SILVER TUNGSTOPHOSPHATE/BETA ZEOLITE – A SOLUTION FOR PESTICIDE INDUCED OXIDATIVE STRESS

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Aim of the study

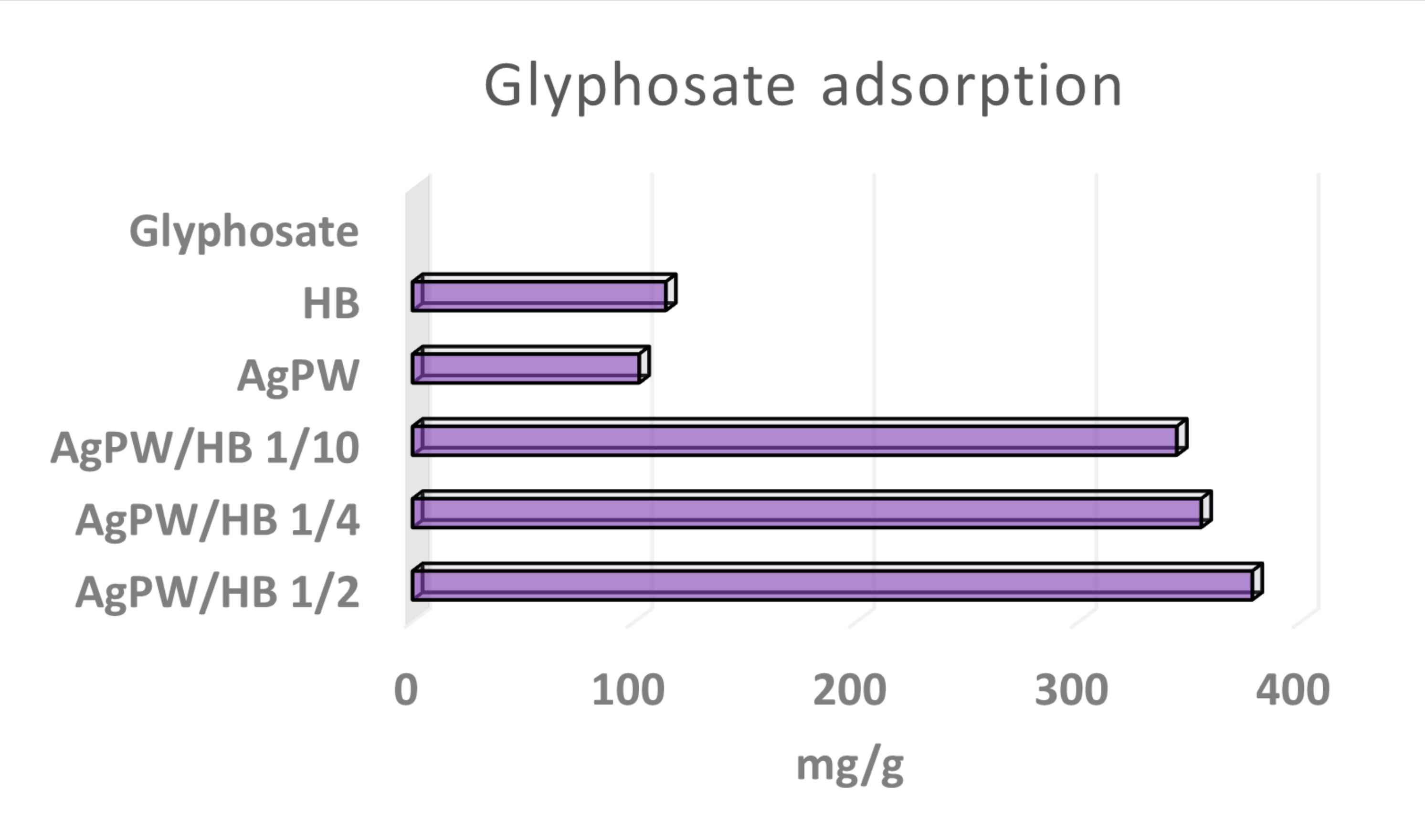
Whether a material used as pesticide adsorbent retains any antioxidant properties after adsorption, we have tested antioxidant activity of the composites with and without glyphosate adsorbed.

Introduction

- Oxidative stress, in non-targeted species exposed to pesticides, results in increased amount of reactive oxygen species. Since radicals are responsible for the harmful effects on the biochemical functions of living organisms, it is essential to examine the ability of pesticide adsorbents to act as radical-scavengers.
- Composites of silver tungstophosphate (AgPW) and Beta zeolite (HB) were designed for advanced applications [1].
- Materials were prepared with three mass ratios of precursors, AgPW/HB, at 1/2, 1/4 and 1/10, for simultaneous glyphosate and radicals removal.

