

The Influence of Moringa Extract, Yeast, and Humic Acid Application on the Antioxidant Content of Marigold Flowers

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ABSTRACT

This study was aimed to investigate the effect of foliar application with moringa extract, yeast, and adding humic acid on antioxidants content of the marigold plant flower. The study was conducted at Research Station A- College of Agricultural Engineering Sciences - University of Baghdad, during the autumn seasons of 2021-2022 and 2022-2023. The experiment was carried out as Randomized Complete Block Design (RCBD) with three replicates. Three factors were included in the study: foliar application of moringa leaf extract at concentrations 4, 6, 8% (M1, M2, M3), in addition to the control treatment M0, as well as yeast suspension at concentrations of 5 and 10 g L⁻¹ (Y1 and Y2), in addition to the control treatment without spraying (Y0). Furthermore, humic acid was applied at two concentrations of 0, and 5 ml L⁻¹ (H0 and H1). The results showed a significant superiority of the treatment M3Y2H1 in Lutin, Rutin, Quercitrin, Kaempferol and Isoquercitrin, at (11.343, 99.23, 66.81, 64.39, and 38.77) µg g⁻¹, respectively, compared to the control treatment (7.043, 95.16, 61.82, 59.46, and 33.16) µg g⁻¹, respectively. For the second season the treatment M3Y2H1 recorded (9.706, 88.22, 62.83, 60.28, and 34.76) µg g⁻¹, respectively, compared to the control treatment, (4.525, 82.18, 58.15, 55.11, and 30.11) µg g⁻¹, respectively.

Keywords: Flavonoids, Isoquercitrin, Kaempferol, Lutin, Quercetin, Rutin.

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INTRODUCTION

Marigold (*Calendula officinalis*), is winter annual herbaceous plant belonging to the Asteraceae family. It is one of the most commonly used medicinal plants and is widely cultivated for use in traditional and herbal medicine. Marigold contains active medicinal compounds and antioxidants that are utilized in numerous pharmaceutical preparations (Szopa, et al. 2020, Baghchejooghi, et al. 2023). It has been established that antioxidants improve human health. As a result, there is a significant demand for new antioxidants produced from natural sources. There has been an increased utilization of plant extracts to provide plants with a portion of their nutritional requirements and growth-promoting substances, thereby contributing to reduction of chemical fertilizer usage (Alwan,

et al. 2023). One of the readily available and environmentally friendly extracts is *Moringa oleifera* leaf extract, which is beneficial for integrated pest management in plant diseases (Al-Taweel, & Al-Anbari, 2019, Arif, et al. 2023). *Moringa oleifera* extract contains essential nutrients, proteins, vitamins, amino acids, flavonoids, phenols, and carotenoids, along with cytokinins like zeatin (Jan, et al. 2022, Sardar, et al. 2021). In a study conducted by Merwad (Merwad, 2018) on pea plants (*Pisum sativum* L.) using foliar moringa extract at concentrations of 0, 1, 2, 3, 4%, the treatment with a concentration of 4% showed superiority. This resulted in the highest yield in fresh pods, chlorophyll content, dry weight of total green mass, biological yield, and increased protein content in the pods. Additionally, there was an

