# Hualu (Lu) ZHOU

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## RESEARCH INTEREST

Food nanoemulsions; Lipophilic bioactives; Gastrointestinal fate of nutrients and nutraceuticals; Plant protein; Plant-based foods; Food digestion

## WORKING EXPERIENCE

04/2021-06/2021 Intern, Good Food Institution Consultation
06/2021- Postdoctoral Researcher, University of Massachusetts Amherst

## EDUCATION

2021 Ph.D. Food Science, University of Massachusetts Amherst
2017 M.A. Chemical Biology, Xiamen University, China
2014 B.M. Food Science and Technology, Nanchang University, China

## SCHOLARSHIPS & AWARDS

2021 1st Place in the Nutrition Division Graduate Student Oral Competition in Institute of Food Technologists (IFT)
2021 NEIFT Graduate Scholarship
2021 AOCS Peter & Clare Kalustian Award
2021 AOCS Honor Student Award
2020 NEIFT Scholarship: The Suppliers Award for the Top Graduate Applicant
2020 Phi Tau Sigma Achievement Scholarships
2020 AOCS Lipid Chemistry and Nutrition Award
2019 Graduate student travel award, University of Massachusetts-Amherst
2019 1st place in Institute of Food Technologists (IFT) Poster Competition in Division of Food Toxicology & Safety Evaluation
2019-2021 Teaching Fellow, College of Natural Science, University of Massachusetts Amherst
2018 Honor student in the Phi Tau Sigma Honor Society
2017 Excellent Graduate Student honor from Xiamen University
2016, 2012 National Scholarship (The highest student honor scholarship in China)
2014-2017 Graduate Research Fellowship of Xiamen University (Covering tuition and stipend)
2013 Meritorious Winner of American College Students' Mathematical Contest in Modeling

## GRANTS

2020 Predissertation research grant in University of Massachusetts Amherst

2013 National undergraduate training program grant

## RESEARCH EXPERIENCE

**Applications of food nanoemulsions in the development of plant-based foods** (2020-)

Advisor: Professor David Julian McClements

Applied food nanoemulsion to fortify plant-based milks with vitamins, calcium, and polyphenols and explored effects of calcium forms and levels on vitamin D bioaccessibility in plant-based milks. Applying the Rubisco protein and curcumin-nanoemulsions into the development of plant-based eggs. Exploring the gastrointestinal fate of plant-based meat, including the changes of physicochemical properties and effects on the lipid and protein digestion.

**Food nanoemulsions for lipophilic polyphenols: increasing the loading/encapsulating efficiency, gastrointestinal stability, and bioaccessibility** (2019-)

Advisor: Professor David Julian McClements

Applying a pH-driven method to encapsulate lipophilic polyphenols into the food nanoemulsions or oil bodies in plant-based milks; Optimizing the loading/encapsulating strategy for multiple lipophilic polyphenols (curcumin, quercetin, and resveratrol); Investigating the gastrointestinal stability and bioaccessibility of lipophilic polyphenols using the INFOGEST digestion model.

**The gastrointestinal fate of organic and inorganic nanoparticles in foods: impacts on lipid digestion and nutraceutical bioavailability** (2017-2020)

Advisor: Professor David Julian McClements

Fabricated and characterized food-grade nanoparticles (Nanoemulsions, Nanocellulose, Nanochitin, Titanium dioxide, etc.) in simulated human gastrointestinal system (*e.g.*, INFOGEST); Utilized structural design principles to reduce food calorie density or digestibility; Revealed physicochemical and molecular mechanisms of how food-grade nanoparticles affect the lipid digestibility and vitamin bioavailability.

**The characteristics of nanoparticles and their cell biological effects: toxicity and autophagy** (2014-2017)

Advisor: Professor Jinhao Gao

Synthesized gold, iron oxide and silica oxide nanoparticles with controllable morphology and sizes; Investigated the effect of dispersity of nanoparticles on their toxicity and autophagic effect; Explored the relationship between their physio-chemical properties (size, morphology, surface modification & dispersity) and autophagic effect.