Antioxidant activity test - DPPH assay

Samples were tested for their ability to scavenge 2,2-diphenyl-1-picrylhydrazyl dpphfree radical (DPPH•), as a fast-screening procedure.



Results were expressed as %INH (percentage of inhibition of DPPH radical) according to the equation:

$$\%INH = \frac{A_{DPPH\bullet} - A_{sample}}{A_{DPPH\bullet}} \times 100$$

where $A_{DPPH}^{\bullet}$ is the absorbance of DPPH• solution sample and A sample is the absorbance of sample, after 60 min reaction time. Trolox was used as a standard antioxidant to validate the method.

In order to assess the effect of pesticide on scavenging activity of investigated materials, a set of measurements were performed in the presence of glyphosate.

Results and Discussion

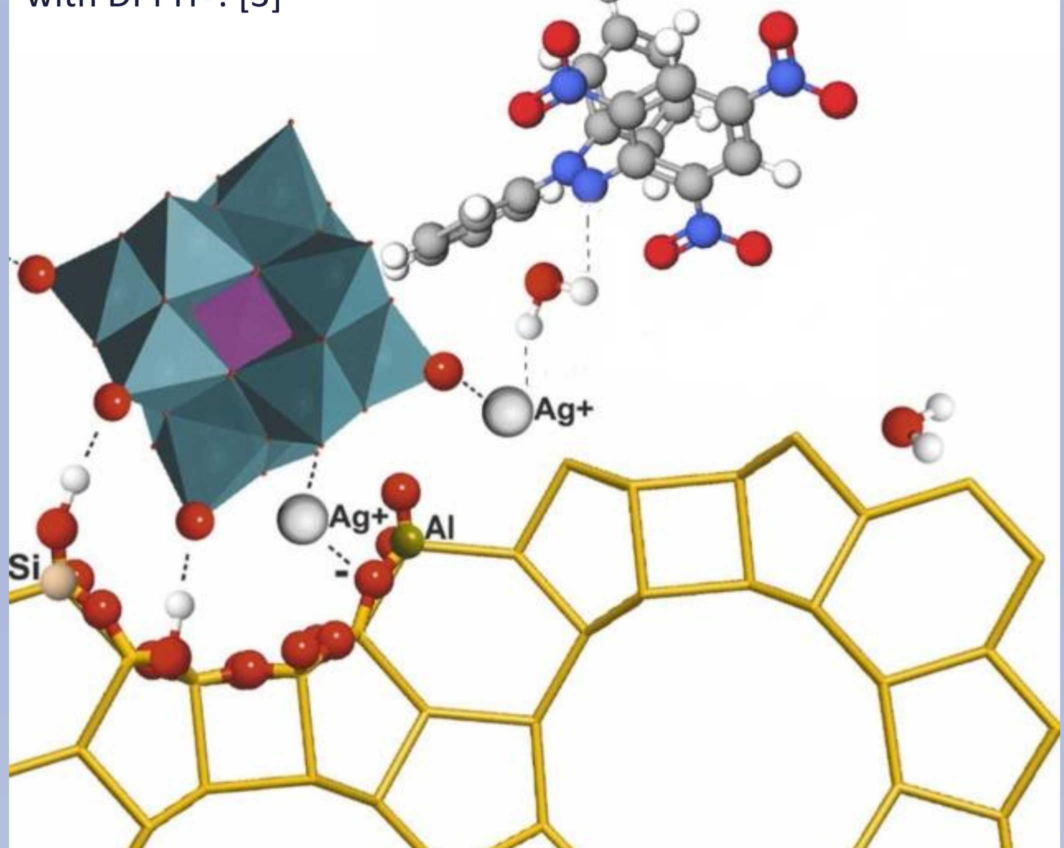
Our results revealed that the HB zeolite shows very little scavenging activity, while AgWPA in a bulk form exhibits good antioxidant activity. Consequently, an increase in antioxidant activity with a higher AgPW fraction, as the radical-scavenging active phase in composites, was expected [2]. Better results for the composite material than for bulk AgPW is a confirmation that salt distribution on the zeolite surface, enabled superior availability of proton-donor centres .

