

Allelopathic effect of some vegetable peels in germination and growth of three ornamental plants

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Abstract

The study was conducted at the University of Mosul/College of Science/Department of Life Sciences, and included experiment in the greenhouse to find out the effect of dry peelings of vegetables added to the soil at percentages (0.5,1,2)% weight: weight for *Solanum tuberosum*, *Solanum melongena* and *Vicia fava* incubated for two weeks on seed germination and some traits Growth and elemental concentrations

(Mg, K, P, N) of three species of ornamental plants, namely *Dianthus caryophyllus*, *Gilardia aristata* and *Convolvulus tricolor*.

The results of the greenhouse showed a significant effect and differences, an increase in % seed germination in ornamental plants when eggplant peels were added, while the addition of potato and bean peels led to a decrease in % seed germination, and significant differences in shoot length were superior to the treatment of adding eggplant and potato peels and inhibition was obtained by the effect of adding bean peels, an increase recorded shoot length and dry weight (23.91, 25.69, 30.88) g and root shoot length and dry weight (16.90, 15.22, (19.20) g sequentially, in the three ornamental plants, as well as an increase in the number of flowers, in the content of chlorophyll in the leaves of ornamental plants and in the concentration of elements (N, P, K, and Mg)%, while the bean extract inhibited most of the mentioned traits.

INTRODUCTION

Allelopathy is defined as any process associated with secondary metabolites produced by plants, fungi, algae and viruses, which affect growth and development in agricultural and biological systems, including harmful and beneficial effects (Torres et al., 1996) by producing chemical compounds called allelochemicals, which are produced in different plant parts, and are released to the environment by leaching, volatilization, by root secretions and decomposition of plant residues in the soil by the action of microorganisms (Aspharipur and Armin, 2010), vegetable peels are considered as

residues or plant waste from several sources and are considered as by-products, which are household or factory products, the studies have confirmed that these peels contain chemical compounds as (secondary metabolites).

The peels of vegetables and fruits constitute a large percentage of household and industrial waste and which added large amounts of waste to the environment, causing some damage to it, examples of the crops that produce residuals (peels) in large quantities when used are: eggplant, potatoes, broad beans, onions and mallow. Several research have indicated that they can be used as eco-friendly materials

and natural sources of compounds and nutrients because they contain various elements such as (N, P, K, Mg) (Numman, 2017). Also, they contain organic phenolic acids such as potato peels contain antioxidant compounds, as well as many phenolic compounds, which include chlorogenic acid and Gallic acid which are natural antioxidants that prevent the oxidation of vegetable oils, rather than glycoalkaloids (Gebrechistos and Chen, 2018). The increasing interest of man in ornamental plants in general and flowers in particular with the development of civilization, as well as adding chemical and organic fertilizers according to their needs, which may be economically costly.

Materials and methods

The experiment was conducted in the greenhouse of the Bio. Depart. /Coll. of Sci./Univ. of Mosul, for the period

(20/11/2021 to 22/4/2022), to study the effect of adding peels of each of (potatoes, eggplants and broad beans) on seed germination and growth of three ornamental plants *Dianthus caryophyllus*.L, *Gaillardia aristata*.L, and *Convolvulus tricolor* L, vegetable peels were collected, washed, air dried, crushed with a blender and kept in plastic containers at 4°C.

three types of winter annual ornamental plants were taken from one of the private offices / Mosul city. Its viability was tested and recorded as follows: Carnation (87.30%), *Gaillardia* (87.45%), *Convolvulus*

(88.34%).

The soil of the experiment was prepared by mixing the peeling powder for each of (potatoes, eggplant and broad beans) with dried soil in the ratio of (0.5, 1, 2) % weight: weight, then placed in plastic pots (30 in diameter, 35 in height) cm, the soil without addition (control), 1 liter of water was added, and covered with perforated plastic covers for ventilation, and placed in the greenhouse.

After 3 weeks, 10 seeds of each ornamental plants were planted in each pot, with 4 replications for each treatment, and placed in the greenhouse randomly and the plants were watered as needed. After two weeks and germination stability, % seed germination was calculated according to (ISTA, 1976) formula.

Germination percentage % = No. of normal seedlings / No. of cultivated seeds \times 100

The seedlings were reduced to five in each pot

The following studies were conducted:

- shoot and root length (cm) and their dry weight (gm):- After five months of cultivation and were removed and washed, then the shoot was separated from the root and measurements were taken for each of them, then putting in oven at 70 °C for 72 hours for their dry weights.
- Number of flowers / plant
- Total chlorophyll content: - It was estimated according to the method of (Karthik, 2020).
- Estimation of N,P,K AND Mg content in the shoot (Ryan et al., 2003).

The reduction and increase % as compared to control according to the equation (Al-mazori,1996).

Reduction or Stimulation from comparison% = $100 - A / B \times 100$

A = measurement for plants in treatment

B = measurement for plants in control

Statistical Analysis:

The experiment was designed according to the randomized complete block design (R.C.B.D), and the data were analyzed statistically according to the SAS program using the Duncan's multiple range test at a probability level of 5% (Antar and Al-Wagaa', 2017).

