hexadecanoic acid	2.4287	-	4.2341	-	2.4025
34	Dibutyl phthalate	0.9715	1.6098	-	-	-
35	Hexadecanoic acid, ethyl ester	0.5346	-	0.5455	0.9825	-
36	Alpha -D-Glucopyranose, 4-O-.beta -D-galactopyranosyl-	0.6667	-	-	-	-
37	3-Methylmannoside	0.3282	-	-	-	-
38	Phytol	15.3782	5.0096	12.1591	4.9549	5.8738
39	Linoelaidic acid	0.684	-	-	-	-
40	9,12,15-Octadecatrienoic acid, (Z,Z,Z)-	2.15547	-	2.7814	-	-
41	Octadecanoic acid	0.8395	-	-	-	-
42	9,12,15-Octadecatrienoic acid, ethyl ester, (Z,Z,Z)-	0.7578	-	2.403	1.5201	-
43	Octadecanoic acid, ethyl ester	0.3355	-	-	-	-
44	Neophytadiene	0.2895	-	-	0.2119	-
45	Hexanedioic acid, bis(2-ethylhexyl) ester	0.5007	-	-	0.9463	-
46	2,5-Dihydroxybenzoic acid, 3TMS derivative	0.2175	-	-	-	-
47	Hexadecanoic acid, 2-hydroxy-1-(hydroxymethyl)ethyl ester	0.3783	-	0.3831	-	-
48	Dicyclohexyl phthalate	0.5206	0.6287	0.3128	-	-
49	Bis(2-ethylhexyl) phthalate	7.1304	4.095	2.9235	5.7025	4.6513
50	Phytyl dodecanoate	0.4116	-	-	-	-

