## International Academic Symposium on Microbial Stress Tolerance and Response

# CONFERENC PROGRAM



October 20-22, 2023 Guangzhou, China **International Academic Symposium on Microbial Stress Tolerance and Response** 

On behalf of the Organizing Committee, you are cordially invited to attend the International Academic Symposium on Microbial Stress Tolerance and Response, held on Oct 20-22 of 2023, in Guangzhou, China.

Under the theme of "Microbial Stress Tolerance and Response", the symposium will focus on microbial stress tolerance and response in food, environmental, and clinical settings, especially on uncultured, dormant, persisters, and viable but unculturable (VBNC) microorganisms. In the relevant fields, distinguished scholars are invited for keynote or invited presentations, and young scientists with latest research findings from various disciplines are also invited for oral presentations. This is undoubtedly the best opportunity for participants to present the recent progress and foster new collaboration. International Academic Symposium on Microbial Stress Tolerance and Response also builds a bridge

The Organizing Committee are making every effort to make this a memorable and valuable biofilm conference.

between Chinese and international universities or enterprises.

Sincerely yours,

**Organizing Committee** 

#### **Organization**

#### **Organizers**

**Zhongkai University of Agriculture and Engineering** 

Qingdao Agricultural University (co-organizer)

#### **Supporting parties**

**Wuhan Institute of Technology** 

**Zhejiang University** 

South China University of Technology/Guangdong Province Key Lab for Green Processing of Natural Products and Product Safety

#### **Zhongkai University of Agriculture and Engineering**



Zhongkai University of Agriculture and Engineering (ZHKU) is a multidisciplinary provincial university for undergraduate and graduate education. Based upon its strong disciplines concerning agriculture and engineering, ZHKU offers a wide variety of disciplines. Situated in Guangzhou, ZHKU boasts of two campuses in districts of Haizhu and Baiyun, covering a total area of about 140 hectares.

ZHKU, formerly known as Zhongkai Agro-technical School, started enrolling students in 1927. ZHKU was identified as the first pilot universities in China for the outstanding agricultural and forestry talents training program in 2014. The university was approved as the doctor's degree authorization project construction unit. Over the

past 95 years, the university has cultivated a large number of outstanding talents for the country's economic and social development, including agricultural technical cadres at the grassroots level, experts and scholars, as well as the provincial and ministerial leaders. Currently, ZHKU has over 1,600 fulltime teachers, 700 of whom have senior titles, over 2,500 full-time undergraduates and over 2,000 graduates. ZHKU has been approved as a doctoral workstation and a post-doctoral workstation of Guangdong, and a Guangdong Provincial Overseas Talent Workstation.



#### Qingdao Agricultural University

Qingdao Agricultural University (QAU) was founded in 1951 currently with four campuses. The total construction area is more than 1.1 million square meters, covers an area of 5,220 mu (about 348 ha) with the campus green coverage rate being 59.7%.

In 2012, QAU was awarded the first batch of key construction universities under the "Shandong Famous School Project". In 2017, it was listed as a Class A Unit for the Establishment of Doctoral Degree Granting Project in Shandong Province. In 2018, it was listed as a first-class discipline project construction unit in Shandong Province. Since the establishment, more than 130,000 graduates have been cultivated for the society. QAU has 8 discipline fields including agriculture, engineering, science, economics, management, literature, art and law. It has 24 teaching colleges, 78 undergraduate majors, 14 first-level and 5 professional Master's degree programs.

QAU is among the Ministry of Education's undergraduate teaching work level assessment, a "high-level university" and "high-level disciplines" construction unit in

Shandong Province, and a "famous university project with Shandong characteristics".

## Agenda

	Oct 20th Registration		
13:00-18:00	Registration		
	Oct 21 <sup>st</sup> International Day International hall A		
Session 1			
Chair	Liang Yang & Zhenbo Xu		
8:50-9:00	Opening Ceremony Lixue Zhu, Zhongkai University of Agriculture and Engineering, Guangzhou		
9:00-9:30	Addressing the microbial stress response in agro-and human body ecosystems: a biofilm approach Gamini Seneviratne, National Institute of Fundamental Studies, Kandy		
9:30-10:00	Clostridioides difficile ferrosome organelles combat nutritional immunity Hualiang Pi, Yale University, New Haven		
10:00-10:30	Exploring the interplay between plant stress and soil microbiome in sustainable agricultural practices Yigal Achmon, Guangdong Technion-Israel Institute of Technology, Shantou		
10:30-10:50	Coffee break		
10:50-11:20	Electrochemical methods for early biofilm characterization Enrico Marsili, University of Nottingham, Ningbo		
11:20-11:50	The study of microbial response to selected environmental stressors using a freshwater multispecies biofilm model Olivier Habimana, Guangdong Technion-Israel Institute of Technology, Shantou		
11:50-12:20	Risk assessment of foodborne <i>Bacillus cereus</i> and control measure development to its hazard Yu Ding, Jinan University, Guangzhou		
12:20-14:00	Lunch		

#### Oct 21st International Day

#### International hall A

Session 2	
Chair	Tian Ding & Yang Deng
14:00-14:30	Novel approaches to deal with biofilm-related tolerance and persistence Tom Coenye, Ghent University, Ghent
14:30-15:00	Active interfacial mechanics promotes biofilm formation Yilin Wu, The Chinese University of Hong Kong, Hong Kong
15:00-15:30	Food Safety in Southeast Asia – the challenge of pesticide lock-in Daniel Tan, The University of Sydney, Sydney
15:30-15:50	Coffee break
15:50-16:20	Metabolic engineering microorganisms for production of high-value products from non-food carbon source Cheng Li, Massachusetts Institute of Technology, Cambridge
16:20-16:50	Danger and safety of street food in Thailand: Process of cooking to reduce sugar from jasmine rice Thanapop Soteyome, Rajamangala University Technology Phra Nakhon, Bangkok
16:50-17:20	Biofilm biochemicals as the next-generation biofertilizers and medicines nutraceuticals Mahesh Premarathna, National Institute of Fundamental Studies, Kandy
17:20-19:00	Dinner
Session 3	
Chair	Xinyu Liao & Xuejie Li
19:00-21:00	Junior Scientists and Student Presentations

### Oct 22<sup>nd</sup> Domestic Day

#### International hall A

Session 4	
Chair	Qingping Zhong & Qingli Dong
9:00-9:30	A bacterial quorum sensing mediated mechanism for intracellular survival within phagocytes Liang Yang, Southern University of Science and Technology, Shenzhen
9:30-9:50	The role of PhoP/PhoQ two-component system in regulating stress responses and virulence of <i>Cronobacter sakazakii</i> Xiaodong Xia, Dalian Polytechnic University, Dalian
9:50-10:10	The prevalence and risk assessment models of <i>Listeria monocytogenes</i> Qingli Dong, University of Shanghai for Science and Technology, Shanghai
10:10-10:30	Point of care testing (POCT) microfluidics for VBNC E. coli detection Shilun Feng, Shanghai Institute of Microsystem and Information Technology, Shanghai
10:30-10:50	Coffee break
10:50-11:10	The effect of quorum sensing on antibiotic resistance of <i>Escherichia coli</i> Xihong Zhao, Wuhan Institute of Technology, Wuhan
11:10-11:30	Molecular mechanism of low temperature tolerance of <i>Staphylococcus aureus</i> in cold chain Biao Suo, Henan Agricultural University, Zhengzhou
11:30-11:50	Formation mechanisms of VBNC yeast cells induced by high concentration of hop bitter acids Yang Deng, Qingdao Agricultural University, Qingdao
11:50-12:10	The resuscitation and adhesion mechanism of sublethally injured <i>Escherichia coli</i> O157:H7 Hui Shi, Southwest University, Chongqing
12:10-12:30	Efficient control techniques for foodborne pathogens: from broad spectrum sterilization to multi-dimensional targeting Zhaohuan Zhang, Shanghai Ocean University, Shanghai
12:30-14:00	Lunch

#### Oct 22<sup>nd</sup> Domestic Day

#### International hall A

<b>Session 5</b>	
Chair	Xihong Zhao & Junyan Liu
14:00-14:30	Using local combinational antibiotics to kill metabolically inactive tolerant cells and staphylococcal biofilms Yue Qu, Monash University, Melbourne
14:30-14:50	Phenotypic and proteomic changes of <i>Staphylococcus aureus</i> biofilm under water stress  Honghua Hu, Zhejiang University, Jinhua
14:50-15:10	Stress resistance mechanisms of viable but nonculturable probiotic <i>Lactobacilli</i> Qiuhua Bao, Inner Mongolia Agricultural University, Hohhot
15:10-15:30	Engineering pili-enabled living materials Yuanyuan Huang, Shenzhen Institutes of Advanced Technology, Shenzhen
15:30-15:50	Coffee break
15:50-16:10	Three-dimensional dynamic characterization of microbial adhesion Xiangjun Gong, South China University of Technology, Guangzhou
16:10-16:30	Staphylococcus aureus small colony variants Wenchang Yuan, Guangzhou Medical University, Guangzhou
16:30-16:50	Advancements in nonthermal plasma techniques for microbial inactivation Xinyu Liao, Innovation Center of Yangtze River Delta, Zhejiang University Jiaxing
16:50-17:10	Transcriptome profiling analysis of CgUpc2A regulon Yu Li, Qiqihar Medical University, Qiqihar
17:10-17:30	Formation and regulation of viable but non-culturable (VBNC) cells: a critica concern extended from microbial biofilms  Xuejie Li, South China University of Technology, Guangzhou
17:30-17:35	Closing ceremony

Oct 21st 9:00-9:30

#### Gamini Seneviratne

#### **Professor**

#### National Institute of Fundamental Studies, Kandy



Dr. Seneviratne had obtained BSc and Ph.D. from University of Peradeniya in 1984 and 1993, respectively. He has been serving as research professor from 2009 to 2015 in National Institute of Fundamental Studies, and then as senior research professor since 2015. At present, he is a Fellow of the National Academy of Sciences of Sri Lanka. He was former Editors to the Agriculture, Ecosystems & Environment (Elsevier), and Ceylon Journal of Science. He introduced beneficial microbial biofilm concept to biofertilizers, being the inventor of Biofilm biofertilizers.

