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THE CHEMICAL BULLETIN

Chicago Section of the American Chemical Society Newsletter

November Virtual Monthly Meeting

Friday, November 17, 2023 7:00 - 8:15 PM CST

Exploration of sustainable hair dyes

Dr. Tova N. Williams

Assistant Professor of Chemistry
North Carolina State University

ABSTRACT

Globally, millions of individuals impart color to their hair using permanent hair dyes, which are popular because of their high degree of wash resistance or "permanence." The quest for alternatives to p-phenylenediamine-based (PPD) hair dyes stems from the fact that PPD is a highly potent skin sensitizer found in most hair dye products. Indeed, most individuals sensitive to hair dyes are allergic to PPD, and the Federal Drug Administration (FDA) acknowledges its high degree of potency. During the hair-application process, the dye forms by coupling, for example, PPD with resorcinol, another potent skin sensitizer, under oxidative conditions to generate indo dyes that are oligomeric and less likely to desorb from the hair during washing.

We decided to pursue metal-complexable arylazonaphthol- and arylide-based monoazo dyes as alternatives to PPD-based hair dyes. Our research goal is to mimic the chemical formation of conventional permanent hair dyes inside hair but using less potent compounds. The new azo dyes were synthesized and evaluated for their dyeability of human hair keratin fibers, color durability and toxicological properties. The dyes were found to form 1:2 metal:dye complexes within the first few minutes of application when using the metal ions (Al^{3+}, Fe^{2+}) at 40ºC. This protocol resulted, in most cases, in a color change that served as an initial indicator of complex formation.

The metal-complexed dyes showed a high degree of wash resistance (up to 20 cycles) for the $Al^{3+}$and Fe^{2+} arylazonaphthol dye complexes. Utilizing Time-of-Flight Secondary Ion Mass Spectrometry imaging, the Al^{3+} and Fe^{2+} arylazonaphthol dye complexes were indeed found to form inside hair. The dye colors displayed better light-fastness properties (up to 36 h) compared with uncomplexed dyes. Furthermore, the dyes were found to be nonmutagenic, and the arylide monoazo dye was nontoxic across all aquatic toxicity tests conducted. Taken together, these results demonstrate the potential of this new class of hair dyes as an alternative to PPD-based ones.

REGISTRATION

By phone (847-391-9091), email (chicagoacs@ameritech.net), or online:

REGISTER HERE

DEADLINE TO REGISTER

Friday, November 17 at 7 PM

MEETING PROGRAM

7:00–7:10 PM	Announcements, Margaret Schott, Chair
7:10–8:00 PM	Presentation, Dr. Tova N. Williams
8:00–8:15 PM	Q&A

IN THIS ISSUE

MEET THE SPEAKER

Dr. Tova N. Williams is an Assistant Professor at NC State. Her laboratory, The Sustainable Dye Chemistry Laboratory, was established in 2022 and focuses on the design and development of sustainable (less toxic) dyes and dyeing processes for human hair, textiles, and other materials. Dr. Williams is a double alumnus of NC State, having earned her B.S. in Polymer and Color Chemistry in 2014 and a Ph.D. in Fiber and Polymer Science (Chemistry minor) in 2018. Her doctoral research investigated approaches to the design of sustainable permanent hair dyes and was conducted under the direction of Dr. Harold S. Freeman. Dr. Williams is a 2015 National Science Foundation Graduate Research Fellow as well as a visionary co-developer of the first publicly available hair-dye substance chemical database (300+ compounds). In addition to her academic research experience, Tova has held various roles in the chemical industry including research and sales. Beyond the bench, she is an advocate for mentoring underrepresented minority groups and engaging in K-12 STEM outreach.

FROM THE EDITOR'S DESK

A Season of Thanks

November marks a time for giving thanks, and this year I am appreciative of the many individuals who contribute their time and expertise to the vitality and continued growth of the Chicago ACS Section. Whether by taking on leadership positions, serving on committees, performing outreach, organizing monthly section meetings, maintaining the section's website, or filling any number of other important roles, my thanks to all those members who volunteered this year. Your generosity, collegiality, and professionalism make this chemistry community possible.

Regarding those volunteering for roles in leadership, please note that the 2023 Chicago ACS elections are ongoing. Polls close on Wednesday, November 8. For further information about candidates and how to vote, please see page 3.

Finally, I would like to offer my special thanks to those who have volunteered their time and talents to help publish The Chemical Bulletin. Contributors to the November, 2023 issue include Fadwa Al-Taher, Paul Brandt, Irene Cesa, Gowri Kuda-Singappulige, Josh Kurutz, Raelynn Miller, Bethel Shekour, Margaret Schott, and Adam Sussman. Thank you for your help!