RESULTS

Table (1): The effect of addition vegetable peels) on seed germination % of three ornamental plants

Ornamental Plants	Addition ratio %	Vegetable Peels			average of Addition ratio
		Potatoes	Eggplants	Broad beans	
Dianthus caryophyllus.L	Control 0%	81.75 c	81.75 c	81.75 c	81.75 b
	0.5%	85.57 a	83.00 b	83.44 b	84.00 a
	1%	81.33 c	85.04 a	75.36 d	80.57 c
	2%	78.00 d	86.02 a	73.08 d	79.03 d
peels type		81.66 b	83.95 a	78.40 c	
Gaillardia aristata.L	Control 0%	80.00 c	80.00 c	80.00 c	80.00 b
	0.5%	83.00 b	82.44 b	82.07 b	82.50 a
	1%	78.33 d	84.00 a	76.03 e	79.45 c
	2%	76.85 e	86.00 a	73.22 f	78.69 d
peels type		79.54 b	83.11 a	77.83 c	
Convolvulus tricolor L	Control 0%	82.00 b	82.00 b	82.00 b	82.00 b
	0.5%	84.11b	85.71b	84.05 ab	84.62 a
	1%	86.09 ab	87.17a	80.77 c	84.67 a
	2%	76.23 d	88.81 a	77.62 d	80.88 c
peels type		82.10 ab	85.92 a	81.11 b	

* Similar letters indicate that there are no significant differences at 5% probability level, according to Duncan's multiple range test.

The results in Table (1) indicate the effect of adding peels (potato, eggplant and broad beans) at percentages of (0.5, 1, 2) % on the % seed germination in three types of ornamental plants showing there are significant differences according to the type of plant (type of peel) as well as the effect of the percentage of addition.

In Carnations, by comparing the effect of the peel type, it was found that the highest germination % reached (83.95) % with the effect of eggplant peels, while the lowest is (78.40) % with the effect of broad bean peels. % seed germination also varied with the effect of the addition ratio showing a decrease in seed germination compared with control, the interaction between the type of peel and the addition ratio to the soil, the highest % germination reached (86.02) % due to the

effect of eggplant peel added by 2%, while the lowest was (73.08) % when adding 2% of broad bean peels. In the Gaillardia plant, % seed germination also varied according to the type of peel and the its addition ratio to the soil. The interaction between the type of peel and the addition ratios showed that the highest % seed germination was (86.00%) when adding 2% of eggplant peel. As for the Convolvulus plant, there was an increase from the control when the addition ratio was (0.5, 1) %, and the lowest was (81.11%) with the effect of broad bean peels, compared to eggplant peels, which gave (85.92%), and the interaction between the addition ratios of peels and their type, showed that the highest % seed germination reached (88.81%) when adding 2% of eggplant peels, while the lowest was (76.23%) by the effect of broad bean peels added by 2%.

Table (2): The effect of addition vegetable peels on shoot length (cm) of three ornamental plants

Ornamental Plants	Addition ratio %	Vegetable Peels			average of Addition ratio
		Potatoes	Eggplants	Broad beans	
Dianthus caryophyllus.L	Control 0%	34.21 c	34.21 c	34.21 c	34.21 c
	0.5%	40.73 ab	42.83 ab	28.66 de	37.40 a
	1%	38.86 b	46.78 a	23.28 e	36.30 b
	2%	30.68 d	45.14 a	16.33 f	30.71 d
peels type		36.12 b	42.24 a	25.62 c	
Gaillardia aristata.L	Control 0%	39.54 de	39.54 de	39.54 de	39.54 de
	0.5%	44.71 c	43.83 c	30.61 f	39.71 a
	1%	48.86 b	47.78 b	23.37 g	40.00 a
	2%	31.08 e	52.14 a	18.36 h	33.86 c
peels type		41.04 b	45.82 a	27.97 c	
Convolvulus tricolor L	Control 0%	32.16 d	32.16 d	32.16 d	32.16 d
	0.5%	37.67 c	35.25 c	26.76 e	33.22 b
	1%	42.94 b	40.47 b	20.67 f	34.69 a
	2%	45.34 a	42.76 a	15.21 g	34.43 a
peels type		39.52 ab	37.66 a	23.70 b	

* Similar letters indicate that there are no significant differences at 5% probability level, according to Duncan's multiple range test.

Table (2) shows that there was a significant variation in the shoot length of ornamental plants growing in the soil containing the peels of (potatoes, eggplants, and broad beans) added at percentages (0.5, 1, 2)%.