51	1,3,12-Nonadecatriene	0.3812	-	-	-	-
52	(Bis(2-ethylhexyl) terephthalate)	8.5908	7.7896	2.6732	15.3694	3.5591
53	Neophytadiene	0.2651	-	0.5736	-	-
54	4-Methoxyanthranilic acid	0.6341	-	-	-	-
55	Cyclotetracosane	5.0673	-	1.9223	-	-
56	Tris(tert-butyldimethylsilyloxy)arsane	0.3041	-	-	-	-
57	gamma.-Sitosterol	3.6745	-	2.244	-	0.9188
58	2,4(3H,5H)-Furandione, 3-methyl-	-	0.7045	0.5463	-	0.7974
59	2-Propenoic acid, 6-methylheptyl ester	-	0.7521	-	-	-
60	Thiophene, 3-methoxy-	-	5.0523	-	2.6582	-
61	2-Pentenoic acid, 4-methyl-	-	0.5951	-	-	-
62	2-Methoxy-4,4,5,5-tetramethyl-2-oxazoline	-	0.9132	0.7954	-	-
63	Dodecane, 1-chloro-	-	0.6652	-	-	-
64	Cycloheptasiloxane, tetradecamethyl-	-	0.9772	0.3267	1.592	0.8822
65	3-Methylvaleric acid, TMS	-	1.0544			
66	Cyclooctasiloxane, hexadecamethyl-	-	1.0959		0.3058	2.0522
67	.beta.-d-Mannofuranoside, methyl	-	55.3652	51.5768	35.852	
68	Lactose	-	0.7298	0.5533	-	0.8713
69	Hexanedioic acid, dioctyl ester	-	0.7807	-	-	-
70	1, 2- Benzenedicarboxylic acid, mono (1-methylheptyl) ester	-	1.1697	-	-	-
71	.beta.-Sitosterol	-	0.7353	-	-	-
72	2-Methoxythiophene	-	-	2.4565	-	5.7122
73	l-Pyrrolid-2-one, N-carboxyhydrazide	-	-	-	-	2.3638
74	N-Serylserine	-	-	-	-	58.8436
76	Nonacos-1-ene	-	-	-	-	1.3404
77	3,3'-Iminobispropylamine	-	-	0.4028	-	-
78	Cholestan-24-one, 3,12-dihydroxy-, (3. alpha, 5. beta.,12. alpha)	-	-	0.5801	-	-
79	3-Penten-2-one, 4-methoxy-	-	-	0.3303	-	-
90	Diethyl Phthalate	-	-	0.3268	-	-
91	Ethyl .alpha.-d-glucopyranoside	-	-	2.0999	-	-
92	2,5-Dihydroxybenzoic acid, 3TMS derivative	-	-	0.5306	-	-
93	Phytyl hexanoate	-	-	0.3913	-	-
94	Didecyl phthalate	-	-	0.6085	-	-
95	1,2-Bis(trimethylsilyl)benzene	-	-	0.3945	0.6523	-
96	Thymol, TMS derivative	-	-	0.4491	-	-
97	1H-imidazole-2-methanol, 1-decyl-	-	-	0.2952	-	-
98	Boron, trihydro(pyridine)-, (T-4)-	-	-	-	0.8196	-
99	Dodecane, 1,1-dimethoxy-	-	-	-	0.4195	-
100	2-Oxepanone	-	-	-	0.5563	-
101	Oxime-, methoxy-phenyl-_	-	-	-	0.2723	-
102	R(-)-2-Methyl-pyrrolidine	-	-	-	0.6319	-
103	2-Methoxythiophene	-	-	-	0.4961	-
104	3-Methyl-hexanoic acid	-	-	-	3.0368	-
105	Butanedioic acid, methoxy-, dimethyl ester	-	-	-	1.919	-
106	Myo-Inositol, 4-C-methyl-	-	-	-	8.6448	-
107	Loliolide	-	-	-	0.1817	-
108	Dibutyl phthalate	-	-	-	3.0366	-
109	Silane, [[(3.beta.,11.beta.,20S)-pregn-5-ene-3,11,17,20-tetrayl] -	-	-	-	1.493	-
110	cis-4-Amino-1,2,3,4-tetrahydro-2-naphthoic acid	-	-	-	1.4653	-
111	Dicyclohexyl phthalate	-	-	-	0.9393	-
112	Methyltris(trimethylsiloxy)silane	-	-	-	0.1865	-
113	Phthalic acid, monooctyl ester	-	-	-	1.7335	-
114	1,4-Bis(trimethylsilyl)benzene	-	-	-	0.2491	-

P. dactylifera has been associated with the treatment of hypertension through the identification of several substances, such as phytol, stearate, squalene, β-sitosterol, lauric acid, caprate, vitamin E, palmitic acid, linolenic acid, coumarins, isosorbide, and taurine (Obode *et al*., 2020). The primary ingredients come from seeds, but the extract from the leaves contains an isopropyl ester of hexadecenoic acid and a fatty acid ethyl ester (Azmat *et al*., 2010). In addition, we observed a significant increase in n-hexadecanoic acid, 9,12-octadecadienoic acid, and 9,12,15-octadecatrien-1-ol. On the other hand, there is a reduction in tocopherol levels (Latreche & Rahmania, 2010).

Secondary metabolites of plants provide a range of biologically active compounds that are widely employed as chemicals, foods, additives, tastes, pesticides, colorants, and scents (Priya *et al*., 2011). In recent decades some researchers have focused on the chemical components because date palm wastes are made up of fibers that can be used to restore degraded soils, make the soil more fertile, lessen the effects of climate change, keep the nutrients in balance, and improve its physical properties (Jonoobi *et al*. ,2019; Ebrahimi *et al*., 2022).

Conclusion

This study examined the effects of *P. dactylifera* waste compost and found it positively influenced the development and chemical composition of *T. foenum-graecum* plants. The findings highlight the importance of secondary metabolite production processes in the growth and development of *T. foenum-graecum,* and coarse date palm waste is given better use than fine date palm waste. The application of optimal quantities of date palm compost as an organic fertilizer to crops grown near date palm trees proved beneficial. These results suggest that date palm compost can serve as a viable alternative to chemical fertilizers, yielding desirable outcomes.