increase in nutrients such as nitrogen, phosphorus, potassium, calcium, magnesium, and iron in the leaves compared to the control treatment. In a study conducted by Nofal *et al.* (2021) on *Tagetes erecta* L. var. dwarf chrysanthemum plants, treated with seaweed extracts, *Moringa oleifera* leaves, dry yeast extracts, and NPK fertilization at two levels (0, 2 g pot⁻¹) to determine their chemical impact on the plant, the results showed that all treatments with natural extracts recorded a significant increase in all studied chemical components. The most significant enhancement in this regard was obtained from *Moringa oleifera* leaf extract at a concentration 2 g L⁻¹, resulting in raising the beta-carotene and phenols content in the dry flowers. Yeast is utilized to enhance the production and provision of growth regulators such as auxins, gibberellins, and cytokinins, which are essential for promoting cell division and elongation (Alwan, & Sadiq. 2019). Additionally, yeast is known to provide a range of nutrients and improve growth traits, thereby reflecting an increase in the efficiency of the carbon assimilation process and the enhancement of secondary metabolite production. These plant regulators are crucial for the germination, growth, and differentiation of plant tissues, and they determine the plant's response to environmental conditions. (Al-Asadi, 2018). Yeast contains important nutrients for growth and amino acids such as lysine and tryptophan, which collectively contribute to tissue building, plant growth, and increased production (Hammad, & Ali. 2014). Essaa (2023) found in a study on marigold plants that spraying with yeast suspension at a concentration 6 mg L⁻¹ resulted in significant improvements. However, this concentration significantly delayed flowering, which further enhanced the significant increase in plant height, number of lateral branches, number of leaves, percentage of plant dry matter, number of flowers, number of petals, flower diameter, flower stalk length, percentage of dry matter in flowers, and content of active substances in the flowers. Al-Sahaf *et al.*, (2017) found in a study on *Mathiola incaana* L., a desert plant, that spraying it with yeast suspension at a

concentration 6 mg L⁻¹ resulted in significant improvements. However, this concentration significantly delayed flowering, which further enhanced the significant increase in vegetative growth traits, chemical properties, root and floral growth traits. Organic fertilizers are naturally occurring mineral sources that contain moderate amounts of essential plant nutrients and numerous micro nutrients. They help in maintaining soil fertility by replenishing organic matter loss. (Shaji, et al. 2021). Humic acid is one of the organic nutrients used in plant fertilization due to its containing many of the essential nutrients necessary for growth. Humic compounds are great importance in plant nutrition as they are environmentally friendly (Al-Abody , et al. 2021) . Shaabani (2022) found that treating marigold plants with humic acid at concentrations 2, 4 and 6 g L⁻¹ resulted in the highest number of flowers, flower yield, flavonoids, carotenoids, and some active substances in the flower nectar compared to control treatments, which recorded lower significant values. Additionally, Al-Bayati and Al-Khalifa (2019) concluded that treating marigold with humic acid at a concentration 5 ml l⁻¹ led to superior performance in most vegetative and floral traits, such as plant height, number of leaves, number of branches, plant height, and number of flowers plant⁻¹. Furthermore, there was an increase in the length of the floral stem and delayed full bloom of the flower nectar in the plants compared to control treatments, which recorded lower significant values. Based on the foregoing, the study aimed to work within the framework of sustainable agriculture by enhancing the yield of marigold plants and their content of certain antioxidants. This was achieved through foliar application with *Moringa* extract, yeast suspension, and fertilization with organic humic acid.

MATERIALS AND METHODS

The experiment was conducted in the open field during the fall seasons 2021-2022 and 2022-2023 at Research Station A, College of Agricultural Engineering Sciences, University of Baghdad, using marigold plants of the W-Blak variety. Seeds were planted in the nursery to obtain uniform seedlings, which were then

transferred to the open field on 29 December 2021, for the first season and 29 December 2022, for the second season. The plants were planted in raising beds with a distance of 30 cm between rows and 22 cm between plants, with a density of 20 plants per experimental unit. The study was conducted as a factorial experiment with three factors within a randomized complete block design (RCBD) with three replicates. The study included Moringa extract at concentrations 4, 6, and 8%, represented by M_0 , M_1 , M_2 , and M_3 respectively. Yeast suspension at concentrations of 5 and 10 g L⁻¹, represented by Y_0 , Y_1 and Y_2 respectively (Abdulkafoor, et al. 2019, Malik, & Almrani, 2023). Additionally, humic acid at a concentration 0 and 5 ml L⁻¹, represented by H_0 and H_1 (Al-Bayati, & Al-Khalifa. 2019). The plants were sprayed three times during the growth season, with a ten-day interval between each spraying. Additionally, all plants were fertilized with N,P,K compound fertilizer (20,20,20) at a concentration 0.5 g L⁻¹, applied in two doses with a one-month interval. Random samples consisting 5 plants from each experimental unit were selected to determine the flower content of antioxidants, including Lutin $\mu\text{g g}^{-1}$ (Rajashree, et al. 2013), Rutin $\mu\text{g g}^{-1}$, Quercetin $\mu\text{g g}^{-1}$, Isoquercitin $\mu\text{g g}^{-1}$ (Wintola, et al. 2010, Chiang, et al. 2012, Hong-mei, et al. 2006) and Kaempferol $\mu\text{g g}^{-1}$ (Yuegang, et al. 2008).