Showing that the highest length of shoot in Carnations reached (42.24) cm by the effect of eggplant peels, while the lowest length was (25.62) cm by the effect of broad bean peels. The interaction between the type of peels and the addition of ratio, it was found that the highest length of the shoot reached (46.78) cm when adding eggplant peels by 1%, while the lowest was (16.33) cm due to the effect broad

bean peels added at 2%. In Gaillardia and Convolvulus were consistent with the results in Carnations. The highest length of the shoot was (45.82, 37.66) cm, respectively, in both plants with the effect of eggplant peels, the ratio of addition showed an increase at 0.5% compared to the control in the three plants. The interaction between the type of peels and the ratio of its addition gave a significant difference in the length of the shoot in both types, as the highest length of the shoot was (52.14, 42.76) cm, respectively, at the ratio of addition 2% of eggplant peel, while the lowest length was (18.36, 15.21) cm by the effect of broad bean peels added by 2%.

Table (3): The effect of addition vegetable peels on root length (cm) of three ornamental plants

Ornamental Plants	Addition ratio %	Vegetable Peels			average of Addition ratio
		Potatoes	Eggplants	Broad beans	
Dianthus caryophyllus.L	Control 0%	31.66 d	31.66 d	31.66 d	31.66 d
	0.5%	38.13 c	40.21c	24.63 e	34.32 a
	1%	41.16 b	43.14 b	19.03 f	34.44 a
	2%	45.24 a	47.24 a	13.72 g	35.40 a
peels type		39.04 ab	40.56 a	22.26 b	
Gaillardia aristata.L	Control 0%	36.88 ab	36.88 ab	36.88 ab	36.88 ab
	0.5%	43.05 b	42.45 b	25.96 e	37.15 a
	1%	46.63 a	45.96 ab	19.86 f	37.48 a
	2%	39.52 c	47.44 a	16.89 g	34.61 b
peels type		41.52 b	43.18 a	24.89 c	
Convolvulus tricolor L	Control 0%	29.58 d	29.58 d	29.58 d	29.58 d
	0.5%	37.99 c	35.68 c	26.87 e	33.51 ab
	1%	42.19 b	39.88 b	19.93 f	34.00 a
	2%	35.55 c	43.36 a	14.89 g	31.26 ab
peels type		36.32 a	37.12 ab	22.81 b	

* Similar letters indicate that there are no significant differences at 5% probability level, according to Duncan's multiple range test.

Table (3) indicate significant differences in the root length of ornamental plants growing in soil containing the peels of (potatoes, eggplants and broad beans) added at the ratio (0.5, 1, 2) %, compared with plants growing in soil without addition (control).

the peels type showed a significant difference in the length of the three ornamental plants, the highest lengths were (40.56, 43.18, 37.12) cm respectively, by the effect of eggplant peels, while the lowest lengths were (22.26,

24.89, 22.81) cm by the effect of broad bean peels. The ratios of addition caused a significant increase compared to control. The interaction between type of peels and the their addition ratio, showing that the highest length of the root was (47.24) cm in Carnation, in the Gaillardia plant was (47.44) cm, and in the Convolvulus plant (43.36) cm, with the effect of eggplant peels 2% addition ratio. While the lowest root length was recorded (13.72, 16.89, 14.89) cm respectively in the three plants when adding 2% of brad bean peels.

Table (4): The effect of addition vegetable peels on shoot dry weight (gm) of three ornamental plants

Ornamental Plants	Addition ratio %	Vegetable Peels			average of Addition ratio
		Potatoes	Eggplants	Broad beans	
Dianthus caryophyllus.L	Control 0%	10.72 d	10.72 d	10.72 d	10.72 d
	0.5%	15.90 c	16.94 c	8.91 e	13.91 b
	1%	20.94 b	21.11 b	6.69 ef	16.24 a

	2%	8.98 e	23.91 a	5.00 f	12.63 c
peels type		14.13 b	18.17 a	7.83 c	
Gaillardia aristata.L	Control 0%	8.05 e	8.05 e	8.05 e	8.05 e
	0.5%	12.31 d	14.36 c	7.85 f	11.50 b
	1%	15.17 c	18.43 b	5.06 gh	12.88 a
	2%	7.04 ef	25.69 a	3.01 h	11.91 ab
peels type		10.64 b	16.63 a	5.99 c	
Convolvulus tricolor L	Control 0%	12.77 e	12.77 e	12.77 e	12.77 e
	0.5%	19.38 c	21.15 c	9.98 f	16.83 b
	1%	24.04 b	26.76 b	8.11 g	19.63 a
	2%	20.59 cd	30.88 a	6.44 h	19.30 a
peels type		19.19 b	22.89 a	9.32 c	

Table (4) showed the effect (potatoes, eggplant and broad beans) peels with addition ratio of (0.5, 1, 2) % on the shoot dry weight of the ornamental plants (Carnations, Gaillardia and Convolvulus).

For addition ratios, the results indicate a significant increase in the shoot dry weight of the ornamental plants, as compared with (control) according to the type of peels, indicating that the lowest shoot dry weight was (7.83, 5.99, 9.32) gm in ornamental plants, respectively, due to the effect of bean peels, while the highest shoot dry weight reached

(18.17, 16.63, 22.89), respectively, by the effect of eggplant peels. the interaction between the peels type and the addition ratio, the results showed the highest dry weight of the shoot reached (23.91) gm in Carnation plants, in the Gaillardia (25.69) gm, and in the Convolvulus (30.88) gm, with the effect of eggplant peels added at 2 %, while the lowest shoot dry weights (5.00, 3.01, and 6.44) gm, respectively, were recorded in the three ornamental plants, by the effect of adding 2% of broad bean peels.

