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Effect of *Origanum vulgare* subsp *hirtum* essential oil on metabolite profile of *Solanum tuberosum*

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МИНИСТЕРСТВО НА ОБРАЗОВАНИЕТО И НАУКАТА
ИБЕИ

Abstract:

Metabolic profiles of healthy leaves of control potato plants and leaves with spots formed as a result of processing with aqueous solutions of *Origanum vulgare* subsp *hirtum* essential oil, were comparatively analyzed. The metabolite analysis was made by GC/MS. Potato plants were treated with concentrations of essential oil - 5 and 10 µl/mL. Metabolites representatives of basic groups of substances - amino acids, organic and phenolic acids, mono- and disaccharides were identified. In the damaged leaves, a higher content of monosaccharides - fructose and glucose, pyroglutamic acid and amino acids – proline, serine, aspartic acid, was found compared to control leaves. A less differences were found in terms of the accumulation of chlorogenic, ferulic, and quinic acids, sucrose. The results presented complement the knowledge of a plant reaction to abiotic stress.

Keywords: GC/MS; potato; phytotoxic

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Introduction

Essential oils are intensively studied in recent years as promising bio-herbicides [1-4]. A strong inhibitory activity on seed germination and phytotoxic effect on seedling growth of *Trifolim repens, Trifolium pratense, Matricaria chamomilla* and *Sinapis arvensis*, have been reported for *Origanum vulgare* subsp *hitum* (Link) Ietsw. essential oil [5-7]. Nevertheless it has also been found that the phytotoxic effect of the same oil is weaker in the treatment of potato plants [6**].**

Ecometabolomics is a new scientific field that explores metabolites and their shifts in response to abiotic and biotics factors [8,9]. Studies on the effect of pesticides or plant products with phytotoxic effect on the metabolism of the target plants are still insufficient [10-12].

In the present study, the metabolic profiles of healthy leaves of control potato plants and leaves with spots formed as a result of treatment with aqueous solutions of *Origanum vulgare* subsp *hirtum* essential oil, were comparatively analyzed.

Material and Methods:

2.1. Plant material

Aerial parts of *Origanum vulgare* ssp. *hirtum* were collected during the flowering stage from the *ex situ* collection of (IBER), BAS, Bulgaria.

2.2. Isolation and GC/MS analysis of essential oil

The essential oil was extracted on a Clevenger apparatus by water distillation. The composition of EO was analyzed by GC/MS as described by Traykova et al., 2019 [13].

2.3. Phytotoxic test

The phytotoxicity test was applied to potatoes Soraya cultivar. Per one potato tuber was planted in pots (15 cm in diameter) that were placed in a phytotron room. Potato plants with height of 35-45 cm were sprayed with aqueous solutions of EO with concentrations of 5 µl / ml and 10 µl / ml. Seven days after treatment potato plants was estimated to damages. Leaves from control and treated plants were collected.

2.4. Metabolite analysis

50 mg of potato leaves was extracted with 1 mL methanol. 300 µL of the methanolic extract was transferred into glass vial and was evaporated to dryness. The metabolite analysis was made by GC/MS. The dry extract of vials was silylated. The spectra were recorded on a Thermo Scientific Focus G combined with a Termo Scientific DSQ mass detector as described previous (Berkov et al., 2021) [14].

Results and Discussion

3.1. Composition of essential oil

The oil was characterized by high concencentration of monoterpenoid phenol – carvacrol. p-Cymene and γ-terpinene were detected in significant amounts also.

3.2. Phytotoxic test

The results of the phytotoxic test of essential oil on potato plants showed that the vitality of the plants was not disturbed, but a few leaves with white spots (chlorosis) were observed (Figure 2). Synowiec et al. (2017) [15] report that the cultural plants are more resistant than weeds to the toxic effects of essential oils.

