FEED THE FUTURE
The U.S. Government's Global Hunger & Food Security Initiative

Bridging Food Security, Nutrition, and Health Issues

[29th August 2024]

Dr. Aliyar Cyrus Fouladkhah | Ms. Kiyana E Kelly

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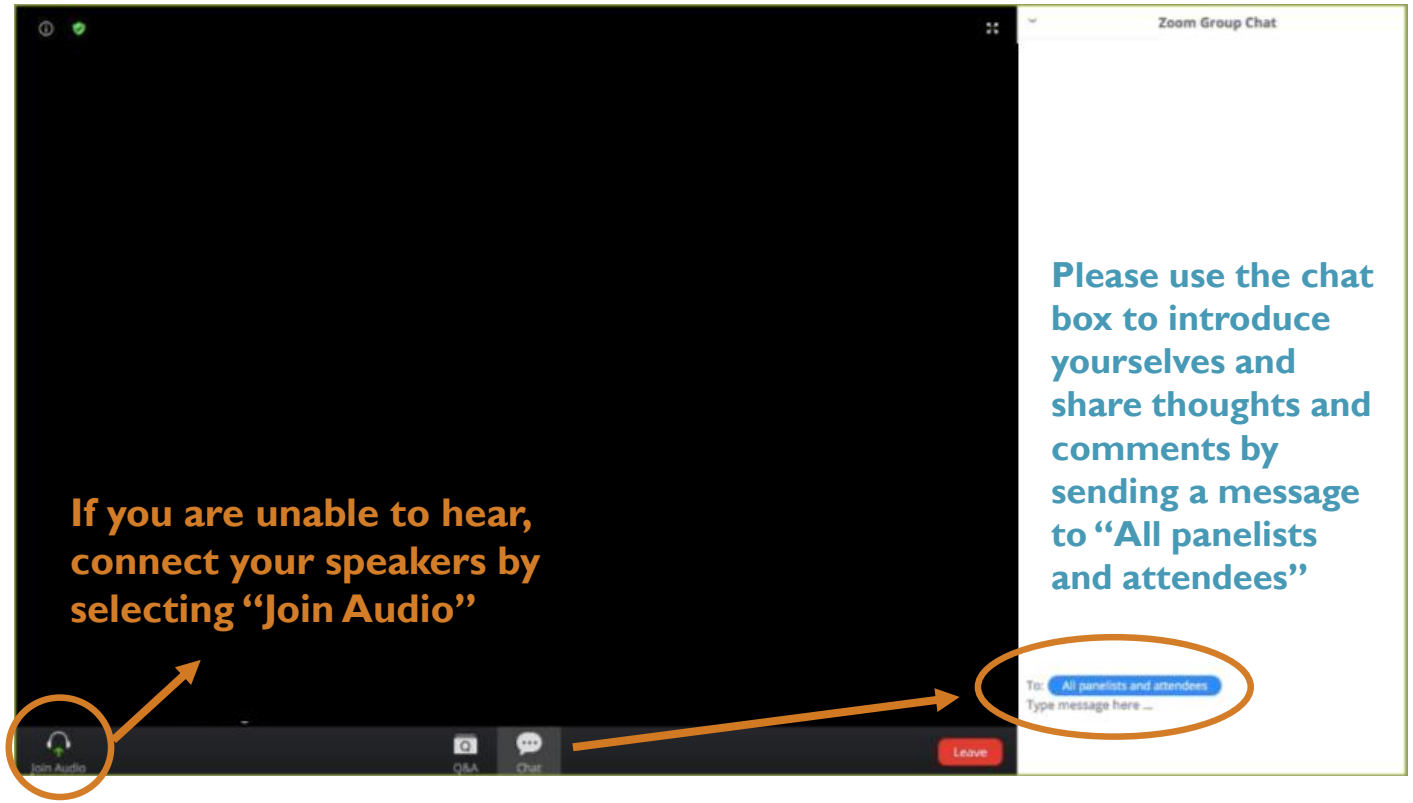
WELCOME TO THE ZOOM WEBINAR



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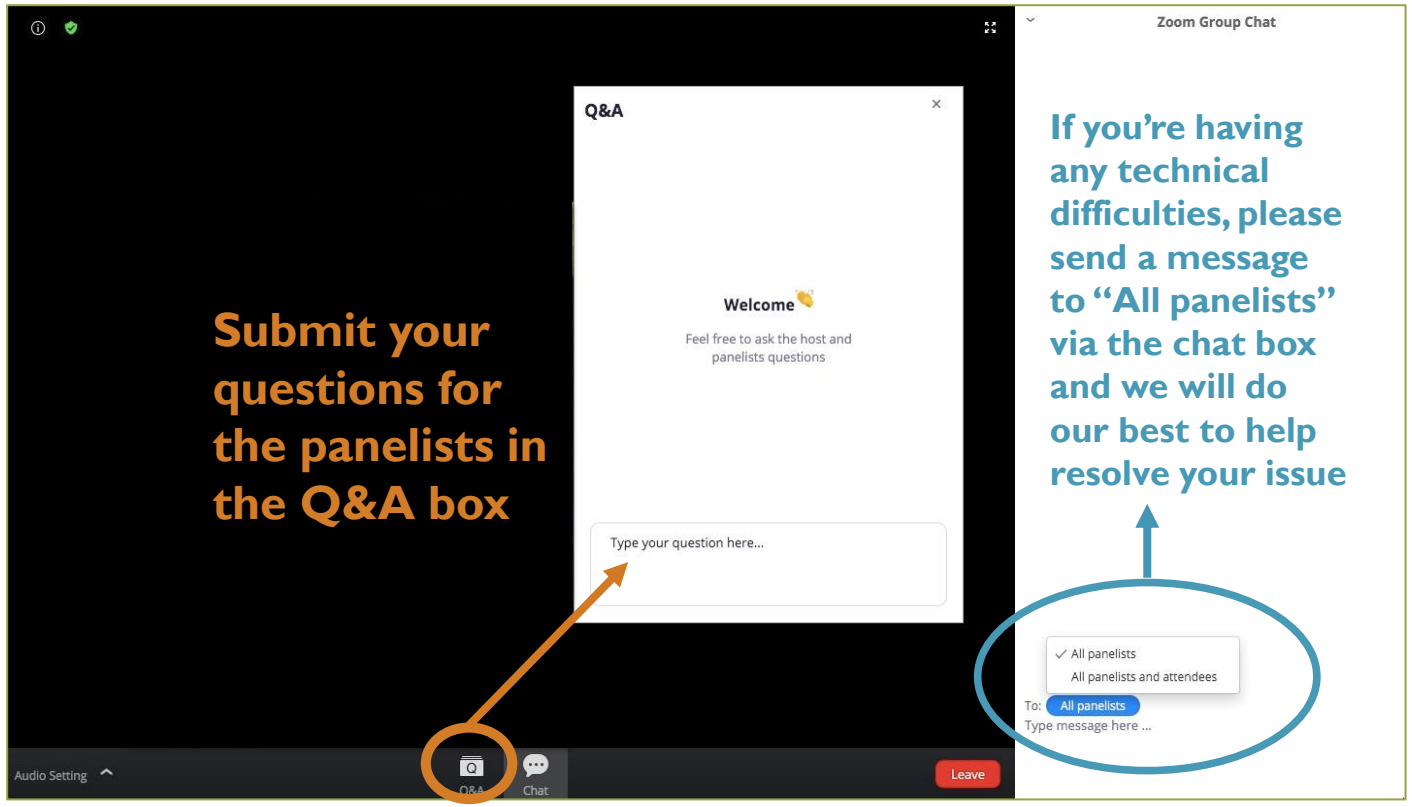
Q&A AND CHAT


Submit your questions for the panelists in the Q&A box
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Feel free to ask the host and panelists questions
Type your question here...
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Dr. Lynne M. Ausman

- Saqr Bin Mohammed Al Qasimi Professor in International Nutrition
- Professor at the Friedman School of Nutrition Science and Policy
- Scientist, Cardiovascular Nutrition Laboratory, HNRCA
- Adjunct Professor, Family Medicine and Consumer Health, Tufts University School of Medicine

Dr. Aliyar Fouladkhah

- Assistant Professor, College of Agriculture, Human, and Natural Sciences
- Director, Public Health Microbiology Laboratory
- Tennessee State University

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The MSI Student Working Group Presents

Bridging Food Security, Nutrition, and Health Issues

Zoom Webinar | Thursday, August 29th, 2024 | 10:00-11:00AM (CST)

**The MSI Student Working Group is a student-led group created by the Feed the Future Food Systems for Nutrition Innovation Lab & the 1890 Universities Foundation.*

Aliyar Cyrus Fouladkhah, PhD,MS, MPH, MACE, CFS, CPH

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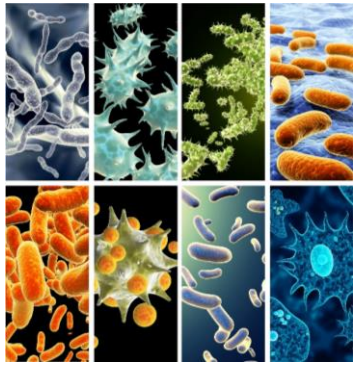
Impact of Climate Change on Food Security and Crop Nutrition



Aliyar Cyrus Fouladkhah, PhD, MS, MPH, CFS, CPH
Associate Professor, Tennessee State University
Faculty Director, Public Health Microbiology Laboratory
Founding Director, Public Health Microbiology Foundation

August 29, 2024, Via Zoom

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Public Health Microbiology Foundation
Dr. Aliyar Cyrus Fouladkhah

Tennessee State University

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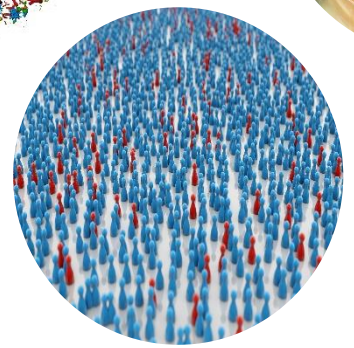
Presentation Content

Part I: *Epidemiology of Foodborne and Waterborne Diseases*

Part II: *Impact of Climate Change on Food Security*

Part III: *Impact Analysis (134,592 reach)*



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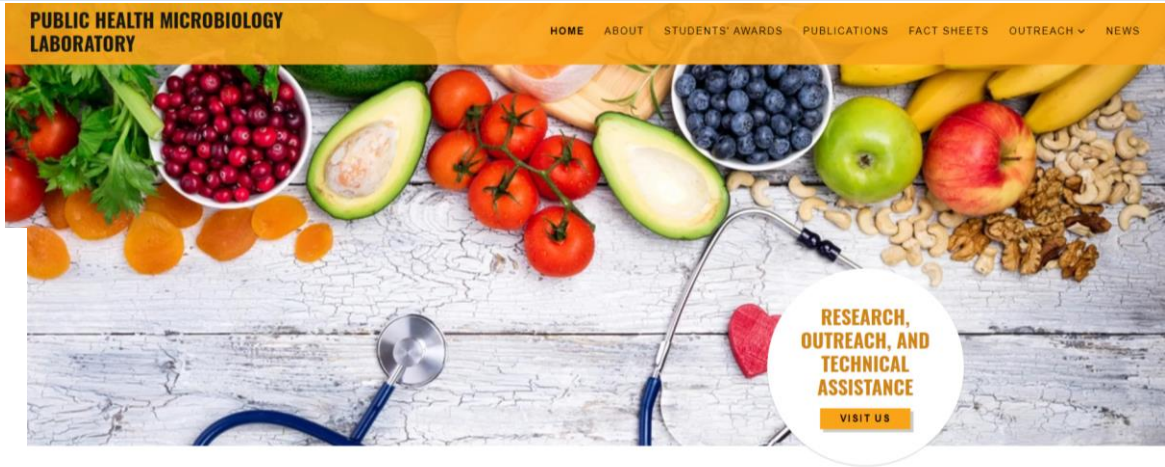
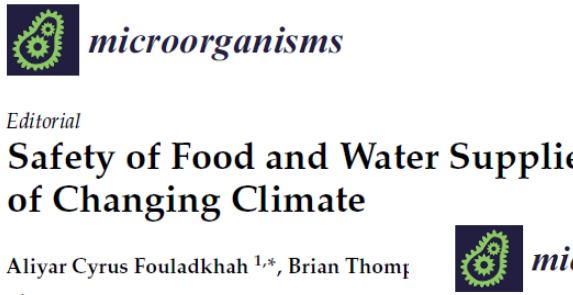
Website: https://publichealthmicrobiology.education/




microorganisms

MDPI

Editorial

Safety of Food and Water Supplies in the Landscape of Changing Climate

Aliyar Cyrus Fouladkhah [1,*], Brian Thomp

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microorganisms

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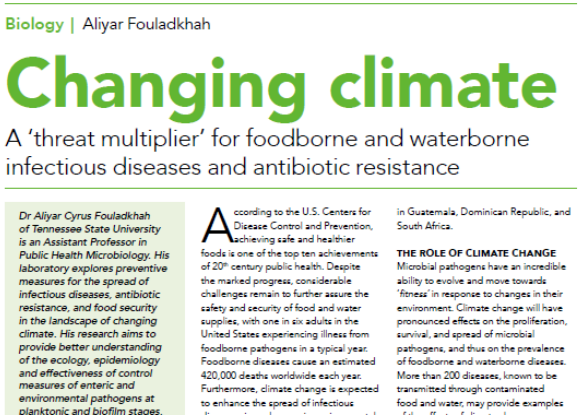
Editorial

The Threat of Antibiotic Resistance in Changing Climate


Biology | Aliyar Fouladkhah

Changing climate

A 'threat multiplier' for foodborne and waterborne infectious diseases and antibiotic resistance

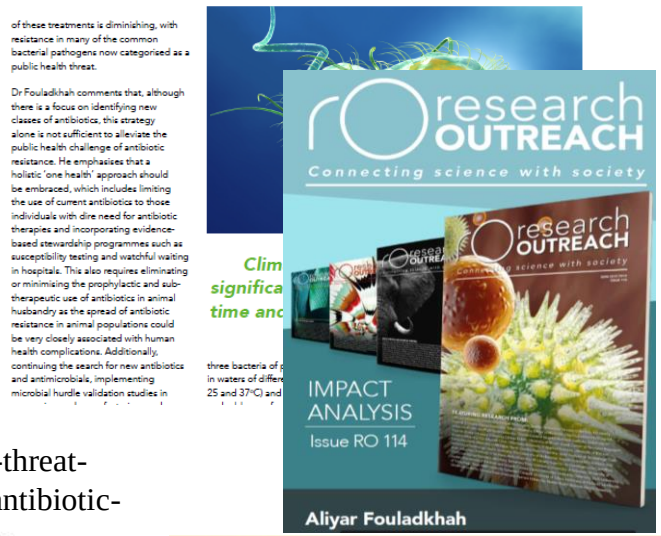
Dr Aliyar Cyrus Fouladkhah of Tennessee State University is an Assistant Professor in Public Health Microbiology. His laboratory explores preventive measures for the spread of infectious diseases, antibiotic resistance, and food security in the landscape of changing climate. His research aims to provide better understanding of the ecology, epidemiology and effectiveness of control measures of enteric and environmental pathogens at planktonic and biofilm stages.