## Title: Addressing the microbial stress response in agro- and human body ecosystems: a biofilm approach

**Abstract:** Microorganisms are sensitive to a range of environmental stressors that can affect their growth and survival, and they have evolved various mechanisms to cope with the stressors. Understanding the impact of these stressors on microorganisms is important in diverse fields, such as microbiology, biotechnology, and environmental science. Microbes in natural environments play a role in nutrient cycling, pollutant degradation and water quality. Knowledge on their stress responses is essential for managing and remediating environmental issues. Microbial stress responses in the environment are also integral to the interactions within the human microbiome as the environmental health directly influences the human health.

In natural ecosystems, microbial stress response may lead to dormant microbial states to bypass the stress factors, thus reducing microbial diversity and abundance. The reduced microbial diversity and abundance under the stress retard internal carbon (biochemicals) and nutrient cycling, while increasing their losses. That in turn leads to deplete ecosystem functioning and sustainability. Moreover, stress response of pathogens may also lead to virulence expression and pathogenicity, among other things. As such, microbial stress response may have negative outcomes leading to ecosystem degradation. Our approach is to produce the biochemicals via *in vitro* biofilm development (biofilms produce a higher diversity of environmentally important biochemicals than planktonic state) and its wider application to degraded ecosystems to break the dormant microbial states for increased microbial diversity, abundance, pathogen control, ecosystem functioning and to revive sustainability.

Oct 21st 9:30-10:00

**Hualiang Pi** 

**Assistant Professor** 

#### Yale University, New Haven



Dr. Hualiang Pi is an Assistant Professor in the Department of Microbial Pathogenesis and Microbial Sciences Institute. Her received her Ph.D. in Microbiology from Cornell University and conducted her postdoctoral training at Vanderbilit University Medical Center. Her lab focuses on elucidating microbial stress defense mechanisms important for bacterial infection. She is the recipient of an NIH Pathway to Independence Award (K99/R00).

#### Title: Clostridioides difficile ferrosome organelles combat nutritional immunity

**Abstract:** Iron is indispensable for almost all forms of life but toxic at elevated levels. To survive within their hosts, bacterial pathogens have evolved iron uptake, storage, and detoxification strategies to maintain iron homeostasis. However, these iron homeostatic systems are largely undefined in the human pathogen Clostridioides difficile. Here, we report that C. difficile undergoes an intracellular iron biomineralization process and stores iron in membrane-bound ferrosome organelles containing non-crystalline iron phosphate biominerals. We found that a membrane protein (FezA) and a P1B6-ATPase transporter (FezB), repressed by both iron and the ferric uptake regulator Fur, are required for ferrosome formation and play an important role in iron homeostasis during transition from iron deficiency to excess. Additionally, using two mouse models of C. difficile infection (CDI), we demonstrated that the ferrosome system is activated in the inflamed gut to combat host-mediated iron sequestration and is important for bacterial colonization and survival during CDI. Further studies are underway to elucidate the molecular basis of ferrosome biogenesis. Nonetheless, the ferrosome nanoparticles have the potential to redefine the concept of trace element storage in anaerobes, unveil important insight into how gut microbes cope with changes in elemental levels within the hosts, and provide a prototype for production of metal nanoparticles and drug delivery vesicles, and other bionanotechnology applications. Finally, the importance of ferrosomes to combat nutritional immunity establishes ferrosome formation as a new target for the development of antimicrobial therapeutics against this important pathogen.

Oct 21st 10:00-10:30

**Yigal Achmon** 

Associate professor

#### **Guangdong Technion-Israel Institute of Technology, Shantou**



Dr. Yigal Achmon is a food and agriculture scientist. He holds a BSc in Biochemistry and food science from the Faculty of Agriculture at the Hebrew university of Jerusalem and direct Ph.D. in Biotechnology and Food Engineering from the Technion – Israel Institute of Technology. He spent three years at Professor Christopher Simmon's lab at the University of California at Davis as a postdoctoral researcher. There he had developed an interdisciplinary approach to industrial food waste valorization research. He had done a postdoctoral at Volacni Israeli agricultural center, working on the microbiome of fresh cow milk.

## Title: Exploring the interplay between plant stress and soil microbiome in sustainable agricultural practices

Abstract: Sustainable agricultural practices exert a substantial influence on soil and plant microbial ecology, with profound consequences for plant health. To comprehensively grasp the ramifications of these techniques, it is imperative to closely investigate the alterations and interactions within relevant microbial populations. This presentation zeroes in on a sustainable agricultural practice known as Soil Biosolarization (SBS). SBS stands out as an innovative approach to soil pest control, providing an eco-friendly alternative to conventional methods like soil fumigation and soil solarization (SS). By harnessing the combined forces of solar heating and organic amendment fermentation, SBS delivers expedited and more effective control of soilborne pathogens. Recent studies underscore the introduction of the concept of Circular Soil Biosolarization (CSBS), which opens up a new dimension by enabling the creation of a circular economy through the reuse of crop residues as organic amendments in fields dedicated to the same crop.

In this presentation, we will delve into several studies that explore different soil amendments used in conjunction with SBS, such as tomato pomace (TP), digestate, and green waste, and their impact on the soil microbial population. For instance, we will discuss a study that focuses on the utilization of CSBS for biosolarizing soil with amended residues and its implications for tomato cultivation in the face of abiotic stressors, notably high salinity and nitrogen deficiency. The findings reveal that, in the absence of abiotic stress, CSBS confers tangible benefits to plant physiological performance, growth, and yield compared to traditional SS. Furthermore, CSBS significantly mitigates the adverse effects of abiotic stress conditions.

Our exploration of the soil microbiome and plant metabolome yields crucial insights. Genera like *Mycoplana* and *Kaistobacter* exhibit a positive correlation with improved tomato plant health under abiotic stress conditions, while the relative abundance of orders RB41, MND1, and the family Ellin6075 shows a negative association with tomato plant vitality. Additionally, numerous metabolites exhibit significant shifts in plants cultivated in SS- and CSBS-treated soils under abiotic stress conditions. Notably, the metabolite xylonic acid isomer emerges as a substantial negative factor in overall tomato plant performance across all treatments.

These findings significantly contribute to our deepened understanding of the intricate interplay between CSBS, soil ecology, and crop physiology in the face of abiotic stress conditions.

Oct 21st 10:50-11:20

Enrico Marsili

**Associate Professor** 

#### University of Nottingham, Ningbo



Enrico Marsili received Ph.D. from the University of Rome, Italy. After postdoctoral research at University of Minnesota, he took a Lecturer position at Dublin City University. In 2012, he joined Singapore Centre for Environmental Life Sciences Engineering as Principal Scientist. In 2019, he moved to Nazarbayev University as Associate Professor in the Department of Chemical and Materials Engineering. Currently, he is Associate Professor in Green Chemicals and Energy at China Beacons Institute, University of Nottingham. His research interests include biofilm electrochemistry, development of antimicrobial and antibiofilm agents, and biosensors for clinical applications.

#### Title: Electrochemical methods for early biofilm characterization

**Abstract:** Biofilms comprise of microorganisms encased in self-produced extracellular polymeric matrix, which provide mechanical stability, resistance to antimicrobials, and favors adhesion to nearly any surfaces. When biofilms grow onto electrodes, they are termed electroactive biofilm (EABs). The microorganisms in EABs are also known as electricigens. EABs are capable of extracellular electron transfer (EET) to and from solid acceptor, through direct or mediated mechanism. EABs are beneficial to wastewater treatment, contribute to biogeochemical processes and are responsible for microbially influenced corrosion (MIC). A thorough comprehension of the mechanism underlying EET is needed for biofilm management and to develop productive EABs for bioremediation, biomedical, and biosensing applications. The EET mechanisms are investigated through a combination of electrochemical techniques chronoamperometry and potentiostatic electrochemical impedance spectroscopy) and microscopy techniques. Following early studies on strong electricigens like Geobacter sp. and Shewanella sp., recent research has shown that most prokaryotes and even few eukaryotes (e.g., Candida sp.) exhibit weak electricigens activity under specific conditions, thus extending the validity of electrochemical methods for biofilm analysis. The majority of research focuses on single species biofilms while there is a lack of understanding of the properties of mixed species biofilms, making animal models necessary for validation. Furthermore, no single technology is available for monitoring mixed species biofilms, making complicated and unique techniques necessary for both laboratory and industry research studies of these systems. For quick pathogen identification in biofilm infections, the development of quick and affordable techniques for characterizing mixed-species biofilms is essential.

In our group, we develop electrochemical methods for characterization of early biofilms (both single species and multispecies) in the subsurface environment and in biomedical devices. I will give a brief introduction to electrochemical biofilm characterization and show how electrochemical methods provide complementary information to classical techniques for biofilm analysis, especially for weak electricigens.