RESULTS AND DISCUSSION

Indicators of active compounds

The results presented Table (1) indicate a significant influence of the study factors on the antioxidant properties for both seasons. The results showed a significant superiority of the treatment combination $M_3Y_2H_1$ in Lutin, Rutin, Quercetin, Kaempferol and Isoquercitin. at (11.343, 99.23, 66.81, 64.39, and 38.77) $\mu\text{g g}^{-1}$ for the first season and (9.706, 88.22, 62.83, 60.28, and 34.76) $\mu\text{g g}^{-1}$ for the second season respectively, compared to the control treatment (7.043, 95.16, 61.82, 59.46, and 33.16) $\mu\text{g g}^{-1}$ for the first season and (4.525, 82.18, 58.15, 55.11, and 30.11) $\mu\text{g g}^{-1}$ for the second season respectively. The results from Table (2) indicate a significant influence of the study factors on antioxidants for both seasons.

There was a significant superiority for the two-way interaction treatment M_3Y_2 in Lutin and Kaempferol at (11.097 and 63.95) $\mu\text{g g}^{-1}$ for the first season, and Quercetin, Kaempferol and Isoquercitin (62.32, 34.39 and 59.88) $\mu\text{g g}^{-1}$ for the second season respectively. Additionally, the M_3Y_1 interaction treatment outperformed in Rutin and Quercetin at (98.75 and 66.33) $\mu\text{g g}^{-1}$ for the first season, and 87.39 $\mu\text{g g}^{-1}$ for Rutin in the second season compared to the control treatment, which recorded (7.342, 95.46, 62.29, 59.84, and 33.59) $\mu\text{g g}^{-1}$ for the first season and (4.926, 82.66, 58.42, 55.69, and 30.36) $\mu\text{g g}^{-1}$ for the second season respectively. Moreover, the M_3H_1 interaction treatment outperformed in Lutin, Rutin, Quercetin, Kaempferol and Isoquercitin, recording (10.893, 98.76, 66.26, 63.73, and 38.24) $\mu\text{g g}^{-1}$ for the first season and (9.058, 86.64, 62.32, 59.70, and 34.20) $\mu\text{g/g}$ for the second season respectively compared to the control treatment, which recorded (7.411, 95.35, 62.39, 59.70, and 33.63) $\mu\text{g g}^{-1}$ for the first season and (5.066, 82.56, 58.46, 55.56, and 30.63) $\mu\text{g g}^{-1}$ for the second season respectively. Furthermore, the Y_2H_1 interaction treatment outperformed in Lutin, Quercetin, Kaempferol and Isoquercitin, recording (10.203, 65.42, 63.02, and 37.26) $\mu\text{g g}^{-1}$ for the first season and (8.460, 86.39, 61.43, and 58.93) $\mu\text{g g}^{-1}$ for the second season respectively, it is non significant compared to the control treatment, which recorded (8.203, 96.16, 63.34, 60.73, and 35.01) $\mu\text{g g}^{-1}$ for the first season and (5.754, 83.66, 59.36, 56.55, and 31.30) $\mu\text{g g}^{-1}$ for the second season respectively. The results of Table (3) indicate a significant influence of the study factors on the antioxidants for both seasons. The treatment M_3 showed significant superiority in Lutin, Rutin, Quercetin, Kaempferol and Isoquercitin at (10.58, 98.32, 65.94, 63.29, and 37.88) $\mu\text{g g}^{-1}$ for the first season and (8.510, 86.95, 61.66, 59.26, and 33.78) $\mu\text{g g}^{-1}$ for the second season, compared to the control treatment which recorded (7.810, 95.77, 62.81, 60.25, and 34.21) $\mu\text{g g}^{-1}$ for the first season and (5.677, 83.14, 58.82, 56.13, and 30.95) $\mu\text{g g}^{-1}$ for the second season. Additionally, treatment Y_2 showed superiority in the same attributes, recording (9.932, 97.57, 65.15, 62.58, and