Table (5): The effect of addition vegetable peels on root dry weight (gm) of three ornamental plants

Ornamental Plants	Addition ratio %	Vegetable Peels			average of Addition ratio
		Potatoes	Eggplants	Broad beans	
Dianthus caryophyllus.L	Control 0%	7.15 e	7.15 e	7.15 e	7.15 e
	0.5%	10.58 d	11.57 c	4.54 f	8.89 b
	1%	13.49 b	14.11 b	2.88 g	10.16 a
	2%	12.60 c	16.90 a	1.98 h	10.49 a
peels type		10.95 b	12.43 a	4.13 c	
Gaillardia aristata.L	Control 0%	5.22 e	5.22 e	5.22 e	5.22 c
	0.5%	9.75 c	9.07 c	2.94 f	7.25 a
	1%	7.97 d	12.05 b	2.04 fg	7.35 a
	2%	4.09 e	15.22 a	1.03 g	6.78 b
peels type		6.75 b	10.39 a	2.80 c	
Convolvulus	Control 0%	9.45 e	9.45 e	9.45 e	9.45 e

tricolor L	0.5%	12.98 d	14.60 d	5.09 f	10.89 c
	1%	15.55 c	17.75 b	3.93 fg	12.41 a
	2%	11.39 d	19.20 a	2.12 g	10.90 b
peels type		12.34 b	15.25 a	5.14 c	

* Similar letters indicate that there are no significant differences at 5% probability level, according to Duncan's multiple range test

Table (5) showed a significant differences in the root dry weight of the growing ornamental plants, with the effect of the peels type added and the ratio of its addition to the soil.

About the addition ratio it was found that the highest root dry weight reached (10.49) gm in Carnation at 2%, and in the Gaillardia plant was (7.35) gm, in the Convolvulus plant was (12.41) gm at the 1%. The type of peels also varied in their effect, showing that the highest dry weight was (12.43, 10.39, 15.25) gm, respectively, by the effect of eggplant peels

compared with the broad bean peels, which gave the lowest dry weights (4.13, 2.80, 5.14) gm respectively, the interaction between the type of peels and their addition ratio, the lowest root dry weight was (1.98) gm in the Carnation plant, (1.03) gm in the Gaillardia plant, and (2.12) gm in the Convolvulus plant at addition of 2% broad bean peels, while the highest dry weights were (16.90, 15.22, 19.20) gm, respectively, in the three ornamental plants, with the effect of eggplant peels added at 2%.

Table (6): The effect of addition vegetable peels the number of flowers / plant of three ornamental plants

Ornamental Plants	Addition ratio %	Vegetable Peels			average of Addition ratio
		Potatoes	Eggplants	Broad beans	
Dianthus caryophyllus.L	Control 0%	11.80 e	11.80 e	11.80 e	11.80 e
	0.5%	16.70 d	18.30 c	9.49 f	14.83 b
	1%	20.60 c	22.30 b	7.51 g	16.80 a
	2%	14.90 d	27.80 a	5.32 h	16.00 ab
peels type		16.00 b	20.05 a	8.53 c	
Gaillardia aristata.L	Control 0%	6.13 d	6.13 d	6.13 d	6.13 d d
	0.5%	9.30 c	10.10 c	4.06 e	7.82 c
	1%	11.60 b	13.50 b	3.00 f	9.36 a
	2%	8.00 cd	16.20 a	1.15 g	8.45 b
peels type		8.75 b	11.48 a	3.58 c	
Convolvulus tricolor L	Control 0%	4.04 e	4.04 e	4.04 e	4.04 e d
	0.5%	7.80 de	8.98 d	2.85 f	6.54 c
	1%	10.50 c	12.70 b	2.10 g	8.43 a
	2%	8.60 d	15.30 a	1.75 gh	8.55 b
peels type		7.73 b	10.25 a	2.68 c	

The results in Table (6) indicated that there were significantly differin the number of flowers for the three ornamental plants, due to the effect of peels type and the addition ratio

of them. Regarding the effect of peel type, it was found that the highest number of flowers reached (20.05) in carnation, and in the Gaillardia (11.48), and in Convolvulus (10.25)

by the effect of eggplant peels, while the lowest number of flowers recorded (8.53, 3.58, 2.68) respectively, by the effect of broad bean peels. The addition ratio showed an increase compared to the control, the highest number of flowers in the Carnation and Gaillardia plants reached (16.80, 9.36), respectively, at the ratio of addition 1%, while

the Convolvulus plant recorded (8.55) at of addition 2%. the interaction between the type of peels and the addition ratio, the highest number of flowers was (27.80, 16.20, 15.30), respectively, in ornamental plants at the addition 2% of eggplant peels, while the lowest number (5.32, 1.15, 1.75) by the effect of broad bean peels added at 2%.