Oct 21st 11:20-11:50

#### Olivier Habimana

#### **Associate professor**

#### Guangdong Technion-Israel Institute of Technology, Shantou



Dr. Olivier Habimana's achievements in the areas of food and environmental microbiology research have allowed him to explore microbial communities on abiotic surfaces, bridging the areas of food safety and water safety as they relate to the water-food-energy-nexus. He has emerged as an established scientist within the biofilm research community based on his significant contributions in the broad topic area of microbial ecosystems on inert surfaces, focusing on microbial biofilms, from the investigation of initial bacterial adhesion onto surfaces to finally, biofilm detachment. He values developing multispecies biofilm models to be used for fundamental and applied research.

## Title: The study of microbial response to selected environmental stressors using a freshwater multispecies biofilm model

**Abstract:** A focus on developing an experimental mixed-species biofilm model to characterize bacterial communities' diversity and functional shifts in freshwater ecosystems and their reactivity to various environmental stressors is presented. The body of work is among the few in the biofilm research area, showcasing the necessity of employing multispecies models to answer fundamental questions related to a broad spectrum of treatments and relevant environmental scenarios.

A laboratory-based experimental system using a controlled artificial freshwater laboratory source was developed by successfully applying an annular biofilm reactor to study dynamic structural changes and microbial community shifts during maturation and exposure to specific pollutant and nutrient conditions.

This developed experimental system was demonstrated to be a reliable means to study early-stage multispecies biofilm from a biofilm structure and microbial community perspectives while providing invaluable insights into stress response at the microbial community level through the application of state-of-the-art advanced microscopy, next-generation sequencing, and other analytical tools.

Oct 21st 11:50-12:20

Yu Ding

**Professor** 

#### Jinan University, Guangzhou



Dr. Yu, Research Fellow, Doctoral Supervisor, Winner of National Talent Support Program, and Project Leader of National Key R & D Program of China. He is a member of the Third Youth Chapter of Chinese Institute of Food Science and Technology, an expert member of the First Food and Medical Products Administration of Guangdong Province on suspected cases of endangering food safety and food related food assessment and identification expert database, and Vice Secretary General of Guangdong Edible Fungi Association. Director of food microbial safety and functional food research team, College of Science & Engineering Jinan University. The main research directions are: Food microbiological safety and control, Research and development of plant derived functional food, Bioreactor, etc. In the past five years, he has presided over a number of national, provincial and ministerial scientific research projects including National Key R & D Programs. So far, more than 60 SCI papers have been published.

## Title: Risk assessment of foodborne *Bacillus cereus* and control measure development to its hazard

Abstract: 蜡样芽胞杆菌是我国乃至世界范围内最为常见的食源性致病菌,可形成强耐受芽孢,分布范围广,极易造成食品污染。据国家卫健委统计数据显示,蜡样芽胞杆菌引起的食物中毒事件在细菌性食物中毒事件中排名第四,危害极为严重。本研究系统开展了我国7大类市售食品中蜡样芽胞杆菌的风险调查,全面分析了不同类型食品中蜡样芽胞杆菌污染风险与特征,发现我国食品中蜡样芽胞杆菌污染严重,在特定食品中污染率接近50%。此外,超过90%的蜡样芽胞杆菌分离株为多重耐药菌株,且携带不同毒力基因,潜在致病风险极高。在此基础上,建立了全球单库最大的食源性蜡样芽胞杆菌风险识别数据库、全基因组数据库、菌种资源库等,为蜡样芽胞杆菌危害形成机制与高效防控奠定基础。针对蜡样芽胞杆菌危害形成机制,依托构建的科学大数据库资源,开展了蜡样芽胞杆菌精准鉴定、呕吐毒素合成的调控研究与基于特异性烈性噬菌体的新型生物防控机制研究。本研究最终旨在为加强对蜡样芽胞杆菌引发的生物危害防控提供理论依据与技术支撑。

Oct 21st 14:00-14:30

**Tom Coenye** 

**Professor** 

#### **Ghent University, Ghent**



Dr. Tom Coenye's Ph.D. studies were funded by the Institute for the Promotion of Innovation by Science and Technology in Flanders (IWT) and the Cystic Fibrosis Trust (UK) and were carried out in the Laboratory of Microbiology in the Faculty of Sciences at Ghent University, under the *B. cepacia* supervision of Prof. Peter Vandamme. Subsequently Dr. Coenye worked as a postdoctoral fellow in the lab of Prof. John J. LiPuma (University of Michigan) on epidemiology and population structure of *B.cepacia* complex isolates and the identification of unusual respiratory pathogens present in the lungs of CF patients.

#### Title: Novel approaches to deal with biofilm-related tolerance and persistence

**Abstract:** In this talk I will first present an introduction to microbial biofilms and their involvement in (chronic) infections. Subsequently, I will present an overview of the state-of-the-art concerning mechanisms contributing to the lack of antimicrobial susceptibility in microbial biofilms, highlighting the importance of resistance, tolerance and persistence. Finally, I will present examples of innovative approaches that are being developed for the treatment of biofilm-related infections. This involves using metabolic 'potentiators' to increase the activity of conventional antibiotics. Throughout the talk I will highlight the importance of performing biofilm studies in physiologically relevant conditions.

Oct 21st 14:30-15:00

Yilin Wu

**Professor** 

#### The Chinese University of Hong Kong, Hong Kong



Employment: Postdoctoral Fellow, Harvard University, 2009-2012; Professor, Department of Physics, The Chinese University of Hong Kong, 2012-2018;

Awards and Honors: 2007, Scholarship and travel award, the First Q-bio Summer School and Conference, Los Alamos National Laboratory, Sante Fe, New Mexico; 2009, Thesis award, Department of Physics, University of Notre Dame; 2011, Semifinalist of Burroughs Wellcome Fund's Career Awards at the Scientific Interface (CASI); 2017, Young Researcher Award, The Chinese University of Hong Kong; 2020-2025, RGC Research Fellow, Research Grants Council of Hong Kong SAR.

#### Title: Active interfacial mechanics promotes biofilm formation

Abstract: Microbial communities such as biofilms are commonly found at interfaces, and biofilm formation generally represents a response to environmental stress such as nutrient depletion. We found that an interfacial process denoted as "active interface bulging" promotes biofilm formation. During this process, an initially two-dimensional layer of swarming bacteria spontaneously develops scattered liquid bulges; the bulges have a higher propensity to transit from motile to sessile biofilm state. Combining multi-mode imaging, single-cell tracking and numerical simulations, we attributed the higher propensity of biofilm transition in liquid bulges to the enrichment of pre-existing immotile cells towards the bulge area due to their lower diffusivity in the bulge area. Our findings reveal a unique physical mechanism of biofilm formation and provide a new strategy for biofilm patterning in engineered living materials.

Oct 21st 15:00-15:30

**Daniel Tan** 

**Professor** 

#### The University of Sydney, Sydney



Professor Daniel Tan was Senior Lecturer in 2010 in Faculty of Agriculture and Environment, to Associate Professor in 2015 and to Professor in 2021. Daniel has been unit coordinator of the 3rd year units, Production Horticulture from 2017 and Sustainable Plant Production from 2020. He is the Development Agriculture Theme Leader of the Sydney Institute of Agriculture, Faculty of Science Postgraduate Coursework Program Director, Cambodian Country Coordinator of the Sydney Southeast Asian Centre and Agriculture, Food and Environment Node Leader of the Sydney Vietnam Centre. He has published papers at conferences such as the International Crop Science Congress.

#### Title: Food Safety in Southeast Asia - the challenge of pesticide lock-in

Abstract: There is increasing awareness in food safety issues in Southeast Asia and many Southeast Asian countries have introduced Food Safety Acts mainly focusing on microbial food safety. Fruit and vegetables are implicated in a disproportionate number of food safety incidents, and these can be caused by chemical, physical and microbial contaminants. In Southeast Asia, pesticide residue contamination is more challenging as crops including rice, fruits and vegetables are mostly produced by smallholder farmers. This paper discusses the need to understand the motivations of smallholder farmers and input sellers in the use of pesticides and proposes the use of mobile applications and training of government regulators, input sellers and smallholder farmers in integrated pest management to reduce the incidences of pesticide residues being detected above the maximum residue limit.

Oct 21st 15:50-16:20

Cheng Li

#### Researcher

#### Massachusetts Institute of Technology, Cambridge



Researcher in the Department of Biology at Massachusetts Institute of Technology, co-founder and CTO of Polynovo Biotechnology Co., Ltd. He is engaged in synthetic biology, metabolic engineering, enzyme engineering, etc. He mainly uses engineering cell factories to produce value-added products or chemical material platform molecules using straw or plastic as carbon sources. He is an editorial board member of journals such as Genes and Frontier Genome Editing. He has published dozens of articles, patents and multiple books, as well as collaborated with numerous Fortune 500 companies to develop product pipelines.

## Title: Metabolic engineering microorganisms for production of high-value products from non-food carbon source

**Abstract:** Synthetic Biology is one of the frontline representatives in biology that catalyzes disruptive innovations and one of the underlying core technology sources of the biochemical industry chain. Carbon source, as the food of cell factory, plays an important role in synthetic biology. However, most of carbon sources are glucose, mainly from corn, which its massive consumption can cause food crisis. We engineered *Corynebacterium glutamicum* to utilize straw or PET to produce carotenoids or succinate acid, identifying affordable and sustainable non-food carbon sources for biosynthesis to ensure the commercial success of biosynthesis and to contribute to the United Nations' Sustainable Development Goals. Novel genome editing tools were developed based on CRISPR system coupled with transposase providing for rate-limiting bottlenecks.

