TENNESSEE STATE UNIVERSITY

Department of Chemistry

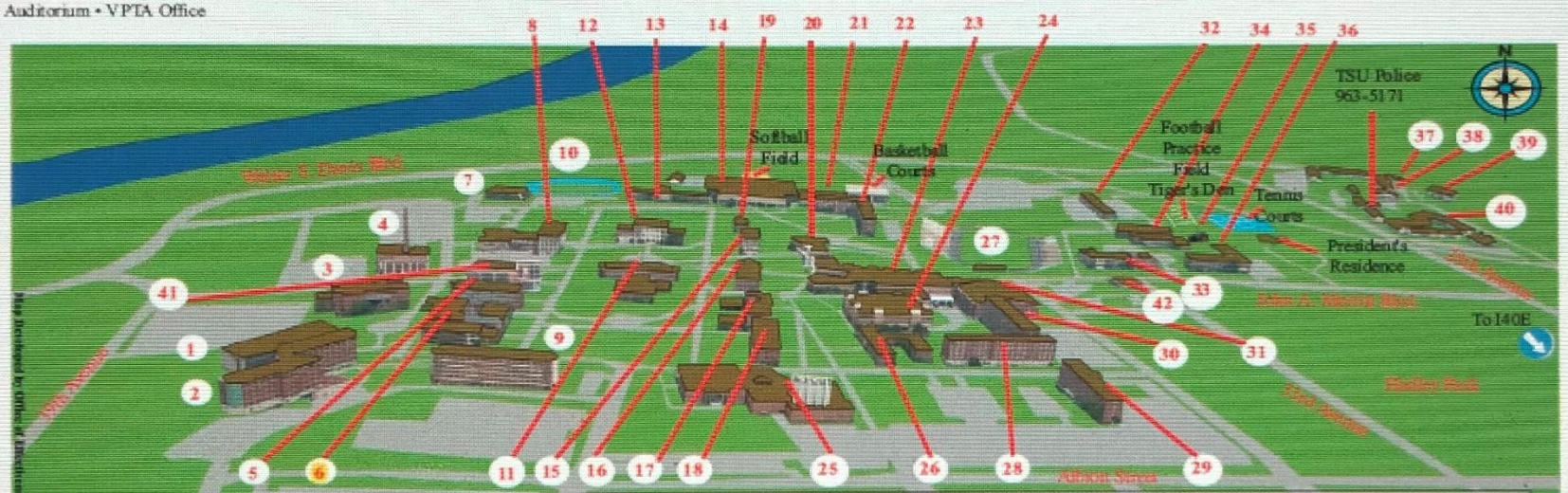
17th Annual

CHEMISTRY DAY

April 8, 2021

TENNESSEE STATE UNIVERSITY

1. ET **Torrence Hall** - College of Engineering
2. **Rudolph Hall** - Female Housing
3. SB **Holland Hall** - College of Business • Centers of Excellence (Robotics Engineering Lab, Testing Center)
4. **Power Plant** - Chillers • Boilers
5. GRD **Crouch Hall** - Graduate School • History • Political Science • Geography • Criminal Justice • Dean Arts & Sciences • TSLAMP/Massie Chair • Interdisciplinary Studies
6. PMB **Boswell Complex** - Physics • Math • Chemistry
7. **Queen Washington Health Bldg** - Health Clinic • Psychologist Office • Internal Audit • Ombudsman
8. WB **Elliott Hall (Women Bldg)** - Art Dept • Effectiveness, Quality & Assesment • Africana Studies • Van Gordon Art Gallery • Sociology Dept • Social Work Dept
9. **Hale Hall** - Co-ed Housing (Honors)
10. **Temple Track** - Track / Infield System
11. HUM **Davis Hall (Humanities Bldg)** - Languages, Literature, Philosophy • CIT Division / Labs • Poag Auditorium • VPTA Office
12. LRC **H.M. Love Learning Research Cntr** - Media Center • Developmental Studies • Title III • Events Mgt • Honors Cntr
13. **Hankal Hall** - Female Housing
14. PEC **Gentry Complex** - HPSS Dept • Athletics • Ticket Office • Activities Mgt • Athletics HOF • McClendon Court • Hughes Pool • Indoor Track • Crutchfield Weight Room • Crutchfield HOF
15. HH **Harned Hall** - Biology
16. IND **Industrial Arts Bldg** - Engineering / AIT • Health Sciences
17. MH **McCord Hall** - Biology • Computer Science • CIT Offices / Labs
18. ED **Clay Hall** - Education
19. **Goodwill Manor** - Alumni Affairs • Development • Foundation
20. **McWherter Administration Bldg** - President's Office • VPBF Office • VPAA-Provost Office • VPUR Office • AA/EEO Office • Payroll • Bursar • Acct Payable
21. **Wellness Center** -Weight Room • Student Diagnostic/ Prescriptive Svcs • Aerobics Room
22. **Wilson Hall** Female Housing
23. **Floyd-Payne Campus Center**- Cafeteria • Food Court • Coffee Shop • VPSA Office • Bookstore • Recreation • Faculty Senate • Adm & Records • Financial Aid • Pres Dining Room • Minority St Afrs • Career Center • Housing Office • Murrell Forum • International Student Ofc
24. **Brown-Daniel Library** - Library • Special Collections • Display
25. MUS **Strange Music/Performance Arts Bldg** - Music Dept • Greer Band Room • Recital Hall • Cox-Lewis Theater • TV Studio • Comm / Drama Dept



26. CLH **Clement Hall** -Health Sciences Dean • Dental Clinic / Dept. • OT / PT
27. **Hale Stadium Fieldhouse**
28. **Watson Hall** - Male Housing
29. **Eppse Hall** - Female Housing
30. **Boyd Hall** - Male Housing
31. KH **Kean Hall** - Athletics / Football • AD Office • Disabled Student Svcs • Xerox Center • AFROTC • Kean Gym • Student Newspaper • Yearbook • Student Activities Office • Cheerleading Office
32. **Operations** - Maintenance • Physical Plant • Planning Design, Constr • Safety-Environmental • Grounds-Fac Services
33. AGR **Lawson Hall** - Ag Dept (academic) • NASA Lab
34. **James E. Farrell and Fred E. Westbrook Agricultural Complex** - Ag Barn • Ag Extension • Ag Rsch – CARP • Dairy Barn • Ag Dept (academic) • VPRSP Office
35. **Agriculture Industrial Technology** - Distance Learning • Teleconference
36. HEN **Humphries** - Nursing • Agriculture • Family and Consumer Sciences
37. **Central Receiving**
38. **New Apartment Complex** - Co-ed Housing
39. **TSU Motor Pool**
40. **Ford Apartment Complex** - Co-ed Housing
41. **Research and Sponsored Programs Building** - Office of Research and Sponsored Programs
42. **Health Research**

TENNESSEE STATE UNIVERSITY

COLLEGE OF LIFE & PHYSICAL SCIENCES
DEPARTMENT OF CHEMISTRY

W E L C O M E & THANK YOU

On behalf of the Department of Chemistry at Tennessee State University, let me welcome you to the 17th Annual Chemistry Day Celebration. I apologize for not being able to celebrate Chemistry Day 2020 due to pandemic caused by COVID-19. This year, being in a restricted situation, we decided to celebrate Chemistry Day 2021 virtually. I am really pleased to see an overwhelming enthusiasm among faculty, staff and students to celebrate Virtual Chemistry Day 2021. I would therefore, like to congratulate all students who are presenting their research today. I understand it involved a great deal of dedication and hard work.I appreciate and thank all faculty and staff for their efforts in organizing this event,as well as training our students to preparing them for their future challenges. Special thanks to all vendors, high school students, contributors and visitors for your support. Thank you very much for taking some of your valuable time of the day to spend with us. I feel strongly that it is a wise investment of your time to an event such as "***Celebrate Chemistry Day at TSU***."

