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SULFAMETHOXAZOLE PHYTOTOXIC EFFECTS ON GERMINATION AND GROWTH OF SOME AROMATIC PLANTS

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Introduction

Antibiotics have been worldwide used in fields from clinic sector to animal farm where they are used to heal sick livestock, prevent sickness and encourage weight gain and growth.

The presence of antibiotic residues in feedstuffs is currently a significant issue in many regions of the world, in part because of the related risks to public health, such as toxicity, teratogenicity, antibiotic resistance, and hypersensitivity reactions. There is substantial debate about the use of subtherapeutic antibiotics versus the risk they pose to human health. A significant class of synthetic antimicrobial medications are sulfonamides that are used pharmacologically as broad-spectrum antibiotics to treat bacterial infections in both humans and animals.

Sulfamethoxazole, a sulfanilamide, is a structural analog of para-aminobenzoic acid that inhibits the production of the intermediate dihydrofolate that interferes with bacterial synthesis of folic acid. Folic acid is an essential metabolite for bacterial growth and its inhibition by sulfamethoxazole blocks the bacterial growth.

Sulfamethoxazole was found to be the most phytotoxic within the sulphonamide class of antibiotics. The aim of the study was to analyse the effect of sulfamethoxazole on seed germination from plants with medicinal properties.

Materials and methods

The seeds used were rosemary *(Rosmarinus officinale)*, sage *(Salvia officinalis)*, thyme *(Thymus serpyllum)* and parsley *(Petroselinum crispum)*. The purity of sulfamethoxazole (Dr. Ehrenstorfer GmbH, Hong Kong) used in the study was 99.7%. The substrate used for seed germination had the following characteristics: 60 to 70% humidity, 6.5÷7.0 pH, 70% minimum organic substance in dry product, 13.96% organic carbon, 1.78% N, 0.21% P, 0.82% K according to ICPA Bucharest.

Germination and root elongation have been analyzed with the Phytotoxkit, (Microbiotests, Belgium). Briefly, 50 g of soil was poured into the lower compartment of the test plate and hydrated with 30 ml water for control and 30 ml of 1.2 mg/L sulfamethoxazole solution for the tests. The hydrated soils were covered with filter paper and were place 10 seeds of the same plant on top of filter paper in

one row at equal distance of each other. For germination, the plates were incubated at 25 ºC for 5 days and for growth 20 days. The number of seeds germinated was then recorded and the amount of root formed was measured.

Results and conclusions

It was previously studied that for the amount of sulfamethoxazole between 0.1 mg/L and 1 mg/L in water, the accumulation of antibiotic in plants was situated in the range of 0.08 μg/g to 1.2 μg/g [1]. In the present study, a solution of 1.2 mg/L sulfamethoxazole was used to hydrate the seeds, in order to check the accumulation in the plants and subsequently potentially disrupt the plant development.

The results of germination or root growth inhibition of plants incubated in the presence of sulfamethoxazole were calculated based on control samples, plants without sulfamethoxazole incubation (Table 1).

Table 1. Seed germination inhibition, root growth inhibition

Species	Number of seeds germinated (control)	Number of seeds germinated (test)	Inhibition of germination	Root growth (control) (cm)	Root growth (test) (cm)	Inhibition of root growth
Sage	10	8	20.0%	9.0	8.1	10.0%
Thyme	9	8	20.0%	5.0	3.9	22.0%
Parsley	8	6	25.0%	7.1	5.7	19.74%
Rosemary	9	6	33.3%	4.5	4.1	8.88%

The results of seed germination showed that sulfamethoxazole induced an average of 20% inhibition for most of the plants with a peak of 33% for rosemary. The concentration of sulfamethoxazole inhibited the growth of root for all of the tested species, the most affected was thyme with a percentage of 22%. For the rosemary, thyme, and parsley was observed no branching of the root-hairs and no secondary roots. In summary, the tested 1.2 mg/L concentration of sulfamethoxazole caused phytotoxicity on the species tested both for germination and root growth.

Reference

[1] HILLIS D.G., FLETCHER J., SOLOMON K.R. & SIBLEY P.K., Arch Environ Contam Toxicol 60, 220–232 (2011). https://doi.org/10.1007/s00244-010-9624-0.

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