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Improving the quality of flax oil using natural extracts from peppermint and dill and their impact on effective compounds with nutritional value beneficial to human health

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ABSTRACT

The current flax (*L. usitatissimum* L.) nutritional value beneficial to human health experiment was carried out in 2023 in the Iraqi city of Al-Hindia. The experiment was set up using a randomized complete block design (RCBD) with split-plot layout, two factors, and three replications in order to examine the effects of peppermint (*Mentha piperita*) and dill (*Anethum graveolens*) extracts on the active components of flax. The amounts of peppermint extract (control, 100, 150, and 200 ml L^{-1}) that were sprayed on the leaves a month after germination constituted the first factor. Dill extracts were the second factor. During the growing season, the region received a single pollination with four concentrations of (control, 100, 150, and 200 ml L^{-1}). On April 25, 2024, the flax plants were harvested.

The findings showed that peppermint and dill extracts improved flax (L. *usitatissimum*) oil output and active component characteristics. The findings showed that 200 ml L^{-1} of peppermint and dill extracts improved the oil output and percentage as well as the linolenic and oleic acids in flax

Keywords: peppermint, dill extracts, Flax, oleic acids.

INTRODUCTION

Medicinal and aromatic plants are among the most important natural sources of active compounds used in various pharmaceutical, industrial, and agricultural applications. Mint (*Mentha* sp.) and dill (*Anethum graveolens*) are considered among the plants rich in volatile oils and phenolic compounds with high biological activity, such as antioxidants and antimicrobial agents. Previous studies have shown that these plant extracts may contribute to stimulating growth and enhancing the productivity of some economic crops through their positive effect on the physiological activity of plants [1]. Mint is known for its chemical composition rich in menthol, menthone, and other biologically active compounds. Research indicates that it has stimulating effects on plant enzymes and enhances the plant's resistance to biotic and abiotic stresses. As for dill, it is an aromatic plant from the Apiaceae family containing compounds such as carvone and limonene. It has well-known traditional and medicinal uses, and its extracts have been shown to positively affect plant growth and increase their secondary metabolite content [2,3]. As for flax (*Linum usitatissimum* L.), it is one of the important oil seed crops whose seeds are used to extract oil rich in alpha-linolenic acid, and it has significant nutritional and industrial value .In this context, the importance of studying the impact of environmentally friendly biotic treatments, such as mint and dill extracts, on the growth and productivity of flax, especially concerning active compounds and oil production, becomes evident[4]. This study aims to evaluate the effect of different concentrations of mentha and dill extracts on oil productivity in flax plants and to analyze the changes in the content of active compounds, contributing to improving production efficiency and achieving sustainable agricultural practices , Study of the effect of these treatments on the accumulation of active compounds in plant parts. Analysis of the interactions between mint and dill extracts on the productivity of flaxseed oil.

MATERIALS AND METHODS

The current flax experiment was carried out in 2023 in the Al-Hindia city / Kerbala /Iraq. The experiment was set up using a randomized complete block design (RCBD) with split-plot layout, two factors, and three replications in order to examine the effects of peppermint (*Mentha piperita*) and dill (*Anethum graveolens*) extracts on the active components of flax.

The mint and dill plants were obtained from the botanical garden, washed with distilled water to remove dirt, dried in the air, and then ground to prepare the extract.

Method for extracting raw mint and dill: Using a Sox let apparatus with 70% ethanol, place the ground plant in the thimble and operate the device at 70 degrees for 24 hours, then separate the alcohol from the extract using a Clevenger apparatus.