Sincerely,

Mohammad R. Karim
Professor and Head
Department of Chemistry
Tennessee State University

Chemistry Day Guest Speaker

Clarice Phelps

Clarice Phelps is a graduate of Tennessee State University where she received her B.S. in Chemistry in 2003. She also received her Master's degree in Nuclear and Radiation Engineering from the University of Texas- Austin in 2020. After serving in the United States Navy's Nuclear Power Program, Clarice began working at Oak Ridge National Lab (ORNL) in 2009. She was a part of the team that helped to purify the Berkelium 249 (Bk-249) used to confirm the discovery of element 117, Tennessine (Ts). She was the first African American Woman recognized by the International Union of Pure and Applied Chemistry (IUPAC) to be involved with element discovery. Clarice's research history involves UV/VIS/NIR spectroscopy work on Plutonium 238 (Pu-238) and Neptunium 237 (Np-237) valence states for the Pu-238 program for NASA at ORNL, Californium 252 (Cf-252) thin film electrodeposition work for the Californium Rare Isotope Breeder Unit (CARIBU) for Argonne National Lab and Actinium 225/ Lanthanum 140 (Ac-225/La-140) separations work using microfluidic devices. In 2017 she was awarded the YWCA Tribute to Women Award for Technology, Research, and Innovation, and in 2019 she was honored by the IUPAC Periodic Table of Younger Chemists by representing the element Einsteinium (Es). More recently she has earned the Top 40 Under 40 recognition in Knoxville, TN for her service to the community as well as an award from ORNL for community outreach. She is currently working towards her PhD in Nuclear Engineering at the University of Tennessee- Knoxville and still serves as the project lead for Nickel 63 (Ni-63) and Selenium 75 (Se-75) industrial use isotopes at ORNL while serving on several diversity and outreach committees at ORNL and in the community.

Seminar Title:

“Isotopic Separations: An Overview of Select Routine and Novel Techniques for Actinide and Lanthanide Segregation”

Abstract:

Purification and isolation of rare isotopes is an essential part of applications for nuclear and radiochemistry as well as experimental physics, materials science, and biological applications. An overview of basic concepts behind the separations processes of select actinides and lanthanides will be discussed along with their practical applications and the future of where these purified isotopes will take us.

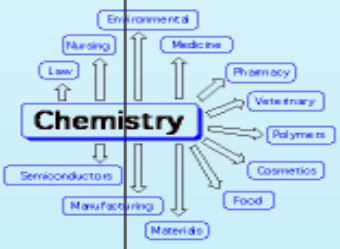
VIRTUAL CHEMISTRY DAY

TENNESSEE STATE UNIVERSITY, DEPARTMENT OF CHEMISTRY

APRIL 8, 2021

Join Zoom Meeting
https://zoom.us/j/97848919784?pwd=d0lNVlVYb2gzN1ZoNkRIT05YUWRqQT09

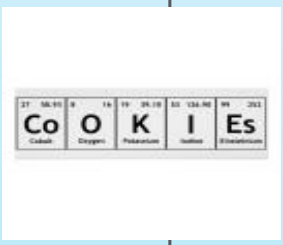
Meeting ID: 978 4891 9784
Passcode: 678674



9:00-9:05 AM
Welcome by Chemistry Department Head, Dr. Karim

9:05-9:30 AM
Career Fair

9:30-10:00 AM
Chemistry Demonstrations

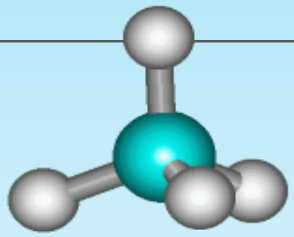


10:00-10:30 AM
Chemistry Challenge Game
Via "Kahoot"

10:30-11:00 AM
Student Research Presentations

2:20-3:00 PM
Seminar by Guest Speaker, Clarice Phelps
Oak Ridge National Lab

3:00-3:05 PM
Concluding Remarks by Dr. Karim



17th Annual

Chemistry Day

RESEARCH ABSTRACTS

01

EFFICIENT CROSS-COUPLING REACTION OF ARYLTRIFLUOROBORATES AND AROYL CHLORIDES FOR THE SYNTHESIS OF FLUORINE SUBSTITUTED AROMATIC KETONES

Grady Clopton, Tasfia Islam, and Mohammed Al-Masum*
Department of Chemistry, Tennessee State University, 3500 John A. Merritt Blvd., Nashville, TN

The direct aroylation of ArCOPdCl with potassium aryltrifluoroborates establishes a new cross-coupling synthetic tool for the synthesis of various fluorine substituted benzophenones. The new microwave irradiated process is very efficient and produce high yield benzophenone products within minutes.

02

MICROPLASTICS IN FOOD AND DRINK PACKAGES AND THEIR HEALTH EFFECTS IN RELATION TO SOCIOECONOMIC DISPARITIES

Joel Agyemang, Sujata Guha,* and Ryan Beni*
Department of Chemistry, Tennessee State University, 3500 John A. Merritt Blvd., Nashville, TN

There is no secret that plastic is a significant contributor to the world's pollution. High-income countries are shown to generate more plastic waste per person, with China, the United States, and Germany being the top three leaders in this category. This is mainly because plastic has a high usage rate in the country, from beverage bottles to trash bags to food packaging. The utilization of plastic packaging gives rise to the presence of microplastics within food and beverages alike. This research is a quantitative study of the microplastics present in the general human diet due to plastic food and drink packaging, and attempts to relate the health effects associated with the consumption of microplastics to socioeconomic disparities. Since many chemicals are present in plastic production, the ingestion of such chemicals (ex. Bisphenol A, PCBs, styrene) has negative consequences. Health effects related to microplastic consumption include but are not limited to: hearing loss, cancer, lowered hormone levels, and infertility. The data presented in this work may be able to support claims that low-income individuals are more susceptible to such negative health effects due to microplastics being present in their "lower quality" diet, in addition to their inability to properly manage plastic waste because of insufficient funding.