According to the U.S. Centers for Disease Control and Prevention, achieving safe and healthier foods is one of the top ten achievements of 20th century public health. Despite the marked progress, considerable challenges remain to further assure the safety and security of food and water supplies, with one in six adults in the United States experiencing illness from foodborne pathogens in a typical year. Foodborne diseases cause an estimated 420,000 deaths worldwide each year. Furthermore, climate change is expected to enhance the spread of infectious

in Guatemala, Dominican Republic, and South Africa.

THE ROLE OF CLIMATE CHANGE

Microbial pathogens have an incredible ability to evolve and move towards 'fitness' in response to changes in their environment. Climate change will have pronounced effects on the proliferation, survival, and spread of microbial pathogens, and thus on the prevalence of foodborne and waterborne diseases. More than 200 diseases, known to be transmitted through contaminated food and water, may provide examples


of these treatments is diminishing, with resistance in many of the common bacterial pathogens now categorised as a public health threat.

Dr Fouladkhah comments that, although there is a focus on identifying new classes of antibiotics, this strategy alone is not sufficient to alleviate the public health challenge of antibiotic resistance. He emphasises that a holistic 'one health' approach should be embraced, which includes limiting the use of current antibiotics to those individuals with dire need for antibiotic therapies and incorporating evidence-based stewardship programmes such as susceptibility testing and watchful waiting in hospitals. This also requires eliminating or minimising the prophylactic and sub-therapeutic use of antibiotics in animal husbandry as the spread of antibiotic resistance in animal populations could be very closely associated with human health complications. Additionally, continuing the search for new antibiotics and antimicrobials, implementing microbial hurdle validation studies in

Clim
significa
time and

Outreach Article Available at:
https://researchoutreach.org/articles/changing-climate-threat-multiplier-foodborne-waterborne-infectious-diseases-antibiotic-resistance/

Extramural Funding: >$3.4M since 2015

- Pressure BioScience Inc.: **$35,000** (Role: PD, 2019-2024)
- USDA-NIFA CBG: **$350,000** (Role: PD, 2018-2022)
- USDA-NIFA HEC: **$50,000** (Role: PD, 2018-2021)
- USDA-NIFA FSOP: **$165,000** (Role: PD, 2018-2021)
- Pressure BioScience Inc.: **$23,500** (Role: PD, 2017-2019)
- USDA-NIFA FSOP: **$59,750** (Role: PD, 2016-2019)
- Pressure BioScience Inc.: **$9,400** (Role: PD, 2017-2019)
- NIFA FSOP.: **$880,000** (Role: CO-PD, 2019-2023)**
- USDA-NIFA FSOP.: **$1,197,751** (Role: CO-PD, 2015-2020)**
- NIFA CBG.: **$300,000** (Role: CO-PD, 2018-2022)

**Pending account setting and internal administrative approval.*
*** Sub-awardee of Southern Center Main Awards.*

PUBLIC HEALTH MICROBIOLOGY LABORATORY

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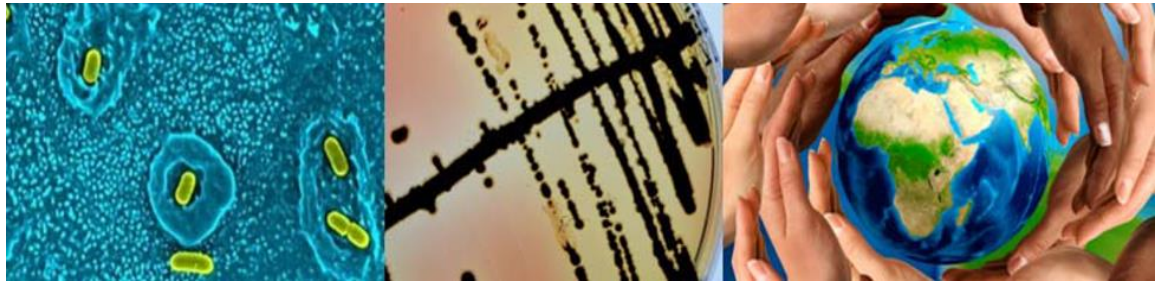

Part I: *Epidemiology of Foodborne Diseases*

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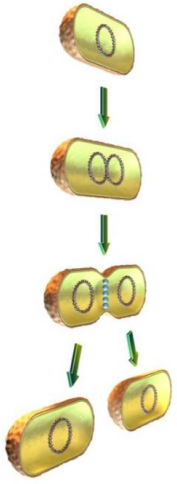
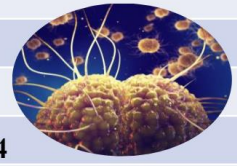
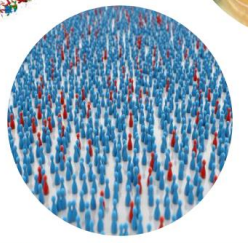
Bacterial Multiplication

Binary Fission: 20 minutes or less when intrinsic and extrinsic factors are optimal.



Time	# of Bacteria
0 minutes	1
20 minutes	2
40 minutes	4
1 hour	8
2 hours	64
4 hours	4,096
6 hours	262,144
8 hours	16,777,216
12 hours	68,719,476,736





Bacteria	Estimated Infective Dose*
Salmonella serovars	<10 cells
Shiga toxin-producing *E. coli*	10 to 100 cells
Cronobacter sakazakii	10 to 100 cells
Listeria monocytogenes	<1000 cells
Campylobacter spp.	5000 to 10,000 cells
Staphylococcus aureus	>100,000 cells
Vibrio cholerae	1,000,000 cells

Information and photos are modified and adopted from BBB of Food and Drug Administration, BAM Resources of Centers for Disease Control and Prevention. Photo Courtesy: Adobe Stock (standard license of photos purchased by the Public Health Microbiology laboratory).

** Calculated for oral ingestion based on epidemiological data from outbreaks and human feeding trials of volunteers. Data obtained from BBB of Food and Drug Administration (2nd edition).*

Public Health Microbiology Laboratory: Education, Research, Outreach, and Technical Assistance: https://publichealthmicrobiology.education/

Emerging pathogens

Vertical and Horizontal Gene Transfer and Emerging Pathogens

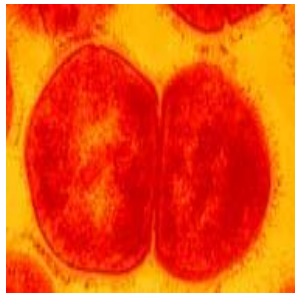
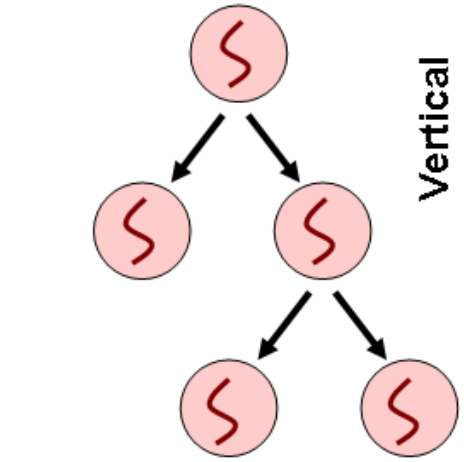
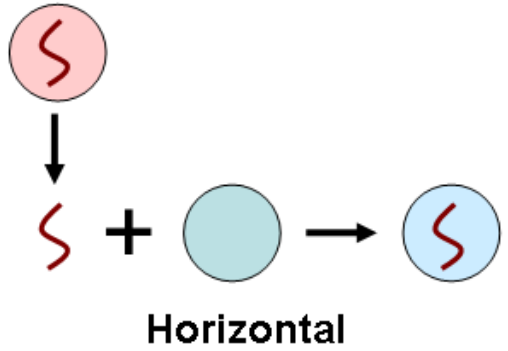
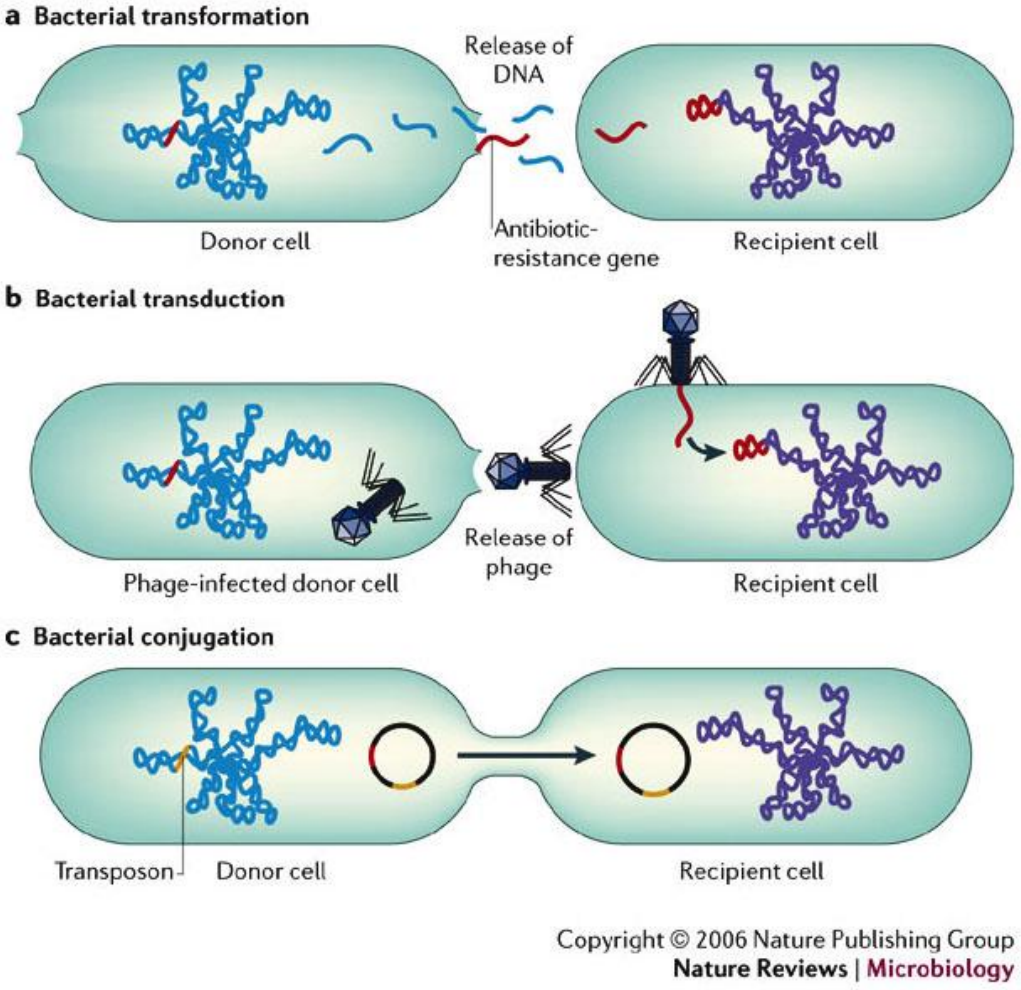