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Contributions of authors

Z.J. A.: Collection of specimens, Laboratory techniques.

S.A.M.A.: Suggestion the proposal of the article, Laboratory techniques, wrote and revised the manuscript.

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Ethical approval

There was no need for ethics approval for the present research.

References

Abbood, M.A., Azhar A. F., AL- Attraqchi, H., & Sahib, B. (2023). Evaluation of the effect of crude extracts of fenugreek on resistant isolates of *Candida* species (In vitro study). *Journal of Population Therapeutics and Clinical Pharmacology. 30*(3), e291–e302. https://doi.org/10.48112/bcs. v 2i2.458.

Abd, A. M., Altemimy, I. H. H., & Altemimy, H. M. A. (2020). Evaluation of the effect of nano-fertilization and disper osmotic in treating the salinity of irrigation water on the chemical and mineral properties of date palm (*Phoenix dactylifera* L.). *Basrah Journal of Agricultural Sciences, 33*(1), 68–88. https://bjas.bajas.edu.iq/index.php/bjas/article/view/176

Abd-Alrasoul, S.M., & Al-Saadi, S.A. A. M. (2022). Chemical composition and antioxidants of *Artemisia herba-alba* (Asteraceae). *Iranian Journal of Ichthyology 9* (Special Issue 1, 2022), 302-308. https://ijichthyol.org/index.php/iji/article/view/815.

Abdou, M.A.H, & Abdel-Fatah, A.A. (2021). Effect of planting date and compost fertilization on fenugreek plant. *Minia J. of Agric. Res. & Develop.41* (2), 15-22. https://mjard.journals.ekb.eg/article_222455.html

Akbari, S., Abdurahman, N.H., Yunus, R.M., Alara, O.R., & Abayomi, O.O. (2019). Extraction, characterization and antioxidant activity of fenugreek (*Trigonella-foenum graecum*) seed oil. *Materials Science for Energy Technologies 2*, 349–355. https://doaj.org/article/afd99a67590d473db0d6934d353568c0.

Alamri, E.S., Bayomy, H.M., Hussein. M.A.M., Ozaybi, N.A., Almasoudi, S.E., Zidan, N.S., Albalwi, R.A., Atteia, H.H., & EL-Ezaly, F. M. (2024). Nanoemulsions of *Phoenix dactylifera* L. (decaffeinated) and *Coffea arabica* L. extracts as a novel approach for the treatment of carbon tetrachloride-mediated liver fibrosis. *Antioxidants*. *13*(3),355. https://pubmed.ncbi.nlm.nih.gov/38539888/.

Ali, Y. (2008). Use of date palm leaves compost as a substitution to peatmoss. *Am. J. Plant Physiol 3(*4):131–136. https://scialert.net/fulltext/?doi=ajpp.2008.131.136.

Al-Saadi, S.A.A.M., Al-Derawi, K.H., & Abd Alrasool, S. (2017). The effect of steroidal extract of *Nerium oleanderon* the liver tissue structure of albino mice. *IOSR Journal of Pharmacy and Biological Sciences. 12*(2), 52-55. https://www.researchgate.net/publication/317487497_.

Al-Asadi, A. Z., Abdulwahid, A. H., & Al-Mayahi, A. M. W. (2019). The effect of thidiazuron on callus and in vitro shoots development of date palm (*Phoenix dactylifera* L.) cv. barhee. *Basrah Journal of Agricultural Sciences, 32*, 258-265. https://bjas.bajas.edu.iq/index.php/bjas/article/view/90.

Al-Shammary, H., Al-Saadi, S.A. A.M., & Al-Saeidy, A. (2013). Evaluation of analgesic activity and toxicity of alkaloids in *Myristica fragrans* seeds in mice, *Journal of Pain Research*, 611-615. https://pmc.ncbi.nlm.nih.gov/articles/PMC3738253/.