03

INORGANIC CONTAMINANTS AND DRINKING WATER DISPARITIES IN TENNESSEE

D'Yonna Almon, Sujata Guha,* and Ryan Beni*
Department of Chemistry, Tennessee State University, 3500 John A. Merritt Blvd., Nashville, TN

Inorganic contaminants such as chlorine, fluoride, nitrate, and sodium are naturally present in the Earth's crust. These contaminants are known to cause health problems in people, if ingested in large amounts, and are regulated by the US Food and Drug Administration (FDA). The US federal Safe Drinking Water Act requires all drinking water to meet health standards set by the Environmental Protection Agency (EPA), but violations occur regularly. We have accomplished a case study with emphasis on inorganic contaminants in different geographic regions of the state of Tennessee, with different household income data to explain environmental injustice in the context of drinking water. The framework builds on the social epidemiology and environmental justice literatures and is populated with field data from various Tennessee's counties. We traced the mechanisms through which natural, built, and sociopolitical factors work through state, county, community, and households to constrain access to safe water and to financial resources for communities. These constraints and regulatory failures produce social disparities in exposure to drinking water toxic heavy metals contaminants. Water system and household coping capacities lead, at best, to partial protection against exposure. This composite burden explains the origins and persistence of social disparities in exposure to toxic heavy metals in drinking water.

04

ANALYSIS OF WATER QUALITY FROM DRINKING WATER FOUNTAINS IN TENNESSEE AND RELATED SOCIOECONOMIC DISPARITIES

D'Leah Bates, Sujata Guha,* and Ryan Beni*
Department of Chemistry, Tennessee State University, 3500 John A. Merritt Blvd., Nashville, TN

Drinking water fountains are made available for public use all across the United States for access to fresh drinkable water. However, it is important to determine how fresh the water truly is by the time it reaches its final destination. Water fountains are placed everywhere from schools and public parks, to doctors and dentist offices. Studies have shown that water fountains have more germs on them than a public toilet seat. It has also been studied that the water fountains have a link to the spread of infectious diseases such as influenza, and some older water fountains may even use water that comes from lead- soldered pipes. This research explored the quality of the water we drink from fountains, in addition to the quality of water sent to those fountains. Demographics of race and average income were explored and compared in different regions of Tennessee to determine if more privileged areas have access to better tap water.

05

DIVERSIFYING CLEAN WATER: AN EXAMINATION OF DRINKING WATER QUALITY AND SOCIAL DISPARITIES IN MICHIGAN

Tyra Blair, Ryan Beni,* and Sujata Guha*
Department of Chemistry, Tennessee State University, 3500 John A. Merritt Blvd., Nashville, TN

Water is one of the most essential resources required to sustain life; however, it could be detrimental to the health of those without access to water that is properly treated. The Safe Drinking Water Act of 1974 set regulations to protect citizens from naturally occurring and man-made contaminants, but some are still without clean and safe water and is speculated to be because of their race. This research examines the disproportionality of available clean water provided by government sources in Michigan and its correlation with race and household income. In the study, it has been found that one of the leading causes of water contamination is industrial activity, with the automobile industry being responsible for approximately 300 million tons of lead contamination in water, and that manufacturing company's locations mostly centered in minority and low-income areas. Lower income cities, such as Hamtramck and Benton Harbor, have an average of 14.8 drinking water standard violations totaled with the highest being 99 total violations, while higher income cities, like Novi and Bloomfield hills, have an average of 4 total violations. Cities, like Flint and Detroit, that have a higher minority population are 10 times more likely to have a water standard violation, and the minority population is proportionally related to the possibility of industrial manufacturing being located in the area. These communities also face a higher risk of birth defects, developmental issues in children, and organ failure in adults due to continuous exposure to water contaminants. Race as a direct causation could not be proven, but there are links to direct correlation through historical redlining and housing trends.

06

CHEMICAL INDUSTRY AND CHEMIST'S JOBS AFTER THE COVID-19 PANDEMIC: A LONG-TERM PREDICTION OF EMPLOYMENT OUTLOOK FOR CHEMICAL PROFESSIONALS

Sujata Guha,[1] Kaleh Karim,[2] and Ryan Beni[1]
[1]*Department of Chemistry, Tennessee State University, 3500 John A. Merritt Blvd., Nashville, TN*
[2]*Department of Biological Sciences, Tennessee State University, 3500 John A. Merritt Blvd., Nashville, TN*

In March 2020, the whole world was impacted by the ripple effects of COVID-19 and was in the midst of battling this infectious disease. A global pandemic caused by a microscopic enemy, which outbroke in Wuhan, China, quickly spread, bringing the world's largest economies to a halt. As a consequence, the financial infrastructures of several countries have been severely damaged. In just 3 weeks, unemployment

claims surpassed 16 million in the United States alone, which soared to over 40 million by the end of May 2020. This accounts for a jobless rate of over 24%, a record high in history. Production of chemicals that go into construction and consumer uses trended down in March, and continued plummeting downward in the following months. The chemical manufacturing sector showed a slight drop in employment rate. It is important to understand these broad trends in the demand for chemicals and unemployment in chemistry in the coming months and years. In an economic downturn, fewer people buy new houses and new cars, which decreases the demand for the chemicals that go into manufacturing them. The dramatic drops in the stock market will also affect the pharmaceutical sector. It may become harder for small biotech firms to raise money from investors and seed new positions in start-ups. For major chemical and pharmaceutical companies, if stock prices and quarterly results suffer, we may begin to see layoffs—a reversal of the hiring trends of the past few years. Academia will be affected as well. For many universities and colleges, the sudden disruption in the academic structure of the Spring 2020 semester is having an immediate financial impact. Hiring freezes have begun. However, the effects of the economic downturn on new tenure-track positions won't be clear until early Fall. In this article we have investigated the worldwide effects of major wars and global recessions on the chemical industry. We have analyzed the effects on job market trends to achieve a comprehensive long-term prediction of employment outlook for chemical professionals. In this regard, we have compared the Great Depression, World War II, Cold War, and other recession periods to predict a 10-year pattern after each event. The current impacts of COVID-19 on manufacturing jobs, faculty positions, hiring freezes, and student graduation due to university closures have also been evaluated. Strategies for maximizing job opportunities during the current pandemic have been provided.

07

GLOBALISM AFTER COVID-19 PANDEMIC: A TURNING POINT IN THE SEPARATION OF SOCIAL AND ECONOMIC ASPECTS

Kaleh Karim,[1] Sujata Guha,[2]* and Ryan Beni[2]*

[1]*Department of Biological Sciences, Tennessee State University, 3500 John A. Merritt Blvd., Nashville, TN*

[2]*Department of Chemistry, Tennessee State University, 3500 John A. Merritt Blvd., Nashville, TN*

A global pandemic caused by a microscopic enemy, which outbroke in Wuhan, China, quickly spread throughout the modern world, bringing world's largest economies to a halt. By March 2020, the whole world was impacted by the ripple effects of COVID-19 and was in the midst of battling this infectious disease. The pervasive economic consequences of the coronavirus are not a macroeconomic problem that can be solved or reduced. Instead, the world is seeing a fundamental change in the nature of the global economy. The immediate crisis is considered to have affected both supply and demand. Declining supply shall be considered as a short-term issue, that stimulus plans by various countries, including a massive plan by the US government, along with historic low interest rates, may remedy. In this article we examine different scenarios of the supply chain's future and its separation from social trends. Moving nations toward self-sufficiency may deeply alter globalization, which requires the division of labor between different economies. Unless strong economic policy measures are taken to prevent social disintegration, this change may be an end to globalization. Hence, many global leaders have implemented stimulus packages in an effort to relieve the economic stress felt by businesses and families, as a short-term economic stress relief. This pandemic has demonstrated the fragile nature of the US and the global trade system, due to majority of products being manufactured in China. There is an urgent need to expand manufacturing industries to various countries rather than concentrate most of them in one location. This pandemic will result in a shift to self-sufficiency, in the short-term, within borders. However, in the long-run, it will re-define globalization to include more countries functioning as micro-hubs for production, which should be implemented to avoid the "all eggs in one basket" scenario. In addition, this system will enable smaller economies to participate in the global platform.