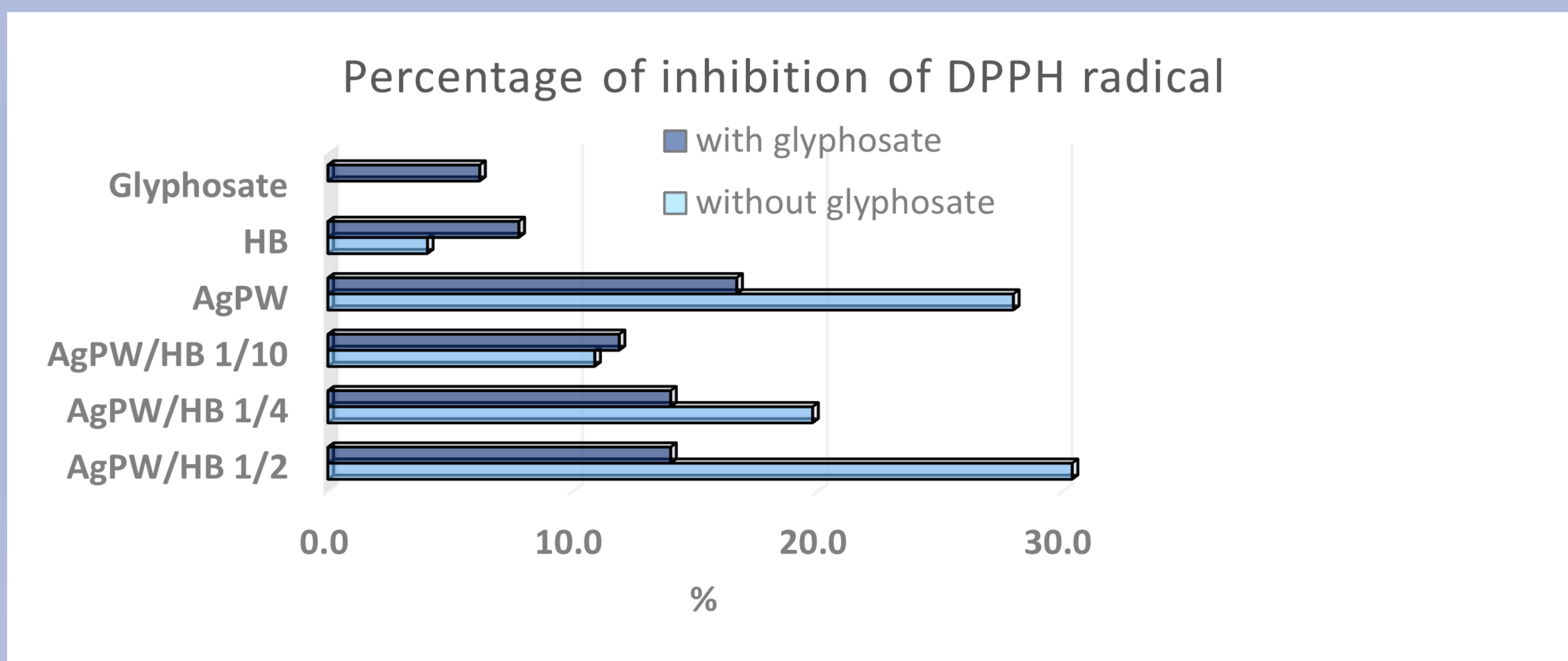
The composites AgPW/HB 1/4 and AgPW/HB 1/2, where AgPW is present in amounts over 20%, adsorb glyphosate in the highest capacity, and there is a decrease in radical removal, since glyphosate and radical reagent (DPPH ●) are binding via amino groups at the same AgPW active sites.

An AgPW expressed a lower decrease in activity in comparison to composite samples as it was proved to be an inferior adsorbent, and glyphosate did not occupy all active sites, allowing radical reaction with protons surrounding hydrated silver ions.

Glyphosate itself reacts with DPPH● via hydrogen bonding which explains the increase in HB activity in the presence of pesticide. Similar to HB, for composite with high zeolite content AgPW/HB 1/10, the rise in antioxidant activity is regarded as glyphosate interaction with radical species.

The proposed binding route AgPW/HB composite with DPPH•. [3]





References
[1] D. Janićijević, S. Uskoković-Marković, D. Ranković, M. Milenković, A. Jevremović, B. Nedić Vasiljević, M. Milojević-Rakić, D. Bajuk-Bogdanović, Sci. Total Environ. 735 (2020) 139530. doi:10.1016/j.scitotenv.2020.139530.
[2] S. Uskoković-Marković, M. Milenković, A. Topić, J. Kotur-Stevuljević, A. Stefanović, J. Antić-Stanković, J. Pharm. Pharm. Sci. 10 (2007) 340–349.
[3] D. Janićijević, A. Jevremović, A. Janošević Ležaić, B. Nedić Vasiljević, S. Uskoković-Marković, D. Bajuk-Bogdanovića, M. Milojević-Rakić, Environ. Chem. Eng., 2021, 106341

Conclusion

Glyphosate pesticide definitely provokes modulation of high antioxidant activity of AgPW/HB adsorbents, which can still act as both, radical-scavenger and pesticide adsorbents.