

# CHEMISTRY SEMINAR

## Molecular Gastronomy

By Ofek Eisenbach, '25 Chemistry

11:30 am

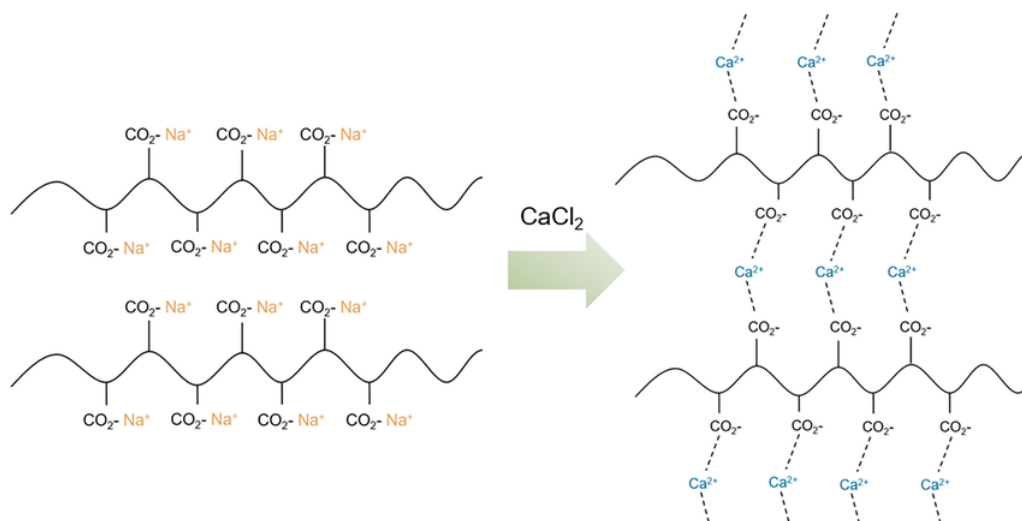
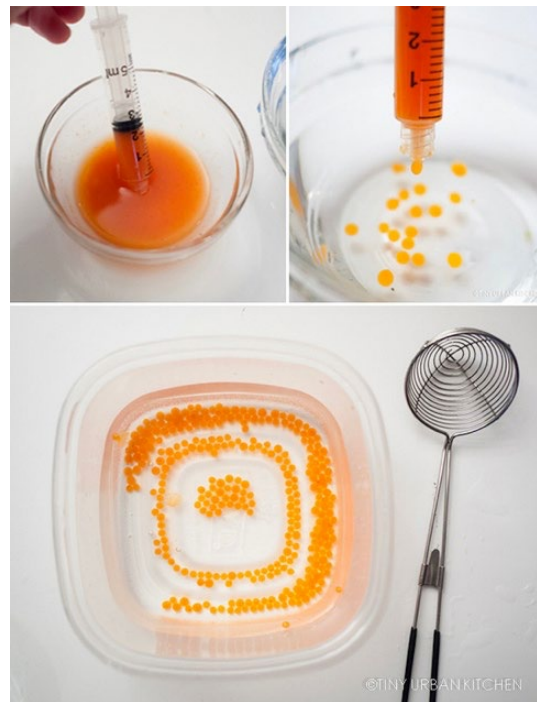
Thursday, November 30, 2023

Science Center Room 300

### Abstract:

Molecular Gastronomy is a fairly recent scientific discipline, branched off of food science. The term was coined in the late 1980's by French physical chemist Hervé This and British Physicist Nicholas Kurti. Molecular Gastronomy takes a scientific approach to food preparation, and allows for unconventional preparation of ingredients, with the utilization of chemical processes and based in an understanding of their chemical and physical properties.

This presentation reviews the history and foundations of the field of Molecular Gastronomy as a science, as well specific chemical processes that occur in common Molecular Gastronomy recipes/reactions, including the process of spherification (pictured to the right) which utilizes a substitution reaction between sodium alginate and calcium salt (typically  $\text{CaCl}_2$ ), to form a cross-linked membrane around a given liquid, creating what are essentially caviar-like spheres from said liquid. The chemistry behind other specialized molecular gastronomy ingredients and techniques will also be discussed.



### Image Credit:

Che, J. (2012). Spherification Progress Photos. Tiny Urban Kitchen. Retrieved from <https://tinyurbankitchen.com/spherification-making-caviar/>

Erdal, N. B.; Hakkarainen, M.; Blomqvist, A. G. Polymers, Giant Molecules with Properties: An Entertaining Activity Introducing Polymers to Young Students. *Journal of Chemical Education* **2019**, 96 (8), 1691–1695. <https://doi.org/10.1021/acs.jchemed.8b00918>.