Photo Courtesy:
http://www.daviddarling.info/encyclopedia/B/binary_fission.html







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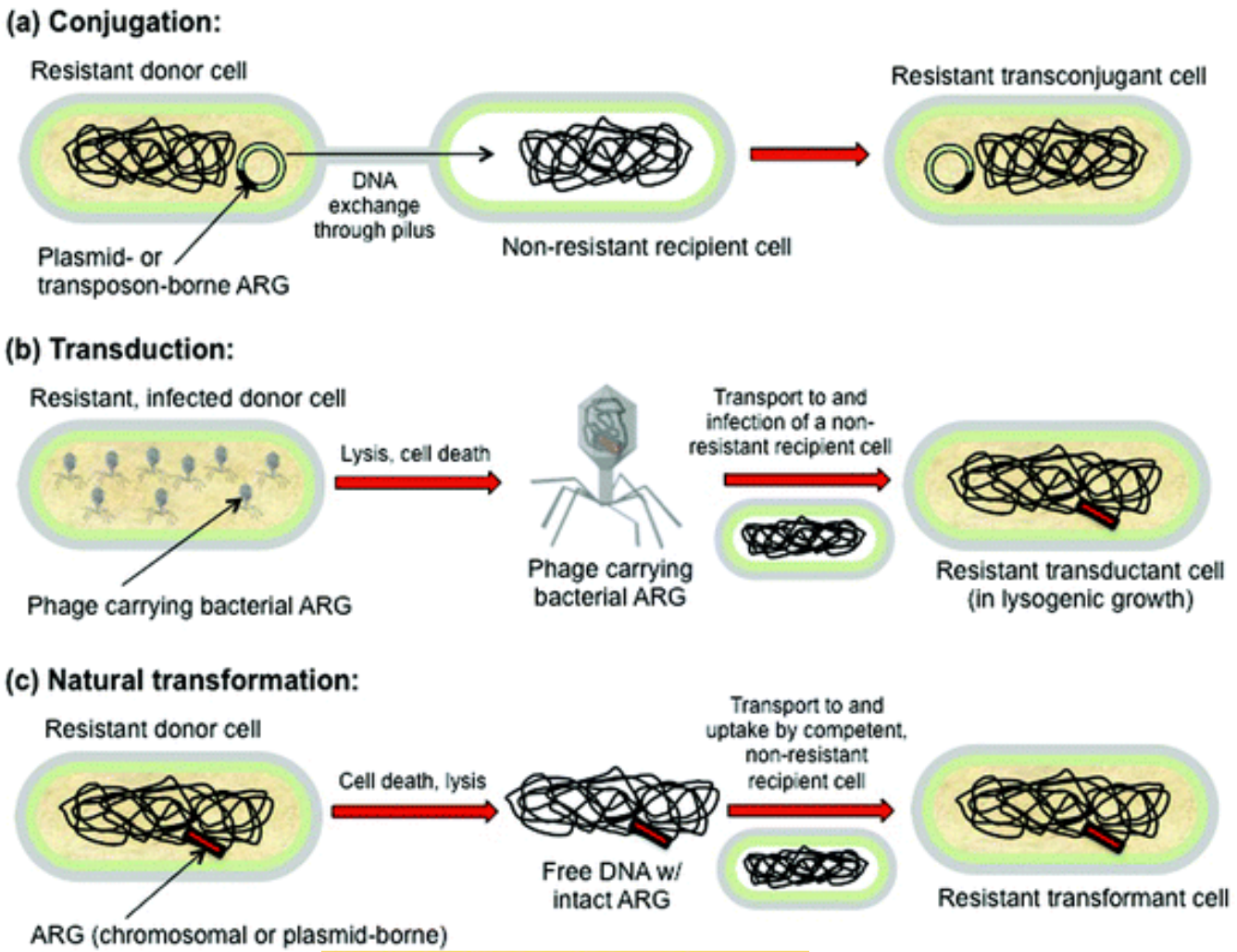
Horizontal Gene Transfer



Donn, 2012

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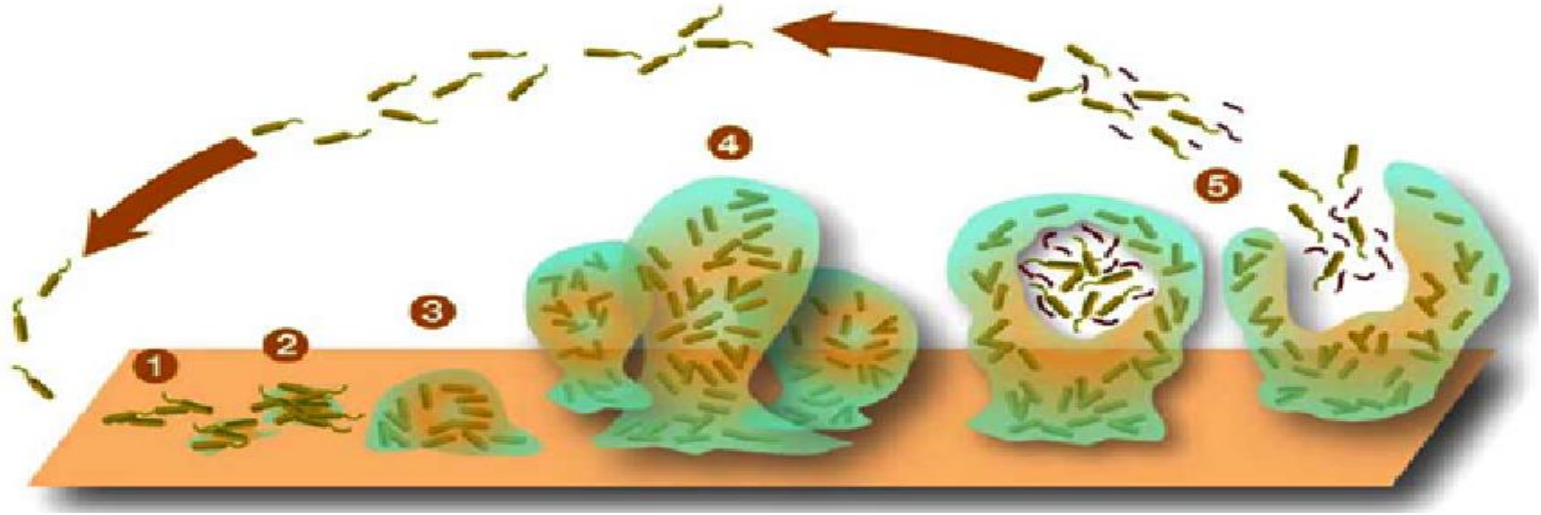
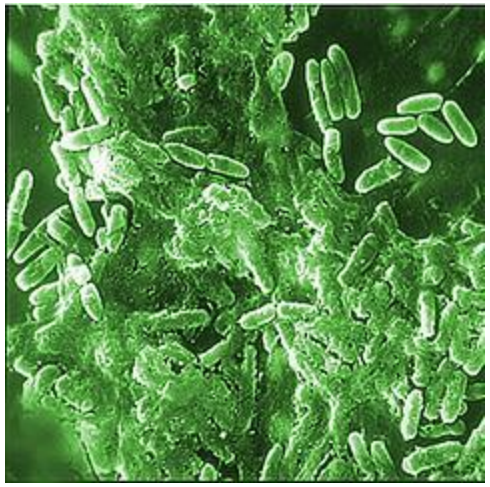
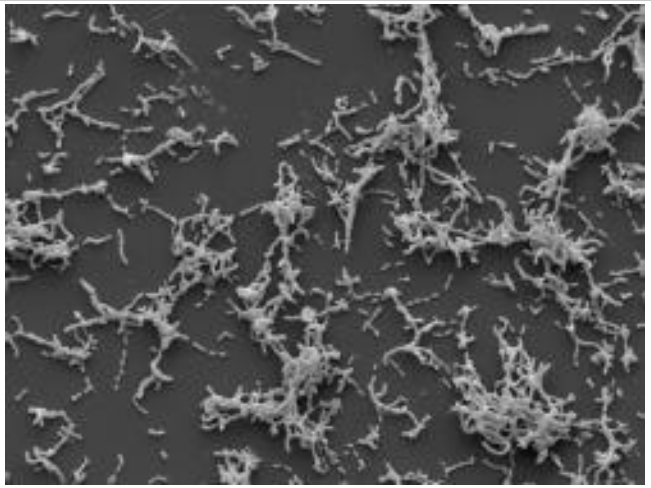
Planktonic cells and Biofilm Communities

Biofilm formation on **biotic** and **abiotic** surfaces







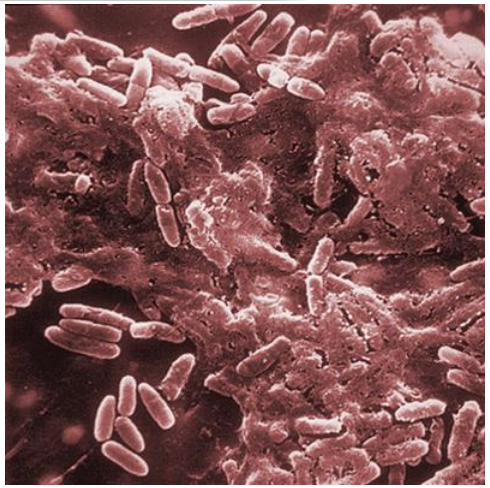


Photo Courtesy: http://prometheus.matse.illinois.edu/glossary/biofilms/

Photo Courtesy: http://micro-writers.egybio.net/blog/?tag=antibiotic-resistance

Photo Courtesy: http://www.ifenergy.com/50226711/boosting_microbial_fuel_cells_with_biofilm.php

Photo Courtesy: http://www.microbiologybytes.com/blog/category/biofilms/

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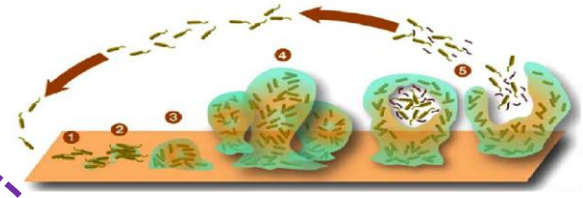
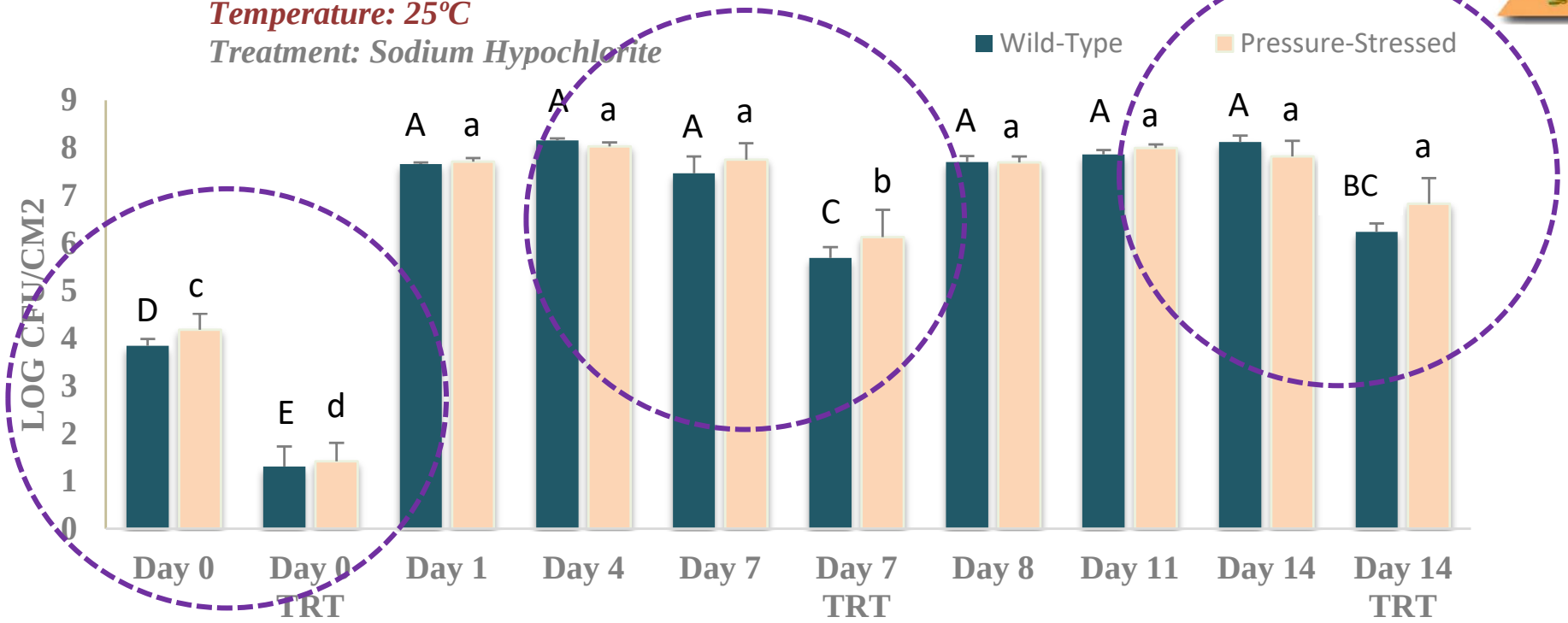
Cronobacter sakazakii
Two outbreaks in Tennessee (1998, Memphis; 2001 Knoxville)

Biofilm Formation and Decontamination of Wild-Type and Pressure-Stressed *Cronobacter Sakazakii*



Temperature: 25ºC

Treatment: Sodium Hypochlorite



Allison et al., 2020

Planktonic cells — **One-week-Mature Biofilm** — **Two-week-Mature Biofilm**

DAYS AND TREATMENT (MEAN±SE)

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Quorum Sensing and Biofilm formation

Shiga toxin producing *E. coli*, not antibiotic treatment due to Quorum Sensing Concerns