Table (7): The effect of addition vegetable peels on the total chlorophyll content of three ornamental plants

Ornamental Plants	Addition ratio %	Vegetable Peels			average of Addition ratio
		Potatoes	Eggplants	Broad beans	
Dianthus caryophyllus.L	Control 0%	20.21 f	20.21 f	20.21 f	20.21 d
	0.5%	24.75 e	26.06 d	12.67 h	21.16 c
	1%	30.24 c	33.41 b	9.56 i	24.40 a
	2%	16.43 g	37.60 a	7.85 j	22.62 b
peels type		22.90 b	29.32 a	12.57 c	
Gaillardia aristata.L	Control 0%	26.21 e	26.21 e	26.21 e	26.21 e
	0.5%	32.76 d	34.24 d	24.53 e	30.51 b
	1%	39.30 c	42.40 b	19.10 f	33.60 a
	2%	21.64 f	46.57 a	12.29 g	26.83 c
peels type		29.97 b	37.35 a	20.53 c	
Convolvulus tricolor L	Control 0%	33.21 g	33.21 g	33.21 g	33.21 g
	0.5%	40.66 e	43.75 d	30.91 g	38.44 c
	1%	46.99 c	50.06 b	19.14 h	38.73 a
	2%	37.14 f	59.34 a	13.91 i	36.79 b
peels type		39.50 b	46.59 a	24.29 c	

It appears from Table (7) that there is a significant difference in the chlorophyll content in ornamental leaves by the addition of the vegetable peels compared with plants growing in soil without addition (control).

The highest content of total chlorophyll reached (29.32, 37.35, 46.59) %, respectively, for the three ornamental plants by the effect of eggplant peels, while the lowest content was (12.57, 20.53, 24.29) %, respectively, due the effect of broad bean peels, due to the addition ratio, it was found a significant increase showing that the highest content reached

(24.40, 33.60, 38.73) % respectively at the addition of 1%. The interaction between the type of peel and their addition ratio showed significant differences, the highest content of chlorophyll in Carnations (37.60%), in Gaillardia (46.57%), and in Convolvulus (59.34%), by the effect of eggplant peels added by 2%. While the lowest content was (7.85, 12.29, 13.91) %, respectively, for the three ornamental plants, with the effect of adding 2% of broad bean peels.

Table (8): Effect of vegetable peels addition ratio on N% in the shoot of three ornamental plants

Ornamental Plants	Addition ratio %	Vegetable Peels			average of Addition ratio
		Potatoes	Eggplants	Broad beans	
Dianthus caryophyllus.L	Control 0%	2.45 d	2.45 d	2.45 d	2.45 b
	0.5%	2.54 c	2.63 c	2.25 e	2.47 ab
	1%	2.74 b	2.86 b	2.05 f	2.55 a
	2%	2.04 f	3.04 a	1.07 g	2.05 c
peels type		2.44 b	2.74 a	1.95 c	
Gaillardia aristata.L	Control 0%	2.45 g	2.45 g	2.45 g	2.45 d
	0.5%	3.26 d	3.44 c	2.75 f	3.15 b
	1%	3.58 c	3.76 b	2.97 e	3.43 a
	2%	2.91 e	3.94 a	1.08 h	2.64 c
peels type		3.05 b	3.39 a	2.31 c	
Convolvulus tricolor L	Control 0%	2.45 g	2.45 g	2.45 g	2.45 d
	0.5%	2.91 d	3.02 c	2.65 f	2.86 b
	1%	3.16 b	3.27 b	2.36 h	2.93 a
	2%	2.88 e	3.61 a	1.77 i	2.75 c
peels type		2.85 b	3.08 a	2.30 c	

Table (8) the results showed significant differences in concentration of N in the shoot of ornamental plants. In the Carnation plant, the highest concentration of nitrogen was (2.74) % by the effect of eggplant peels, while the lowest concentration was (1.95) % by the effect of broad bean peels. The nitrogen concentrations also varied with the effect of the addition ratio, as the highest concentration was observed at the addition 1%. The interaction between the type of peels and its addition ratio, in Carnation plants, the highest concentration of nitrogen reached (3.04) % by

the effect of eggplant peels added at 2%, while the lowest concentration recorded (1.07%) when adding 2% of broad bean peels. In Gaillardia, it reached (4.63%) when adding 2% of eggplant peels, while the lowest concentration (1.77%) with the effect of broad bean peels added at 2%. In the Convolvulus plant, the highest concentration of nitrogen was (6.61%) when adding 2% of eggplant peels, while the lowest concentration was (3.77%) due to the effect of broad bean peels added by 2%.

