

ABSTRACT

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spiked (5–1000 ppb) cornmeal in the presence of UPSN at pH 6 (A) and pH $3.5 (B)^{[3]}$.

Development of Broad-Acting Entero-sorbents for Mitigation of Superfund Chemicals and Mixtures during Emergencies and Natural Disasters Meichen Wang, Steven Wheeler* and Timothy Phillips

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RESULTS

Table 1. Isothermal adsorption of BaP at 26 and 37°C							
Temperature	Sorbent	Qmax	Kd				
26°C	Mont-choline	0.1	9E4				
	Mont-carnitine	0.09	9E4				
37°C	Mont-choline	0.14	4.1E4				
	Mont-carnitine	0.09	4.8E4				

• The enthalpy was calculated by comparing the individual Kd values at 26 °C and 37°C given

$$uds = \frac{1}{\left(\frac{1}{T_2}\right) - \left(\frac{1}{T_1}\right)}$$

• Based on the Langmuir and enthalpy equation, $\Delta H_{mont-choline} = -55$ kJ/mol, $\Delta H_{mont-carnitine} = -45$ kJ/mol. The fact that the enthalpies of Mont-carnitine/choline were much higher than -20 suggests that the adsorption process involves chemisorption. Also, the thermodynamics of the Mont-carnitine/choline reaction with BaP favor tight binding.

> Figure 6. Langmuir plots of lindane on PSM.

Qmax = 0.53; Kd = 1.5E5.

• Lindane is one of the most widely detected organochlorine pesticide found in environmental samples including air, surface water, soil and living organisms. It impacts central nervous, endocrine, immune and reproductive systems and is a probable carcinogen. The results in figure 6 show that PSM is able to increase lindane adsorption with a higher capacity and

In this work a broad-acting sorbent material was developed using a process that significantly Diazinon is an organophosphate insecticide that is still approved for agricultural use. Diazinor enhanced the reactivity of the parent materials. Isothermal analyses, along with the hydra assay inhibits acetylcholinesterase (AChE), which hydrolyzes the neurotransmitter acetylcholine (*in vivo*), showed that processed sorbent material (PSM) was able to serve as a very effective (Ach). Isothermal results in figure 7 show that Mont-amended with carnitine/choline and entero-sorbent for prioritized chemicals from various solvents, PAHs, and pesticides. These especially PSM both significantly increase binding capacity and affinity for diazinon compared included pentachlorophenol, benzo[a]pyrene, lindane, diazinon and aldicarb. This is the first report of a sorbent material (other than activated carbon) with high binding capacity and Figure 8. Langmuir plots enthalpy for these chemicals. Importantly, the hydra assay confirmed our *in vitro* results.

of aldicarb on PSM and Mont-carnitine/choline

Qmax = 0.4; Kd = 4E86;Mont-carnitine/choline: Qmax = 0.55; Kd = 2E6.

REFERENCES Aldicarb is a carbamate pesticide and the active substance in the Temik pesticide. Aldicarb is a cholinesterase inhibitor which prevents the breakdown of acetylcholine (Ach) at the 1. Wang, M., Maki, C. R., and Phillips, T.D. (2017). "Development of High Capacity Enterosorbents" synaptic cleft. In the case of severe poisoning, the victim dies of respiratory failure. It is for Aflatoxin B1 and Other Hazardous Chemicals." Chemical Research in Toxicology. important in potato production, where it is used to control soil-borne nematodes and some 2. Celis, R., et al. (2007). "Selective modification of clay minerals for the adsorption of herbicides foliar pests. As shown in Figure 8, both PSM and Mont-carnitine/choline improved binding to widely used in olive groves." J Agric Food Chem 55(16): 6650-6658. aldicarb with high Qmax that fit the Langmuir model. Mont-carnitine/choline showed the 3. Elmore, S.E., et al. (2014). "Common African cooking processes do not affect the aflatoxin binding efficacy of refined calcium montmorillonite clay." Food Control 37.

In summary, newly developed, broad-acting sorbents can serve as binders to decrease toxin exposures and mitigate the adverse effects of diverse environmental chemicals. The development of PSM has already drawn interest from 3 companies (from the US and China). One of these is currently in the process of negotiating a license agreement and a supplemental grant for the Phillips laboratory with the Office of Technology Commercialization at TAMU.





Table 2. Qmax, % bound and Log P values for PCP, BaP, lindane, diazinon and aldicarb							
	BaP Log P = 6.13	PCP Log P = 5.12	Diazinon Log = 3.81	Lindane Log P =3.72	Aldicarb Log P = 1.13		
Mont	/	/	3%	/	/		
PSM	0.1 (4.3%)	0.21 (8.3%)	11%	0.53 (22%)	0.4 (12%)		
Mont- carnitine/choline	0.09 (3.8%)	0.04 (0.7%)	7%	/	0.55 (17%)		

• One goal of this project is to analyze the possible correlations between different chemical properties and adsorption parameters. This data will help us to predict and tune binding performance and delineate mechanisms



Figure 9. Analysis of superfund water and sediment samples using the hydra assay The hydra assay can serve as a toxicity indicator for a single toxin, as well as toxin mixtures. Water and sediment samples collected from Hurricane Harry in Houston, Libby Montana and Duwamish Washington exhibited different toxicities in the hydra assay. In figure 9, water samples E and G, and Libby 2-1&5 are more toxic to the hydra compared to other samples. In ongoing studies, we will determine which sorbents/sorbent mixtures will protect the hydra from these water samples.

CONCLUSIONS

This work indicated that natural nutrients, L-carnitine and choline, significantly increased binding capacities and efficacy of newly developed clays for benzo[a]pyrene and aldicarb. These amended clays are tunable for diverse toxins based on differences in Qmax, Kd, LogP, enthalpy, solubility, charge distribution, functional groups, volume, size, etc.

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