08

COMPARATIVE ANALYSIS OF WATER QUALITY DISPARITIES IN THE UNITED STATES IN RELATION TO HEAVY METALS AND BIOLOGICAL CONTAMINANTS

Kaleh Karim,[1] Sujata Guha,[2]* and Ryan Beni[2]*
[1]*Department of Biological Sciences, Tennessee State University, 3500 John A. Merritt Blvd., Nashville, TN*
[2]*Department of Chemistry, Tennessee State University, 3500 John A. Merritt Blvd., Nashville, TN*

Drinking water quality can be compromised by heavy metals, such as copper and lead. If consumed raw, water can pose a health burden to the general population. In this study, the roles of heavy metals and biological contaminants have been explored in determining the quality of drinking water available to consumers of various socioeconomic backgrounds in the United States. In an effort to gain an understanding of possible social disparities in drinking water, a quantitative analysis was conducted to examine whether vulnerable populations are disproportionately impacted by drinking water contaminants. Our data indicated that states with middle-average household incomes were statistically more susceptible to higher levels of lead in drinking water. The states with higher-average household incomes demonstrated lower copper levels compared to those with lower incomes, although a direct correlation was not present. No statistical significance was observed in the total coliform and turbidity levels in correlation to the average household incomes. In general, more violations in water quality were prevalent in middle-income states when compared to the states with lower-average household incomes.

09

COMPARATIVE ANALYSIS OF CHEMICAL, PHYSICAL AND BIOLOGICAL CONTAMINANTS IN DRINKING WATER IN VARIOUS DEVELOPED COUNTRIES AROUND THE WORLD

Kaleh Karim,[1] Sujata Guha,[2]* and Ryan Beni[2]*
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[2]*Department of Chemistry, Tennessee State University, 3500 John A. Merritt Blvd., Nashville, TN*

Sustaining a reliable and contaminant-free drinking water is becoming an increasing challenge worldwide due to human activity, industrial waste, and agricultural overuse. Surface water is the main source of drinking water around the world. However, groundwater is also becoming increasingly popular, due to its clarity and minimal need for processing to reduce turbidity. Over the years, the demand and growth in the agricultural industry has also been the means of groundwater contamination. Due to the health burden that raw water can pose, water must be processed and purified prior to consumption. Raw water quality can be compromised by physical, chemical (heavy metals and disinfection by-products), and biological contaminants. Biological contaminants can significantly impact immunocompromised populations, while chemical contaminants can impact the growth and development of young children. Although obtaining a steady and high-quality water flow to the general population is an increasing challenge, developed countries have utilized state-of-the-art technologies and techniques to provide contaminant free water to their citizens. This research aims to provide information about the regulatory parameters, characteristics, and sources of safe drinking water in the world as a model for future use in the developing world. In this, secondary data was used to compare and contrast drinking water quality among countries in the European Union, the United States, Canada, the United Kingdom, Singapore, New Zealand, Australia, Qatar, and the United Arab Emirates. The data indicates that Ireland and the United Kingdom have relatively lower amounts of contaminants in their drinking water. Upon completing this research, it is recommended that countries desiring clean drinking water systems should initiate and invest in programs that control and protect treatment plants, water distribution systems, water sources, and catchments.

10

POTABLE WATER IN THE UNITED STATES, CONTAMINANTS AND TREATMENT: A REVIEW

Kaleh Karim,[1] Sujata Guha,[2]* and Ryan Beni[2]*

[1]*Department of Biological Sciences, Tennessee State University, 3500 John A. Merritt Blvd., Nashville, TN*

[2]*Department of Chemistry, Tennessee State University, 3500 John A. Merritt Blvd., Nashville, TN*

Potable water is a basic need for humans, but attaining clean drinking water is a significant challenge for many developing and underdeveloped countries around the globe. In the United States, potable water is obtained from ground and surface sources and treated with various chemicals to meet federal and state standards, prior to its delivery to consumers. The United States Environmental Protection Agency (EPA) has established standards for the maximum level of contaminants (MCLs) to regulate their amounts in the public drinking water. Raw water can be compromised of physical, chemical, and biological contaminants and can pose a health burden among immunocompromised individuals such as elderly, pregnant women, and especially children. The EPA publishes a contaminant candidate list (CCL) every five years. However, many of the drinking water regulations were established decades ago. This review aims to explore factors impacting water safety, processes used to purify water, the by-products that might remain after the purification process, and their impact on the health of the general populace, especially the immunocompromised individuals. In addition to the multibarrier water treatment process, ultraviolet treatment is also evaluated to determine its benefits and limitations.

11

RADIOACTIVE CONTAMINANTS IN U.S. DRINKING WATER AND WATER QUALITY DISPARITIES

Kaleh Karim,[1] Sujata Guha,[2]* and Ryan Beni[2]*

[1]*Department of Biological Sciences, Tennessee State University, 3500 John A. Merritt Blvd., Nashville, TN*

[2]*Department of Chemistry, Tennessee State University, 3500 John A. Merritt Blvd., Nashville, TN*

Radioactive contaminants, such as radium, radon, and uranium isotopes are naturally present in drinking water, and gas and oil extraction like hydraulic fracturing can exasperate radionuclide leakage into groundwater. The concentration of radionuclide in drinking water is dependent upon the water source and the underlying lithology within the aquifers. In United States, the Environmental Protection Agency regulates the level of radioactivity in drinking water via the gross alpha test, which is conducted to measure the emitted alpha particles as a result of the radioactive elements' natural decay. Radionuclides, such as radium and uranium, are known to cause bone cancer and other forms of cancer. Communities with crippling water purification infrastructure may be at a higher risk of being exposed to radionuclides, and this is a significant environmental justice concern. The radionuclide concentrations for the metropolitan or most populated city in each state in the United States and its territories (Puerto Rico, US Virgin Islands and Guam) were analyzed and correlated to the annual household income, to determine any disparities that maybe present. Lower income communities had elevated levels of radionuclides when compared to higher income communities which had lower frequency in elevated radionuclide contaminants.

12

TOTAL TRIHALOMETHANE LEVELS IN MAJOR WATERSHEDS ACROSS THE UNITED STATES

Kaleh Karim,[1] Sujata Guha,[2]* and Ryan Beni[2]*

[1]*Department of Biological Sciences, Tennessee State University, 3500 John A. Merritt Blvd., Nashville, TN*

[2]*Department of Chemistry, Tennessee State University, 3500 John A. Merritt Blvd., Nashville, TN*

Trihalomethanes, such as chloroform, bromoform, dibromo(chloro)methane, and bromo(dichloro)methane, are present in the major watersheds across the United States. These chemicals play an important role in the development of cancer, have adverse reproductive outcomes, and were found to be present above the threshold established by the Environmental Protection Agency. To

understand the impact of socioeconomic background on the quality of water and possible disparities, we have analyzed the levels of total trihalomethanes in the metropolitan areas in the major watersheds across the United States, in 2018, as they correlated to average household incomes. Our study found that Arkansas, Nevada, and Rhode Island demonstrated higher than federally mandated levels of total trihalomethanes in their watersheds. The median annual household and per capita incomes of the three states (Arkansas, Nevada, and Rhode Island) were lower than the national average. In addition, Delaware, New Hampshire, and Wisconsin, which had higher median income levels, demonstrated the lowest total trihalomethane levels across the United States.