Amran, D. A., Al- Derawi, K. H., & Al-Saadi, S. A. A. M. (2024). The protective effects of *Zingiber officinale* essential oils extract against Atenolol induced adrenal gland in rats (*Rattus norvigicus*). *Multidisciplinary Science Journal, 6*(8),2024152. https://malque.pub/ojs/index.php/msj/article/view/2091/1237.

Ashraf, S.A., Khan, M.A., Awadelkareem, A.M., Tajuddin, S., Ahmad, M.F., & Hussain, T. (2019). GC-MS analysis of commercially available *Allium sativum* and *Trigonella foenum-graecum* essential oils and their antimicrobial activities. *J. Pure Appl. Microbiol., 13*(4), 2545-2552. https://doi.org/10.22207/JPAM.13.4.69.

Azmat, S., Ifzal, R., Rasheed, M., Mohammad, F. V., & Ahmad, V. U. (2010). GC-MS analysis of n-hexane extract from seeds and leaves of Phoenix dactylifera L. *Journal of the Chemical Society of Pakistan. 32* (5), 672-676. https://hero.epa.gov/hero/index.cfm/reference/details/reference_id/5208883.

Barreveld, W.H. (1993). *Date palm products. FAO, agriculture services bulletin. No. 101.* https://www.fao.org/4/t0681e/t0681e00.htm.

Benabderrahim, M.A., Elfalleh, W., Belayai, H., & Haddad, M. (2018). Effect of date palm waste compost on forage alfalfa growth, yield, seed yield and minerals uptake. *International Journal of Recycling of Organic Waste in Agriculture 7*,1–9. https://www.researchgate.net/publication/320860813.

Ebrahimi1, G., Shakeri, A., Ahmadi, P., Dalvand, M., Shafie, M., & Hosseinabadi, Z. H. (2022). Chemical constituents of palm waste slow pyrolysis derived vinegar. Maderas. *Cienciay tecnología. 24*(47), 1-8. https://www.scielo.cl/scielo.php?script=sci_arttext&pid=S0718-221X2022000100447.

Farag, M. A., Mohsen M., Heinke, R., & Wessjohann, L. A. (2014). Metabolomic fingerprints of 21 date palm fruit varieties from Egypt using UPLC/PDA/ESI–qTOF-MS and GC–MS analyzed by chemometrics. *Food Res. Int. 64*, 218–226. https://pubmed.ncbi.nlm.nih.gov/30011643/.

Gabash, H. M., Resan, A. Z., Awad, K. M., Suhim, A. A., & Abdulameer, A. H. (2024). Biochemical responses of date palm *Phoenix dactylifera* L. to combined stress of salinity and nickel. *Basrah Journal of Agricultural Sciences, 37*(1), 236-246. https://bjas.bajas.edu.iq/index.php/bjas/article/view/1415.

Ghouili, E., Sassi, K., Hidri, Y., M'Hamed, H.C., Somenahally, A., Xue, Q., Jebara, M., Nefissi, R., Riahi, J., de Oliveira, A.C., Abid, G., & Muhovski, Y. (2023). Effects of date palm waste compost application on root proteome changes of barley

(*Hordeum vulgare* L.). *Plants (Basel). 12*(3),526. https://www.researchgate.net/publication/367379962_.

Grozdanov, A., Gaceva, B., Boskovic, A., Avella, M., Gentile, G., & Dekanski, A. (2009). "Thermal stability of differently treated natural fiber reinforcements for Composites", *ICOSECS International Conference of the Chemical Societies of the South-East European Countries.* https://elchem.ihtm.bg.ac.rs/ECO-PCCM/publikacije/Grozdanov-Thermal%20stability.pdf.