Oct 21st 16:20-16:50

#### **Thanapop Soteyome**

#### **Professor**

#### Rajamangala University of Technology Phra Nakhon, Bangkok



Professor Thanapop Soteyome is currently the President of Rajamangala University of Technology Phra Nakhon. He graduated with a Ph.D. from South China University of Technology in 2015. He is also a consultant to the Ministry of Industry Promotion, the Ministry of Industry, and the Thailand Small and Medium Enterprise Alliance (Innovative Food and Beverage). Formerly served as a member of the organizing committee for the 8th International Conference on Sustainable Development Science, Technology, and Innovation, the 1st Food Technology Forum in Thailand and so on.

## Title: Danger and safety of street food in Thailand: Process of cooking to reduce sugar from jasmine rice

Abstract: In this study, we improved different rice cooking methods to reduce the sugar in rice. The improvement of jasmine rice will lead to the development of products suitable for people suffered from diabetes. The aim of this investigation was to study the method of cooking rice to reduce sugar amount and study the sensory properties of jasmine rice. Jasmine Rice brand of Royal Umbrella were cooked with five different methods, then the Glucose Tolerance Test measured sugar content, and taste acceptance was measured. Jasmine rice was soaked before cooking and had the least sugar out of all five cooking methods at 0.04%. The soaking made the rice sticky and softer than cooking rice with a normal rice cooker (hot). The hardness was 19.71  $\pm$ 0.73 (N) and 23.73  $\pm$  2.60. The difference was statistically significant (p<0.05). Sensory quality tests and acceptance of jasmine rice cooking were found to be depending on soaking the rice before cooking. The sugar content, sensory qualities, and acceptance of jasmine rice cooking were found to be depending on soaking the rice before cooking. Soaking jasmine rice before cooking effectively decreased sugar levels while preserving its sensory properties and overall taste. This technique can be beneficial for individuals who have diabetes or are interested in reducing sugar intake. It is worth mentioning, however, that this method results in a stickier and softer texture than traditional rice cooking methods.

Oct 21st 16:50-17:20

#### Mahesh Premarathna

#### **Post-Doctoral Research Fellow**

#### National Institute of Fundamental Studies, Kandy



Dr. Mahesh Premarathna obtained a B.Sc. Hons. of Agriculture (Special) in Biotechnology Degree from Wayamba University of Sri Lanka, in 2019., and a Ph.D. degree from the University of Peradeniya in 2023, with a thesis titled "Microbial biofilms and their network interactions". He is a member of the pioneering group of Biofilm-based Biofertilizers (BFBF) at the NIFS, and he has contributed to the novel applications of microbial biofilms. His research interests include Molecular Biology and Biochemistry, Biotechnology, Microfluidics, Soil carbon sequestration, Astrobiology, Agriculture, Ecosystems and Environment, Biofilm Medicines, and Philosophy.

## Title: Biofilm biochemicals as the next-generation biofertilizers and medicines / nutraceuticals

Abstract: Microorganisms respond to environmental stressors, evolving coping mechanisms. Understanding these responses is vital for addressing environmental and health issues. Stress can lead to dormant microbial states, reducing diversity and ecosystem functioning. Alternatively, stress can induce virulence and harm to ecosystems. We aim to produce biofilm biochemicals (BBCs) via in-vitro development to break microbial dormancy, enhancing diversity, abundance, and sustainability. These biochemicals are poorly understood but crucial for biotechnological applications like biofilm biofertilizers (BFBF) and biofilm medicines/nutraceuticals. We have performed a cross-disciplinary study by applying productive biofilms to degraded agroecosystems and simulated gut environments. Results showed that the BFBF improved plant immunity, soil quality, and sequestered carbon up to 30% with its subsequent stabilization, increased crop quality and yields up to 25%, while cutting down chemical fertilizers up to 50% when compared to the chemical fertilizer alone application. Due to these beneficial effects, the BFBF practice has expanded up to 16% of total paddy cultivation in Sri Lanka. As a next step, 69 industrially and medicinally important BBCs were identified, indicative of ecosystem restoration, including the human gut. In addition, BBCs were non-toxic and promoted gut microbiota restoration. These studies suggests that the biofilms with BBCs have a potential as the next-generation biofertilizers and medicines / nutraceuticals.

Oct 22nd 9:00-9:30

**Liang Yang** 

**Professor** 

#### Southern University of Science and Technology, Shenzhen



Dr. Liang Yang joined Nanyang Technological University (NTU, Singapore) as an Assistant Professor in 2012 and was promoted as an Associated Professor (with tenure) in Feb 2018. He was appointed as the Assistant Chair in the School of Biological Sciences and the Deputy Research Director of the Public Health Cluster in Singapore Centre for Environment Life Science Engineering (SCELSE) in NTU. In 2018, he joined SUSTec as a Full Professor in School of Medicine. his research group employs molecular microbiology, systems biology and chemical biology approaches to investigate bacterial biofilm formation mechanisms, antibiotic resistance, pathogenesis and next generation antimicrobial compounds. He is currently an editor board member of Applied and Environmental Microbiology (ASM) and Biofilm (ELSEVIER). He has published more than 200 research papers in international peer reviewed journals, including The New England Journal of Medicine, Lancet, Nature Communications, Advanced Sciences, Science Signaling, Nature Protocols, Proc Natl Acad Sci U S A, etc (Total citations >13000, H-index 57). Dr. Yang is ranked as the World's Top 2% most-cited scientists by Stanford University.

## Title: A bacterial quorum sensing mediated mechanism for intracellular survival within phagocytes

**Abstract:** Bacterial pathogens have developed strategies to survive inside host cells without triggering the innate immune surveillance in ways that are still not fully understood. Here, we reported that *Pseudomonas aeruginosa* induces its quorum sensing mechanism after macrophage engulfment. Further investigation of its secretome identified a quorum sensing regulated product, LasB, was responsible for innate immune suppression. Moreover, we showed that this specific type of pathogen-mediated innate immune suppression was due to the enzymatic digestion of the death domains of the innate immune adaptors, mainly MyD88, and attributed to LasB's large substrate binding groove. Hence, we discovered an example of bacterial quorum sensing-regulated cellular innate immune suppression by direct cleavage of immune adaptors.

Oct 22nd 9:30-9:50

Xiaodong Xia

**Professor** 

#### Dalian Polytechnic University, Dalian



Dr. Xiaodong Xia obtained a PhD from the University of Maryland from 2006 to 2010, served as a professor at Northwest A&F University from 2010 to 2018, and has been a professor at Dalian University of Technology since 2018. He is a member of the American Food Technology Association, and a member of the American Society of Microbiology. He serves as an editorial board member for Frontiers in Microbiology and Foods journals, as well as a youth editorial board member for iMeta journals. The main research direction is natural antibacterial substances, new probiotics and health, gut microbiota, and immunity.

## Title: The role of PhoP/PhoQ two-component system in regulating stress responses and virulence of *Cronobacter sakazakii*

Abstract: Cronobacter sakazakii, an opportunistic foodborne pathogen, causes necrotizing enterocolitis, meningitis and bacteremia in neonates and infant. Two-component system (TCS) is a primary form of bacterial signal transduction, which can regulate the ability of bacteria to sense and respond to the external environment. Among them, the PhoP/PhoQ TCS plays an important role in regulating stress response and pathogenicity. However, the regulatory role of PhoP/PhoQ system in C. sakazakii has not been thoroughly studied. In this study, the phoPO gene deletion strain of C. sakazakii and the corresponding complementation strain were constructed, and the tolerance of the wild-type (WT) strain, the phoPQ gene deletion strain and the complementation strain to various environmental stress, biofilm formation, the ability of adhesion and invasion, and the ability to cause intestinal inflammation of newborn mice were studied. In addition, RNA-seq was used to screen the differential expressed genes (DEGs) after the phoPQ gene deletion. The growth of ΔphoPQ strains was limited compared with WT and ∆phoPQ<sup>C</sup> strains in low Mg<sup>2+</sup> medium and acidic pH medium; under the Polymyxin B, heat, oxidation, osmotic and bile salts stress, the tolerance of ∆phoPQ strain was significantly reduced compared with WT strain, while the  $\Delta phoPQ^{C}$  strain restored the growth characteristics and tolerance to these environmental stress. Deletion of phoPQ gene significantly reduced the biofilm biomass of C. sakazakii. Compared with the WT strain, the biofilm metabolic viability of the  $\triangle phoPQ$  strain and  $\triangle phoPQ^{C}$  strain were reduced by 62.79% and 27.13%. ATR-FTIR spectrum analysis showed that the corresponding peaks of polysaccharides and protein were much lower in the spectrum of  $\Delta$ phoPQ strain biofilm than those in the WT and AphoPO<sup>C</sup> strains. The adhesion and invasion assay showed that the adhesion and invasion rates of the ∆phoPQ strain to HT-29 cells were reduced to 39.84% and 21.88% of the WT strain, respectively. Deletion of phoPQ gene reduced intestinal damage and ileum colonization ability in neonatal mice. The mortality of mice infected with WT, ΔphoPQ and ΔphoPQ<sup>C</sup> strains were 54.55%, 12.50% and 35.71%, respectively. RNA-seq showed that there were 2008 DEGs between WT and AphoPO strain, including 1029 up-regulated genes and 979 down-regulated genes. DEGs related to bacterial environmental tolerance and virulence involved in multiple KEGG pathways, including bacterial secretion system, flagella assembly, bacterial chemotaxis and lipopolysaccharide biosynthesis. In conclusion, these findings suggested that the PhoP/PhoQ system is an important regulatory mechanism for C.

sakazakii to resist various environmental stress and to cause infections.