Table (9): Effect of vegetable peels addition ratio on P% in the shoot of three ornamental plants

Ornamental Plants	Addition ratio %	Vegetable Peels			average of Addition ratio
		Potatoes	Eggplants	Broad beans	
Dianthus caryophyllus.L	Control 0%	0.33 e	0.33 e	0.33 e	0.33 a
	0.5%	0.35 d	0.37 c	0.23 g	0.31 b
	1%	0.38 c	0.44 b	0.17 h	0.33 a
	2%	0.26 f	0.49 a	0.11 i	0.28 c
peels type		0.33 b	0.40 a	0.21 c	
Gaillardia aristata.L	Control 0%	0.33 e	0.33 e	0.33 e	0.33 d
	0.5%	0.41 c	0.43 c	0.25 f	0.36 b

	1%	0.46 b	0.48 b	0.19 g	0.37 a
	2%	0.36 d	0.51 a	0.16 h	0.34 c
peels type		0.39 b	0.43 a	0.23 c	
Convolvulus tricolor L	Control 0%	0.33 e	0.33 e	0.33 e	0.33 c
	0.5%	0.35 d	0.41 c	0.28 fg	0.34 b
	1%	0.40 c	0.47 b	0.21 g	0.36 a
	2%	0.29 f	0.52 a	0.18 h	0.33 c
peels type		0.45 b	0.57 a	0.33 c	

Table (8) the results showed significant differences in concentration of N in the shoot of ornamental plants. The comparison of the addition ratio, it was found that the highest concentration of phosphorus was (0.32, 0.39, 0.36) %, respectively, at the addition of 1%. Also it was noted that the highest concentration of phosphorus was (0.38, 0.47, 0.57) %, respectively, in the three ornamental plants with the effect of eggplant peels, compared with broad bean peels, which

caused the lowest concentration (0.33, 0.24, 0.19) %, respectively, in the three ornamental plants. The interaction between the type of peels and the ratio of its addition, showed that the lowest concentration of phosphorus (0.10, 0.16, 0.18) %, respectively, affected by broad bean peels added at 2%, while the highest concentration reached (0.46, 0.55, 0.52) %, respectively, by the effect of adding eggplant peels at 2%.

Table (10): Effect of vegetable peels addition ratio on K% in the shoot of three ornamental plants

Ornamental Plants	Addition ratio %	Vegetable Peels			average of Addition ratio
		Potatoes	Eggplants	Broad beans	
Dianthus caryophyllus.L	Control 0%	0.36 f	0.36 f	0.36 f	0.36 c
	0.5%	0.42 d	0.44 c	0.39 e	0.41 b
	1%	0.46 c	0.52 b	0.33 g	0.43 a
	2%	0.37 e	0.57 a	0.29 h	0.41 ab
peels type		0.40 b	0.47 a	0.34 c	
Gaillardia aristata.L	Control 0%	0.36 f	0.36 f	0.36 f	0.36 c
	0.5%	0.46 c	0.49 b	0.42 d	0.45 ab
	1%	0.52 ab	0.55 a	0.31 g	0.46 a
	2%	0.39 e	0.46 c	0.26 h	0.37 b
peels type		0.43 b	0.46 a	0.33 c	
Convolvulus tricolor L	Control 0%	0.36 e	0.36 e	0.36 e	0.36 d
	0.5%	0.43 c	0.45 b	0.39 d	0.42 b
	1%	0.48 ab	0.51 a	0.34 f	0.44 a
	2%	0.39 d	0.44 bc	0.31 fg	0.38 c
peels type		0.41 b	0.44 a	0.35 c	

Also in the content of potassium the results showed, that the highest concentration of potassium reached (0.20%) in Carnation plant, in Convolvulus plants it gave (0.44%) at addition of 1%, and Gaillardia plants it was

(0.68%) when adding 0.5%. The type of peel also varied in their effect, showing that the highest concentration was (0.24, 0.69, 0.44) %, respectively, by the effect of eggplant peels, compared with broad bean peels, which

gave the lowest concentration (0.11, 0.46, 0.35) %, respectively. The interaction between peels type and the ratio of its addition, indicated that the lowest concentration of potassium was (0.07%) in Carnation, (0.20%) in Gaillardia, and (0.31%) in Convolvulus, at

the addition 2% of broad bean peels, while the highest concentration reached (0.34, 0.68, 0.44) %, respectively, in the three ornamental plants, with the effect of eggplant peels added at 2%.

Table (11): Effect of vegetable peels addition ratio on Mg% in the shoot of three ornamental plants

Ornamental Plants	Addition ratio %	Vegetable Peels			average of Addition ratio
		Potatoes	Eggplants	Broad beans	
Dianthus caryophyllus.L	Control 0%	0.68 g	0.68 g	0.68 g	0.68 d
	0.5%	1.82 c	1.96 b	1.31 e	1.69 b
	1%	1.91 b	2.28 a	1.43 d	1.87 a
	2%	1.21 e	2.16 ab	1.08 f	1.48 c
peels type		1.40 b	1.77 a	1.12 c	
Gaillardia aristata.L	Control 0%	0.68 i	0.68 i	0.68 i	0.68 d
	0.5%	2.07 c	2.33 b	1.87 e	2.09 b
	1%	1.98 d	2.86 a	1.77 f	2.20 a
	2%	1.39 h	2.05 c	1.45 g	1.63 c
peels type		1.53 b	1.98 a	1.44 c	
Convolvulus tricolor L	Control 0%	0.68 h	0.68 h	0.68 h	0.68 d
	0.5%	1.91 d	2.00 c	1.89 d	1.93 b
	1%	2.11 b	2.58 a	1.61 e	2.10 a
	2%	1.32 f	2.19 b	1.26 g	1.59 c
peels type		1.50 b	1.86 a	1.38 c	