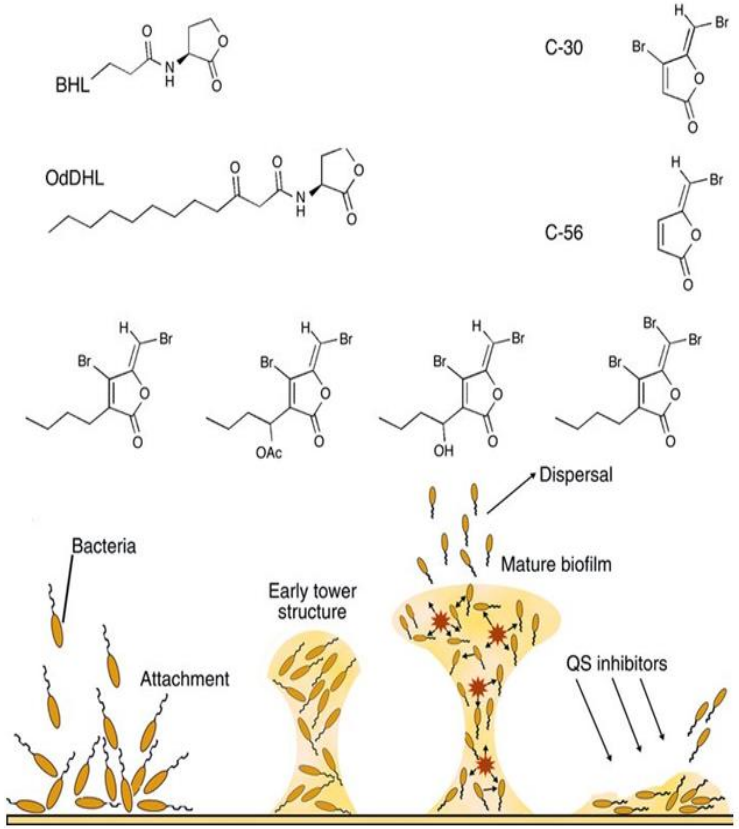

Photo Courtesy: http://www.jci.org/articles/view/20074/figure/2

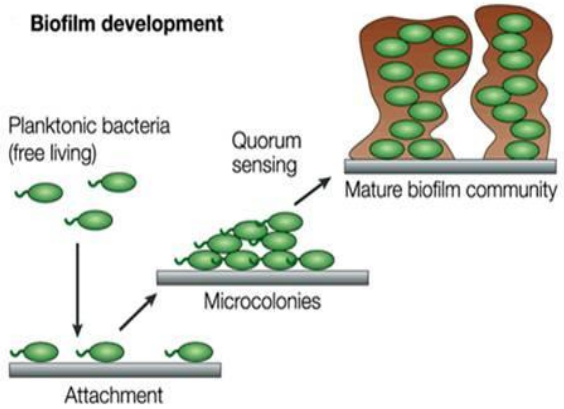

Photo Courtesy: http://labrat.fieldofscience.com/2010/07/quorum-sensing-and-biofilms.html

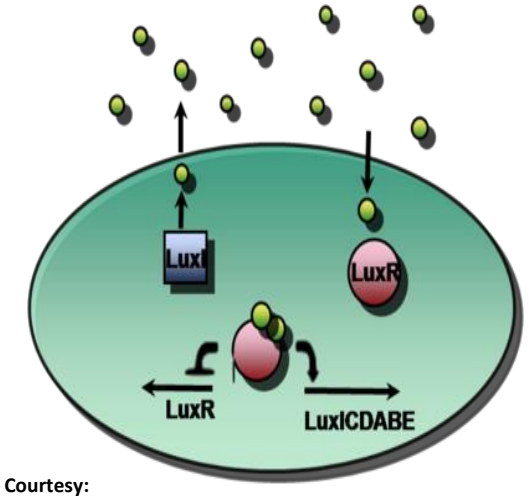

Photo Courtesy: http://2009.igem.org/Team:Aberdeen_Scotland/WetLab/quorumsensing

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Infectious Diseases is a Moving Target…

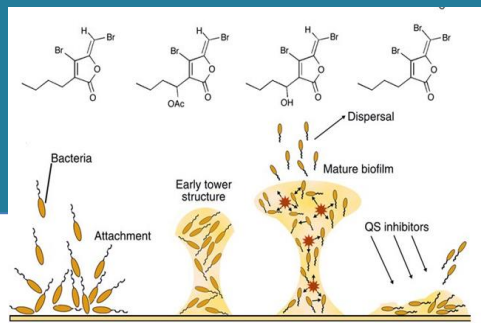


Photo Courtesy: http://www.jci.org/articles/view/20074/figure/2

- It is estimated only 1% of microbial community has been identified.
- Currently **etiological agent** of 80.3% of foodborne illnesses, **56.2% of hospitalization**, and 55.5% of deaths remain unknown (in a typical year, Scallan et all., 2011).

4.5 Billion, 3.5 Billion years
100,000 to 300,000 years

"Emerging" Pathogens:

- Vertical and horizontal gene transfer spores and biofilm formation
- Quorum sensing and cell to cell communication

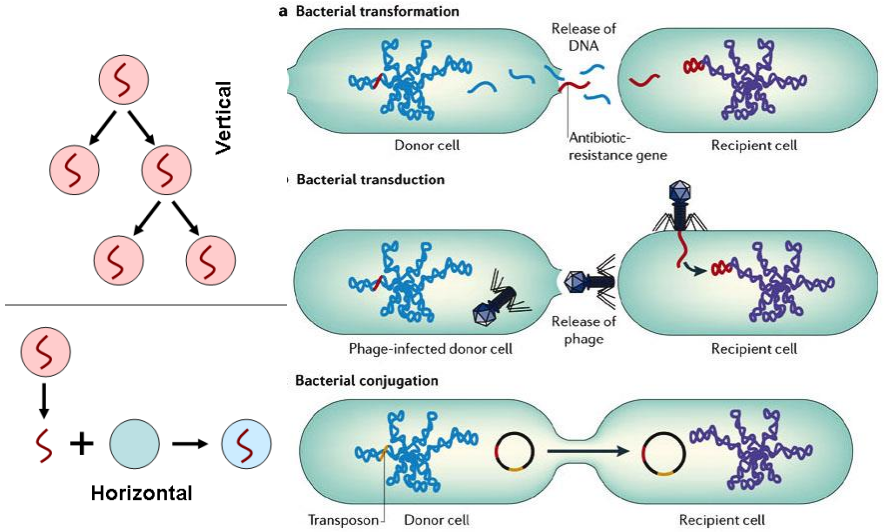
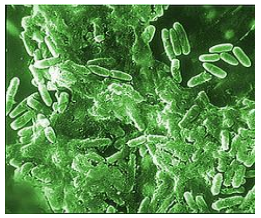
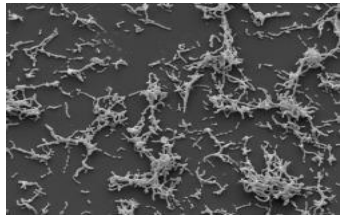
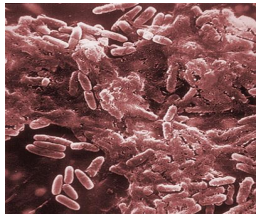


Photo Courtesy: http://www.microbiologybytes.com/blog/category/biofilms/
http://www.ifenergy.com/50226711/boosting_microbial_fuel_cells_with_biofilm.php
http://micro-writers.egybio.net/blog/?tag=antibiotic-resistance

"*It is the microbes who will have the last word.*"
-Louis Pasteur

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Epidemiology of Foodborne Diseases in the United States

Based on data from 1990s: *(Mead et al., 1999)*

76 million illnesses, 323,000 hospitalizations, 5,200 deaths in the United States.

More recent estimates show: *(Scallan et al., 2011)*

- 47.8 million illnesses, 127,839 hospitalizations, and more than **3,037** deaths in the United States. **(c. 1.7M cases 300K deaths/year of sepsis)**

- 9.4 million illnesses, 55,961 hospitalizations, and 1,351 deaths are cause by 31 known foodborne agents.
- In addition to consumer insecurity, foodborne diseases cause around $**77.7 billion** for losses in productivity and economical losses.

  (2021 GPD of Jamaica 14.7 Billion)

– Approximately 30% of population are especially "at risk" for foodborne diseases (The YOPI's: The young, the old, Pregnant, and Immunocompromised)

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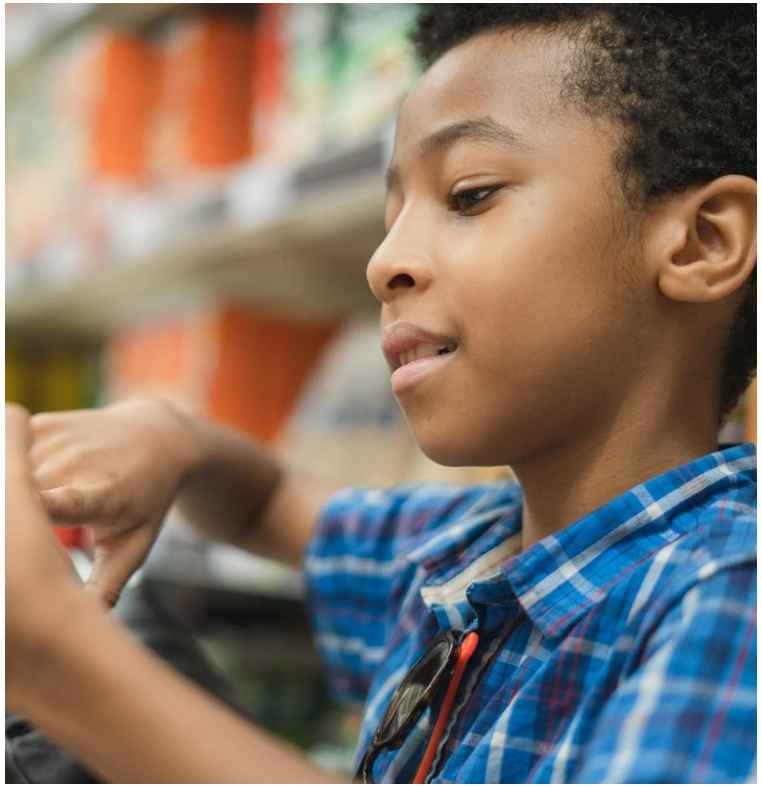
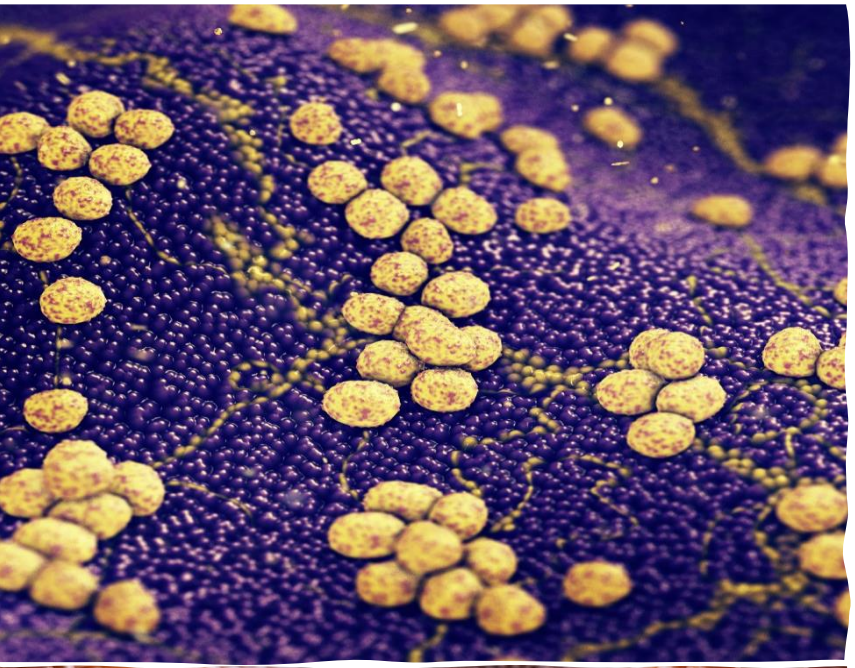
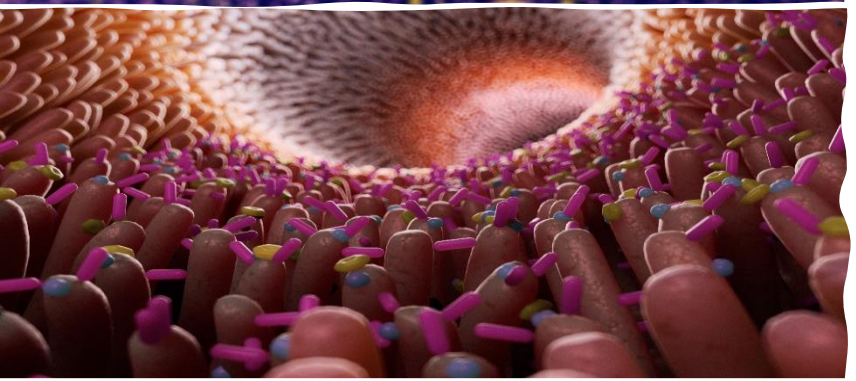
Significant foodborne pathogens…
based on Mead et al., 1999 and Scallan et al., 2011 studies

- **Leading etiological agents for illnesses**: *Norovirus* (58%), Nontyphoidal *Salmonella* serovars (11%), *Clostridium perfringens* (10%), and *Campylobacter* spp (9%).
- **Leading etiological agents for hospitalization:** Nontyphoidal *Salmonella* serovars (35%), *Norovirus (26%), Campylobacter* spp (15%), and *Toxoplasma gondii* (8%).
- **Leading etiological agents for death:** Nontyphoidal *Salmonella* serovars (28%), *T. gondii* (24%), *Listeria monocytogenes* (19%), and *Norovirus (11%).*



Photos Courtesy: Adobe Stock, royalty purchased (standard license) by public health microbiology laboratory





Signs and Symptoms of Foodborne Diseases

- Mild illness (no medical care sought)
- **Guillain–Barré syndrome** (*Campylobacter* and *Salmonella*)
- **Post-infectious irritable bowel syndrome** (*Campylobacter* and *Salmonella*)
- **Reactive arthritis** (*Campylobacter* and *Salmonella*)
- **Haemolytic uraemic syndrome** (*E. coli* O157)
- **End-stage renal disease** (*E. coli* O157)
- Death

Significant foodborne pathogens… *(Scallan et al., 2015 study)*

Disability adjusted life year (DALY). *DALY: Loss of life and health due to illness*

Non-typhoidal *Salmonella* (329000)
Toxoplasma (32700)
*Campylobacte*r (22500)
Norovirus (9900)
Listeria monocytogenes (8800)
Clostridium perfringens (4000)
Escherichia coli O157 (1200)

62% bacterial agents; 29% parasitic agents; 9% viral agents

One DALY can be thought of as one **lost year of "healthy" life**.