Oct 22nd 9:50-10:10

**Qingli Dong** 

**Professor** 

#### University of Shanghai for Science and Technology, Shanghai



Dr. Qingli Dong is a professor and doctoral supervisor of the University of Shanghai for Science and Technology (USST), P. R. China, and he received his M.E. and PhD on food science and engineering at 2004 and 2007, respectively. Afterwards Dr. Dong worked as a post-doctoral fellow in USST during 2007-2009. Dr. Dong worked as a visiting scholar at the Institute of Food Research, UK, supported by the Chinese Scholarship Counci during 2013-2014, and was seconded to the Major Project Office, Ministry of Science and Technology of P. R. China during 2017-2018. His research is focus on predictive food microbiology and its application on the quantitative microbiological risk assessment, mainly supported by the MoST, Natural Science Foundation of China, China National Center for Food Safety Risk Assessment, and Shanghai Municipal Natural Science Foundation. Dr. Dong is a member of FAO/WHO JEMRA, a member of the 2nd National Food Safety Risk Assessment Commission by the National Health Commission of P. R. China, also a member of the academic commission of National Key Lab for Drug Microbial Detection by the National Medical Products Administration of P. R. China.

#### Title: The prevalence and risk assessment models of Listeria monocytogenes

Abstract: Listeria monocytogenes (LM) is a major problem for the food industry. In order to investigate the prevalence of LM in meat products in China, a meta-analysis method was used to systematically analyze the contamination information. Focusing on the cross-contamination caused by LM, systematic research has been conducted in food processing and housing storage. Firstly, the biofilm formation of LM in simulated meat processing was explored, and the biofilm formation probability boundary model of LM under simulated meat processing conditions was established. Then beef juice and standard medium were used as cultures to observe formation process and microstructure of LM biofilms. Secondly, the biofilm formation model of Pseudomonas aeruginosa and LM in a simulated chicken environment was established, and the formation of LM biofilm and the expression of related genes were studied under nutritional stress conditions. Finally, the transfer and residual of biofilm cells after a single and successive contacts at specific stages was studied. Our findings provide a theoretical reference for the prevention and control of LM biofilms in food processing.

In recent years, much chemical, physical and biotechnologies have been used as practical methods to control LM in food. Probiotics and their derivatives have great potential for the control of LM and provide better options for biological control strategies in food. By imparting "sterilization", "anti-adhesion" or a combination of the two functions on the food contact surface, the formation of biofilm can be reduced by reducing the reversible adhesion of foodborne pathogens in the primary stage, so as to realize the prevention of foodborne pathogens. In-depth research on the mechanism and modeling of biofilm formation and transfer is required. Taking environmental factors into full consideration, and setting standards for cleaning and disinfection are conducive to reducing the potential risk of food borne pathogens transmission.

Oct 22nd 10:10-10:30

**Shilun Feng** 

Associate researcher

Shanghai Institute of Microsystems and Information

Technology, Shanghai

Dr. Shilun Feng obtained a Ph.D. in Engineering from Macquarie University in Australia in 2018 and had postdoctoral research experience at Nanyang Polytechnic University in Singapore for 2 years. He joined Shanghai Institute of Microsystem and Information Technology, Chinese Academy of Sciences in 2020. He has long been engaged in research in the field of POCT biological microfluidic chips and complete machines facing pathogens (bacteria, viruses, etc.), with 8 years of work experience. His main research directions include microfluidic sampling needles, on chip online sample manipulation, integrated on chip optical detection, etc.

Title: Point of care testing (POCT) Microfluidics for VBNC E. coli detection

**Abstract:** To be determined



Oct 22nd 10:50-11:10

Xihong Zhao

**Professor** 

#### Wuhan Institute of Technology, Wuhan



Professor Xihong Zhao was selected for the Hubei Province "Connected Talent Program". He joined Wuhan Engineering University in July 2010 and served as a postdoctoral researcher at Gangwon University in South Korea and Taiwan University from 2011 to 2014. In 2014, he was appointed as a distinguished professor at Wuhan University of Engineering and selected for relevant talent projects in Hubei Province. He has achieved a series of research results in the formation mechanism and rapid detection technology of foodborne pathogenic bacteria VBNC and biofilm. He has been the first author or corresponding author of over 20 SCI international journals and has been selected for three ESI high citation papers.

Title: The effect of quorum sensing on antibiotic resistance of Escherichia coli

Abstract: To be determined

Oct 22nd 11:10-11:30

Biao Suo

**Professor** 

#### Henan Agricultural University, Zhengzhou



Professor Biao Suo is a scientific and technological innovation talent in universities of Henan province. His research area includes the molecular ecology of food microorganisms and food safety, as well as the utilization of microbial resources in traditional fermented noodle based staple foods. He was a visiting scholar in the Department of Food Science at Purdue University from 2018 to 2019; From 2010 to 2013, he was a lecturer in the Department of Food Quality and Safety at the School of Food Science and Technology, Henan Agricultural University. He had been an associate professor in the Department of Food Quality and Safety at the School of Food Science and Technology, Henan Agricultural University since 2013. He has hosted multiple national level grants including National Natural Science Foundation of China and Sub-project of the National Key R&D Program of the 14<sup>th</sup> Five-Year Plan. He has published more than 70 papers, including more than 20 papers indexed by SCI as the first or corresponding author, and 1 ESI highly cited paper in 2020. He has published 1 book in English and 3 planning textbooks.

## Title: Molecular mechanism of low temperature tolerance of *Staphylococcus* aureus in cold chain

Abstract: 近年来,随着居民生活水平的提高和人们消费习惯的改变,冷链物流 和冷藏食品的需求在日益增加。金黄色葡萄球菌是冷藏食品中最容易检出的食源 性致病菌,并且低温会诱导小菌落变种产生,增大微生物控制难度。本研究对实 验室分离鉴定的 178 株金黄色葡萄球菌进行低温耐受性分析,发现 38 株低温敏感 型,26 株低温耐受型,并发现一株能形成小菌落变种的BB-1 菌株。其在低温胁 迫下具有更好的细胞膜完整性,并且抗逆基因及细胞膜脂肪酸合成基因的表达水 平显著上调。随后,比较基因组学发现小菌落变种 BB-1 有 468 个特有基因,特 有基因主要富集在翻译、DNA 重组、DNA 修复、代谢途径、双组分系统和群体 感应等通路,可能广泛参与小菌落变种的形成。对 rsbW 基因测序显示 BB-1 发生 单核苷酸突变,分子对接拟合发现碱基突变的 RsbW 蛋白与 SigB 蛋白的结合能力 降低,与 RsbV 蛋白的结合能力增强。RNA-seq 结合生物信息学分析显示,由于 细胞膜受损,与低温敏感型菌株相比,低温耐受型菌株中氧化应激反应能力增加, 防御机制相关基因表达上调,而且能量代谢可能在低温胁迫下的金黄色葡萄球菌 中起作用。随后对湿法汤圆的加工流程进行微生物多样性分析后发现,磨浆槽内 壁、米浆转运罐壁、米浆运输管道菌落较多,金黄色葡萄球菌的污染明显,表明 湿法汤圆生产过程中会受到该致病菌的污染。模型拟合发现低温耐受型 BB-11 的 在 10℃的低温下达到 t4.0 值需要 96 h, 而低温敏感型 BA-26 在 144 h 的观察期内 仅仅也增加了 2.4 log CFU/g。这些结果表明在进行微生物风险评估时,应进一步 考虑菌株对低温的不同抗性由此带来的生长速率和迟滞期方面的差异,对冷链食 品企业建立致病菌高效安全控制技术提供一定的理论依据。

Oct 22<sup>nd</sup> 11:30-11:50

**Yang Deng** 

Associate professor

#### Qingdao Agricultural University, Qingdao



Dr. Yang Deng is the director of the Research Department of the Qingdao Special Food Research Institute, guest editor for Frontiers in Microbiology, member of the National Liquor Standardization Technical Committee, expert reviewer for the National Natural Science Foundation of China, and reviewer for journals such as Critical Reviews in Food Science and Nutrition, Journal of Agricultural and Food Chemistry, and International Journal of Food Microbiology. His research direction is applied basic research in the manufacturing and quality control of microbial new resource food.

## Title: Formation mechanisms of VBNC yeast cells induced by high concentration of hop bitter acids

Abstract: 本研究首先明确了在高浓度啤酒花异α-酸条件下 VBNC 状态酵母的形成及生理代谢特性,300 mg/L 异α-酸处理酵母 2 h 后,可培养菌数降到零,活菌数约为 1.02×10<sup>6</sup> cfu/mL; 2500 U/mL 过氧化氢酶培养 48 h 可使细胞复苏至可培养状态。与正常状态相比,VBNC 酵母起发时间延长,增殖能力、糖和α-氨基氮消耗速率下降;发酵结束后啤酒风味协调性差。通过比较不同状态酵母的基因表达差异,再结合 GO 和 KEGG 富集分析发现,VBNC 状态形成的关键途径可能涉及氧化还原酶、过氧化物酶体、MAPK 信号通路、淀粉和蔗糖代谢等。采用LFH-PCR 同源重组构建了氧化应激反应关键调控基因 Yap1 的敲除载体,转化酵母获得基因缺失突变体,证实 Yap1 在 VBNC 酵母形成过程中的调控作用,初步揭示了高浓度异α-酸诱导酵母应激进入 VBNC 状态的调控机制。

Oct 22nd 11:50-12:10

Hui Shi

**Professor** 

#### **Southwest University, Chongqing**



Professor Hui Shi, doctoral supervisor, mainly focuses on the prevention and control mechanisms and detection technologies of foodborne pathogenic microorganisms. She serves as the deputy director of the National Nutrition and Quality Evaluation and Appraisal Center for Famous and Excellent New Agricultural Products (Southwest University), the head of the Southwest Biotechnology Popularization Base, and a scientist in the modern agricultural industry technology system of Chongqing City. She has led over 20 national science and technology major subprojects, as well as the National Natural Science Foundation Youth and General Programs, and edited the textbook "Food Molecular Microbiology" for the 13<sup>th</sup> Five-Year Plan.