The results indicated that there was a significant increase in the magnesium concentration, and that the highest concentration was (1.79, 2.22, 2.10) %, respectively, at the addition ratio 1%. Rather than a significant variation by the effect of peels, showing that the highest concentration of magnesium in the shoot reached (1.69, 2.05, 1.86) % by the effect of eggplant peels, while the lowest concentration (1.04, 1.40, 1.38) %, respectively in the three ornamental plants. As for the interaction between the type of peels and ratio of its addition, it is clear that the highest concentration of magnesium reached (2.08%) in Carnation plants, in Gaillardia plant (2.12%), and in Convolvulus (2.19%), by the effect of the eggplant peels added at 1%, while the lowest concentration was (1.00, 1.37, 1.26) %, respectively, in ornamental

plants, due to broad bean peels at the addition ratio 2%.

Discussion

The peels of many fruits and vegetables are generally considered as waste products and are usually thrown away, but they contain important minerals that can be used for pharmaceutical and medical purposes.

The results showed a significant difference in the effect of peels of the three crops (potato, eggplant and broad bean) on seed germination of the studied ornamental plants, which differed according to the type of peels and the ratio of its addition as compared to the control treatment (without peels), as it was noted that the peels of broad bean added at 2% caused the highest inhibition in seed germination% in the three ornamental plants (10.60) %in

carnation, while eggplant peels gave the highest percentage of increase of germination (8.30) % in convolvulus at the same ratio, as for the effect of the percentages of addition, the lowest germination rate occurred at 2%, compared with the 0.5 percentage of addition, which showed better germination. While there was a significant difference in the effect of the interaction between the type of peel and the percentages of adding them in germination, as the highest percentage of germination was when eggplant peels were added at 2%, while the lowest seed germination % was observed with the effect of broad bean peels added at 2%. This effect may be due to the allelopathic compounds released from the vegetable peels powder that added to the soil, by leaching (water solubility) or as a result of decomposition by microorganisms in the soil, which can accumulate in the soil or adsorb on the clay surfaces to show its effect on the receptor affected plants (grown in this soil), the studies have shown that these compounds have an effect that depends on their chemical nature as well as their concentrations, and the surrounding conditions, and their effect lies on the seeds through the effect on the process of seed imbibition with water (osmosis), or the effect on the cell mitosis and elongation of cells in the diverging stages of seed germination (Rice, 1984), or the effect on some enzymes involved in the germination process, such as the alpha-amylase enzyme, causing a different effect (inhibition or stimulating). The same effect was reflected in some of the studied growth characteristics, which represent the shoot and root length and their dry weights, indicating that there was an increase in the shoot and root length of the ornamental plants growing in the soil containing powdered peels of potato and eggplant, indicating that the highest length of the shoot and root was observed by the effect of potato peels added at 2%, the highest percentage increase compared to the control in the length of the shoot and root reached (40.98, 49.21%), respectively, in

the (Convolvulus and Carnations) and the highest percentage increase in the shoot and root dry weight were

(219.13, 191.57 %) in (Gaillardia) plants when eggplant peels were added at 2%, while a decrease in these characteristics occurred with the effect of broad bean peels, the highest percentage of inhibition compared to control in shoot and root (53.56, 56.66 %) in (Gaillardia and Carnations) and their dry weights were (62.60, 80.26) also in the (Gaillardia) plant.

The same effect continued to the stage of flowering and the formation of flowers in those plants, which showed an increase in the number of flowers /plant by the effect of eggplant and potato peels, while a significant decrease occurred by the effect of broad bean peels.

And when the estimation of some elements content that include

(N, P, K, Mg) in the leaves of the treated ornamental plants, the results showed that they are consistent with the allelopathic effect on growth, as there was an increase in the concentrations of these elements in the ornamental plants growing in the soil containing the peels of eggplant and potato, while the broad bean peels caused an inhibitory effect, indicating that the effect is associated with the addition ratio, as the highest rate of increase in the concentrations of these elements was recorded in nitrogen and phosphorus (+50.22, +57.57) % in Convolvulus plants by the effect of eggplant peels at the percentage of addition 2 % and in potassium (+161.53) % in Carnations at the aforementioned addition, and the highest percentage of inhibition was achieved when adding 2% of broad bean peels to nitrogen and phosphorous were (-56.22, -67.74) % in Carnations and in potassium (-66.10) % in the Gaillardia plant, as for the magnesium, an increase was obtained from the control from

the addition of the peels of the three crops and for all treatments, and it gave the highest percentage of increase amounted to (+280.51) % in the *Gaillardia* plant when the percentage of addition was 1%.