MATT VAN DUZOR

ELECTION

2023 Chicago ACS Election

Elections are underway for eighteen leadership roles in the Chicago ACS Section, including Chair Elect, Vice Chair, Secretary, Treasurer, seven Directors, Councilors, and three Alternate Councilors. The Chemical Bulletin is once again pleased to present below the slate of candidates produced by the Nominating Committee for the Chicago Section. The elections for Chicago ACS officers will be open until **Friday, November 8 at 12 PM**.

Please contact the Chicago Section Office at office@chicagoacs.org if you have not received your election materials, which have been sent by email from AssociationVoting.com.

Complete information about each candidate can be found on our section website. Statements from candidates for Chair-Elect can be found in the October 2023 issue of *The Chemical Bulletin*.

2024 ELECTION SLATE

Chair Elect

Nicholas Gerst

Anita Mehta

Vice Chair

Mike Koehler

Tim Marin

Secretary

Amy Balija*

Raelynn Miller

Treasurer

Adam Sussman

Mike Morello*

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(seven to be elected)

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Claire Baxter

Bob Chapman

Lucas Claussen

Ken Fivizzani

Tanya Hunter*

Russ Johnson*

James Kiddle*

Gowri Kuda-Singappulige

Margy Levenberg

Inessa Miller

Sherri Rukes

Sunshine Silver*

Andrea Twiss-Brooks*

Councilor

(four to be elected)

Paul Brandt*

Russ Johnson*

Fran Kravitz*

Milt Levenberg

Sherri Rukes

Alternate Councilor

(three to be elected)

Amy Balija

Sharada Buddha

Mike Morello

Becky Sanders*

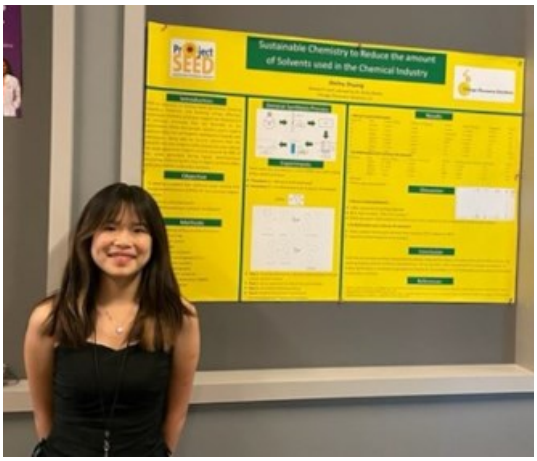
*Incumbent

AWARDS

Project SEED Summer!

From left to right: Natalia Klejka, Shirley Zhuang, and Dr. Anita Mehta

High school interns Natalia Klejka and Shirley Zhuang successfully completed their Project SEED internships with Dr. Anita Mehta at her Chicago Discovery Solution laboratory. Chicago Discovery Solutions LLC is dedicated to developing new environmentally friendly technologies in pharmaceutical research. The company's goal is to reduce the environmental impact of synthetic chemistry in all areas. As a second-year intern, Natalia continued working on mechanochemical techniques by optimizing reaction conditions to enhance reaction efficiency for the synthesis of the patented MCAT-53 catalyst. Shirley was a SEED I intern and worked toward greener syntheses and procedures by attempting solvent-free syntheses of target compounds. In addition to achieving the synthesis, the reaction procedure was optimized to create higher yield while maintaining an environmentally friendly approach. Dr. Mehta brought the interns to the University of Illinois Chicago NMR Lab to learn about utilizing this technique for product characterization.



Shirley at Chicago Section ACS Education Night Meeting

Beyond the lab work, the interns travelled to Loyola University where graduate student Claire Baxter shared her experiences and gave them a personalized tour of the chemistry and biochemistry labs. At Argonne National Lab, Dr. Vivian Sullivan and Dr. Shelly Kelly showed them the campus and Advanced Photon Source (APS) and discussed future internship opportunities offered at Argonne. Dr. Mehta was able to arrange a tour of the Veolia research and development laboratories where they got to appreciate how industrial water from shale oil extraction is cleaned for reuse. Travelling all the way to California, Natalia participated in her second ACS National Meeting where she presented her poster during the Sci-Mix session. Staying local, Shirley presented her poster at the Chicago Section ACS Education Night Meeting in September. Both interns have been awarded the Chicago Section Project SEED Scholarship.

Natalia at ACS National Meeting

Congratulations to both Natalia and Shirley for a successful Project SEED Summer!