# CHEMISTRY SEMINAR

## The Reactivity of New Vanadium Enzymes

By Sarah Marcus, '26 Chemistry

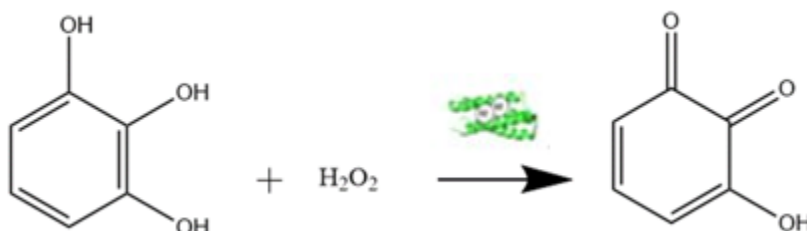
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### Abstract:

Vanadium is used by nature and carries out interesting reactions, like those of haloperoxidases enzymes found in algae that are essential to biosynthesis and ecological cycling of halogenated organic compounds. This reactivity can only be carried out in the presence of water by these enzymes. Beyond these natural haloperoxidases, these reactions can only occur when water is excluded. Our hope is to capitalize on what nature does using the Due Ferri single chain (DF) protein scaffold. These are computationally designed proteins developed to mimic the way nature protects iron from its unwanted reactions with water. The active site of these DFsc proteins was recently modified to incorporate a series of arginine residues to mimic vanadium haloperoxidase active sites. Through colorimetric assays, we have begun to measure the activity of these modified species to determine their ability to function as haloperoxidases. These assays allow us to determine the enzyme's kinetics and what is happening with the peroxidases over time to determine exactly how reactive these vanadium enzymes are and therefore how well they function as peroxidases.



Reaction of Pyrogallol Peroxidase Assay

# CHEMISTRY SEMINAR

## Myofibroblast for Cardiovascular Drug Development

By Hannia Reyes, '25 Chemistry

11:30 am

Thursday, November 30, 2023

Science Center Room 300

### Abstract:

Angiotensin II type one receptors (AT<sub>1</sub>Rs) in myofibroblast are important in keeping heart health balanced and controlling blood pressure. If targeting these receptors is possible without harming the heart muscle, they could be used to combat myocardial fibrosis— production of collagenous scar tissue— and cardiac hypertrophy— thickening of the left ventricle. AT<sub>1</sub>Rs are located in the myofibroblast membrane and in the nuclear membrane and can be activated by  $\beta$ -arrestin ( $\beta$ arr) and G proteins. Previous synthesis of [Tyr(DMNB4)]Ang II, a caged Ang II, demonstrated that when AT<sub>1</sub>Rs cellular activation occurs there is presence of biased signaling which triggers different signaling pathways and location bias to certain receptors to evoke different responses. This seminar will focus on the chemistry behind the experimental caged Ang II derivatives that show either bias and their respective intracellular responses. TRV027—one of the tyrosine-caged peptides attached to the 4,5-dimethoxy-2-nitrobenzyl (DMNB)— induced  $\beta$ arr recruitment allowing for photolysis and peptide activation [LT1] upon UV exposure while antagonizing G protein-mediated vasoconstriction and maladaptive phenotypes. By introducing a cell-permeable photoactivated derivative of Ang II, intracellular stimulation of iAT<sub>1</sub>Rs is achieved, leading to the release of calcium in both extracellular and intracellular domains. This, in turn, regulates RNA synthesis in isolated cardiomyocytes and cultured myofibroblasts, enhancing the exploration of spatiotemporal dimensions in cellular signaling studies. It was previously found that a caged version of Ang II could selectively activate iAT<sub>1</sub>Rs in isolated nuclei and intact cells triggered upon UV irradiation. The activation of the iATR<sub>1</sub>s led to aortic contraction in myofibroblasts and increased proliferation and collagen production, in cardiomyocytes, it evoked transcription of RNA molecules. It was found that only G protein-biased agonists of the angiotensin receptors respond intracellularly, but both TRV055 (G protein-biased) and TRV027 ( $\beta$ arr biased) induced collagen secretion when applied extracellularly. Overall, knowledge of signaling pathways associated with intracellular AT<sub>1</sub>Rs would further insights in disease-relevant biological mechanisms and drug development.