DALY= YLL+YLD

YLL: Years of Life Lost (YLL) due to **premature mortality** in the population
YLD: Years Lost due to Disability (YLD) for **people living with the health condition**

Source: WHO, 2019

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National-wide and Regional Foodborne Episodes

- Centers for Disease Control and Prevention: Foodborne diseases episodes 1998 to 2019.

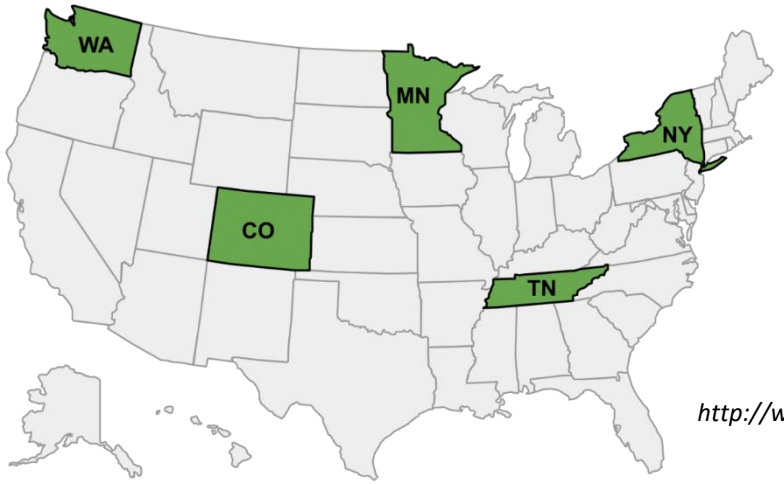
*Etiological agents for Tennessee episodes:

>200 species of bacteria, viruses, parasites, and chemical toxins.

Total	Outbreaks	Illness	Hospitalization	Deaths
Nation-wide	36,680*	999,364	25,332	1,404
California	1,154	29,642	4,257	123
Tennessee	982	39,005	3,717	104
Colorado	1098	37,429	323	8

Per 100K	Outbreaks	Illness	Hospitalization	Deaths
Nation-wide	11.1	304.5	7.7	0.4
California	2.9	75.0	10.7	0.3
Tennessee	14.4	571.2	54.4	1.5
Colorado	1.90	64.99	0.56	<0.02

CDC Centers for Disease Control and Prevention
CDC 24/7: Saving Lives, Protecting People™



Data source: http://wwwn.cdc.gov/foodborneoutbreaks/

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Water Safety Study

microorganisms

MDPI

Article

Fate and Biofilm Formation of Wild-Type and Pressure-Stressed Pathogens of Public Health Concern in Surface Water and on Abiotic Surfaces

Md Niamul Kabir [1], Sadiye Aras [1], Sabrina Wadood [1], Shahid Chowdhury [1] and Aliyar Cyrus Fouladkhah [1,2,*]

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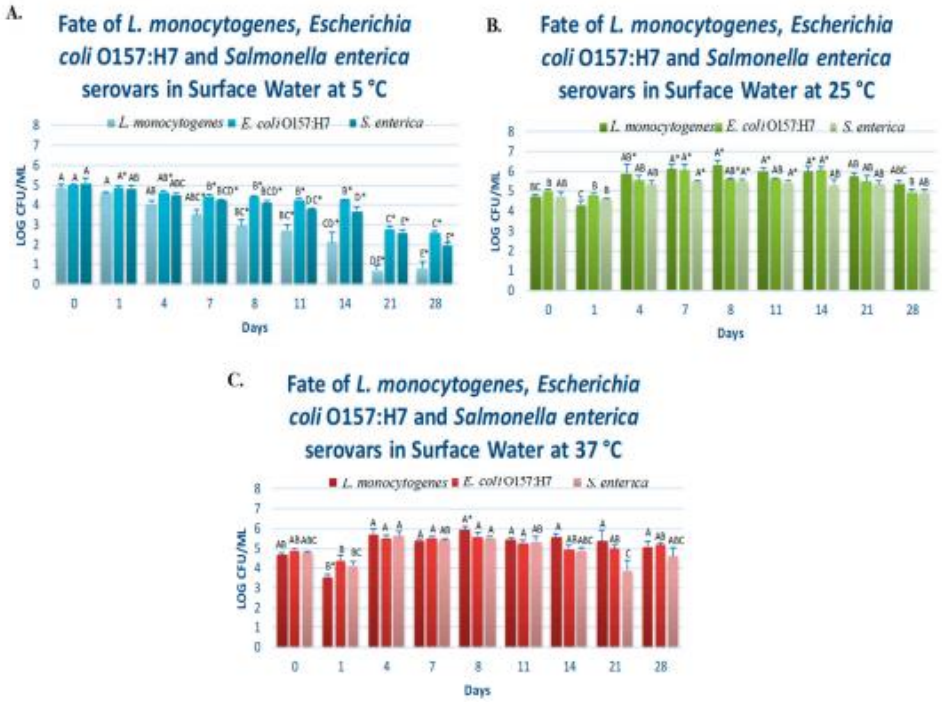
Public Health Burden of Waterborne Diseases

17 waterborne pathogens cause estimated: (Collier et al., 2021)

601,000 **illness**; 118,000 **hospitalization**; 6,630 **deaths**, and cost the economy up to $ 8.77 **billions.**



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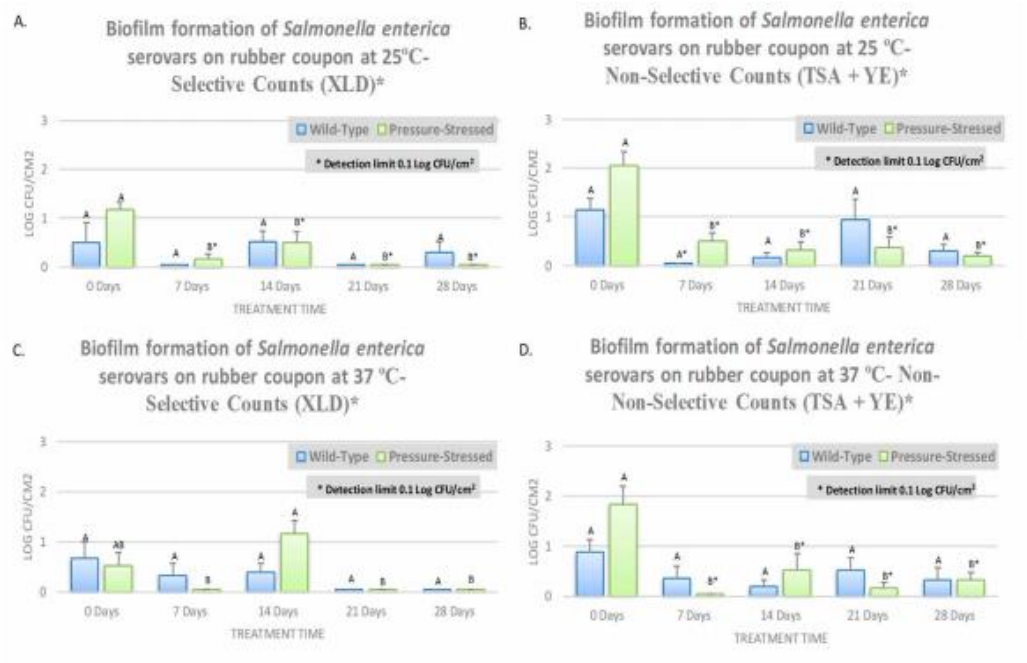
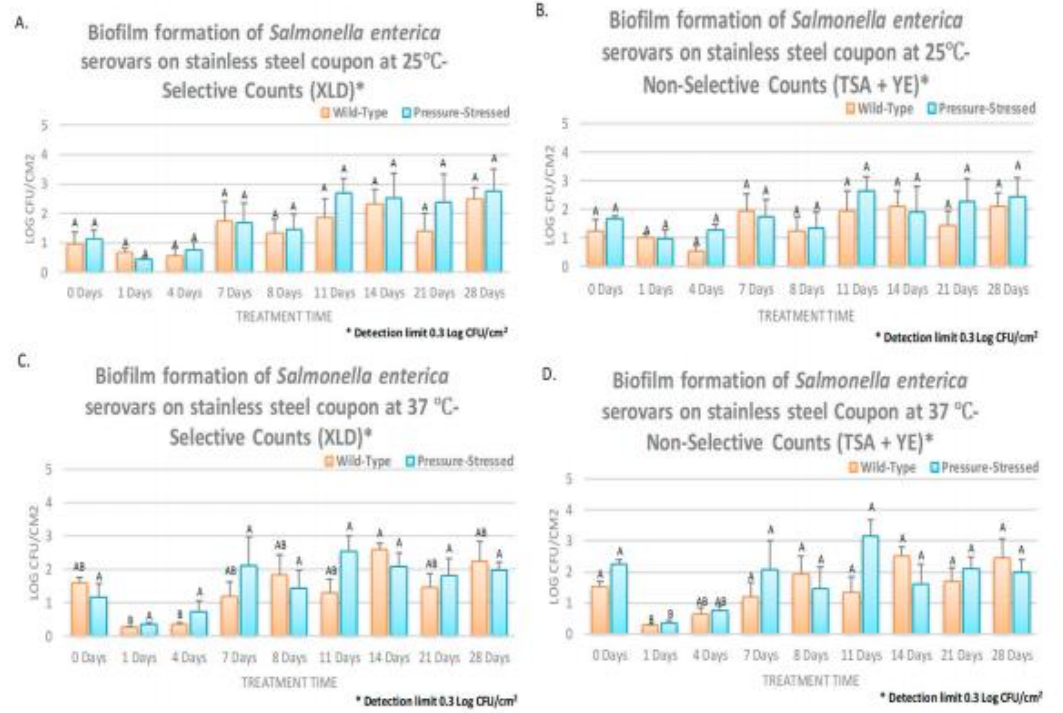
Water Safety Study-
Biofilm Formation on Abiotic Surfaces





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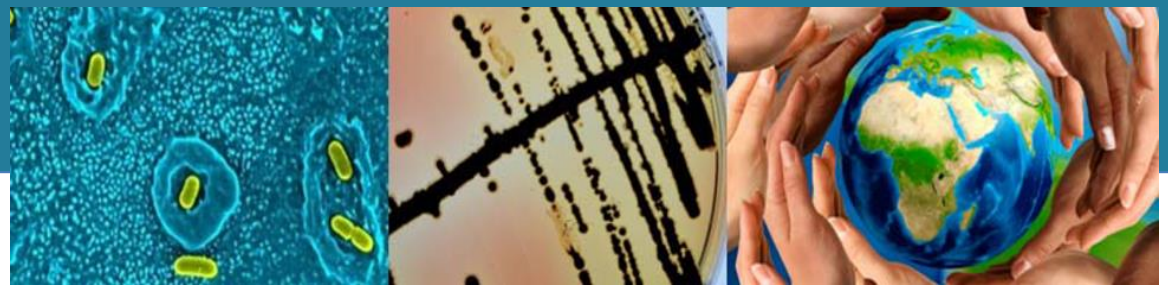

Part II: *Impact of Climate Change on Food Security*

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Salmonella serovars (Non-typhoidal)

- **Annual illness (death): 1,027,561 (378) in humans**
- **Infection** causes nausea, vomiting, diarrhea, fever, headache
- **Primary sources**: Intestinal tract of people and animals
- **Transmitted by** meat, poultry, eggs, raw milk, unpasteurized juice, many other foods (nuts, spices, produce, chocolate, flour)
- **Contributing factors**: cross-contamination, undercooked food, poor agricultural practices

Growth parameters	Minimum	Optimum	Maximum
Temperature	41°F (5.2°C)	95-109°F (35-43°C)	115°F (46.2°C)
pH	3.7	7-7.5	9.5
a_w	0.94	0.99	>0.99
Other	Non-spore former		
Atmosphere	Facultative - grows with or without oxygen		

Sources: ICMSF 1995 and Bad Bug Book 2nd edition, Scallan et al., 2011, and FSPCA

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Climate Change and Public Health Microbiology

Non-typhoidal *Salmonella enterica* serovars

- **Global death:** 50,000 global death in 2010 (WHO, 2020)
- **Public Health Burden in the U.S.:** >1 million annual cases in 2011 (CDC, 2011)

Climate Change:

- **1 °C increase : 5 to 10% increases in Salmonellosis (WHO, 2010)**
- 2500 to 5000 additional global death
- 50,000 to 100,000 U.S. morbidity

At our current rate (2021 IPCC report)

- >1.5 °C by 2040
- >4.8 °C by 2100

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Biology | Aliyar Fouladkhah

Changing climate

A 'threat multiplier' for foodborne and waterborne infectious diseases and antibiotic resistance

Dr Aliyar Cyrus Fouladkhah of Tennessee State University is an Assistant Professor in Public Health Microbiology. His laboratory explores preventive measures for the spread of infectious diseases, antibiotic resistance, and food security in the landscape of changing climate. His research aims to provide better understanding of the ecology, epidemiology and effectiveness of control measures of enteric and environmental pathogens at planktonic and biofilm stages, including several foodborne and waterborne bacteria. His work contributes to

According to the U.S. Centers for Disease Control and Prevention, achieving safe and healthier foods is one of the top ten achievements of 20th century public health. Despite the marked progress, considerable challenges remain to further assure the safety and security of food and water supplies, with one in six adults in the United States experiencing illness from foodborne pathogens in a typical year. Foodborne diseases cause an estimated 420,000 deaths worldwide each year. Furthermore, climate change is expected to enhance the spread of infectious diseases since changes in environmental temperatures appreciably augment the multiplication of bacterial pathogens.

in Guatemala, Dominican Republic, and South Africa.