Gupta, R., Sharma, A., Maina, P., & Shukla, R. N. (2014). Study of chemical composition of garlic oil and comparative analysis of co-trimazole in response to in-vitro antibacterial activity. *International Research Journal of Pharmacy 5*(2), 97-101. https://www.researchgate.net/profile/Rainy-Gupta/publication/321314047_.

Hadi, S.T., Abed, M.M., & Fadhil, N.j. (2018). Chemical composition of *Trigonella foenum-graecum* seeds and inhibitory activity of their seeds oil against some microbes. *International Journal of Life Sciences and Biotechnology. 1*(2), 75-83. https://www.researchgate.net/publication/329969157_.

Jonoobi, M., Shafie, M., Shirmohammadli, Y., Ashori, A., Zarea-Hosseinabadi, H., & Mekonnen, T. (2019). A review on date palm tree: properties, characterization and its potential applications. *Journal of Renewable Materials 7*(11), 1055-1075. https://doi.org/10.32604/jrm.2019.08188

Kaviarasan, S., Ramamurty, N., Gunasekaran. P., Varalakshmi, E., & Anuradha, C.V. (2006). Fenugreek. (*Trigonella foenum graecum*) seed extract prevents ethanol-induced toxicity and apoptosis in chang liver cells. *Alcohol & Alcoholism; 41*(3), 267-273. https://pubmed.ncbi.nlm.nih.gov/16574673/.

Khiyami, M., Masmali, I., & Abu-khuraiba, M. (2008). Composting a mixture of date palm wastes, date palm pits, shrimp, and crab shell wastes in vessel system. *Saudi Journal of Biological Sciences. 15*(2),199–205. https://www.researchgate.net/publication/253741714_.

Kumaravel, S., Muthukumaran, P., & Shanmugapriya, K. (2017). Chemical composition of *Trigonella foenum graecum* the coarse compost gas chromatography mass spectrometry analysis. *Journal of Medicinal Plants Studies. 5*(3), 01-03. https://www.researchgate.net/publication/316700028_.

Latreche, K., & Rahmania, F. (2010). GC/MS screening of volatile compounds profiles from healthy and brittle leaf disease (BDL) affected date palm (*Phoenix dactylifera* L.)-A comparative study. *Acta Hortic. 882*, 903-908. https://www.researchgate.net/publication/284343206_.

Lim, S.L., Lee, L.H., & Wu, T.Y. (2016) Sustainability of using composting and vermicomposting technologies for organic solid waste biotransformation: recent overview, greenhouse gases emissions and economic analysis. *J. Clean Prod. 111*,262–278. https://doi.org/10.1016/j.jclepro.2015.08.083.

Mahdi, A. S., Abd, A. M & Awad, K. M. (2022). Effect of foliar application of nano-selenium on the anatomical characteristics of date palm *Phoenix dactylifera* L. barhi cultivar under salt stress. *Basrah Journal of Agricultural Sciences, 35*(2), 313–325. https://www.bjas.bajas.edu.iq/index.php/bjas/article/view/763.

Mishra, S. C., Nayak, N.B., & Satapathy,A. (2009). "Investigation on bio-waste reinforced epoxy composite". *Journal of reinforced plastics and composites, 1*(1), 1-5. https://www.researchgate.net/publication/249356359_.

Mohammadi, G.A. (2013). Effect of date palm wastes and rice hull mixed with soil on growth and yield of cucumber in greenhouse culture. *International Journal of Recycling of Organic Waste in Agriculture. 2*(17), 2–5. https://www.researchgate.net/publication/274362961_.

Mohammadi-Ghehsareh, A., Borji, H., & Jafarpour, M. (2011). Effect of some culture substrates (date-palm peat, cocopeat and perlite) on some growing indices and nutrient elements uptake in greenhouse tomato. *African Journal of Microbiology Research, 5*(12), 1437-1442. https://www.researchgate.net/publication/268344025.