Studies have confirmed that the effect is due to the fact that the peels of these vegetables contain secondary metabolic compounds that differ in the chemical nature and concentrations in different plants (vegetables), the vegetables are valuable sources of many nutrients and beneficial chemical compounds such as flavonoids, reducing sugars, amino acids, saponins, carbohydrates, steroids, terpenes and chalcones (Geetha, et al., 2014; Parashar, et al., 2014). The peels of each of the vegetables, potatoes, eggplants and broad beans, are considered important waste from factories, household wastes, containing sufficient quantities of phenolic compounds, which in turn are used or replaced with synthetic antioxidant and antimicrobial compounds, and the eggplant peel as a by-product is an important source of bioactive compounds, such as anthocyanins and polyphenols.

In the study of (Khattak and Rahman, 2017), they emphasized that the peels of some ground vegetables contain chemical compounds and nutrients as well as a number of vitamins B, C, thymine and thiazine in varying quantities, in addition to a number of minerals such as (Ca, Na, Mg, Fe, Mn, K and Z).

The study of Numman (2017) confirmed that eggplant peels and their aqueous extracts contain effective compounds that represent (alkaloids, saponins, tannins, and resins) in addition to containing the elements (Ca, Na, Mg, and K) at different concentrations, and this is in line with the results we obtained, which is attributed to the increase in the growth of ornamental plants by the effect of eggplant peels.

Also, the effect shown by potato peels on the growth of ornamental plants may be attributed to the fact that they contain different compounds, which were diagnosed by researchers as including a number of phenolic compounds, so the use of potato waste as antioxidants, and according to the high content of phenols in its peels which were built by potato plants to protect against bacteria, fungi, viruses and insects

(Akyol et al., 2016). The whole tissue of fruits and vegetables is rich in bioactive compounds and phenols, but by-products have a high content of antioxidants (Sonia et al., 2016). The effect of potato peels may be attributed to the compounds present in potato peels, as research indicated that potato peels contain important Pharmacological compounds such as glycoalkaloids, which can be used as primer of steroid hormones (Schicber and Aranda, 2009). The highest amount of these compounds was found in the peel compared to other parts (Chem, 2009).

The current results showed an increase in the concentrations of each of chlorophyll and the elements (N, P, K, Mg) in the shoot of ornamental plants growing in the soil to which peels of both potatoes and eggplant were added, that may be attributed to the fact that these peels contain glycoalkaloids, as potato peels contain 43% of phenolic acids and 10% of glycoalkaloids, and steroidal alkaloids such as alpha-solanine and alpha-chaconine, while eggplant peels contain tannins, glycoalkaloids, saponin and alkaloids, in addition to higher amounts of proteins, minerals and the elements (Ca, Na, K and Mg) in different quantities (Numman, 2017), which may be the reason of the stimulating effects that appeared in the ornamental plants that were treated with these peels, as these peels led to an increase in the soil content of those elements, which in turn were reflected or led to an increase in some elements in the shoot of the three ornamental plants grown in those soils. While

the broad bean peels caused an inhibitory effect on growth, chlorophyll content, and the concentration of the mentioned elements in the shoot of ornamental plants growing in the soil containing those peels added in the three ratio, noting that the inhibition increased with the increase in the amount of the added peels, this reduction in growth may be attributed to the broad bean peels contain phenolic compounds that may be in high concentrations compared with (eggplant and potato) peels, which may contained these compounds in lower concentrations, and this may justify the stimulating effect of them as the research indicated that the allelopathic effect of the compounds is depended on their chemical nature as well as their concentrations, as the same compounds may cause an stimulating effect on germination and growth at high concentrations, while high concentrations of these compounds have a toxic or inhibitory effect on germination and growth of affected plants, the inhibitory effect of broad bean peels is attributed to the water-soluble compounds produced from broad bean plants, which studies have confirmed the inhibitory effect of aqueous extracts and broad bean residues that have been exploited in treating types of weeds and limiting their growth, it inhibits seed germination and growth of those weeds (Alvarez et al., 2014).

Our results agreed with (Ghassan et al., 2020) who he confirmed the allelopathic effect broad beans extracts on seed germination and growth of tomato plants, which showed an inhibitory effect on seed germination and growth.

The change in the concentration of the elements (Ca, Na, K and Mg) in the shoot of ornamental plants may be due to compounds released from vegetable peels into the soil by leaching or decomposition by the action of soil microorganisms, which can affect the readiness of the elements and their ability to be absorbed by the plant. The compounds can be associated with soil components or undergo

some transformations such as oxidation, reduction, hydration and polymerization, which in turn may change their chemical nature or concentration, and some of these compounds may be associated with soil elements and form humus, which in turn may increase soil fertility. In addition, some compounds may be associated with the cellular membranes of the plant, such as the plasma membrane, and this affects the absorption of ions, the water balance within the plant, the mechanism of opening and closing stomata, and the functioning of plastids, and thus affects the division and elongation of cells, which is reflected in plant growth (AL-Atrakche, 2022).

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