37.00) $\mu\text{g g}^{-1}$ for the first season and (8.024, 85.80, 61.15, 58.15, and 33.10) $\mu\text{g/g}$ for the second season, compared to the control treatment which recorded (8.701, 96.64, 63.85, 61.28, and 35.61) $\mu\text{g g}^{-1}$ for the first season and (6.553, 84.40, 59.88, 57.19, and 31.79) $\mu\text{g g}^{-1}$ for the second season. Furthermore, treatment H₁ showed superiority in the same

attributes, recording (9.799, 97.62, 64.94, 62.53, and 36.90) $\mu\text{g g}^{-1}$ for the first season and (7.996, 85.88, 60.95, 58.45, and 32.92) $\mu\text{g g}^{-1}$ for the second season, compared to the control treatment which recorded (8.934, 96.72, 64.13, 61.41, and 35.86) $\mu\text{g/g}$ for the first season and (6.714, 84.53, 60.15, 57.30, and 32.07) $\mu\text{g g}^{-1}$ for the second season.

Table 1. Three-way interaction effect of spraying with moringa leaf extract, dry yeast suspension, and humic acid on some antioxidants of Marigold flowers for two seasons.

M* Y* H	First season 2021-2022					Second season 2022-2023				
	Lutin $\mu\text{g g}^{-1}$	Rutin $\mu\text{g g}^{-1}$	Quercitin $\mu\text{g g}^{-1}$	Kaempferol $\mu\text{g g}^{-1}$	Isoquercitin $\mu\text{g g}^{-1}$	Lutin $\mu\text{g g}^{-1}$	Rutin $\mu\text{g g}^{-1}$	Quercitin $\mu\text{g g}^{-1}$	Kaempferol $\mu\text{g g}^{-1}$	Isoquercitin $\mu\text{g g}^{-1}$
M ₀ Y ₀ H ₀	7.043	95.16	61.82	59.46	33.16	4.525	82.18	58.15	55.11	30.11
M ₀ Y ₀ H ₁	7.640	95.76	62.75	60.21	34.01	5.327	83.14	58.68	56.28	30.61
M ₀ Y ₁ H ₀	7.377	95.39	62.38	59.74	33.43	4.974	82.62	58.41	55.67	30.69
M ₀ Y ₁ H ₁	8.170	96.10	63.24	60.79	35.10	6.336	83.79	59.21	56.57	31.27
M ₀ Y ₂ H ₀	7.813	95.51	62.96	59.91	34.29	5.698	82.88	58.81	55.89	31.10
M ₀ Y ₂ H ₁	8.763	96.73	63.70	61.38	35.28	7.202	84.26	59.66	57.23	31.91
M ₁ Y ₀ H ₀	8.003	95.95	63.12	60.39	34.85	5.954	83.59	59.01	56.33	31.21
M ₁ Y ₀ H ₁	8.950	96.91	64.04	61.79	36.15	7.665	84.57	60.03	57.66	32.02
M ₁ Y ₁ H ₀	8.630	96.56	63.82	60.92	35.75	6.810	84.13	59.81	56.74	31.69
M ₁ Y ₁ H ₁	9.927	97.52	64.49	62.33	37.14	8.122	85.72	60.45	58.16	33.00
M ₁ Y ₂ H ₀	9.627	97.30	65.10	62.17	36.90	7.677	85.24	61.16	57.95	32.81
M ₁ Y ₂ H ₁	9.800	97.40	64.75	62.43	36.77	7.908	85.51	60.76	58.39	32.60
M ₂ Y ₀ H ₀	8.373	96.32	63.50	61.17	35.45	5.910	83.92	59.47	56.93	31.52
M ₂ Y ₀ H ₁	10.037	97.71	65.23	62.59	37.33	8.463	86.01	61.30	58.62	33.16
M ₂ Y ₁ H ₀	9.180	97.03	64.33	61.62	36.31	7.029	84.76	60.25	57.46	32.15
M ₂ Y ₁ H ₁	10.720	98.32	65.94	63.74	38.02	8.736	87.05	61.95	59.61	33.81
M ₂ Y ₂ H ₀	10.353	97.80	65.62	62.92	37.67	8.110	86.22	61.72	59.02	33.50
M ₂ Y ₂ H ₁	10.907	98.69	66.40	63.88	38.19	9.025	87.56	62.46	59.81	34.09
M ₃ Y ₀ H ₀	9.390	97.18	64.91	61.90	36.56	6.628	84.96	60.92	57.83	32.38
M ₃ Y ₀ H ₁	10.170	98.10	65.43	62.77	37.40	7.951	86.80	61.48	58.79	33.28
M ₃ Y ₁ H ₀	10.573	98.54	66.13	63.16	37.88	8.389	87.30	62.23	59.18	33.65
M ₃ Y ₁ H ₁	11.167	98.95	66.53	64.02	38.56	9.517	87.89	62.65	60.04	34.56
M ₃ Y ₂ H ₀	10.850	97.91	65.82	63.51	38.11	8.870	86.55	61.82	59.47	34.02
M ₃ Y ₂ H ₁	11.343	99.23	66.81	64.39	38.77	9.706	88.22	62.83	60.28	34.76
LSD	0.412	0.20	0.22	0.18	0.45	0.333	0.19	0.05	0.37	0.36
M*Y*H										