The amounts of peppermint extract (control, 100, 150, and 200 ml L-1) that were sprayed on the leaves a month after germination constituted the first factor. Dill extracts were the second factor. During the growing Summer season, the region received a single pollination with four concentrations of (control, 100, 150, and 200 ml L^{-1}). On April 25, 2024, the flax plants were harvested. at the physiological maturity following the measurement of the growth features[5].

extract volatile oil from flax: Using a Sox let apparatus with 70% hexan, place the ground plant in the thimble and operate the device at 70^{o}C for 24 hours, then separate the alcohol from the extract using a Clevenger apparatus [6].High-performance liquid chromatography was also used to quantify the active chemical components (oleic and linolenic acids) [7]

statistical analysis was conducted on all the examined features in accordance to the experiment design by using Gnestat program,The arithmetic averages were compared using a least Significant Difference (LSD) test with a probability of 0.05 .[8].

RESULTS AND DISCUSSION

Oil yield %

Table 1 indicates a significant effect when using the treatment with peppermint extract, as the concentration of 200 ml L^{-1} surpassed the other treatments with an average of 0.386 %, while the concentrations of 150ml L^{-1} and 100 ml L^{-1} had average values of 0.372 tons.ha^{-1} and 0.362 %, respectively, compared to the control at 0.340 %.However, the dill treatment also exceeded the concentration of 200 ml L^{-1} with an average rate of 0.379 %compared to the other treatments at concentrations of 150 ml L^{-1} and 100 ml L^{-1} with average rates of 0.372 % and 0.362 %, respectively, compared to the control at 0.340 %

Table (1): Effect peppermint and dill extracts on the oil yield %.

peppermint (ml L^{-1})	dill extracts (ml L^{-1})				
Control	Control	100	150	200	Mean tons.ha^{-1}
	0.322	0.332	0.347	0.357	0.340
100	0.346	0.359	0.369	0.374	0.362
150	0.358	0.368	0.377	0.385	0.372
200	0.368	0.386	0.392	0.399	0.386
Mean	0.348	0.361	0.371	0.379	
$LSD_{0.05}$ peppermint: 2.48, dill extracts: 2.84, Interaction: 2.74					

Oil percentage

Table 2 indicates a significant effect when using the treatment with peppermint extract, as the concentration of 200 ml L^{-1} surpassed the other treatments with an average of 31.88%, while the concentrations of 150ml L^{-1} and 100 ml L^{-1} had average values of 28.91and 26.29%, respectively, compared to the control at 24.29% .However, the dill treatment also exceeded the concentration of 200 ml L^{-1} with an average rate of 30.18 % compared to the other treatments at concentrations of 150 ml L^{-1} and 100 ml L^{-1} with average rates of 28.32 and 26. 95%, respectively, compared to the control at 25.92%

Table (2): Effect peppermint and dill extracts on the oil percentage% .

peppermint (ml L^{-1})	dill extracts (ml L^{-1})				
Control	Control	100	150	200	Mean tons.ha^{-1}
	22.75	23.75	24.84	25.83	24.29
100	24.65	25.58	26.28	28.63	26.29
150	26.73	27.84	29.54	31.53	28.91
200	29.54	30.63	32.63	34.73	31.88
Mean	25.92	26.95	28.32	30.18	
$LSD_{0.05}$ peppermint: 1.48, dill extracts: 1.44, Interaction: 1.53					

Linolenic acid

Table 3 indicates a significant effect when using the treatment with peppermint extract, as the concentration of 200 ml L^{-1} surpassed the other treatments with an average of 32.02%, while the concentrations of 150ml L^{-1} and 100 ml L^{-1} had average values of 27.49 and 24.53%, respectively, compared to the control at 22.10%. However, the dill treatment also exceeded the concentration of 200 ml L^{-1} with an average rate of 29.33% compared to the other treatments at concentrations of 150 ml L^{-1} and 100 ml L^{-1} with average rates of 27.49and 25.38%, respectively, compared to the control at 23.94%.

