Betty A. and Donald J Baumann Family Scholarship Fund Application Form

1. Name and NetID

   Johnny Zigmond, jwz73071

2. Chemistry Faculty Research Director

   Dr. Fletcher

3. Title: Exploring Antimicrobial and Chemosensing Properties of Aryl-Substituted Triazolium Salts
4. The proposal should be limited to about 500 words and may include a few figures as appropriate. Your proposal should briefly outline the overall project and its goal(s). If you have previous results related to your proposed project, concisely summarize these results and describe what you expect to accomplish during the time frame of this scholarship.

Previous studies of triazolium salts, 5-membered rings containing 3 nitrogens, have primarily focused on their antimicrobial properties. These salts are synthesized with varying substituents at the first, third, and fourth position (1, Fletcher). We propose, instead, the synthesis of 12 different triazolium salts with varying aryl components (shown below I figure 1) at the first position and a central benzene ring at the fifth position.

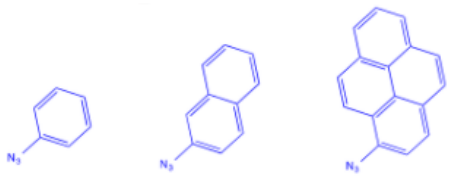

Figure 1

We will also vary the number of triazoles on the central benzene. By switching the position and number of aryl-substituted triazoles, we hope to see more favorable interactions with different analytes. The synthesis will start with an aryl azide and varying terminal alkynes to synthesize distinct triazoles. Previous studies have examined a similar synthesis but focused on one triazole ring (2, Kwok). We will be using these synthetic conditions, expanding upon them by applying them to the ortho di-triazole and the tri-triazole, and by varying the aryl component. This step is likely to take 2-4 weeks and will involve extractions using tetraethylammonium hydroxide with DMSO. The next step will take no longer than 2 weeks and will involve converting the triazoles into the triazolium salts using benzyl bromide. The synthesis will be performed using reaction conditions from synthesis of similar

triazolium slats (3, Fletcher). An overview of the synthesis is shown in figure 2 below. Each step will use ^{1}H NMR to verify the product.

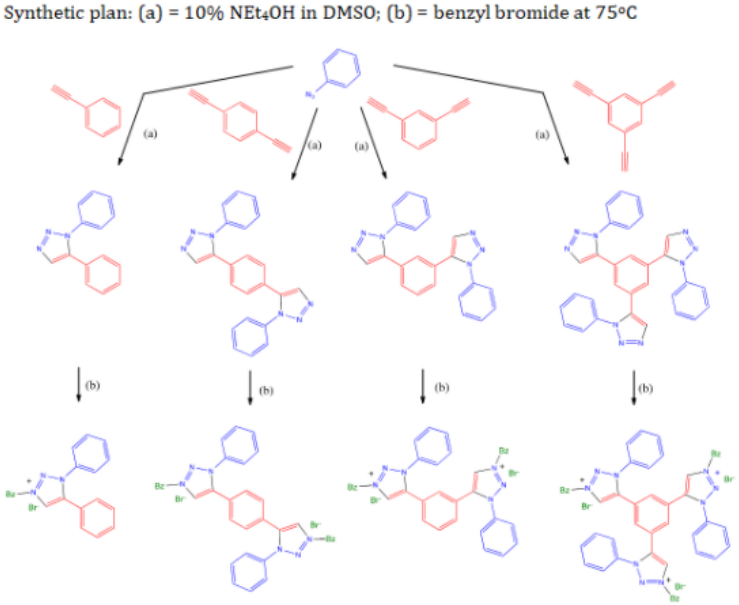

Figure 2

While previous studies have examined varying alkyl groups at the first position of the triazole ring, we are focusing on aryl substituents instead. Triazoles have shown antimicrobial properties, such as antimalarial, but by changing from alkyl substituents to aryl, we expect different interactions involving chemosensing. When the triazolium salts are paired with an aryl analyte with similar substitutions (i.e. the para di-triazolium salt shown above with the second analyte shown below), we expect to see dimerization of the triazolium salts. Examples of possible aryl analytes are shown below in figure 3.

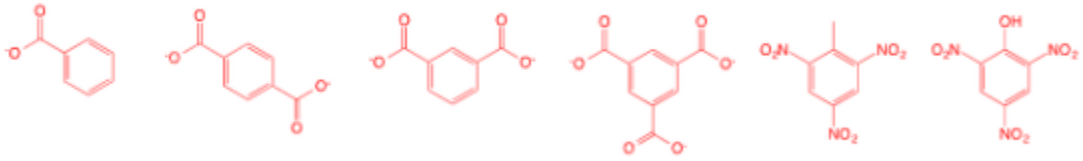

Figure 3

This dimerization will lead to stacking of the aryl components of the triazolium salts. This interaction leads to a unique type of fluorescence called excimer emission. Excimers are dimers that are in an excited state but dissociate when in the ground state (4, Samanta). Therefore, the triazolium salts may allow for detection for the aryl components above though this emission since excimer emission should only occur in the presence of one of the analytes. We will spend 2-3 weeks using 96 well plates and a fluorescence platereader to determine the salt and analyte combinations at which we can get excimer emission. Since the last two aryl

compounds shown above are TNT and picric acids, both explosives, the salts could be used in conjunction with fluorescence to possibly detect explosives in small concentrations. Previous studies have also been able to detect aryl explosives such as TNT using different methods (5, Naddo). As mentioned earlier, triazolium salts have also been shown to demonstrate antimicrobial properties. If time allows, we will spend 2-3 weeks testing for the antimicrobial properties of these aryl substituted and perform a complete structure-activity relationship study on the impact of the aryl units.

References

(1) Fletcher, James T, et al. "Antimicrobial 1,3,4-Trisubstituted-1,2,3-Triazolium Salts." *Bioorganic and Medicinal Chemistry Letters*, vol. 28, no. 20, 1 Nov. 2018, pp. 3320–3323.
(2) Kwok, Sen W., et al. "Transition-Metal-Free Catalytic Synthesis of 1,5-Diaryl-1,2,3-Triazoles." *Organic Letters*, vol. 12, no. 19, 8 Sept. 2010, pp. 4217–4219., doi:10.1021/ol101568d.
(3) Fletcher, James, et al. "1-Allyl- and 1-Benzyl-3-Methyl-1,2,3-Triazolium Salts via Tandem Click Transformations." *Synthesis*, vol. 2010, no. 19, 22 July 2010, pp. 3339–3345., doi:10.1055/s-0030-1257909.
(4) Samanta, Partha, and Subhajit Dutta. "Excimer or Exciplex Formation in Metal-Organic Frameworks." *Metal-Organic Frameworks (MOFs) for Environmental Applications*, by Sujit K. Ghosh, Elsevier, 2019, pp. 231–283.
(5) Naddo, Tammene, et al. "Detection of Explosives with a Fluorescent Nanofibril Film." *Journal of the American Chemical Society*, vol. 129, no. 22, 15 May 2007, pp. 6978–6979., doi:10.1021/ja070747q.

5. Presentation of research results (past and future conferences, publications, seminars, etc.)

   None

6. Post-graduate plans (job market, graduate school, medical school, etc.)

   Graduate school for a PhD in Organic chemistry

7. Number of semesters completed in research, including the current semester (summers count as two semesters).

   5

8. Anticipated graduation date:

   May 2021

Applicant signature Chemistry research director's signature