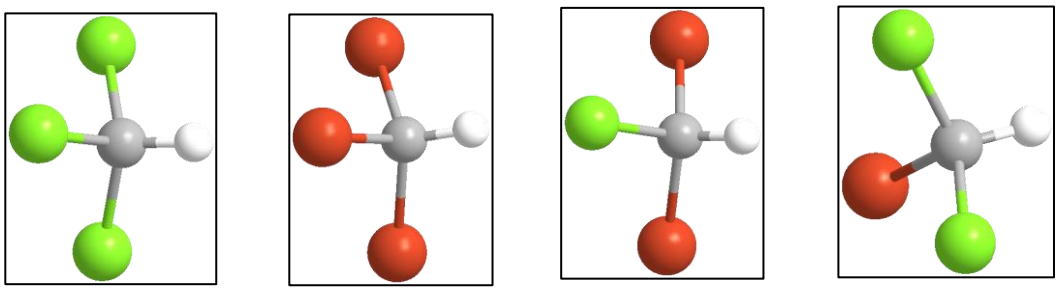
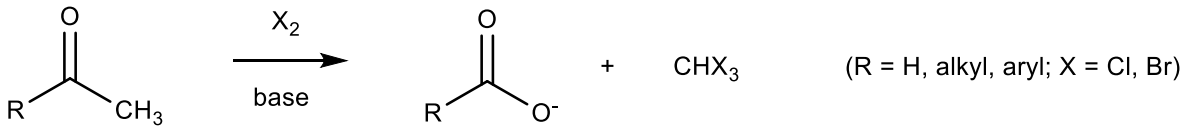


Figure 1. Molecular structure of common trihalomethanes in watersheds. from left: Chloroform; Bromoform; Dibromo(chloro)methane; and Bromo(dichloro)methane. Green = chlorine; Grey = carbon; White = hydrogen; Red = bromine.



Scheme 1. Formation of trihalomethanes via haloform reaction.

13

DRINKING WATER DISPARITIES IN VARIOUS COUNTIES IN TENNESSSE

Natasia Shaw, Sujata Guha,* and Ryan Beni*

Department of Chemistry, Tennessee State University, 3500 John A. Merritt Blvd., Nashville, TN

Safe and readily available fresh water is important to the well-being of the public health. In 2010, the UN General Assembly explicitly recognized the human right to water and sanitation. Everyone has the right to continuous, safe, acceptable, accessible, and affordable water for personal and domestic use. Though drinking water is essential to the public health, the differences in quality of drinking water within different communities has become a significant issue. We determined the percentage of contaminants within the water sources of varies counties with annual incomes ranging from $10,00 to over $100,000. We collected levels of chloroform, turbidity, and total organic carbon in order to compare the number of contaminants and determine if higher levels correspond with lower incomes. We found that the contaminants levels were way below the threshold established by the State of Tennessee. Although each county has an acceptable percentage of contaminants, we discovered that counties with lower income averages have higher levels than those counties whose composed of higher income households.

14

GLUTATHIONE SYNTHETASE (GSH-SYN) ACTIVITY IN CELLS FOLLOWING EXPOSURE TO KAEMPFEROL AND GENISTEIN

William Y. Boadi and Alekzander S. Garcia
Department of Chemistry, Tennessee State University, 3500 John A. Merritt Blvd., Nashville, TN

We have previously reported in the literature that exposure of 3T3-L1 preadipocytes to various concentrations of quercetin, kaempferol and genistein increases and maintain the cell's glutathione (GSH) levels after the oxidative stress. The findings warranted the need to investigate the possible mechanism(s) leading to the increase in GSH and its maintenance. One possible explanation could be due the increase in the activity of the enzyme glutathione synthetase (GSH-Syn). Towards this end, the objective of the study was to investigate the effects of single exposure at different doses of the flavonoids, kaempferol and genistein on GSH-Syn activities in preadipocytes (3T3-L1), and various cancer cell lines, namely, breast (BT-549 and MCF-7) and lung (A-549). Cells were exposed to each flavonoid at concentrations of 0, 5, 10, 15, 20 and 25 µM and the activities of GSH-Syn, in the respective cells were measured and quantified. The results indicate a gradual and sturdy increase in GSH-Syn activities in all cells following exposure to the respective flavonoids after the oxidative damage. These findings may suggest that flavonoids play an important role in protecting cells from oxidative damage.

15

EFFECTS OF LUTEOLIN AND QUERCETIN ON LIPID PEROXIDES IN POOLED HUMAN LIVER MICROSOMES (HLMs)

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Among plants, flavonoids exist in several forms, and serve many roles. They are the critical pigments that create the colors required for attracting the insects. They are found in fruits, vegetables, stems, roots, wine, and tea. These compounds are ubiquitous in most plants and are consumed by animals and humans in large quantities. The two flavonoids used in the current studies are Luteolin and Quercetin. The purpose was to investigate the effects of these compounds, on the levels of lipid peroxides in human liver microsomes (HLMs) at several time points namely, 4 hrs, 6 hrs, 18 hrs, and 24 hrs. HLMs at 1 mg/mL were incubated each with the respective flavonoids at concentrations of 0, 5, 10, 15, 20, and 25 µM following which the levels of lipid peroxides measured as thiobarbituric reactive substances were quantified. The results indicate that luteolin and quercetin decreased TBARS in a dose- and time-dependent manner.

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LIPID PEROXIDES IN PERIPHERAL BLOOD MONONUCLEAR CELLS FOLLOWING EXPOSURE TO FLAVONOIDS

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Studies have been shown that human and peripheral blood mononuclear cells (PBMCs) are mostly used for research purposes to study several biochemical endpoints. The effects of the flavonoids, genistein, kaempferol and quercetin on the levels of lipid peroxides (LP) in peripheral blood mononuclear cells (PBMCs) were investigated. PBMCs from several donors were each exposed to each of the flavonoids at concentrations of 0, 5, 10, 15, 20 and 25 µM. Our hypothesis was, that exposure of PBMCs to genistein, kaempferol and quercetin can decrease lipid peroxides in those cells to better cope with oxidative stress. Our results indicate that decreases in lipid peroxides were observed in the PBMCs for the flavonoid treated samples compared to those exposed to flavonoids and with oxidative stress. Levels of LP in quercetin

treated samples were lower compared to kaempferol and genistein. The findings suggest that the flavonoids play an important role in controlling oxidative stress in several donors of PBMCs.