#### Title: The resuscitation and adhesion mechanism of sublethally injured Escherichia coli O157:H7

Abstract: It is difficult to completely eliminate sublethally injured foodborne pathogens because they can be recovered, which is a major food safety concern. We established a sublethally injured bacteria model (Escherichia coli O157:H7, injured ratio>99%), and compared gene expression of injured and early recovered bacteria by RNA-sequencing. We confirmed that the upregulated genes duirng early recovery were significantly enriched in the function of biological adhesion, and synthesis of pili and flagella are important pathway. Curli-deficient mutant ∆csgB, type IV pili-deficient mutant  $\Delta ppdD$ , type 1 fimbriae-deficient mutant  $\Delta fimA$  and flagella-deficient strain (ΔfliD, ΔfliS, ΔcheA and ΔmotA) were constructed by lambda-red recombination system to examine their adhesion on spinach, lettuce, arugula, red cabbage, cucumber, stainless steel, and glass. The bacteria were also observed by scanning electron microscopy. It was validated that different types of pili or flagella dominated adhesion on different surfaces. Non-treated, injured, and recovered bacteria displayed the strongest adhesion to spinach among these surfaces, which was dominated by curli. All types of pili significantly affected the adhesion on red cabbage, yet it exhibits distinct phenotypes during different phases. This can be related to different pili-encoding gene expression under different bacterial states and the roughness of surfaces. Through correlation analysis of vegetables surface property, it was discovered that surface hydrophobicity and charge density showed strong and moderate relevance to adhesion, respectively. Among flagella-deficient strains, deficient in fliD increased adhesion population on red cabbage, deficient in motA decreased adhesion population on cucumber. Flagella-deficient strains all exhibited non-motile property. In addition, deficient in flagella-related genes made a decrease in early stage of adhesion, which demonstrated the key role of flagella in early stage of adhesion.

Oct 22nd 12:10-12:30

**Zhaohuan Zhang** 

**Associate professor** 

#### Shanghai Ocean University, Shanghai



Dr. Zhaohuan Zhang is the Deputy Secretary General of the Youth Work Committee of the Shanghai Food Society, participating in the National Postdoctoral Innovation Talent Support Program and the Shanghai "Super Postdoctoral" Incentive Program. He is an editorial board member of the CYTA Journal of Food, a youth editorial board member of the Journal of Fisheries of China, and a core member of the "Food Safety Control and Nutritional Health" key innovation team of high-level local universities in Shanghai, Shanghai Ocean University and the University of East Anglia in the UK jointly cultivate doctoral programs (National Public Scholarship Fund). The main research direction is the resistance mechanism, risk assessment, and targeted prevention and control of foodborne pathogens. He has published 43 scientific research papers, participated in the compilation of 2 English monographs, authorized 10 national/international patents, and 3 software copyrights as first or correspondence author. He has hosted 8 national/provincial/ministerial level scientific research projects, including the National Natural Science Foundation Youth Fund and the Shanghai Natural Science Foundation General Fund.

# Title: Efficient control techniques for foodborne pathogens: from broad spectrum sterilization to multi-dimensional targeting

Abstract: 食品安全乃国之大者,食源性致病菌严重危害食品安全与人类健康,并造成极大的经济损失。对于食源性致病菌高效防控技术的研究,一直是食品安全领域的重点、难点问题。在广谱杀菌技术层面,本课题组针对电解水技术展开研究,系统地对电解水食品杀菌关键技术进行了基础研究、工艺优化、设备改进、产品研发以及推广应用,有效延缓了食品腐败变质,提升了食品质量安全。在靶向杀菌技术层面,本课题组针对食源性致病菌的耐药生物被膜、耐药菌体及耐药防御屏障,系统地开发了基于生物被膜水解酶、噬菌体裂解酶及靶向抗菌小分子的多维靶向杀菌技术,从耐药源头上阻止食源性致病菌耐药性的产生,实现了食源性致病菌的精准清除。

Oct 22nd 14:00-14:30

Yue Qu

#### **Senior Research Fellow**

## Monash University, Melbourne



Dr. Yue Qu is a senior research fellow at the Department of Infectious Diseases, the Alfred Hospital and Monash University. He received a MBBS from Wenzhou Medical University in 2000, a Ph.D. from RMIT University in 2010 and an Australian Research Council (ARC) Super Science Fellowship at Monash University in 2012. His research expertise is in biofilm-related infections, developing and validating *in vitro* assays that mimic clinically relevant environmental conditions to study medical biofilms. He worked closely with leading clinicians and engineers and used laboratory-based methodologies to address clinical issues.

# Title: Using local combinational antibiotics to kill metabolically inactive tolerant cells and staphylococcal biofilms

**Abstract:** Background: Recurrent driveline infections due to biofilm formation in the tissue tunnel may be managed by surgery and local antibiotic therapy. Efficacy of antibiotics in killing biofilms in the tunnel needs to be accurately predicted. The aim was to assess the potential of seven first-line antibiotics and their combinations, when used locally, in treating biofilm-related driveline infections.

Methods: Reference strains and clinical isolates of staphylococci from patients with driveline infections were used. Susceptibility testing was performed with vancomycin, oxacillin, cephalexin, gentamicin, ciprofloxacin, rifampicin and minocycline, their combinations, on bacteria grown as planktonic cells and biofilms in 96-well microplates. Minimum inhibitory concentration (MIC), minimum bactericidal concentration, and different levels of the minimum biofilm eradication concentration (MBEC) were determined. Dependency of bacterial killing on cell metabolism was evaluated for each antibiotic. An interstitial biofilm assay that mimics the driveline tunnel was used to evaluate the activity of Stimulan antibiotic beads (with gentamycin and vancomycin) and TYRX (with rifampicin and minocycline) in killing biofilms grown on HMIII driveline smooth and velour sections.

Results: High concentrations of local antibiotics were required to kill microplate-based biofilms. Gentamicin outperformed other antibiotics in eradicating staphylococcal biofilms, supported by the lowest MBECs that leads to long-term treatment success. Gentamicin and vancomycin appeared to be synergistic, with a combination at MEBCs completely eradicating microplate-grown staphylococcal biofilms. STIMULAN antibiotic beads with gentamicin and vancomycin effectively killed staphylococcal biofilms on smooth drivelines by 2.1-6.8 logs, and that on velour by 2.1-3.0 logs, more effective than local vancomycin at 1280 mg/L, and TYRX that contains rifampicin and minocycline. Gentamicin at a concentration greater than 128 ug/mL was found to have little dependence on cell metabolism and can effectively eradicate tolerant cells.

Conclusions: Combinational vancomycin and gentamicin, if used locally may be useful in treating driveline infections that are associated with staphylococcal biofilms.

Oct 22<sup>nd</sup> 14:30-14:50

Honghua Hu

Researcher

## Zhejiang University, Jinhua



Dr. Honghua Hu is currently the team leader for the diagnosis and prevention of pathogen infections in Jinhua Institute of Zhejiang University. She is also a talent introduced by the "Double Dragon Plan" in Jinhua City, China. She obtained her Ph.D. in Molecular Microbiology from the University of Sydney, Australia in 2005 and was a Research Fellow and a Ph.D. supervisor at Macquarie University in Australia. She has 22 years of research experience in the diagnosis and prevention of pathogenic bacterial infections and is the first to reveal the correlation between breast implant biofilm infection and lymphoma internationally, attracting worldwide attention.

# Title: Phenotypic and proteomic changes of *Staphylococcus aureus* biofilm under water stress

Abstract: Staphylococcus aureus is responsible for serious acute and chronic infections worldwide and is well - known for its biofilm formation ability. Recent findings of biofilms on hospital dry surfaces emphasize the failures in current cleaning practices. Here, we compared the phenotypic and proteomic changes of S. aureus biofilm under water stress semi-hydrated condition dry surface biofilms (DSB) with traditional hydrated conditions. Phenotypically DSB demonstrated higher resistance to sodium hypochlorite treatment and wiping test, indicating the difficulty in removing these DSBs. Microscopy study revealed that DSB presented thicker extracellular polymeric substances (EPS) than hydrated biofilm. S. aureus biofilm cells in DSB presented increased cell wall width and higher peptidoglycan content compared to biofilm cells in hydrated biofilm. The proteins significantly upregulated in DSB include PTS **IIBC** glucose transporter subunit (PtaA), UDP-N-acetylmuramate-L-alanine ligase (MurC) and UDP-N-acetylenolpyruvoylglucosamine (MurB) compared to hydrated biofilm. These three proteins are all linked with peptidoglycan biosynthesis pathway and are responsible for cell - wall formation and EPS matrix deposition. Our study suggests that DSB under water stress produced more peptidoglycan and EPS with increased cell - wall width to reduce the water loss. The tolerance of S. aureus to sodium hypochlorite was increased as peptidoglycan synthesis increased, which was reflected in increased cell wall width and increased EPS production. These also contribute to the persistence of DSB on hospital dry surfaces and could be new targets to combat hospital dry surface biofilms.