Table 2. Two-way interaction effect of spraying with moringa leaf extract, dry yeast suspension, and humic acid on some antioxidants of Marigold flowers for two seasons.

	First season 2021-2022					Second season 2022-2023				
M*Y	Lutin $\mu\text{g g}^{-1}$	Rutin $\mu\text{g g}^{-1}$	Quercitin $\mu\text{g g}^{-1}$	Kaempferol $\mu\text{g g}^{-1}$	Isoquercitin $\mu\text{g g}^{-1}$	Lutin $\mu\text{g g}^{-1}$	Rutin $\mu\text{g g}^{-1}$	Quercitin $\mu\text{g g}^{-1}$	Kaempferol $\mu\text{g g}^{-1}$	Isoquercitin $\mu\text{g g}^{-1}$
M ₀ Y ₀	7.342	95.46	62.29	59.84	33.59	4.926	82.66	58.42	55.69	30.36
M ₀ Y ₁	7.773	95.74	62.81	60.27	34.26	5.655	83.20	58.81	56.12	30.98
M ₀ Y ₂	8.288	96.12	63.33	60.65	34.79	6.450	83.57	59.24	56.56	31.51
M ₁ Y ₀	8.477	96.43	63.58	61.09	35.50	6.809	84.08	59.52	56.99	31.62
M ₁ Y ₁	9.278	97.04	64.16	61.62	36.45	7.466	84.93	60.13	57.45	32.34
M ₁ Y ₂	9.713	97.35	64.93	62.30	36.84	7.792	85.37	60.96	58.17	32.70
M ₂ Y ₀	9.205	97.02	64.37	61.88	36.39	7.187	84.96	60.39	57.78	32.34
M ₂ Y ₁	9.950	97.68	65.14	62.68	37.17	7.883	85.90	61.10	58.54	32.98
M ₂ Y ₂	10.630	98.25	66.01	63.40	37.93	8.567	86.89	62.09	59.41	33.80
M ₃ Y ₀	9.780	97.64	65.17	62.34	36.98	7.290	85.88	61.20	58.31	32.83
M ₃ Y ₁	10.870	98.75	66.33	63.59	38.22	8.953	87.59	62.44	59.61	34.11
M ₃ Y ₂	11.097	98.57	66.32	63.95	38.44	9.288	87.39	62.32	59.88	34.39
LSD	0.292	0.14	0.16	0.13	N.S	N.S	0.13	0.04	0.26	0.26
M* H										
M ₀ H ₀	7.411	95.35	62.39	59.70	33.63	5.066	82.56	58.46	55.56	30.63
M ₀ H ₁	8.191	96.19	63.23	60.79	34.80	6.288	83.73	59.18	56.69	31.26
M ₁ H ₀	8.753	96.61	64.02	61.16	35.83	6.813	84.32	59.99	57.01	31.90
M ₁ H ₁	9.559	97.28	64.43	62.18	36.69	7.898	85.27	60.41	58.07	32.54
M ₂ H ₀	9.302	97.05	64.48	61.90	36.48	7.016	84.96	60.48	57.80	32.39
M ₂ H ₁	10.554	98.24	65.86	63.40	37.85	8.741	86.87	61.90	59.35	33.69
M ₃ H ₀	10.271	97.88	65.62	62.86	37.52	7.962	86.27	61.65	58.83	33.35
M ₃ H ₁	10.893	98.76	66.26	63.73	38.24	9.058	86.64	62.32	59.70	34.20
LSD	0.238	0.12	0.13	0.11	0.26	0.192	0.11	0.03	0.21	0.21
Y *										
Y ₀ H ₀	8.203	96.16	63.34	60.73	35.01	5.754	83.66	59.39	56.55	31.30
Y ₀ H ₁	9.199	97.12	64.36	61.84	36.22	7.351	85.13	60.37	57.84	32.27
Y ₁ H ₀	8.940	96.88	64.17	61.36	35.85	6.800	84.70	60.17	57.26	32.05
Y ₁ H ₁	9.996	97.72	65.05	62.72	37.21	8.178	86.11	61.07	58.60	33.16
Y ₂ H ₀	9.661	97.13	64.87	62.13	36.74	7.589	85.22	60.88	58.08	32.86
Y ₂ H ₁	10.203	98.01	65.42	63.02	37.26	8.460	86.39	61.43	58.93	33.34
LSD	0.206	N.S	0.11	0.09	0.22	0.166	0.09	0.03	0.18	0.18
Y*H										