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MODULATION OF REDUCED GLUTATHIONE BY LUTEOLIN IN POOLED IN POOLED HUMAN LIVER MICROSOMES (HLMs)

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Flavonoids can be found in fruits, vegetables, stems, roots, wine, and tea. Studies have shown that these compounds do act as antioxidants and do have some protective effects. While these may account for the anti-mutagenic activities of flavonoids in experimental systems, relatively little is known about the mechanisms of the modulation of glutathione (GSH) in human liver microsomes (HLMs). The objective of this study was to investigate the effects of low doses of luteolin on the modulation of GSH, a natural antioxidant, found in many cell systems. HLMs (at 1 mg/ml) were incubated with luteolin at concentrations of 0, 5, 10, 15, 20 and 25 µM, and incubated for 4, 6, 18 and 24 hrs respectively following the oxidative damage. Cells were centrifuged at a very low speed (3000 rpm, 10 minutes) in a refrigerated centrifuge. HLMs were then lysed using a lysis buffer and the levels of GSH were assayed using a colorimetric GSH assay kit from Fisher Scientific (Suwanee, GA). The results indicate that luteolin increased GSH levels in HLMs in a dose- and time-dependent fashion.

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MAPPING PARTICULATE MATTER EXPOSURE IN RELATION TO COVID-19'S MORTALITY RATE IN NASHVILLE, TENNESSEE

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COVID-19 is a pathogenic disease that causes severe respiratory illness. One development discovered is the notion of COVID-19 clusters. According to the Tennessee Health Department, a "COVID-19 cluster is two (2) or more confirmed cases (with positive lab results) of COVID-19 that are linked by the same location of exposure (for example a hospital) or exposure event (for example a vacation) that is not a household exposure." When exposed to particulate matter, exclusively $PM_{2.5}$, long or short term, it exacerbates the symptoms of COVID-19. Particulate matter is made up of many different types of substances, and is an air pollutant. $PM_{2.5}$ has a diameter of 2.5 micrometers or less and is more lethal to one's health. The objective was to investigate particulate matter exposure in Nashville, Tennessee in relation to COVID-19 cluster data. Once achieved, data could be put to use by health officials to facilitate the placing of testing sites and determine vaccine distribution. Using the computer applications ARCgis, EJScreen, and Microsoft Excel, maps were developed to show $PM_{2.5}$ exposure, COVID-19's mortality rate, and COVID-19 clusters in affected Nashville areas. Collecting data from the Tennessee Department of Health, the Metro Public Health Department, and the EPA's EJScreen, these maps were developed. The percentile ranges of $PM_{2.5}$ exposure on a statewide scale for the Nashville zip codes with the highest mortality rates was determined. From the developed visualization, there was no confirmation of whether there was a direct correlation between $PM_{2.5}$ exposure and the COVID-19 mortality rate in Nashville. There are direct contributing factors to the mortality rate of COVID-19 in Nashville, Tennessee, but there wasn't enough information to determine that $PM_{2.5}$ had a direct effect on its lethality.

19

INTERACTIONS OF THE ANTIMICROBIAL PEPTIDE CKR WITH MODEL MEMBRANES

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The emergence of resistance in bacterial pathogens to conventional antibiotics is a serious threat to human life and to the healthcare system. The scientific community is searching for alternatives to antibiotics with new killing mechanisms. This project investigates the interaction of the antimicrobial peptide CKRWWKWIRW with E. Coli and Staphylococcus Aureus model membranes. The main goal and broader purpose of this research is to determine whether adding the antimicrobial peptide (AMP) will alter or destroy the model membrane of E. Coli or Staph. For that, we use simplistic lipid models, palmitoyloleoylglycerophosphoglycerol (POPG) and palmitoylglycerophosphoethanolamine (POPE), which mimic the chemical composition of E. Coli and Staph bacteria. To achieve this main goal, the function of each amino acid in the CKR sequence was identified to assess the importance of the AMP in general. Then, the killing mechanism of CKR on E. Coli and Staph was determined using infrared and fluorescence spectroscopy. Infrared spectroscopy was used to determine the functional groups in these phospholipids, and fluorescence spectroscopy will be used to detect any changes to the CKR peptide when it interacts with these phospholipids. The specific hypothesis of this experiment was that significant interactions with CKR do occur with selected members of the model membranes of various compositions, and our results proved our hypothesis to be correct. When we ran the infrared spectroscopy, the CKR peptide showed an amide 1 group initially at 1651.47 cm^{-1}, E. Coli showed a C-O functional group at 1734.47 cm^{-1}, and Staph showed a C-O functional group at 1733.14 cm^{-1}. We used a 1:100 molar ratio meaning that 1 mole of CKR interacted with 100 mol of E. Coli or Staph bacteria, and the results showed that these numbers changed indicating that CKR does interacts with E. Coli and Staph through the C-O bond by changing the structure.

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STUDYING CAR T CELLS IN A SOLID TUMOR MODEL

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T cells orchestrate immune responses when their receptors bind specific antigen of a pathogen or cancer. Cancer immunotherapy eliminates cancer cells primarily by enabling anti-tumor T cell activity. Chimeric antigen receptor (CAR) T cells are a revolutionary form of cellular immunotherapy. CARs are genetically engineered antigen binding receptors that permit CAR T cells to recognize and eliminate cancer cells. While CAR T cells recognizing CD19 have proven efficacious against B cell leukemias and lymphomas, navigating the more complicated microenvironment of solid epithelial tumors is a challenge for CAR T cell therapies. Optimizing CAR T cell metabolism may permit enhanced anti-tumor function in the nutrient-deprived tumor microenvironment. To study CAR T cells in a solid tumor microenvironment, we endeavored to develop murine B16 melanoma and MC38 colorectal carcinoma cell lines that ectopically express CD19. Previous work has demonstrated that inhibition of Glutaminase, an enzyme that converts glutamine to glutamate, alters T cell differentiation which may enhance anti-tumor immunity. We hypothesized that Glutaminase inhibition by small molecule CB-839 would alter mitochondrial metabolism, which has been associated with improved CAR T cell functions. CB-839 treatment of CD8 T cells increased mitochondrial mass without increasing mitochondrial membrane potential, suggesting enhanced mitochondrial fitness. Our results suggest that glutaminase inhibition may be a promising approach to enhance CAR T cell function in solid tumors.

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DETERMINING THE EFFECT OF GLI2 ON TUMOR-MACROPHAGE INTERACTIONS

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Breast cancer often metastasizes or spreads to the skeleton, resulting in bone destruction known as tumor-induced bone disease (TIBD). Our lab has previously shown that bone-metastatic breast cancer cells overexpress the transcription factor Gli2 which stimulates secretion of parathyroid hormone-related protein (PTHrP) and promotes bone destruction. Several small molecule inhibitors targeting Gli proteins have been developed including GANT58. However, the mechanisms by which GANT58 and other Gli antagonists alter tumor cell growth and intracellular signaling are largely unknown due to the complexity of the tumor-bone microenvironment. In other diseases, such as allergy and pancreatitis, Gli2 has been shown to be associated with changes in cytokine expression, and many of these cytokines are those that are known to be associated with polarizing macrophages toward an M2 (immune-suppressive, tumor-supportive) phenotype. Polarizing macrophages toward an M1 (pro-inflammatory, anti-tumor) phenotype has been shown in many cancer types, including bone metastases, to reduce tumor growth and improve outcomes. We hypothesize that GANT58 will decrease the expression of cytokines that suppress the immune system's response, such as TGFβ, resulting in the polarization of the cytokines away from M2 and towards M1. We will evaluate the effects of GANT58 treatment on cytokine expression of mouse breast cancer cells (4T1) by PCR. We will then measure the expression of NOS2 (M1 marker) and CD206 (M2 marker) in macrophages treated with conditioned media from the GANT58-treated 4T1 cells. We believe this will provide a better understanding of how to target tumor-immune interactions and the mechanism of GANT58 in the tumor microenvironment beyond the role it plays in reducing bone destruction.