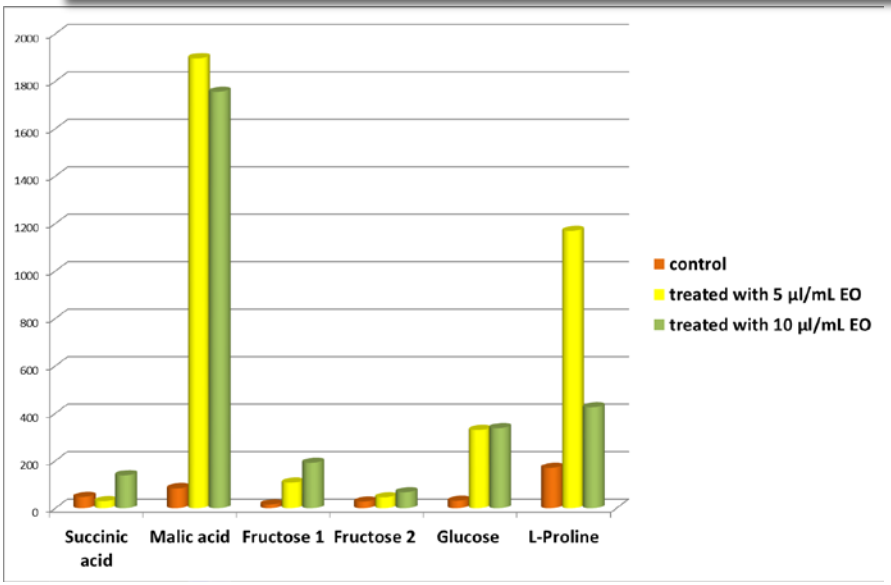
Figure 1. Potato plants, seven days after spraying with a solution of essential oil at a concentration of 10 µl/mL

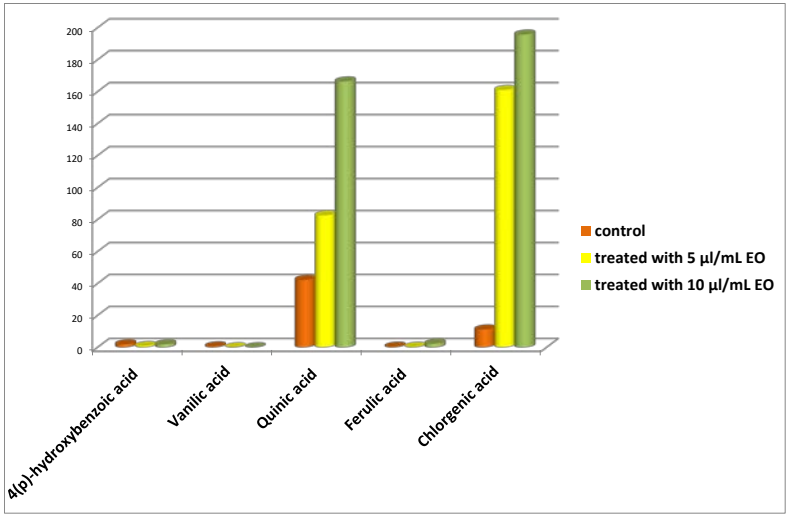
Results and Discussion

3.3. Metabolite analysis

Metabolites representatives of basic groups of substances - amino acids, organic and phenolic acids, mono- and disaccharides were identified. In the damaged leaves, a higher content of monosaccharides - fructose and glucose, pyroglutamic acid and amino acids – proline, serine, aspartic acid, was found compared to control leaves. A less differences were found in terms of the accumulation of chlorogenic, ferulic, and quinic acids, Relative quantification was based on internal standard added in the begging of extraction.

Content of some metabolites in the control (untreated) and treated potato plants with 5µl/mL and 10µl/mL concentration of oregano essential oil solutions





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Conclusion

The present study evaluated the impact of essential oil of *Origanum vulgare* ssp. *hirtum* on potato metabolism. GC/MS analysis revealed that the content of fructose, glucose, malic acid, proline increased in the treated leaves. The accumulation of ocmolites is a common response of plant to abiotic factors such as drought, heavy metal. The results presented complement the knowledge of a plant reaction to abiotic stress.

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