Table 3. Single effect of spraying moringa leaf extract, dry yeast suspension, and humic acid on some antioxidants of Marigold flowers for two seasons.

	First season 2021-2022					Second season 2022-2023				
M	Lutin $\mu\text{g g}^{-1}$	Rutin $\mu\text{g g}^{-1}$	Quercitin $\mu\text{g g}^{-1}$	Kaempferol $\mu\text{g g}^{-1}$	Isoquercitin $\mu\text{g g}^{-1}$	Lutin $\mu\text{g g}^{-1}$	Rutin $\mu\text{g g}^{-1}$	Quercitin $\mu\text{g g}^{-1}$	Kaempferol $\mu\text{g g}^{-1}$	Isoquercitin $\mu\text{g g}^{-1}$
M ₀	7.801	95.77	62.81	60.25	34.21	5.677	83.14	58.82	56.13	30.95
M ₁	9.156	96.94	64.22	61.67	36.26	7.356	84.79	60.20	57.54	32.22
M ₂	9.928	97.65	65.17	62.65	37.16	7.879	85.92	61.19	58.58	33.04
M ₃	10.58	98.32	65.94	63.29	37.88	8.510	86.95	61.99	59.26	33.78
LSD	0.168	0.08	0.09	0.07	0.18	0.136	0.08	0.02	0.15	0.15
M										
Y ₀	8.701	96.64	63.85	61.28	35.61	6.553	84.40	59.88	57.19	31.79
Y ₁	9.468	97.30	64.61	62.04	36.53	7.489	85.41	60.62	57.93	32.60
Y ₂	9.932	97.57	65.15	62.58	37.00	8.024	85.80	61.15	58.51	33.10
LSD	0.146	0.07	0.08	0.06	0.16	0.118	0.07	0.02	0.13	0.13
Y										
H ₀	8.934	96.72	64.13	61.41	35.86	6.714	84.53	60.15	57.30	32.07
H ₁	9.799	97.62	64.94	62.53	36.90	7.996	85.88	60.95	58.45	32.92
LSD	0.119	0.06	0.06	0.05	0.13	0.096	0.05	0.01	0.11	0.11
H										