THE ROLE OF CLIMATE CHANGE

Microbial pathogens have an incredible ability to evolve and move towards 'fitness' in response to changes in their environment. Climate change will have pronounced effects on the proliferation, survival, and spread of microbial pathogens, and thus on the prevalence of foodborne and waterborne diseases. More than 200 diseases, known to be transmitted through contaminated food and water, may provide examples of the effects of climate change on the magnitude of infectious diseases. One example of this is salmonellosis,

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microorganisms
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Editorial

Safety of Food and Water Supplies in the Landscape of Changing Climate

Aliyar Cyrus Fouladkhah [1,*], Brian Thompson [2] and Janey Smith Camp [3]

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3 Department of Civil and Environmental Engineering, Vanderbilt University, Nashville, TN 37235, USA; janey.camp@vanderbilt.edu
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check for updates

In response to evolving environmental, production, and processing conditions, microbial communities have tremendous abilities to move toward increased diversity and fitness by various pathways such as vertical and horizontal gene transfer mechanisms, biofilm formation, and quorum sensing [1,2]. As such, assuring the safety of water and food supplies from various natural and anthropogenic microbial pathogens is a daunting task and a moving target. Recent outbreaks of *Listeria monocytogenes* in South Africa associated with a ready-to-eat product (affecting close to 1000 individuals) and the 2018 outbreak of Shiga toxin-producing *Escherichia coli* O26 associated with ground meat in the United States (leading to the recall of more than 132,000 pounds of products) are bitter reminders of the devastating influences of foodborne diseases on the public health and food manufacturing [3,4].

Recent epidemiological studies of world populations indicate that 420,000 people lose their lives every year due to foodborne diseases, with around one-third of those being 5 years of age or younger. It is further estimated that every year, 1 in 10 individuals experience foodborne diseases around the globe, leading to an annual loss of 33 million healthy life years [5]. These episodes of food and water

Vibrio spp.

V. cholera
V. vulnificus
V. parahaemolyticus

Currently 760,000 global illness/24,000 death per year.

- Causing about **80,000 illness and 100 death** annually in the United States.
- **Infection symptoms** vary depending on strain, ranging from diarrhea to high fever
- Vibrio is a **halophilic bacterium** and is a major concern in aquaculture industry
- **Primary sources**: Salt water environments and seafood
- Requires salt to reproduce (halophile)

Growth parameters	Minimum	Optimum	Maximum
Temperature	41°F (5°C)	99°F (37°C)	114°F (45.3°C)
pH	4.8	7.8-8.6	11
a_W	0.94	0.98	0.996 (10% NaCl)
Other	Non-sporeformer, requires salt		
Atmosphere	Facultative - grows with or without oxygen		

Sources: Seafood Hazards Guide 2011, ICMSF 1995 and Bad Bug Book 2nd edition

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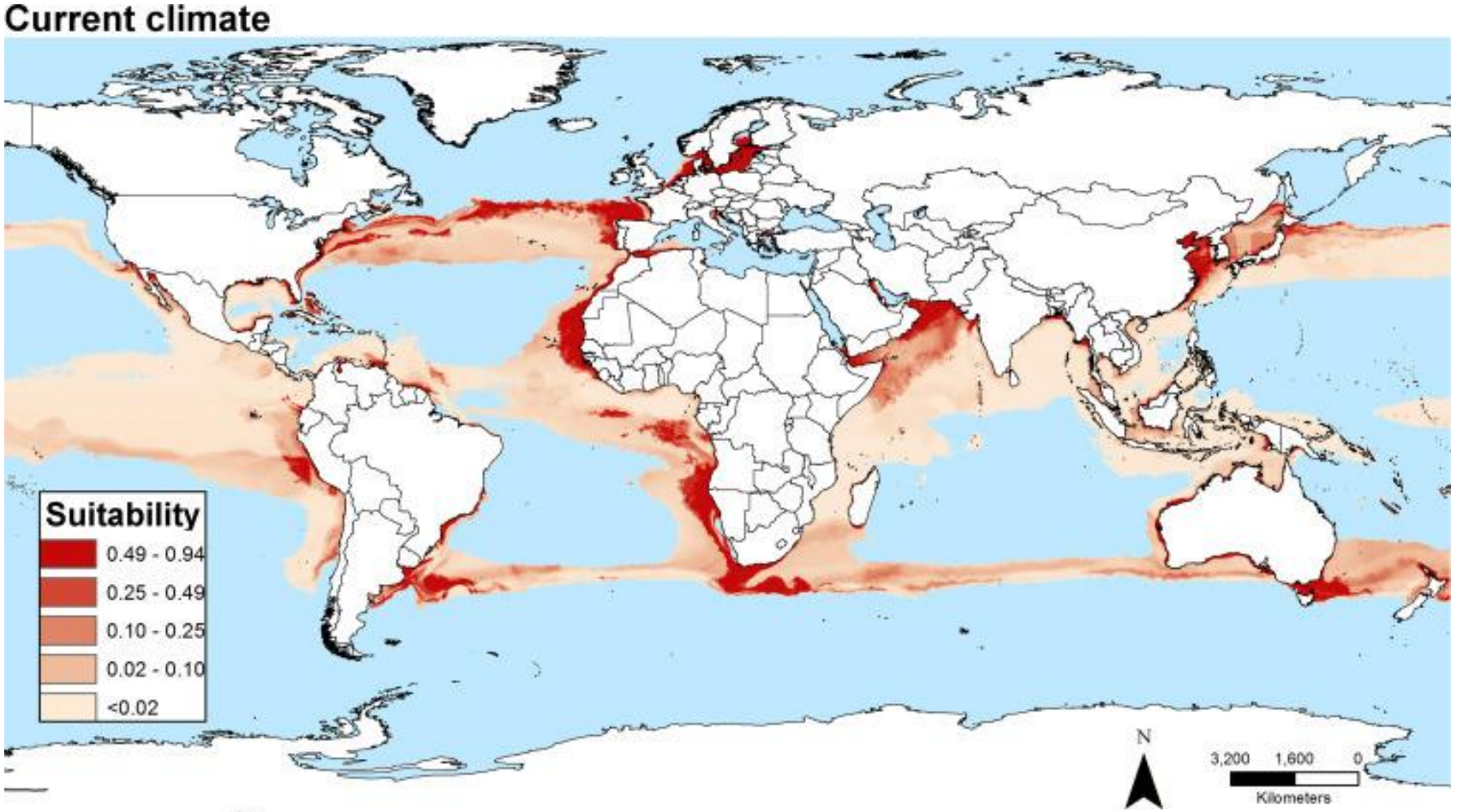
Vibrio cholerae proliferation in sea water: Current Climate

***Vibrio Cholerae*:** currently 760,000 global illness/24,000 death per year



Escobar LE et al.
Acta Tropica
2015;149:202-11

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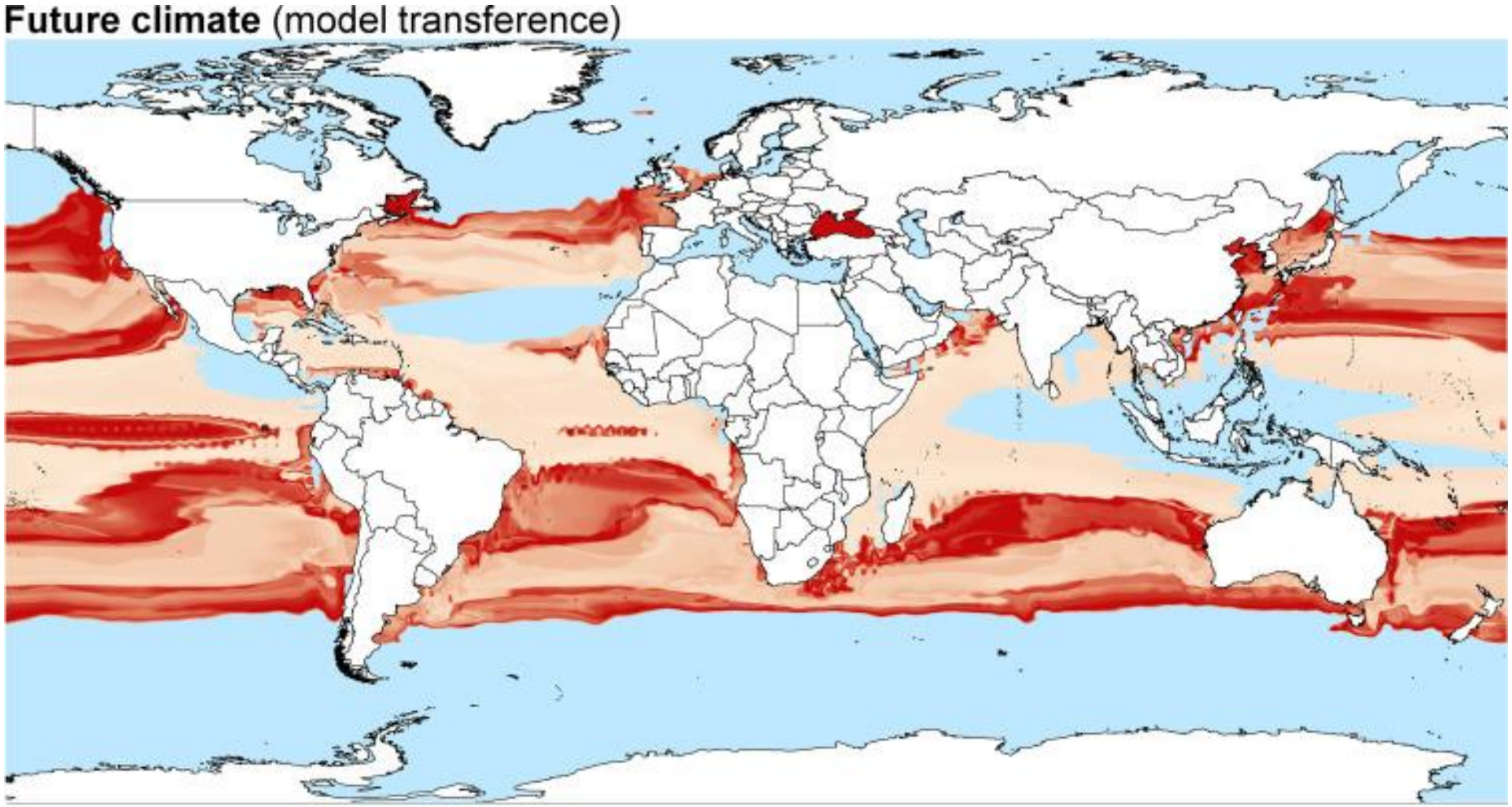
Vibrio cholerae proliferation in sea water: Business-as-Usual Projection in 2100