Naimi, I., Zefzoufi, M., Bouamama, H., & M'hamed, T.B. (2022). Chemical composition and repellent effects of powders and essential oils of *Artemisia absinthium*, Melia azedarach, *Trigonella foenum-graecum* and *Peganum harmala* on *Tribolium castaneum* (Herbst) (Coleoptera: Tenebrionidae). *Industrial Crops and Products 182*, 114817. https://www.researchgate.net/publication/359693235.

Nalbantova, V., Benbassat, N., Delattre, C., Todorova, V., Georgieva, Y., Lukova, P., Ivanova, S., Ivanov, K., & Karcheva-Bahchevanska, D. (2023). Comparative study of the chemical composition of

Trigonella foenum-graecum L. essential oil. *Pharmacia 70*(1), 85–89. https://doi.org/10.3897/pharmacia.70.e98413.

NIST. (2005). Mass spectral search program for the NIST/EPA/NIH Mass Spectral Library. Version 2.0 d. https://chemdata.nist.gov/dokuwiki/doku.php?id=chemdata:start.

Obode, O.C., Adebayo, A.H., & Li, C. (2020) Gas chromatography-mass spectrometry analysis and *in vitro* inhibitory effects of *Phoenix dactylifera* L. on key enzymes implicated in hypertension. *J. Pharm. Pharmacogn. Res. 8*(5), 475–490. DOI: https://doi.org/10.56499/jppres20.838_8.5.475.

Priya, V., Jananie, R. K., &Vijayalakshmi, K. (2011). GC/MS determination of bioactive components of *Trigonella foenum graecum*. *Journal of Chemical and Pharmaceutical Research., 3*(5), 35-40. https://www.jocpr.com/articles/gcms-determination-of-bioactive-components-oftrigonella-foenum-grecum.pdf.

Qader, K. O., Al-Saadi, S.A.A. M., & Faraj, I. M. (2018). Phytochemical constituents of leaves essential oils of *Achillea fragrantissima* (Asteraceae) from Iraq. *ARO-The Scientific Journal of Koya University 5*(2), 56-62. http://aro.koyauniversity.org/index.php/aro/article/view/ARO.10425.

Rahbarian, P., & Sardoei, A.S. (2014). Effect waste of palm trees and sand and perlite mixed with some growth indices *Ficus benjamina*. *International journal of Advanced Biological and Biomedical Research. 2*(3), 573-578. https://www.researchgate.net/publication/277669542.

Rajhi, I., Baccouri, B., Rajhi, F., Hammami, J., Souibgui, M., Mhadhbi, H., & Flamini, G. (2022). HS-SPME-GC–MS characterization of volatile chemicals released from microwaving and conventional processing methods of fenugreek seeds and flour. *Industrial Crops and Products 182*, 114824. https://doi.org/10.1016/j.indcrop.2022.114824.

Rostami, Z., Ghahsarei, A.M., & Kavoosi, B. (2014). Date palm waste application as culture media for strawberry and its impact on some growth indices and yield components. *Agricultural Communications*, *2*(3), 15-21. https://www.cabidigitallibrary.org/doi/pdf/10.5555/20143287046.

Samiei, L., Khalighi, A., Kafi, M., Samavat, S., & Arghavani, M. (2005). An investigation of substitution of peat moss with palm tree celluloid wastes in growing aglaonema (*Aglaonema commutatum* cv. Silver Queen). *Iranian Journal of Agriculture Science., 36*, 503-10. https://www.scirp.org/reference/referencespapers?referenceid=1711745

Singh, N., Yadav, S.S., Kumar, S., & Narashiman, B. (2022). Ethnopharmacolog -ical, phytochemical and clinical studies on Fenugreek (*Trigonella foenum-graecum* L.) *Food Biosci* (46), 101546. https://www.sciencedirect.com/science/article/abs/pii/S2212429222000049.

