

26th World Nutrition Congress

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Food ingredients modulating the expression of virulence factors in bacteria

Statement of the Problem: Disease-causing properties (virulence) of microbial pathogens are greatly influenced by environmental factors such as temperature, pH, and food ingredients like carbohydrates. As human bodies are inhabited by a number of opportunistic pathogens, factors modulating the virulence of these potential disease-causing bacteria may have important health consequences. We have developed reporter systems in bacteria for evaluating the virulence modulating properties of various agents including common food ingredients.

Methodology & Theoretical Orientation: We have constructed *gfp-luxABCDE* dual-reporter plasmids with selected promoters from bacterial virulence-associated genes. The plasmids were introduced into bacteria to establish a *gfp-lux* based multiplex promoter reporter platform for monitoring bacterial virulence gene expressions in real time to identify factors that may modulate virulence factors expression. We have selected a number of common food ingredients and tested these ingredients in our multiplex promoter reporter platform to evaluate their virulence modulating properties. Virulence gene expression in bacteria was monitored by luminescence signals detected with an IVIS Spectrum *In Vivo* Imaging System (PerkinElmer).

Findings: We have profiled the virulence modulating activities of common food ingredients on 9 bacterial virulence gene promoters, namely promoters from genes involved in the production of α -toxin, Pantone-Valentine leukotoxin, phenol-soluble modulins, Protein A, Extracellular Adhesion Protein, fibronectin binding protein A, fibronectin binding protein B, clumping factors A, and capsular polysaccharide. The tested virulence factors are important for the establishment of bacterial infections in humans.

Conclusion & Significance: Microbial virulence is an overlooked factor while considering food ingredients and nutritional supplements for healthy individuals or patients with special needs. Our study has provided an evidence-based scientific platform for the effective evaluation of various food substances that may modulate the virulence of opportunistic pathogens residing in humans.

Recent Publications

1. Woo P C Y, Lau S K P, Lau C C Y, Tung E T K, Au-Yeung R K H, Cai J P, Chong K T K, Sze K H, Kao RY, Hao Q and Yuen K Y (2018) Mp1p homologues as virulence factors in *Aspergillus fumigatus*. Med Mycol. 56(3):350-360.
2. Gao P, Ho P L, Yan B, Sze K H, Davies J and Kao R Y T (2018) Suppression of *Staphylococcus aureus* virulence by a small-molecule compound. Proc Natl Acad Sci U S A. 115(31):8003-8008.

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3. Tse H, Yang D, Sze K H, Chu I K, Kao R Y T, Lee K C, Lam C W, Gu Q, Tai S S, Ke Y, Chan E, Chan W M, Dai J, Leung S P, Leung S Y and Yuen K Y (2017) A tricyclic pyrrolbenzodiazepine produced by *Klebsiella oxytoca* is associated with cytotoxicity in antibiotic-associated hemorrhagic colitis. *J Biol Chem.* 292(47):19503-19520.
4. Gao P, Davies J and Kao R Y (2017) Dehydrosqualene Desaturase as a novel target for anti-virulence therapy against *Staphylococcus aureus*. *mBio* 8(5):e01224-17.
5. Gao P, Wang Y, Villanueva I, Ho P L, Davies J and Kao R Y (2016) Construction of a multiplex promoter reporter platform to monitor *staphylococcus aureus* virulence gene expression and the identification of usnic acid as a potent suppressor of psm gene expression. *Front Microbiol.* 7:1344.

Biography

Richard Y Kao has obtained his PhD in Microbiology at UBC in 1999 and subsequent Postdoctoral training at Harvard Medical School. He has joined the University of Hong Kong as a Research Assistant Professor in 2001 and now a tenured Associate Professor in the Department of Microbiology, Li Ka Shing Faculty of Medicine. His research focuses on the application of chemical genetics in infectious diseases. Most recently, he has extended his chemical genetic studies to virulence and antibiotics resistance in bacteria and has illustrated the potential use of anti-virulence compounds to treat MRSA infections. The research results have been published in top microbiology journals *Frontiers in Microbiology*, *mBio*, and *PNAS* in 2016, 2017, 2018 respectively. He has received the Innovation Academy Award from International Consortium of Prevention and Control of Infection (ICPIC) in Geneva, Switzerland in 2017.

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