Perhaps the increase in concentration of medicinal compounds in flower is attributed to the addition of humic acid, moringa extract, and yeast suspension to their nutrient, vitamin, and acid concentration, as well as their role in improving growth indicators. This is reflected in the results of carbon metabolism, which, if these sugars are broken down, produce Acetyl CoA, which is the basic material in the manufacture of lutein. (Deng, et al. 2023). The increase in the phenolic concentration of flowers can be attributed to the improvement of growth indicators by the study factors and the resulting carbohydrates and sugars that enter the shikimic acid pathway, which is one of the pathways responsible for the production and synthesis of phenolic compounds, which in turn are responsible for the formation of Quercetin. By the action of the enzyme Isoquercitrin synthase and the conversion of the UDP-Glu compound to UDP, the Isoquercitrin compound is formed. This is due to the action of the enzyme Rutin synthase and the conversion of the UDP-Rha compound to UDP to form Rutin (Lucci, & Mazzafera .2009). In addition to the role of the shikimic pathway in the synthesis of Naringenin and the resulting Kaempferol compound (Tartik, et al. 2023).

CONCLUSION

Based on the results presented, it is concluded that the chrysanthemum plant responds significantly to some natural extracts—such as Moringa leaf extract (8%), baker's yeast (10 g L⁻¹), and humic acid (5 mL L⁻¹)—resulting in a notable increase in some secondary antioxidant compounds in the flowers; this signifies an increase in the yield of medically important constituents through the use of eco-friendly treatments.

CONFLICT OF INTEREST

The author declares that they have no conflicts of interest.

DECLARATION OF FUND

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تأثير الرش بمستخلص المورنجا والخميرة وازضافة حامض الهيوميك لبعض مضادات الاكسدة في ازهار نبات الاقحوان

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المستخلص

أجري البحث في المحطة البحثية A التابعة الى كلية علوم الهندسة الزراعية – جامعة بغداد في الموسمين الخريفي 2021-2022 و 2022-2023 بهدف دراسة تأثير الرش بمستخلص المورنجا والخميرة وازضافة حامض الهيوميك في مضادات الاكسدة لمحتوى ازهار نبات الاقحوان ، نفذ البحث كتجربة عاملية ضمن تصميم R.C.B.D. بثلاثة مكررات تضمنت ثلاثة عوامل للدراسة هي الرش الورقي بمستخلص أوراق المورنجا بالتركيز 8،6،4 % (M_3, M_2, M_1) فضلا عن معاملة القياس M_0 على الترتيب ومعلق الخميرة بالتركيز 10،5 غم لتر⁻¹ (Y_2, Y_1) فضلا عن المعاملة بدون رش Y_0 على الترتيب وحامض الهيوميك وبتراكيزين 5-0 مل لتر⁻¹ (H_1, H_0) على الترتيب، اظهرت النتائج تفوقا معنويا لمعاملة التداخل $M_3Y_2H_1$ في Lutin و Rutin و Quercetin و Kaempferol و Isoquercitin وسجلت (11.343 و 99.23 و 66.81 و 64.39 و 38.77 مايكروغرام غم⁻¹) للموسم الأول و (9.706 و 88.22 و 62.83 و 60.28 و 34.76 مايكروغرام غم⁻¹) للموسم الثاني على التوالي مقارنة بمعاملة القياس التي سجلت (7.043 و 95.16 و 61.82 و 59.46 و 33.16 مايكروغرام غم⁻¹) للموسم الأول و (4.525 و 82.18 و 58.15 و 55.11 و 30.11 مايكروغرام غم⁻¹) للموسم الثاني على التتابع . بحسب ما تقدم من نتائج نستنتج ان نبات الاقحوان يستجيب بشكل كبير لبعض المستخلصات الطبيعية مثل مستخلص اوراق المورنجا (8%) وخميرة الخبز (10غم لتر⁻¹) وكذلك حامض الهيوميك (5 مل لتر⁻¹) مما انعكس على زيادة ملحوظة في بعض المركبات الثانوية المضادة للاكسدة في الازهار ، وهذا يعني زيادة الحاصل النوعي المهم طبيا باستخدام معاملات صديقة للبيئة

كلمات مفتاحية: الفلافونويدات , Rutin. , Quercetin , Lutin, , Kaempferol, Isoquercitin.