RAELYNN MILLER

SAFETY FIRST

Food Allergens: What to Know

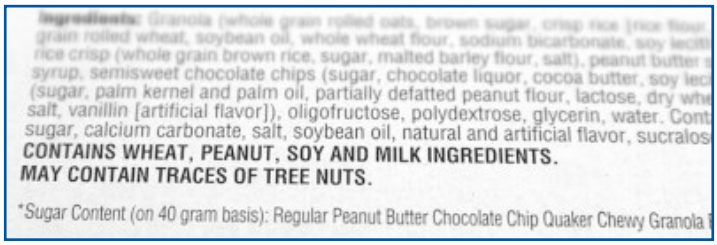
Food allergies and other types of food sensitivities affect millions of Americans and about 8% of children. Food allergies occur when the body's immune system reacts to certain proteins in food. Food allergies can range from mild symptoms of lip swelling and hives to severe, life-threatening symptoms including anaphylaxis, which involves fatal respiratory problems and shock.

More than 160 foods cause allergies in sensitive individuals, but eight major allergens are referred to as the Big 8:

- Milk
- Eggs
- Fish
- Crustacean shellfish
- Tree nuts
- Peanuts
- Wheat
- Soybeans

These foods account for about 90% of all food allergens with serious allergic reactions in the U.S. On Jan.1, 2023, the U.S. declared sesame as the 9th major food allergen.

To protect consumers with food allergies and other hypersensitivities, the U.S. Food and Drug Administration (FDA) requires companies to list ingredients on packaged foods and beverages. The Big 8 food allergens must be declared on labels for processed foods according to the USA Food Allergen Labeling and Consumer Protection Act of 2004 (FALCPA). Labeling of the Big 8 is also required in the EU, Canada, Japan, Australia, and New Zealand, all of which follow standards and practices outlined by the United Nations Codex Alimentarius recommendations.


Ingredients: Granola (whole grain rolled oats, brown sugar, crisp rice [rice flour, whole grain rolled wheat, soybean oil, whole wheat flour, sodium bicarbonate, soy lecithin], rice crisp (whole grain brown rice, sugar, malted barley flour, salt), peanut butter [peanuts, sugar, palm kernel and palm oil, partially defatted peanut flour, lactose, dry whey, salt, vanillin [artificial flavor]), oligofructose, polydextrose, glycerin, water, Contains 2% or less of: sugar, calcium carbonate, salt, soybean oil, natural and artificial flavor, sucralose.
CONTAINS WHEAT, PEANUT, SOY AND MILK INGREDIENTS.
MAY CONTAIN TRACES OF TREE NUTS.
*Sugar Content (on 40 gram basis): Regular Peanut Butter Chocolate Chip Quaker Chewy Granola

Example of nutrition labeling with "Contains" allergen information.

Labeling requirements also apply to those products containing sesame; however consumers should be aware that some products containing sesame may not have allergen labels on them. If products were on retail shelves before this regulation went into effect, they would not have been removed from the marketplace or relabeled. Consumers should check with the manufacturer or distributor if they are concerned that sesame will be in a product.

Additionally, allergen cross contact may result in the unintentional introduction of allergens into foods that do not properly declare the allergens on the labels. Cross contact can occur when a small amount of a food allergen gets into another food accidentally. This can happen through the manufacturing or food preparation process or through utensils or surfaces. A small amount of an allergen can cause an allergic reaction. In the manufacturing process, cross contact can occur in the manufacture of food through shared production lines such as juice manufactured using the same equipment as milk. At home, nuts added to a salad or into a cake will lead to cross contact even if the nuts were removed. Also, cookware or utensils that have not been properly cleaned before preparing food for an individual with a food allergy could cause cross contact.

Some food companies have put in place voluntary precautionary labeling such as "may contain" on their products to warn consumers of the risk of cross contact. Products with these labels do not have the identified allergen in their original recipe or ingredient list, but the product may have come in contact with it during processing. This may occur if the same equipment is used, for example, to prepare both chocolate chip cookies and shortbread cookies. The shortbread cookies might have a label stating, "may contain nuts," even though no nuts or nut products have been used to make the actual cookie. The FDA emphasizes that food processors should use good manufacturing practices like cleaning and sanitizing machines when handling food allergens and should not rely on precautionary labels as a replacement for these practices.