## TEACHING EXPERIENCE

**Instructor**

2019 *New Food Technology: What will we eat in the future* (1 credit), University of Massachusetts Amherst

2020 *The Science and Nutrition Behind Plant-Based Foods* (1 credit), University of Massachusetts Amherst

**Guest Lecture**

2022 *The Science of Plant-Based Foods*, University of Massachusetts Amherst

**Teaching Assistant**

2019 *Future Food*, University of Massachusetts Amherst

2018 Proctor of *General Chemistry,* University of Massachusetts Amherst

2015 *Cell Biology*, Xiamen University

**Pedagogical Training**

2019, 2020 Teaching Fellows Training (4-day intensive course design workshop and a semester long learning community) and achieved CIRTL Associate level status

**Laboratory Assistant Mentor**

2018-2021 Trainer of the analytical instruments, including Light and Confocal Microscopy, HPLC, Laser diffraction instrument, University of Massachusetts Amherst

2020- Undergraduate research mentor, University of Massachusetts Amherst

## PUBLICATIONS

In near five years, authored and co-authored 35 peer-reviewed papers, total citation was 739, *h*-index is 18 (as of 06/22).

1. Zhou, H.; McClements, D. J., Recent Advances in the Gastrointestinal Fate of Organic and Inorganic Nanoparticles in Foods. *Nanomaterials-Basel* **2022,** *12* (7).
2. Tan, Y.; Zhou, H.; McClements, D. J., Application of static in vitro digestion models for assessing the bioaccessibility of hydrophobic bioactives: A review. *Trends in Food Science & Technology* **2022,** *122*, 314-327.
3. Zhou, H.; Zheng, B.; Zhang, Z.; Zhang, R.; He, L.; McClements, D. J., Fortification of Plant-Based Milk with Calcium May Reduce Vitamin D Bioaccessibility: An In Vitro Digestion Study. *Journal of Agricultural and Food Chemistry* **2021,** *69* (14), 4223-4233.
4. Zhou, H.; Zheng, B.; McClements, D. J., Encapsulation of lipophilic polyphenols in plant-based nanoemulsions: impact of carrier oil on lipid digestion and curcumin, resveratrol and quercetin bioaccessibility. *Food & Function* **2021,** *12* (8), 3420-3432.
5. Zhou, H.; Zheng, B.; McClements, D. J., In Vitro Gastrointestinal Stability of Lipophilic Polyphenols is Dependent on their Oil–Water Partitioning in Emulsions: Studies on Curcumin, Resveratrol, and Quercetin. *Journal of Agricultural and Food Chemistry* **2021,** *69* (11), 3340-3350.
6. Zhou, H.; Liu, J.; Dai, T.; Muriel Mundo, J. L.; Tan, Y.; Bai, L.; McClements, D. J., The gastrointestinal fate of inorganic and organic nanoparticles in vitamin D-fortified plant-based milks. *Food Hydrocolloids* **2021,** *112*, 106310.
7. Zhou, H.; Hu, Y.; Tan, Y.; Zhang, Z.; McClements, D. J., Digestibility and gastrointestinal fate of meat versus plant-based meat analogs: An in vitro comparison. *Food Chemistry* **2021,** *364*, 130439.
8. Zhou, H.; Dai, T.; Liu, J.; Tan, Y.; Bai, L.; Rojas, O. J.; McClements, D. J., Chitin nanocrystals

reduce lipid digestion and β-carotene bioaccessibility: An in-vitro INFOGEST gastrointestinal study. *Food Hydrocolloids* **2021,** *113*, 106494.

9. Zheng, B.; Zhou, H.; McClements, D. J., Nutraceutical-fortified plant-based milk analogs: Bioaccessibility of curcumin-loaded almond, cashew, coconut, and oat milks. *LWT* **2021,** *147*, 111517.

10. Zhang, Z.; Pham, H.; Tan, Y.; Zhou, H.; McClements, D. J., Investigation of Protein Denaturation and Textural Changes of Atlantic Salmon (Salmo salar) During Simulated Cooking. *Food Biophysics* **2021,** *16* (4), 512-519.

11. Tan, Y.; Zhou, H.; Zhang, Z.; McClements, D. J., Bioaccessibility of oil-soluble vitamins (A, D, E) in plant-based emulsions: impact of oil droplet size. *Food & Function* **2021,** *12* (9), 3883-3897.