Oct 22nd 14:50-15:10

Qiuhua Bao

Associate researcher

## Inner Mongolia Agricultural University, Hohhot



Dr. Qiuhua Bao is a doctoral associate researcher and master's supervisor under Professor Heping Zhang. Since 2005, she has been working at the Key Laboratory of Dairy Biotechnology and Engineering of the Ministry of Education at Inner Mongolia Agricultural University. Mainly engaged in research on dairy microbiology and biotechnology. Since 2010, more than 80 research papers have been published, including 23 first or corresponding authors. She has authorized 12 patents, participated in the compilation of 3 textbooks and 1 monograph. She has received awards such as the Shen Nong China Agricultural Science and Technolog Award.

# Title: Stress resistance mechanisms of viable but nonculturable probiotic Lactobacilli

Abstract: 报告内容主要包括二部分。第一部分介绍内蒙古农业大学乳品生物技术与工程教育部重点实验室及所建立的乳酸菌菌种资源库。自 1989 到 2023 年,实验室在张和平教授的带领下,从 32 个国家采集自然发酵乳制品、自然发酵食品、母乳、婴儿粪便样品 6,202 份,分离、鉴定、保藏共计 47,573 株乳酸菌,建立了全球最大的乳酸菌菌种资源库。有些乳酸菌在生产应用过程中遭受各种环境压力后会进入 VBNC 态,对其抗逆机理研究将会利于乳酸菌资源的挖掘。

第二部分介绍益生乳杆菌进入 VBNC 态过程中的抗逆机理研究。将干酪乳杆菌 Zhang 等菌株在多种胁迫条件下诱导 VBNC 态,通过多种非培养技术和平板计数 方法结合检测其是否进入 VBNC 态,然后观察胁迫过程中的细胞形态变化、检测细胞膜脂肪酸变化;并通过转录组学、蛋白组学及代谢组学等技术解析干酪乳杆菌 Zhang 等菌株在逆境胁迫下的耐受机理。

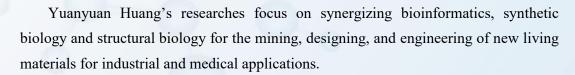
Oct 22nd 15:10-15:30

Yuanyuan Huang

**Assistant Professor** 

Shenzhen Institutes of Advanced Technology, Chinese

# Academy of Sciences, Shenzhen



Positions: 2022-present, Assistant Professor of Shenzhen Institutes of Advanced Technology, Chinese Academy of Sciences; 2020-2022, Postdoctoral Fellow of Shenzhen Institutes of Advanced Technology, Chinese Academy of Sciences; 2018-2020, Postdoctoral Fellow of Shanghai Tech University.

### Title: Engineering pili-enabled living materials

Abstract: Bacteria can be programmed to create engineered living materials (ELMs) with self-healing and evolvable functionalities1. However, further development of ELMs is greatly hampered by the lack of engineerable non-pathogenic chassis and corresponding programmable endogenous biopolymers2. Here, we describe a technological workflow for facilitating ELMs design by rationally integrating bioinformatics, structural biology and synthetic biology technologies. We first develop bioinformatics software, termed "Bacteria Biopolymer Sniffer" (BBSniffer), that allows fast mining of biopolymers and biopolymer-producing bacteria of interest. As a proof-of-principle study, using existing pathogenic pilus as input, we identify the covalently-linked pili (CLP) biosynthetic gene cluster in the industrial workhorse *Corynebacterium glutamicum*. Genetic manipulation and structural characterization reveal the molecular mechanism of the CLP assembly, ultimately enabling a type of programmable pili for ELM design. Finally, engineering of the CLP-enabled living materials transforms cellulosic biomass into lycopene by coupling the extracellular and intracellular bioconversion ability.



Oct 22nd 15:50-16:10

Xiangjun Gong

**Professor** 

#### South China University of Technology, Guangzhou



Professor Xiangjun Gong is a doctoral supervisor. She graduated with a bachelor's degree from University of Science and Technology of China in 2005 and a doctoral degree from the Chinese University of Hong Kong in 2011. From 2011 to 2013, worked as a postdoctoral researcher at the Chinese University of Hong Kong. Joined the School of Materials Science and Engineering at South China University of Technology as an associate professor in 2014 and has been a professor since 2017. Her research interest is to design high-precision real-time characterization tools based on optics and electromagnetics to study the dynamic behavior and physicochemical phenomena of particles, microorganisms, organisms, and environmental molecules near material interfaces. Specifically, it includes: (1) the development of high-precision optical characterization technology for 3D real-time tracking; (2) The interaction, adhesion mechanism, and movement strategy between particles and microorganisms at the near interface; (3) The dynamic behavior of biological molecules and environmental pollution molecules at various interfaces; (4) Microbial and cell screening, identification, and control technologies.

#### Title: Three-dimensional dynamic characterization of microbial adhesion

Abstract: 微观三维动态表征可为预测微生物表面粘附行为规律和污损形成机理提供全新的角度。然而,目前要实现对微生物动态行为的高精度、无损三维观测仍十分困难。近期,我们建立了一种基于光学干涉的三维显微成像技术-数字全息显微镜(Digital Holographic Microscopy (DHM))并发展了高通量、高精度的三维追踪算法。在 DHM 的测量中,光场在目标样品周围形成干涉。结合高速相机,我们可实时记录物体的全息图像序列。结合光学衍射重构,定位及多粒子三维追踪算法,微生物的三维轨迹及形貌变化可被成功获取。该方法的观测范围可从界面至远离界面数百微米,无需标记,适用于同时追踪多个目标物,并具有小于 100 nm的三维定位分辨率。利用 DHM,我们观察了多种细菌在多种高分子表面(包括:疏水高分子刷、可降解、低表面能的高分子涂料)及不同电学环境中的三维动态行为。我们的研究揭示了细菌对界面物理化学性质的主动响应是细菌近界面行为的重要组成部分(与物理作用占比相当甚至更高),为我们设计新一代海洋防污材料提供了新思路。

Oct 22nd 16:10-16:30

**Wenchang Yuan** 

**Professor** 

#### Guangzhou Medical University, Guangzhou



Dr. Wenchang Yuan obtained a doctoral degree from Army Medical University, mainly focusing on pathogen resistance and pathogen host interactions. He is Outstanding Young Medical Talents in Guangdong Province and has been awarded the Outstanding Clinical Laboratory Technician and the United Nations Peacekeeping Medal. He has hosted 9 scientific research projects and published over 30 papers. He currently holds positions including Vice Chairman of the Laboratory Branch of Guangdong Primary Medical Association, member of the Standing Committee of the Youth Group of the Medical Microbiology and Immunology Special Committee of the Chinese Society of Microbiology, and member of the Youth Committee of the Laboratory Branch of Guangdong Medical Association.

#### Title: Staphylococcus aureus small colony variants

Abstract: 金黄色葡萄球菌是引起社区和医院感染的重要病原菌。小菌落变异体是金黄色葡萄球菌重要的临床表型之一,常与金黄色葡萄球菌慢性和复发性感染相关,其大小仅为正常菌落的十分之一。小菌落变异体的主要特征包括缺乏或减少色素沉着,溶血活性降低,生物被膜形成增加,对抗菌素的耐药性增强,黏附分子编码基因上调,毒力因子基因下调。参与细菌多种生物合成途径的基因突变金黄色葡萄球菌小菌落变异株重要原因,因此在临床治疗慢性和复发性感染方面,对于小菌落变异体的形成及感染特点的了解具有重要的意义。

Oct 22nd 16:30-16:50

Xinyu Liao

Researcher

Innovation Center of Yangtze River Delta, Zhejiang University,

### **Jiaxing**



Dr. Xinyu Liao is a distinguished researcher at the Zhejiang University Innovation Center of Yangtze River Delta, with a focus on nonthermal processing technology and food microbiological control. So far, she has published 14 SCI papers as first/corresponding author, edited 1 English monograph, participated in the editing of 2 English monograph, and translated 1 English monograph. She has 6 authorized patents, including 3 international patents. She is currently serving as an editorial board member for Food Research International and Journal of Future Food. She hosted the National Natural Science Foundation of China Youth Program and the China Postdoctoral Science Foundation Project. She has won the first prize of China Industry-University-Research Cooperation Innovation Achievement Award.

# Title: Advancements in nonthermal plasma techniques for microbial inactivation

Abstract: 非热等离子体(nonthermal plasma, NTP)作为一项新兴的非热杀菌技术,具有高效、广谱、绿色等优点,已成为国内外食品杀菌领域的研究热点。尽管 NTP 具有较强的杀菌效果,并克服了传统杀菌技术的一些不足,但在 NTP 杀菌不彻底时,其激发产生的活性氧等活性粒子,可诱导微生物进入活的不可培养(viable but nonculturable, VBNC)状态。由于处于 VBNC 状态的微生物无法在培养基上形成可见菌落,能够逃避常规检测而造成假阴性结果,且其仍具有代谢活性,在适宜条件下可复苏再生长,是危害食品安全的"隐性污染源"。针对上述非热等离子体杀菌处理中存在的潜在风险,以食源性金黄色葡萄球菌作为研究对象,采用分子生物学、转录组学、蛋白组学和生物信息学等相结合的技术手段系统开展了非热等离子体诱导产生 VBNC 状态金黄色葡萄球菌的分子机制及其潜在危害性的研究,为优化非热等离子体杀菌工艺、避免 VBNC 状态微生物的形成奠定理论基础,有助于保障非热等离子体加工食品的安全性。

Oct 22nd 16:50-17:10

Yu Li

Lecturer

### Qiqihar Medical University, Qiqihar



Dr. Yu Li graduated with Master of Biomedical Science degree from University of Tennessee Health Science Center (UTHSC) and PhD of 8-year program of Basic Medical Science degree from Harbin Medical University (HMU) in 2021. She obtained systemic science training in UTHSC and St.jude Children's hospital in USA for 4 years. In 2022, she started to work in the Department of Pathology, Qiqihar Medical University. Her research mainly focuses on the drug resistance in Candida and tumor.