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SAFETY FIRST

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Symptoms of food allergies (allergic reactions):

- Hives
- Rashes
- Face, tongue, or lip swelling
- Tingling or itchy sensation in the mouth
- Vomiting and/or diarrhea
- Abdominal cramps
- Coughing or wheezing
- Dizziness or light-headedness
- Swelling of the throat
- Difficulty breathing
- Loss of consciousness

Some of these symptoms may progress to a severe, life-threatening reaction, called **anaphylaxis.** This can lead to:

- constricted airways in the lungs
- lowering of blood pressure (**anaphylactic shock)**
- suffocation by swelling of the throat and larynx

There is **no known cure** for food allergies. **Here are some tips to reduce the risk of getting sick:**

1. People with food allergies should read the labels.
2. Individuals with food allergies should avoid the foods they are allergic to.
3. Recognize the early signs of an allergic reaction in case of an accidental ingestion.
4. Prepare for medical treatment in case an allergic reaction occurs or emergency treatment (epinephrine).

References:

Centers for Disease Control and Prevention. "Food Allergies," https://www.cdc.gov/healthyschools/foodallergies/index.htm

University of Nebraska-Lincoln, Institute of Agriculture and Natural Resources, Food Allergy and Resource Program. "Allergenic foods and their allergens, with links to Informall", https://farrp.unl.edu/informallbig8

U.S. Food & Drug Administration. "Food Allergies," https://www.fda.gov/food/food-labeling-nutrition/food-allergies

Food Allergy Canada. "Avoiding cross-contamination," https://foodallergycanada.ca/living-with-allergies/day-to-day-management/avoiding-cross-contamination/

U.S. Food & Drug Administration. "Food allergies: what you need to know," https://www.fda.gov/food/buy-store-serve-safe-food/food-allergies-what-you-need-know

FADWA AL-TAHER

How Much Sugar is Really in our Food?

I recently tried gluten-free chocolate chip cookies from Trader Joe's. To my surprise, they tasted remarkably similar to Tate's gluten-free chocolate chip cookies. Upon closer inspection, I found that the ingredients were identical. However, the nutritional labels held a subtle difference – specifically, the added sugar content. Tate's cookies had 12 grams per serving, while Trader Joe's had 11 grams. It's worth noting that Trader Joe's partners with suppliers to rebrand products with Trader Joe's labels, raising suspicions that the two cookies might be identical. Despite this, they displayed different added sugar content. This incongruity prompted me to explore FDA labeling guidelines, and while nutritional labels can provide valuable information, they may not reveal the full story.

Added sugars, a relatively recent addition to nutritional labels, were not present until the FDA modified the guidelines in 2016. Before this change, added sugar content was lumped under the broader category of total sugars. The FDA's new guidelines require a separate line for added sugars, allowing customers to understand how much extra sugar they are consuming.

However, there's a caveat: When "added sugar" appears on a nutrition label, it doesn't exclusively represent the amount of sugar added to a product. According to the FDA, added sugars are defined as those "added during the processing of foods, and include sugars (free, mono- and disaccharides), sugars from syrups and honey, and sugars from concentrated fruit or vegetable juices that are in excess of what would be expected from the same volume of 100 percent fruit or vegetable juice of the same type". This definition implies that added sugar is merely the sugar exceeding what is naturally expected for a food product.

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For example, if apple juice has 10 grams of total sugars and 0 grams of added sugars per glass, it doesn't mean the manufacturer didn't add any sugar; it simply means that if you were to juice apples and measure out a glass, it would naturally have 10 grams of sugar. Therefore, a manufacturer can make their apple juice from various ingredients, including concentrate, and could add sugar to match the natural sugar content of 10 grams. Moreover, added sugar is listed per serving size, determined by the manufacturers themselves. Although the FDA recommends adherence to the reference amount customarily consumed (RACC) guideline, compliance is not obligatory.

Furthermore, measuring added sugars presents challenges. Distinguishing between added and naturally occurring sugars is inherently complex, as sugars are chemically identical regardless of their source. Currently, no analytical tools can differentiate between the two. In fact, there are no analytical tools to differentiate many nutrients, including fiber from certain nondigestible carbohydrates, folic acid from folate, or the various forms of vitamin E. For such nutrients, the FDA relies on documentation from manufacturers.

Even for testable nutrients, discrepancies exist between quantitatively measured amounts and label statements. A study sampling common snacks found that carbohydrate content, which includes sugars, exceeded label statements by 7.7%. Discrepancies also extended to serving size and calories, surpassing label statements by 1.2% and 4.3%, respectively. Despite these variations, food companies may still be within FDA guidelines, which permit a 20% margin of error on certain nutrients such as calories, sugars, total fat, saturated fat, cholesterol, and sodium.

In light of these revelations, it's clear that while nutritional labels are informative, they come with limitations. Rather than treating them as indisputable truths, we should view them as a helpful guide. So next time you're deciding between cookies with 10 g or 12 g of sugar, just pick the one you like more, and if you suspect that they might be the same cookies, they very well could be.