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A BRIEF REVIEW ON ADOPTING X-RAY CRYSTALLOGRAPHY IN UNDERGRADUATE CHEMISTRY CURRICULUM

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In this literature research I have reported on adopting X-Ray Crystallography in Undergraduate Studies. The study is to find precedence in adopting X-Ray Crystallography into the undergraduate curriculum by analyzing various trials from other chemistry departments that have already incorporated it. Incorporating X-ray crystallography in undergraduate curriculum would be useful for students pursuing graduate studies in chemistry. X-Ray Crystallography is mainly taught in graduate schools. This technique could be beneficial for undergraduate students since it helps with visualization of molecules by means of experiments. This would bring familiarity with the technique as another powerful tool in their toolbox of molecular analyses. As a result of this study, we hope to find how undergraduate courses have started to incorporate X-Ray Crystallography into their curriculum and whether it was successful. Such information is helpful in incorporate X-ray Crystallography into more undergraduate curriculum elsewhere.

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EQUITY FOR CHEMISTRY STUDENTS WITH VISUAL IMPAIRMENT

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Equity is one important component considered in the modern education system. Modern educators are considering their contents to have equity for all types of learners. In the design phase of courses educators and educational institutes are applying equity aspects. The universal design of learning is being considered for this purpose. This is because the general education population simply does not have a high percentage of visually impaired students. It is important to include all learning modalities when designing courses for present and future learners. I am investigating the state of equity and accessibility for visually impaired students who study chemistry. The findings of this research will likely contribute in re-designing courses by incorporating the needs of visually impaired students.

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A STUDY OF THE EFFECT OF RECATION PARAMETERS ON THE PHYSICO-CHEMICAL PROPERTIES OF MELANINS

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Melanins (MNs) constitute a ubiquitous class of dark-colored pigments which can be found in all kingdoms of life. Despite many decades of intense research and computer modelling, there is no consensus on the precise chemical structure of these biomolecules, nor a precise explanation for their dark color, exhibited by their broad-range, monotonic absorbance profile over the entire ultraviolet and visible region of the electromagnetic spectrum. In this project, we study the effects of reaction conditions on the physic-chemical properties of melanin. The study focuses on the apparent color of the materials, their physical stability (precipitate or suspension) and their capacity to adhere to inorganic minerals. The reaction parameters studied involve different concentrations of base, different types of base, the kinetics of the reaction and the co-precipitation of the MNs using different concentrations of Ca^{2+}. By using different types of precursors to generate the MNs, the project aims to obtain general information regarding the relationship between reaction conditions and properties of MNs; information that would be applicable to all types of MNs.

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TOLL-LIKE RECEPTOR 4 IS REQUIRED FOR TRIBUTYLTIN-INDUCED INCREASES IN PRODUCTION OF INTERLEUKIN 1 BETA AND INTERLEUKIN 6 BY HUMAN IMMUNE CELLS

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Toll-like receptors (TLRs) activate immune responses through recognition of pathogen associated molecular patterns (PAMPs) and damage associated molecular patterns (DAMPs). TLR4 is a cell surface receptor that recognizes PAMPs. MAP kinases (MAPK) are downstream signaling components of the TLR pathway that lead to the production of chemokines, type I interferons, and pro-inflammatory cytokines, such as interleukin (IL) 1β and IL-6, in response to TLR activation. IL-1β and IL-6 are pro-inflammatory cytokines necessary for appropriate response to injury or infection. However, inappropriate elevation of IL-1β or IL-6 levels leads to chronic inflammation, which is implicated in the development of diseases such as atherosclerosis, cancer, and autoimmunity. Tributyltin (TBT) is an environmental contaminant due to its use as a biocide in numerous products and in anti-fouling paints. Previous studies have found that

exposure to TBT, which is present in human blood, increases the secretion and intracellular concentrations (production) of both IL-1β and IL-6 in peripheral blood mononuclear cells (PMBCs) and these increases require MAPK activation. The current study examines whether the upstream regulator of MAPK activation in immune cell production of IL-1β and IL-6, TLR4, is also required for TBT to induce increases in these cytokines. TLR4 was inhibited with the selective inhibitors TAK-242 or C34. The ability of TBT (100, 50, and 25 nM) to cause increased production of IL-1β or IL-6 in control cells versus inhibitor-treated cells after 24 h of exposure was examined using ELISA and western blot. Results indicate that when TLR4 is inhibited there is a decrease in TBT-induced production of both IL-β and IL-6. Thus, either direct or indirect activation of TLR4 by TBT appears to be part of the mechanism by which it can stimulate IL-1β and IL-6 production in human immune cells.

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THE EFFECT OF HEXABROMOCYCLODODECANE ON THE PRODUCTION OF INTERLEUKIN-6 BY HUMAN IMMUNE CELLS

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Hexabromocyclododecane (HBCD) is used as an additive flame retardant for thermal insulation in buildings, as well as in upholstery and electrical apparatuses. It can leach from treated products and is found in dust particles, soil, and sewage sludge. This environmental contamination has led to its presence and in a number of foods especially fatty seafood, but also nuts and nut butters. HBCD has been detected in human serum samples. Interleukin- 6 (IL-6) is produced by a number of different cell types, including human immune cells. It is involved in cell proliferation, differentiation, apoptosis, and bone remodeling. When IL-6 is overproduced it can lead to chronic inflammation. Diseases such as Castleman disease, Crohn's disease, rheumatoid arthritis, juvenile idiopathic arthritis, bone loss, and cardiovascular disease are associated with overproduction of IL-6. HBCD has been shown to increase the production of other pro-inflammatory cytokines by immune cells. We hypothesize that HBCD may also increase production of IL-6. In this study peripheral blood mononuclear cells (PBMCs) were isolated from leukocyte filters and then exposed to HBCD for 24 hours at different concentrations (5-0.05 µM). Production of IL-6 (combination of secreted and intracellular levels) was determined by measuring secreted levels via enzyme linked immunosorbent assay (ELISA) and intracellular levels via Western blot. Increases in production of IL-6 were seen at five or more of the HBCD exposure levels in cells from 5 different donors. The average increase in IL-6 production seen at the 1 µM exposure was 2.4 fold (ranging from 1.2-3.6 fold) while that at 0.1 µM was 2.2 fold (ranging from 1.2-2.8 fold). These results show that HBCD can induce increases in production of IL-6. Thus, HBCD may have the potential to contribute to inflammation in exposed individuals.