12. Mundo, J. L. M.; Zhou, H.; Tan, Y.; Liu, J.; McClements, D. J., Enhancing emulsion functionality using multilayer technology: Coating lipid droplets with saponin-polypeptide-polysaccharide layers by electrostatic deposition. *Food Research International* **2021,** *140*, 109864.

13. Lv, S.; Zhou, H.; Bai, L.; Rojas, O. J.; McClements, D. J., Development of food-grade Pickering emulsions stabilized by a mixture of cellulose nanofibrils and nanochitin. *Food Hydrocolloids* **2021,** *113*, 106451.

14. Liu, J.; Zhou, H.; Tan, Y.; Muriel Mundo, J. L.; McClements, D. J., Comparison of plant-based emulsifier performance in water-in-oil-in-water emulsions: Soy protein isolate, pectin and gum Arabic. *Journal of Food Engineering* **2021,** *307*, 110625.

15. Dai, L.; Zhou, L.; Zhou, H.; Zheng, B.; Ji, N.; Xu, X.; He, X.; Xiong, L.; McClements, D. J.; Sun, Q., Comparison of Lutein Bioaccessibility from Dietary Supplement-Excipient Nanoemulsions and Nanoemulsion-Based Delivery Systems. *Journal of Agricultural and Food Chemistry* **2021,** *69* (46), 13925-13932.

16. Zhou, H.; Tan, Y.; Lv, S.; Liu, J.; Muriel Mundo, J. L.; Bai, L.; Rojas, O. J.; McClements, D. J., Nanochitin-stabilized pickering emulsions: Influence of nanochitin on lipid digestibility and vitamin bioaccessibility. *Food Hydrocolloids* **2020,** *106*, 105878.

17. Zhou, H.; Lv, S.; Liu, J.; Tan, Y.; Muriel Mundo, J. L.; Bai, L.; Rojas, O. J.; McClements, D. J., Modulation of Physicochemical Characteristics of Pickering Emulsions: Utilization of Nanocellulose- and Nanochitin-Coated Lipid Droplet Blends. *Journal of Agricultural and Food Chemistry* **2020,** *68* (2), 603-611.

18. Zhang, G.; Ni, C.; Ding, Y.; Zhou, H.; Caizhi, O.; Wang, Q.; Wang, J.; Cheng, J., Effects of Low Moisture Extrusion on the Structural and Physicochemical Properties of Adlay (Coix lacryma-jobi L.) Starch-Based Polymers. *Process Biochemistry* **2020,** *96*, 30-37.

19. Tan, Y.; Zhang, Z.; Zhou, H.; Xiao, H.; McClements, D. J., Factors impacting lipid digestion and β-carotene bioaccessibility assessed by standardized gastrointestinal model (INFOGEST): oil droplet concentration. *Food & Function* **2020,** *11* (8), 7126-7137.

20. Tan, Y.; Li, R.; Zhou, H.; Liu, J.; Mundo, J. L. M.; Zhang, R.; McClements, D. J., Impact of calcium levels on lipid digestion and nutraceutical bioaccessibility in nanoemulsion delivery systems studied using standardized INFOGEST digestion protocol. *Food & Function* **2020,** *11* (1), 174-186.