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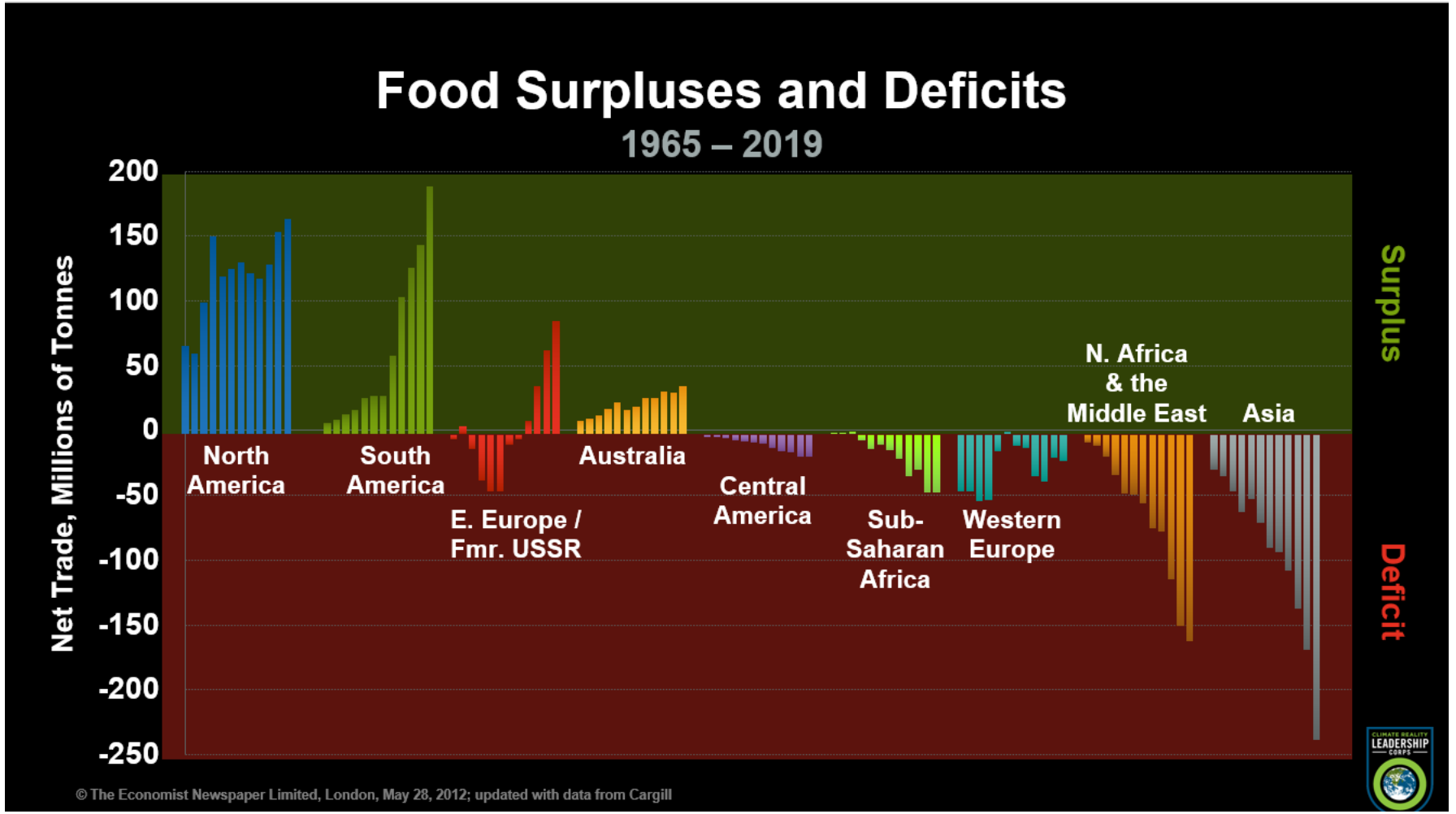

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Projected Yield Declines For Each 1° C of Warming

These four crops make up two thirds of human caloric intake.

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An estimated 60% of known infectious diseases and up to 75% of new or emerging infectious diseases are zoonotic in origin*

Data: S. Machalaba, WB Karesh, "Vector-borne Diseases: Animals and Patterns," *Forum on Microbial Threats,* National Academies of Sciences, Engineering and Medicine, 2016

Tick-borne diseases affect up to 80% of the world's livestock, with a cost of up to $19 billion per year.

*Source: https://www.cdc.gov/onehealth/index.html and * Salyer, 2017*

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Other Climate-Sensitive Challenges

- **Mycotoxins (At 2°C increase, aflatoxin, North America and Europe).**
  - **Aflatoxins:** Peanuts, dried corn (maize), **tree nuts, certain spices**
  - **Ochratoxin A:** Coffee, raisins, wine, cereal grains, certain spices
  - **Patulin:** Fruits (apple and apple juice)
- Attraction of **pests, plant diseases, weeds**
- Changes in **pesticide use pattern is likely**
- Survival and **proliferation of the pathogen** (*e.g. Salmonella* serovars)
- **Antibiotic use and antibiotic residue**
- Changes in **migration pathways** (*e.g.* for avian influenza)
- Changes in **carriers and vectors** (*e.g.* Zika virus)
- Changes in **natural ecosystem**
- **Phycotoxins**

microorganisms MDPI

Editorial

The Threat of Antibiotic Resistance in Changing Climate

Aliyar Cyrus Fouladkhah [1,*], Brian Thompson [2] and Janey Smith Camp [3]

1 Public Health Microbiology Laboratory, Tennessee State University, Nashville, TN 37209, USA
2 School of Public Health, Yale University, 60 College St, New Haven, CT 06510, USA; brian.thompson@yale.edu
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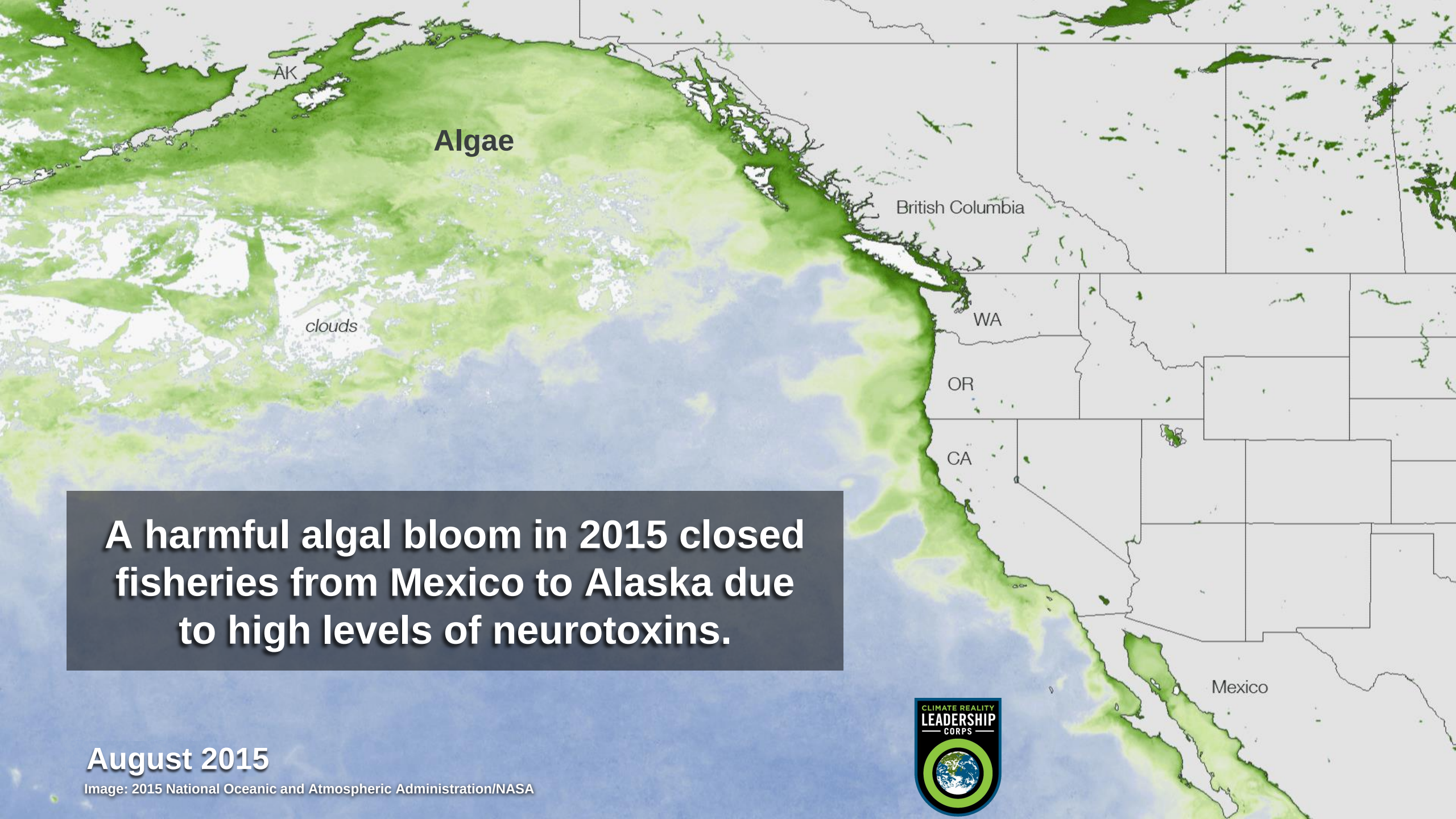
As the earliest form
in environmental conditi
biofilm communities, and



A harmful algal bloom in 2015 closed fisheries from Mexico to Alaska due to high levels of neurotoxins.

August 2015

Image: 2015 National Oceanic and Atmospheric Administration/NASA

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Biology | Aliyar Fouladkhah

Changing climate

A 'threat multiplier' for foodborne and waterborne infectious diseases and antibiotic resistance

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According to the U.S. Centers for Disease Control and Prevention, achieving safe and healthier foods is one of the top ten achievements of 20th century public health. Despite the marked progress, considerable challenges remain to further assure the safety and security of food and water supplies, with one in six adults in the United States experiencing illness from foodborne pathogens in a typical year. Foodborne diseases cause an estimated 420,000 deaths worldwide each year. Furthermore, climate change is expected to enhance the spread of infectious diseases since changes in environmental temperatures appreciably augment the multiplication of bacterial pathogens.

The research group of Dr Aliyar Fouladkhah at Tennessee State University addresses these emerging and re-emerging challenges. His laboratory utilises new technologies, in Guatemala, Dominican Republic, and South Africa.

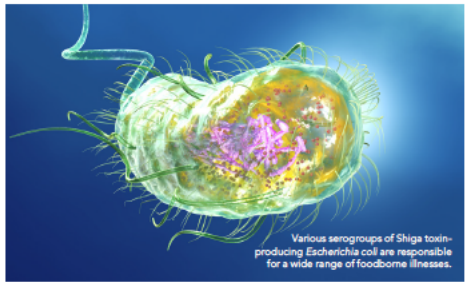
THE ROLE OF CLIMATE CHANGE

Microbial pathogens have an incredible ability to evolve and move towards 'fitness' in response to changes in their environment. Climate change will have pronounced effects on the proliferation, survival, and spread of microbial pathogens, and thus on the prevalence of foodborne and waterborne diseases. More than 200 diseases, known to be transmitted through contaminated food and water, may provide examples of the effects of climate change on the magnitude of infectious diseases. One example of this is salmonellosis, an infection caused by nontyphoidal *Salmonella enterica* serovars, which is currently responsible for over one million cases of foodborne illness in the United States in a typical year.

of these treatments is diminishing, with resistance in many of the common bacterial pathogens now categorised as a public health threat.

Dr Fouladkhah comments that, although there is a focus on identifying new classes of antibiotics, this strategy alone is not sufficient to alleviate the public health challenge of antibiotic resistance. He emphasises that a holistic 'one health' approach should be embraced, which includes limiting the use of current antibiotics to those individuals with dire need for antibiotic therapies and incorporating evidence-based stewardship programmes such as susceptibility testing and watchful waiting in hospitals. This also requires eliminating or minimising the prophylactic and sub-therapeutic use of antibiotics in animal husbandry as the spread of antibiotic resistance in animal populations could be very closely associated with human health complications. Additionally, continuing the search for new antibiotics and antimicrobials, implementing microbial hurdle validation studies in processing and manufacturing, and multiagency efforts to mitigate climate change could assure the control of antibiotics resistance.

Ultimately, Dr Fouladkhah states that the "climate change-induced antibiotic resistance threat will affect citizens of countries with suboptimal public heath



Various serogroups of Shiga toxin-producing *Escherichia coli* are responsible for a wide range of foodborne illnesses.

Climate change is one of the most significant public health challenges of our time and threatens the safety of our food and water supplies.

three bacteria of public health concern in waters of different temperatures (5, 25 and 37°C) and on stainless steel and rubber surfaces. They found that the bacteria included in the study could survive in surface water and form complex biofilms (a collection of microbes which stick to each other and the surface they live on) on abiotic surfaces, detectable for up to 28 days. These results suggest that the occurrence of contamination in water supplies can do not receive any additional processing or treatment before consumption.

Various serogroups of *Escherichia coli* (*E. coli*) are among the top causes of foodborne illnesses, in particular O157 *Shiga toxin-producing E. coli* (STEC) and non-O157 *Shiga toxin-producing E. coli* (nSTEC). The majority of illnesses relating to these serogroups are derived from foodborne infections.