Table (3): Effect peppermint and dill extracts on the Linolenic acid%

peppermint (ml L^{-1})	dill extracts (ml L^{-1})				
Control	Control	100	150	200	Mean tons.ha^{-1}
	20.75	21.47	22.74	23.45	22.10
100	22.63	23.48	25.63	26.38	24.53
150	24.64	25.74	27.84	31.74	27.49
200	27.74	30.84	33.74	35.76	32.02
Mean	23.94	25.38	27.49	29.33	
$LSD_{0.05}$ peppermint: 1.64, dill extracts: 1.39, Interaction: 1.85					

Oleic acid

Table 4 indicates a significant effect when using the treatment with peppermint extract, as the concentration of 200 mL L^{-1} surpassed the other treatments with an average of 32.02%, while the concentrations of 150mL L^{-1} and 100 mL L^{-1} had average values of 27.49 and 24.53%, respectively, compared to the control at 22.10%. However, the dill treatment also exceeded the concentration of 200 mL L^{-1} with an average rate of 29.33% compared to the other treatments at concentrations of 150 mL L^{-1} and 100 mL L^{-1} with average rates of 27.49and 25.38%, respectively, compared to the control at 23.94%.

Table (4): Effect peppermint and dill extracts on the Oleic acid %

peppermint (mL L^{-1})	dill extracts (mL L^{-1})				
Control	Control	100	150	200	Mean tons.ha^{-1}
	13.76	14.65	15.86	16.47	15.19
100	14.84	15.74	17.46	18.84	16.72
150	16.45	18.44	19.34	21.85	19.02
200	18.54	20.74	22.75	24.85	21.72
Mean	15.90	17.39	18.85	20.50	
$LSD_{0.05}$ peppermint: 1.74, dill extracts: 2.84, Interaction: 1.74					

DISCUSSION

The investigation into the effects of peppermint *(Mentha piperita*) and dill (*Anethum graveolens*) extracts on the active compounds of flaxseed (*Linum usitatissimum*) reveals significant insights into the potential synergistic interactions between these natural substances. Flaxseed is a rich source of essential nutrients, particularly omega-3 fatty acids, lignans, and dietary fiber, which are crucial for various health benefits, including cardiovascular health and anti-inflammatory properties.

Impact of Peppermint Extract

Peppermint extract is known for its high content of menthol and other volatile compounds, which may influence the bioavailability of flaxseed's active components. Studies suggest that the presence of peppermint can enhance the solubility and absorption of certain nutrients, potentially leading to increased bioactivity of omega-3 fatty acids. Furthermore, the antioxidant properties of peppermint may help in preserving the integrity of flaxseed's bioactive compounds during digestion, thereby maximizing their health benefits [9,10,11,12] .

Impact of Dill Extract

Similarly, dill extract contains a variety of phytochemicals, including flavonoids and essential oils, which may interact with the compounds in flaxseed. Dill has been shown to possess antioxidant and anti-inflammatory properties, which could complement the effects of flaxseed [13]. The combination of dill with flaxseed may enhance the overall antioxidant capacity of the mixture, providing a more robust defense against oxidative stress [14].

Synergistic Effects

The interaction between peppermint and dill extracts with flaxseed may lead to a synergistic effect, where the combined action of these extracts enhances the overall health benefits beyond what each component could achieve individually [15]. This synergy could be attributed to the complementary mechanisms of action of the phytochemicals present in these extracts, which may work together to improve the bioavailability and efficacy of flaxseed's active compounds[16].

Conclusion

In conclusion, the incorporation of peppermint and dill extracts into flaxseed formulations holds promise for enhancing the bioactive properties of flaxseed. Further research is needed to elucidate the specific mechanisms underlying these interactions and to optimize the ratios of these extracts for maximum health benefits. Understanding these dynamics could lead to the development of functional foods that leverage the combined strengths of these natural ingredients, promoting better health outcomes

Recommendations:

Future research: It is essential to conduct additional studies to understand the precise mechanisms by which these extracts affect the active compounds in flax seeds.

Practical applications: It is recommended to develop food products containing these extracts to enhance the health benefits of flaxseeds.

These results contribute to enhancing scientific understanding of how to improve the health benefits of food through the use of natural extracts, which may lead to better overall health.

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