21. Tan, Y.; Li, R.; Liu, C.; Muriel Mundo, J.; Zhou, H.; Liu, J.; McClements, D. J., Chitosan reduces vitamin D bioaccessibility in food emulsions by binding to mixed micelles. *Food & Function* **2020,** *11* (1), 187-199.
22. Muriel Mundo, J. L.; Zhou, H.; Tan, Y.; Liu, J.; McClements, D. J., Stabilization of soybean oil-in-water emulsions using polypeptide multilayers: Cationic polylysine and anionic polyglutamic acid. *Food Research International* **2020,** *137*, 109304.
23. Muriel Mundo, J. L.; Liu, J.; Tan, Y.; Zhou, H.; Zhang, Z.; McClements, D. J., Characterization of electrostatic interactions and complex formation of ɣ-poly-glutamic acid (PGA) and ε-poly-l-lysine (PLL) in aqueous solutions. *Food Research International* **2020,** *128*, 108781.
24. Liu, J.; Zhou, H.; Muriel Mundo, J. L.; Tan, Y.; Pham, H.; McClements, D. J., Fabrication and characterization of W/O/W emulsions with crystalline lipid phase. *Journal of Food Engineering* **2020,** *273*, 109826.
25. Liu, J.; Kharat, M.; Tan, Y.; Zhou, H.; Muriel Mundo, J. L.; McClements, D. J., Impact of fat crystallization on the resistance of W/O/W emulsions to osmotic stress: Potential for temperature-triggered release. *Food Research International* **2020,** *134*, 109273.
26. Dai, T.; Li, T.; Li, R.; Zhou, H.; Liu, C.; Chen, J.; McClements, D. J., Utilization of plant-based protein-polyphenol complexes to form and stabilize emulsions: Pea proteins and grape seed proanthocyanidins. *Food Chemistry* **2020,** *329*, 127219.
27. Zhou, H.; Pandya, J. K.; Tan, Y.; Liu, J.; Peng, S.; Muriel Mundo, J. L.; He, L.; Xiao, H.; McClements, D. J., Role of Mucin in Behavior of Food-Grade TiO2 Nanoparticles under Simulated Oral Conditions. *Journal of Agricultural and Food Chemistry* **2019,** *67* (20), 5882-5890.
28. Tan, Y.; Liu, J.; Zhou, H.; Muriel Mundo, J.; McClements, D. J., Impact of an indigestible oil phase (mineral oil) on the bioaccessibility of vitamin D3 encapsulated in whey protein-stabilized nanoemulsions. *Food Research International* **2019,** *120*, 264-274.
29. Liu, J.; Tan, Y.; Zhou, H.; Muriel Mundo, J. L.; McClements, D. J., Protection of anthocyanin-rich extract from pH-induced color changes using water-in-oil-in-water emulsions. *Journal of Food Engineering* **2019,** *254*, 1-9.
30. Dai, L.; Zhou, H.; Wei, Y.; Gao, Y.; McClements, D. J., Curcumin encapsulation in zein-rhamnolipid composite nanoparticles using a pH-driven method. *Food Hydrocolloids* **2019,** *93*, 342-350.
31. Zhou, H.; Gong, X.; Lin, H.; Chen, H.; Huang, D.; Li, D.; Shan, H.; Gao, J., Gold nanoparticles impair autophagy flux through shape-dependent endocytosis and lysosomal dysfunction. *Journal of Materials Chemistry B* **2018,** *6* (48), 8127-8136.
32. Huang, D.; Zhou, H.; Gong, X.; Gao, J., Silica sub-microspheres induce autophagy in an endocytosis dependent manner. *RSC Advances* **2017,** *7* (21), 12496-12502.
33. Zhang, Z.; Liu, H.; Zhou, H.; Zhu, X.; Zhao, Z.; Chi, X.; Shan, H.; Gao, J., A facile route to core–shell nanoparticulate formation of arsenic trioxide for effective solid tumor treatment. *Nanoscale* **2016,** *8* (7), 4373-4380.
34. Huang, D.; Zhou, H.; Liu, H.; Gao, J., The cytotoxicity of gold nanoparticles is dispersity-dependent. *Dalton Transactions* **2015,** *44* (41), 17911-17915.
35. Huang, D.; Zhou, H.; Gao, J., Nanoparticles modulate autophagic effect in a dispersity-

dependent manner. *Sci Rep-Uk* **2015,** *5* (1), 14361.