Syed, Q.A., Rashid, Z., Ahmad, M.H., Shukat, R., Ishaq, A., Muhammad, N., & Rahman, H.U.U. (2020) Nutritional and therapeutic properties of fenugreek (*Trigonella foenum-graecum*): a review. *International Journal of Food Properties. 23*, 1777–1791. https://www.researchgate.net/publication/344947302.

Visuvanathan, T., Than, L.T.L., Stanslas, J., Chew, S.Y., & Vellasamy, S. (2022). Revisiting *Trigonella foenum-graecum* L. Pharmacology and Therapeutic Potentialities. *Plants. 11,* 1450. https://pubmed.ncbi.nlm.nih.gov/35684222/.

Zameer, S., Najmi, A.K., Vohora, D., & Akhtar, M. (2018) A review on therapeutic potentials of *Trigonella foenum graecum* (fenugreek) and its chemical constituents in neurological disorders: Complementary roles to its hypolipidemic, hypoglycemic, and antioxidant potential. *Nutritional Neuroscience 21*, 539–545. https://pubmed.ncbi.nlm.nih.gov/28504078/.

Abdulridha *et al.* / Basrah J. Agric. Sci., 38(Special Issue), 208-220,2025

تأثير سماد مخلفات نخيل التمر *Phoenix dactylifera* على محتوى المركبات الكيميائية في نبات الحلبة *Trigonella foenum graecum*

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المستخلص: أجريت دراسة لتقييم مخلفات نخيل التمر كسماد عضوي لنبات *Trigonella foenum graecum* وتمت التجربة في منطقة أبو الخصيب خلال عام 2023 وذلك باستخدام تربة طينية من منطقة البرجسية التي عوملت بمخلفات نخيل التمر الخشن والناعم بتركيز 2.5و 0.5%. أظهرت النتائج أن مخلفات نخيل التمر الخشن بنسبة 2.5% مواد عضوية أنتجت وزن طري بمقدار 6.5 غم ووزن جاف 4.25 غم مقارنة بمعاملة السيطرة التي أنتجت 2.5 غم و1.5 غم من الوزن الطري والجاف على التوالي.

كما أظهرت النتائج أن المستخلص الكحولي لأوراق الحلبة (*T. foenum graecum*) يحتوي على 57 مادة كيميائية. وكانت أعلى نسبة مئوية للمركب diaziridine, 1,3,3-trimethyl وكانت 15.3826% يليه Ethyl. Alpha-d-glucopyranoside (7.9728%) و Phytol (7.37%) و γ- sitosterol (2.6745%). كما كشفت النتائج أن مستخلص نبات الحلبة يحتوي على ثلاث مركبات كيميائية مشتركة في جميع المعاملات المعاملة بنخيل التمر وهي phytol وBis (2-ethylhexyl) phthalate وBis (2-ethylhexyl) terephthalate. وتغايرت المعاملات في عدد المركبات الكيميائية ففي النوع *T. foenum graecum* المعامل بمخلفات السماد الخشن لنخيل التمر بتركيز 2.5% وجد انه يحتوي على 23 مركبًا. وكانت اعلاها سجلت في المركب beta-d-Mannofuranoside بنسبة مئوية (55.3652%) وbeta -d-Mannofuranoside (51.5768%) وn-Hexadecanoic acid(4.2341%)، Phytol (12.1591%). في حين المعاملة بالسماد الخشن من مخلفات نخيل التمر 0.5% سجلت وجود 31 مركبًا كيميائيا" أما السماد الناعم لنخيل التمر بتركيز 2.5% سجل 32مركباً، وكانت النسبة الأعلى للمركب beta-d-Mannofuranoside (35.852%). وبينت الدراسة أن المخلفات الناعمة لنخيل التمر بتركيز 0.5% احتوت على 15 مركب أعلاها للمركب N-Serylserine بنسبة مئوية 58.8436%.

الكلمات المفتاحية: حلبة، سماد عضوي، نخيل التمر ، n-Hexadecanoic acid، Phytol، *Sitosterol*.