Outreach Article Available at:

https://researchoutreach.org/articles/changing-climate-threat-multiplier-foodborne-waterborne-infectious-diseases-antibiotic-resistance/

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researchoutreach.org website analysis

Changing climate: A 'threat multiplier' for foodborne and waterborne infectious diseases and antibiotic resistance

Aliyar Fouladkhah
Tennessee State University

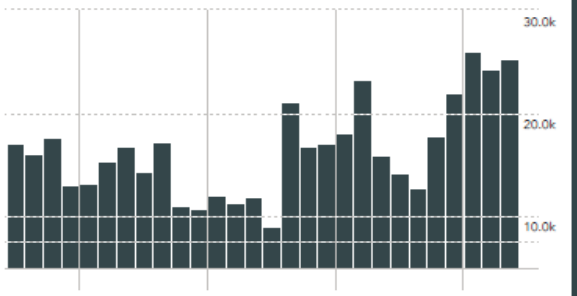
https://bit.ly/3600HB9

Demographics

Male 49%

Female 51%

Number of visits for Research Outreach website



Total number of sessions	99,204
Total number of page views	134,592
Total number of users	82,553
Total number of pages/session	2.92

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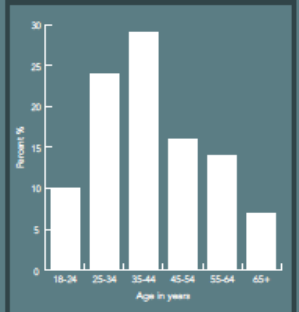

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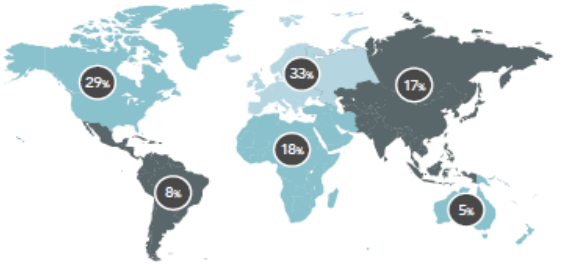
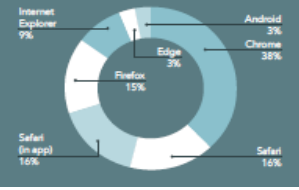


Browser stats



Platform and device stats

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Thank you for photo slides:

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Ms. Kiyana E Kelly

- Director, 1890 Center of Excellence for Nutrition, Health, Wellness, and Quality of Life (COENHWQL)
- Southern University Ag Cente

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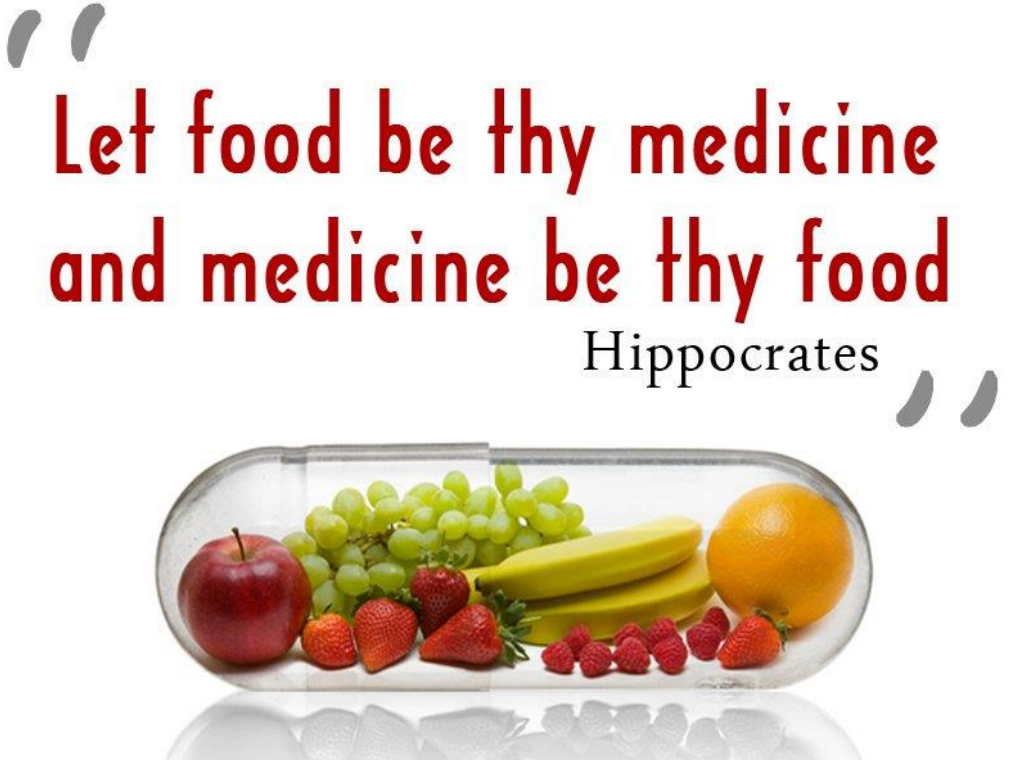
Enhancing Nutrition, Health, Wellness and Quality of Life through Integrative Approaches



Presented by: Kiyana E. Kelly

08/29/2024

Photo credit: Online

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1890 Center of Excellence

Tuskegee University

Tufts University | Gerald J. and Dorothy R. Friedman School of Nutrition Science and Policy

MISSION

The 1890 Center of Excellence for Nutrition, Health, Wellness, and Quality of Life (NHWQL) seeks to support the triple land-grant's mission of research, teaching, and extension to contribute solutions to improve the health and well-being of underserved and minority populations.

INTRODUCTION

- African Americans (AAs) remain the least healthy ethnic group in the USA.
- Diet is a key contributor to disparities in many chronic diseases and conditions.
- AA communities have trusted 1890 institutions for more than a century.
- Therefore, 1890 institutions can play important roles in assisting AAs to combat diet-related disparities, especially obesity and its related chronic diseases.
- Louisiana, North Carolina, and Alabama are among the top 10 most obese states in non-Hispanic black adults. Obesity is a common, serious, and costly disease (approximately $147 billion annually).

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THE 1890 CENTER OF EXCELLENCE GOALS

RESEARCH

To enhance the research capacity at 1890 institutions focusing on food intake and nutritional/health outcomes.

TEACHING

To strengthen and advance innovative food and nutrition educational and instructional strategies for students at 1890 institutions.

EXTENSION

To provide training and education to underrepresented communities through multi-state food and innovative nutrition outreach programs.

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SOUTHERN UNIVERSITY

Objective: To expose students to the best educational and leadership opportunities within the field of nutrition, health, wellness and quality of life.

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SOUTHERN UNIVERSITY

SU Together: Move More, Eat Better

SU Together: Move More, Eat Better is a nutrition and physical fitness program designed to assist African-American men and women in their journey to live their best most healthy lives.

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SU TOGETHER: MOVE MORE, EAT BETTER








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SOUTHERN UNIVERSITY
GARDENS & GREEN SPACES

- Plainview Church
- Westdale Middle School
- Southern University Lab School
- Pinkie E. Thrift Hall
- Exxon Mobil YMCA
- Northeast High School – Fall 2024
- J.W. Fisher Hall – Fall 2024
- Faith-based organization – Fall 2024

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SOUTHERN UNIVERSITY

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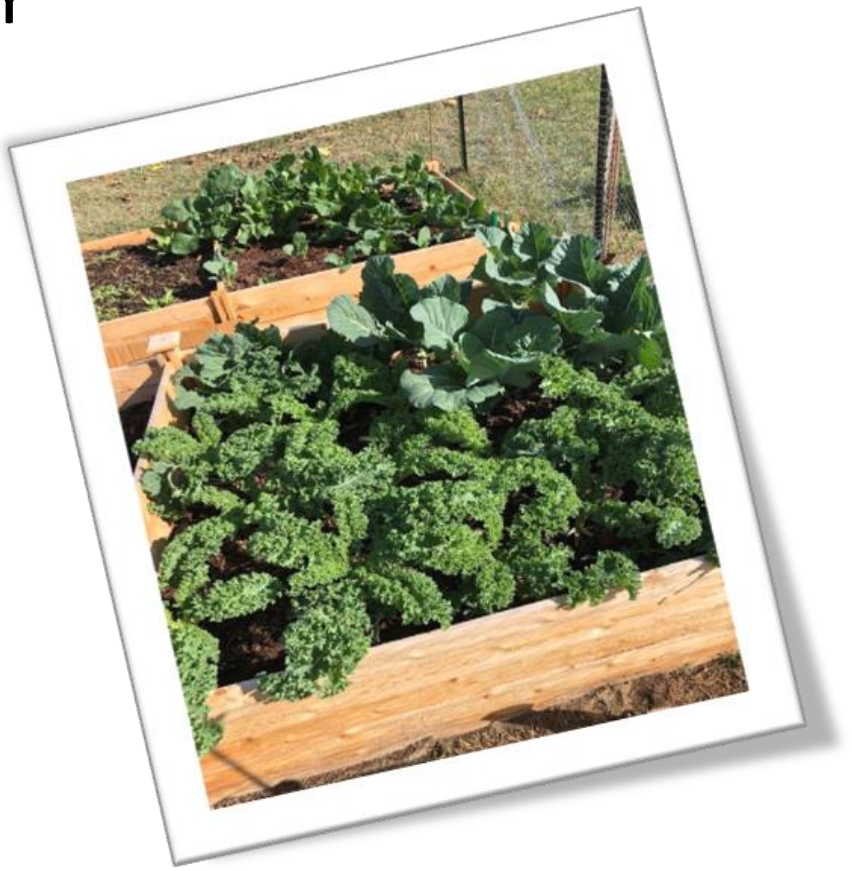
TUSKEGEE UNIVERSITY

Objective: Create the platform and opportunity for Southern, NCA&T and Tuskegee to work collaboratively to strengthen each institution's existing nutrition education programs.

- Make Fruits and Vegetables Available to ALL
- Serves 8 out 15 Blackbelt Counties



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TUSKEGEE UNIVERSITY

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NORTH CAROLINA A&T

Objective: To conduct innovative research in the areas of food, nutrition, health and wellbeing

Please scan QR code to watch students prepare samples.

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NORTH CAROLINA A&T

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1890 UNIVERSITIES FOUNDATION

- The 1890 Universities Foundation welcomes the participation of 1890 Universities who benefit from the Foundation's fund development activities in publicizing financial awards to support Centers of Excellence and other program initiatives.

- Pilot project program for faculty at all 1890 institutions.

Alabama A&M University
Lincoln University
LEARN. LIBERATE. LEAD.
Tennessee State University
Florida Agricultural Mechanical University
Delaware State University
Langston University
West Virginia State University
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CENTER OF EXCELLENCE IMPACTS

2021-2022

Teaching
- 9 Student Scholars
- 5 Virtual Seminar Series
- Research
- Compare 16 lean and 16 obese participants

Extension
- 10 SU Together: Move More, Eat Better classes

Publications
- 4 Road Map to Health Newsletters
- Funded Pilot Projects
- 4 pilot projects were funded

2022-2023

Teaching
- 9 Student Scholars
- 11 Virtual Seminar Series
- 1 COE Symposium
- Attended 5 conferences to present on behalf of COE
- 39 students total

Research
- 97 samples collected
- 80 samples were analyzed

Extension
- 24 SU Together: Move More, Eat Better classes
- 56 garden classes servicing 9 counties/parishes
- 11 health fairs/resource/table displays

Publications
- 1 Road Map to Health Newsletter

Funded Pilot Projects
- 4 pilot projects were funded

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CENTER OF EXCELLENCE IMPACTS

2023- Present

Teaching
9 Student Scholars
14 Virtual Seminar Series
Attended 1 conference to present on behalf of COE

Research
97 samples collected
80 samples were analyzed

Extension
- 18 SU Together: Move More, Eat Better classes
- 64 garden classes servicing 9 counties/parishes
- 23 health fairs/resource/table displays

Publications
- 4 Road Map to Health Newsletter

Funded Pilot Projects
- 4 pilot projects were funded and more to be announced

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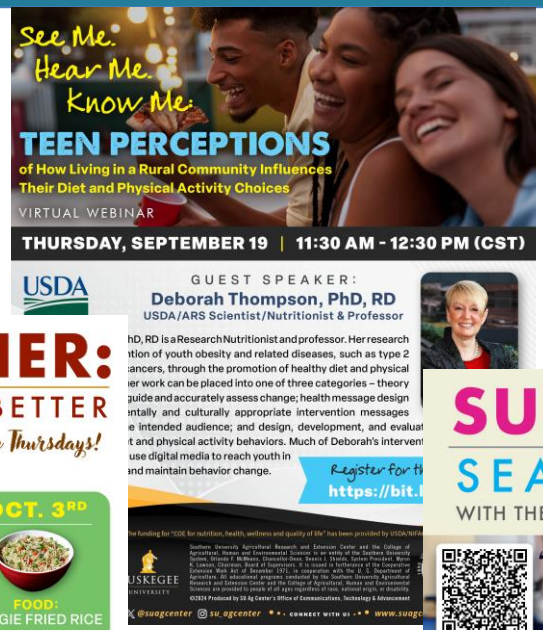
REPLICABLE PROGRAMMING



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1890 Center of Excellence 19-Strong Nutrition, Health, Wellness & Quality of Life

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ACKNOWLEDGEMENTS

In closing, we are very grateful to USDA/NIFA for providing the funds for our team to continue the work under the Center of Excellence for Nutrition, Health, Wellness, and Quality of Life. We are bringing other 1890 universities on board. We are anticipating connecting with Farmers, Food industries, big chain supermarket foundations (such as Walmart), medical society, politicians, and lawmakers and others so we can reduce and someday eradicate health disparities specifically among African Americans and other minorities not only in the Southern Region but also in the Nation.

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LET'S CONNECT!

Instagram: sucenterofexcellence

Facebook: Center of Excellence for Nutrition, Health, Wellness and Quality of Life

Webpage: www.suagcenter.com

The funding for "COE FOR NUTRITION, HEALTH, WELLNESS and QUALITY OF LIFE" has been provided by USDA/NIFA#2021-38427-34836

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Q&A

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