References:

Eater. "What Brands Are Actually Behind Trader Joe's Snacks?" https://www.eater.com/2017/8/9/16099028/trader-joes-products

The Federal Register. "Food Labeling: Revision of the Nutrition and Supplement Facts Labels," https://www.federalregister.gov/d/2016-11867

U.S. Food and Drug Administration. "Guidance for Industry: Food Labeling Guide," https://www.fda.gov/regulatory-information/search-fda-guidance-documents/guidance-industry-food-labeling-guide

U.S. Food and Drug Administration. "Guidance for Industry: Reference Amounts Customarily Consumed (List of Products for Each Product Category)," https://www.fda.gov/regulatory-information/search-fda-guidance-documents/guidance-industry-reference-amounts-customarily-consumed-list-products-each-product-category

Jumpertz R, Venti CA, Le DS, Michaels J, Parrington S, Krakoff J, Votruba S. Food label accuracy of common snack foods. Obesity (Silver Spring). 2013 Jan;21(1):164-9. doi: 10.1002/oby.20185. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3605747/#:~:text=Together%2C%20carbohydrate%20and%20serving%20size,4.3%25%20in%20packaged%20snack%20foods

BETHEL SHEKOUR

CHEMSHORTS FOR KIDS

Wonders of a Candle – Part 1

In 1848, Michael Faraday wrote a series on the Six Lectures on the History of a Candle. I won't go into them here, but suffice it to say there's a lot to know about the burning of a candle.

We see candles burn at every birthday party and you've probably even seen magic candles that, when you blow them out, reignite. We will talk about magic candles later, but in this experiment, we will look at how we can light a candle without touching the flame to the wick.

Materials:

One or two paraffin candles
Lighter or matches

Caution:

Fire always requires the supervision of an adult. The adult should be the one handling the flame. If you use a second candle for the experiment, you may want to protect the surface of the table with something so that wax does not drip onto it.

Experiment:

Light the candle and allow it to burn for a minute. Before you blow out the candle, have the other flame ready to go. The other flame might be from another candle, a match, or a lighter. Blow out the original candle flame and note the smoke that comes from the wick. Quickly, before the smoke goes away, put the second flame into the smoke. If nothing happens, move the second flame closer to the wick. Did the original candle relight? If not, try it again from the beginning.

What's happening?

Just like you've seen with water existing in three phases (solid, liquid, and gas), candle wax can exist in those three phases as well. The wax starts out solid and once the candle is lit, you see the solid turn into a liquid. The smoke you see when you blow out a candle is gaseous wax. The flame can reignite that gaseous wax, and because the flame travels faster than the gas is floating away from the wick, the flame can get back to the wick and light it. It happens so fast that the naked eye can't really see the flame travel, but there is some good slow-motion photography that allows one to see it: https://www.sciencealert.com/watch-the-science-behind-the-coolest-candle-trick-ever.

The magic candles that automatically reignite are made with metal particles (aluminum, magnesium, or iron) in the wick. You often see sparks fly out of those candles due to these metal particles getting very hot. Once you blow out the flame of a magic candle, the hot embers from the wick can reignite the metal and in turn, reignite the wax coming from the wick.

Extension:

Try different kinds of candle waxes such as beeswax, soy, coconut, etc. to see which gives you the best smoke to reignite.

References:

C&E News. "Why are trick candle flames so impossible to blow out?" https://cen.acs.org/articles/88/i32/Trick-Candles.html#:~:text=Magnesium%20is%20a%20highly%20reactive,hydrocarbons%2C%20which%20relights%20the%20wick

Scientific American. "Make a Candle Flame Jump," https://www.scientificamerican.com/article/make-a-candle-flame-jump/

To view all past "ChemShorts for Kids", go to: https://chicagoacs.org/ChemShorts

PAUL BRANDT

UPCOMING EVENTS

Nov. 8	Polls close for Chicago Section Elections
Nov. 9	Chicago Board of Directors Meeting
Nov. 10	Articles due for the December 2023 Bulletin issue
Nov. 17	November Meeting
Dec. 7	Chicago Board of Directors Meeting
Dec. 8	December Meeting
Dec. 10	Articles due for the January 2024 Bulletin issue

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EDITOR
Matt Van Duzor
editor@chicagoacs.org
LAYOUT EDITOR
Gowri Kuda-Singappulige

DIGITAL EDITOR
Josh Kurutz

PROOFREADERS
Fadwa Al-Taher, Bethel Shekour, Margaret Schott, and Adam Sussman

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How to reach us

office@chicagoacs.org
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1400 Renaissance Drive
Suite 312
Park Ridge, IL 60068
(847) 391-9091