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TRICLOSAN INCREASES PRODUCTION OF THE PRO-INFLAMMATORY CYTOKINE INTERLEUKIN-1B IN HUMAN IMMUNE CELLS: THE ROLE OF ERK1/2 PATHWAY

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Triclosan (TCS) is an antimicrobial agent found in medical and personal care products including deodorants, toothpastes, mouthwash, antibacterial soaps, makeup, and lotions. Approximately 1 µM of TCS is found in human blood plasma upon ingestion of TCS-containing mouthwash. Interleukin-1 beta (IL-1β) is a pro-inflammatory cytokine produced by immune cells that plays a critical role in immune response regulation, tissue repair, and cellular growth. Overproduction of IL-1β contributes to chronic inflammation and inflammatory diseases such as rheumatoid arthritis and multiple sclerosis. IL-1β also stimulates tumor

development. A previous study showed that exposure of immune cells (peripheral blood mononuclear cells (PBMCs)) to TCS increased secretion of IL-1β in a MAP kinase (ERK1/2) dependent manner. MAP kinases regulate both secretion and production of IL-1β. The current study examines whether TCS is stimulating the immune cell's ability to produce IL-1β (or solely releasing pre-existing stores of this cytokine) as well as the role of ERK 1/2 pathway in any TCS-induced elevation of IL-1β production. PBMCs were exposed to TCS concentrations (0.05-5 μM) for 30 minutes, 6 hours, or 24 hours. Cellular production (combination of secreted and intracellular levels) of IL-1β in response to this treatment was measured using Enzyme Linked Immunosorbent Assays for secretion and Western Blots for intracellular levels. Results indicate that production of IL-1β was increased at each length of exposure, with the greatest TCS-induced increases seen at 6 h. The mechanism of this increased production was investigated by treating PBMCs with the ERK1/2 pathway inhibitor PD98059 prior to exposure to TCS. The pathway inhibitor diminished TCS-induced IL-1β production. Thus, TCS not only stimulates the secretion of IL-1β from immune cells, but also increases production of this potent inflammatory cytokine, which can contribute to several pathologies. TCS-induced increases in IL-1β were shown to be dependent on the ERK 1/2 MAPK pathway.

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EFFECTS OF TRIBUTYLTIN EXPOSURES ON TRANSLATION REGULATORY FACTORS EIF4E, EIF4B, AND S6 IN HUMAN LYMPHOCYTES

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Tributyltin is an environmental contaminant used in a variety of applications including wood preservation, controlling of slime in paper mills, and as an antifouling agent for ships. Due to its multiple uses in various industries, it has entered the food chain and has been detected in human blood at levels as high as 261 nm. Inflammatory cytokines are important mediators of the response to injury or infection. However, if their levels are increased in the absence of a needed immune response, chronic inflammation can occur. Chronic inflammation is associated with a number of pathologies including, rheumatoid arthritis, Crohn's disease, atherosclerosis, and cancer. TBT can increase the synthesis of pro-inflammatory cytokines such as interferon gamma (IFNγ), tumor necrosis factor alpha (TNFα), interleukin 1 beta (IL-1β), and interleukin 6 (IL-6) in human immune cells. TBT appears to utilize the ERK 1/2 and/or p38 MAPK pathways to stimulate pro-inflammatory cytokine production by immune cells. MAPK pathways have the capacity to regulate translation including processes leading to the phosphorylation (activation) of eukaryotic initiation factor 4E (eIF4E), eIF4B, and the S6 ribosomal subunit. The current study examines the levels and phosphorylation state of eIF4E, eIF4B and S6K after 10-minute, 1-hour, 6-hour, and 24-hour exposures to TBT in monocyte-depleted peripheral blood mononuclear cells (MD-PBMCs). Results indicate that TBT (at several concentrations) caused increased phosphorylation (activation) of eIF4B (S406) and S6 within 10 minutes of exposure across most donors. Within 1 hour of exposure, TBT elevated levels of phospho (P)-S6, S6, P-eIF4B (S406) and eIF4B. At 6 hours of exposure TBT caused significant increases at higher concentrations for P-S6 and P-eIF4B (S406) and at 24-hour exposure TBT caused increased levels of S6 and P-eIF4B (S406). These results suggest that TBT is elevating the synthesis of key pro-inflammatory cytokines in immune cells by its ability to activate translation.

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ANTIMICROBIAL TRICLOSAN (TCS) INCREASES PRODUCTION OF INTERLEUKIN 6 (IL-6) IN HUMAN IMMUNE CELLS

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Triclosan (TCS) is an antimicrobial compound that is widely used in personal hygiene products such as mouthwash and toothpaste. TCS can be ingested or absorbed through the skin and has been found in human blood, breast milk, and urine. Interleukin (IL)-6 is an important pro-inflammatory mediator produced by lymphocytes, monocytes, and other human cells, which regulates cell growth, tissue repair, and immune function. Increased levels have been associated with a number of diseases including rheumatoid arthritis and certain cancers. In a previous study we showed that TCS at concentrations between 0.05-5 µM increased the secretion of IL-6 from immune cells within 24 h. Here we will examine whether the increase in IL-6 secretion stimulated by TCS is due to an increase in the cellular production of IL-6 or only due to release of existing stores of the cytokine. Human peripheral blood mononuclear cells (PBMCs) were exposed to TCS at concentrations of 0-5 µM. The cellular production (combination of secreted and intracellular levels) of IL-6 was measured at 10 minutes, 30 minutes, 6 hours, and 24 hours. Secreted levels were measured in supernatants from exposed cells using enzyme-linked immunosorbent assay (ELISA) and intracellular levels were measured by lysing the exposed- cell pellet followed by Western Blot. Results indicate the production of IL-6 was increased by exposure to one or more concentration of TCS at each length of exposure. The greatest increase in IL-6 production was seen at 6 h, where all TCS exposures caused quite substantial increases in IL-6 production in all donors. The magnitude of these increases varied dependent on the donor. These results indicate that TCS has the capacity to increase cellular production of the important pro-inflammatory cytokine IL-6 from immune cells. TCS-induced fluctuations of IL-6 secretion may serve to produce unwarranted inflammation and its associated pathologies.

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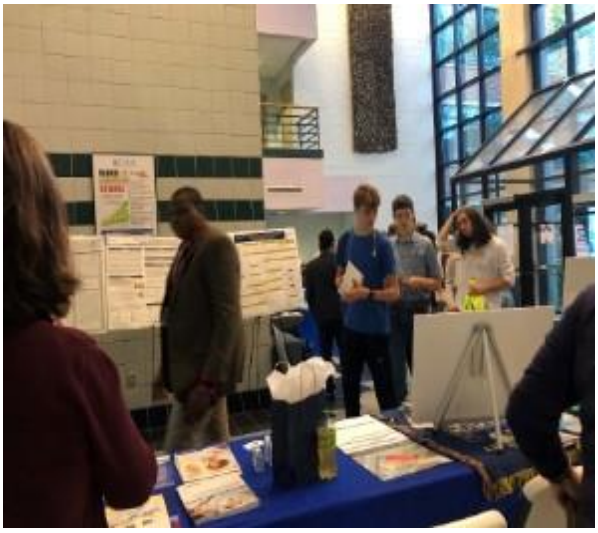

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