#### Title: Transcriptome profiling analysis of CgUpc2A regulon

Abstract: Candida glabrata is the second most common cause of invasive candidiasis. Intrinsic resistance to fluconazole has greatly limited their utility in the treatment of invasive fungal infection. The transcription factor Upc2 contributes to azole resistance in many species, including Saccharomyces cerevisiae, Candida albicans, Candida tropicalis. Disrupting UPC2A in C. glabrata greatly increases its susceptibility to fluconazole (FLU) in both FLU-susceptible and -resistant clinical isolates. Transcriptome sequencing (RNA-seq) analysis was used to compare gene expression profiles of a) wild-type (WT) strains with and without UPC2A under normal condition and b) treated with three sterol biosynthesis inhibitors (SBIs) c) strains with an activating mutation (GOF) in UPC2A. Global chromatin Immunoprecipitation (ChIP-seq) was used to identify genes whose promoters were bound by Upc2A in strains carrying WT and GOF alleles of Upc2A with and without fluconazole exposure. Only three genes were found to be downregulated in the absence of *UPC2A*. Sixteen genes were commonly upregulated in response to SBIs treatment in a Upc2A-dependent way, the promoters of 10 of which were bound by Upc2A. Total 15 genes were upregulated in the strain containing GOF mutation, the promoters of 6 of which were bound by Upc2A. This more comprehensive understanding of the Upc2A regulon in C. glabrata may eventually lead to strategies to overcome FLU resistance and enhance fluconazole activity against this important fungal pathogen.

Oct 22nd 17:10-17:30

Xuejie Li

#### **Postdoctoral Fellow**

## South China University of Technology, Guangzhou



Xuejie Li is a Postdoctoral Fellow in School of Food Science and Engineering, South China University of Technology. She obtained her Ph.D. in School of Biology and Biological Engineering, South China University of Technology in 2022. As a joint Ph.D. student, she studied in Technological University of Berlin, Germany for one year. Her research interests include gene editing with CRISPR, transcription factors research, epigenetic modification, secondary metabolites, and biofilms.

Title: Formation and regulation of viable but non-culturable (VBNC) cells: a critical concern extended from microbial biofilms

Abstract: The formation and regulation of viable but non culturable (VBNC) cells in biofilms is a cutting-edge topic in microbiology research. Although there has been controversy over the concept of VBNC state in the past, its significant impact on ecological balance and public safety cannot be denied. The formation of VBNC state cells regulated by multiple factors has gradually been revealed, including pathways such as gene expression and protein synthesis. These studies laid the foundation for analyzing the survival strategies and ecological adaptability of VBNC state cells. The focus of future research will be on exploring the function and significance of VBNC state cells, intervening in their formation and solving related problems in innovative ways, and deeply revealing the molecular mechanisms and metabolic pathways of VBNC state cells. This review summarizes VBNC state cells from multiple perspectives, including a discussion of their definition, the presence of VBNC state cells in biofilms, their formation triggers, relevant mechanisms, and the regulation and prevention of VBNC cells.

Oct 21st 19:00-19:10

**Huiying Wang** 

Student

Inner Mongolia Agricultural University, Hohhot

Title: Metabolomic differences between viable but nonculturable and recovered *Lacticaseibacillus paracasei Zhang* 

**Abstract:** The fermentation process can be affected when the starter culture enters the viable but nonculturable (VBNC) state. Therefore, it is of interest to investigate how VBNC cells change physiologically. Lacticaseibacillus (L.) paracasei Zhang is both a probiotic and a starter strain. This study aimed to investigate the metabolomic differences between VBNC and recovered L. paracasei Zhang cells. First, L. paracasei Zhang was induced to enter the VBNC state by keeping the cells in a liquid de Man -Rogosa - Sharpe (MRS) medium at 4 °C for 220 days. Flow cytometry was used to sort the induced VBNC cells, and three different types of culture media (MRS medium, skim milk with 1% yeast extract, and skim milk) were used for cell resuscitation. Cell growth responses in the three types of recovery media suggested that the liquid MRS medium was the most effective in reversing the VBNC state in L. paracasei Zhang. Metabolomics analysis revealed 25 differential metabolites from five main metabolite classes (amino acid, carbohydrate, lipid, vitamin, and purine and pyrimidine). The levels of L-cysteine, L-alanine, L-lysine, and L-arginine notably increased in the revived cells, while cellulose, alginose, and guanine significantly decreased. This study confirmed that VBNC cells had an altered physiology.

Oct 21st 19:10-19:20

Li Liu

Student

Qingdao Agricultural University, Qingdao

Title: The effect of LuxS/AI-2 quorum sensing system on the formation of VBNC biofilm in *Lactiplantibacillus plantarun* brewer-spoilt plant

Abstract: 在啤酒生产过程中,啤酒腐败乳杆菌多以生物被膜的形式存在于啤酒酿造环境中,本课题组前期研究证实,相比于浮游细胞,这些啤酒腐败乳杆菌生物被膜更易被诱导进入活的不可培养(Viable but nonculturable,VBNC)状态,因此可以在不被发现的情况下隐藏于酿造环境中,对啤酒生产造成极大的安全隐患。本课题以植物乳植杆菌这一典型啤酒腐败菌为研究对象,首先构建培养模型,诱导植物乳植杆菌形成被膜态细胞后利用啤酒中的异 α 酸诱导其进入 VBNC 状态;其次分析 AI-2 对 VBNC 生物被膜形成能力相关性状的影响;最后通过过表达技术构建 luxS 突变体,比较突变株与原始菌株在 VBNC 生物被膜形成能力方面的差异。从分子水平揭示群体感应系统对腐败乳杆菌形成 VBNC 生物被膜的调控机制,为建立高效的啤酒腐败菌控制体系提供科学依据。

Oct 21st 19:20-19:30

Jiayang Wang

Student

Qingdao Agricultural University, Qingdao

Title: Study on the action mechanisms of *POX1* gene in the formation of VBNC yeast induced by iso-alpha acid from hops

Abstract: 前期研究发现异α酸可以诱导酵母进入 VBNC 状态,转录组测序表明 POXI 基因差异变化显著。为探究 POXI 基因对 VBNC 状态的作用机制,首先通过测定正常状态、短期胁迫状态和 VBNC 状态三种不同状态下酵母细胞的 ROS含量、CAT 酶活、SOD 酶活、GR 酶活以及关键调控基因的 mRNA 表达量,推测出啤酒酵母 VBNC 状态的形成与氧化应激反应有关。之后,利用基因敲除和过表达技术构建啤酒酵母 POXI 基因缺失和过表达菌株,分别测定了敲除和过表达菌株在正常状态和 VBNC 状态下菌株内 ROS含量变化,结果发现敲除菌株细胞内ROS 荧光强度约为 181.5,显著低于正常状态啤酒酵母(p<0.05),VBNC 状态下的过表达菌株显著高于正常状态的啤酒酵母(p<0.05),说明 POXI 基因与啤酒酵母的氧化胁迫反应存在内在关联。

Oct 21st 19:30-19:40

Jing Liu

Student

Shanghai Ocean University, Shanghai

Title: Mining and multiple applications of phage lysin fight Vibrio parahaemolyticus

Abstract: 食源性致病菌及耐药性细菌的发展已成为全球公共卫生与食品安全的 主要威胁之一。因噬菌体裂解酶具有绿色高效、消除致病菌和生物被膜以及防控 耐药性等潜力,已成为新型杀菌技术领域研究热点。本研究以重要食源性致病菌 -副溶血性弧菌为对象,基于数据库挖掘及文献检索,首次对弧菌噬菌体裂解 酶进行了生物信息学分析,并对获得的高活性革兰氏阴性菌噬菌体裂解酶进行了 表达纯化,进一步探究其在不同条件(温度、pH、NaCl、金属离子、外膜渗透剂) 下的酶学性质,并对其在临床、食品安全及环境的潜在应用进行了研究。结果表 明,筛选后共获得37条噬菌体裂解酶信息,这些裂解酶保守结构域多样,且保守 氨基酸占比较高。基于生信分析结果成功获得了噬菌体溶菌酶 Lyz V pgrp、 Lyz V prgp60 和 Lyz V zlis。酶学特性分析表明,在 45℃、800 mM NaCl 的高盐 条件和 pH 8-10 内保持其最高活性, 1 mM 左右的膜渗透剂(EDTA/有机酸)可显 著促进其渗透活性。多元应用结果表明,3种噬菌体裂解酶可逆转多重耐药菌耐 药性,与抗生素结合可显著增强其控制效果,表现出良好的生物被膜清除效果, 并可显著减少食品及其接触样品、环境样品的平均生物负荷。以上结果充分体现 了噬菌体裂解酶的良好作用效果和多元应用价值,这为开发食源性致病菌的新型 高效控制方法提供了积极策略。



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