**PRESENTATIONS**

1. **H. Zhou,** (2022). RuBisCO proteins as plant-based alternatives to egg white proteins: Characterization of thermal gelation properties. **Poster** Presentation at 2022 AOCS Annual Meeting & Expo, Atlanta, GA, May 1-4.
2. **H. Zhou,** (2022). The application of plant-based emulsions in the development of egg analog. **Oral** presentation at Next Generation Plant-based Foods Symposium, Department of Food Science, University of Massachusetts, Amherst, April 20th 2022.
3. D.J. McClements, Y. Tan, **H. Zhou,** (2021) Utility of INFOGEST Method to Test the Efficacy of Vitamin and Nutraceutical Delivery System. INFOGEST Webinar Series on Food Digestion, INFOGEST, Dec 1, 2021.
4. X. Hu, K. Kabota, H. Pham, Y. Tan, G. Vu, K. Zhang, **H. Zhou**, & D.J. McClements, (2021). The Rise of Plant-based Foods: Meat, Egg, and Dairy, Food Analytics Conference, Copenhagen, Denmark, November 17th, 2021.
5. **H. Zhou,** (2021). Fortification of Plant-Based Milk with Calcium may Reduce Vitamin D Bioaccessibility: An In Vitro Digestion Study. **Poster** presentation at Institute of Food Technologist 2021 Annual Meeting.
6. **H. Zhou,** D.J. McClements, (2021). Food Hydrocolloids: Application as Functional Ingredients to Control Lipid Digestion and Bioavailability. **Invited keynote** presentation at 2021 AOCS Annual Meeting & Expo.
7. **H. Zhou,** (2021). Chitin Nanocrystals Reduce Lipid Digestion and β-carotene Bioaccessibility: An in-vitro INFOGEST Gastrointestinal Study. **Oral** presentation at 2021 AOCS Annual Meeting & Expo.
8. **H. Zhou,** (2021). Fortification of Plant-based Milk with Calcium May Reduce Vitamin D Bioaccessibility: An in Vitro Digestion Study. **Oral** presentation at 2021 AOCS Annual Meeting & Expo.
9. D.J. McClements, Y. Tan, **H. Zhou,** (2020) Utility of INFOGEST Method in Design and Development of Next-generation Functional Foods. **Invited oral** presentation at the 34th EFFoST International Conference, November.
10. **H. Zhou,** (2020). Fortification of Plant-Based Milk with Calcium may Reduce Vitamin D Bioaccessibility: An In Vitro Digestion Study. **Poster** presentations at 2020 NORA Meets BASF Challenges conference, October.
11. D.J. McClements, Y. Tan, B. Zheng, **H. Zhou,** (2020). Next-Generation Nutritionally Fortified Plant-based Milks: A Colloid Science Approach. **Invited oral** presentation at the Good Food Institute, September.
12. **H. Zhou,** (2020). Impact of Nanochitin on Gastrointestinal Fate of Pickering Emulsions: Lipid Digestion and Nutraceutical Bioavailability. **Oral** presentations at 2020 AOCS Annual Meeting & Expo.
13. **H. Zhou,** B. Zheng, D.J. McClements, (2019). Delivery by Design: Biopolymer-based Nanoparticles for Encapsulation and Controlled Release of Bioactives. **Invited oral** presentation

at Institute of Food Technologist Annual Meeting, New Orleans, LA.
14. **H. Zhou,** (2019). Role of Mucin on Behavior of Food-Grade $TiO_2$ Nanoparticles Under Simulated Oral Conditions. **Poster** Presentation at Institute of Food Technologist 2019 Annual Meeting, New Orleans, LA.
15. **H. Zhou,** (2018). Role of Mucin on Behavior of Food-Grade $TiO_2$ Nanoparticles Under Simulated Oral Conditions. **Poster** Presentation at Life Science Graduate Research Symposium, UMass, Amherst.
16. **H. Zhou,** (2017). Gold nanoparticles impair autophagy flux through shape-dependent endocytosis and lysosomal dysfunction. **Poster** Presentation at International Symposium on Nanotechnology & Nanoimpact, Fujian, China.
17. **H. Zhou,** (2016). The cytotoxicity of gold nanoparticles is dispersity dependent. **Poster** presentation at National Nanotechnology Institution Annual Meeting, Fujian, China.
18. **H. Zhou,** (2013). Preparation and immunoregulatory activity of carboxymethyl polysaccharide from the seeds of Plantago asiatica L. **Poster** Presentation at International Symposium of Food Science and Human Health, Guangzhou, China.

## UNIVERSITY SERVICE

2022- Secretary, IFT Nutrition Division
2021 Organizer, UMass Next Generation Plant-based Foods Mini-conference
2021 Committee member, IFT Nutrition Division
2021 Guest Speaker, Leadership and Volunteering Boost Your Career, Chinese American Food Society Webinar
2020 Judge, Senior Food Science Elevator Pitch Competition, University of Massachusetts Amherst
2020-2022 President, ACS/AGFD UMass Chapter
2019 Chair, UMass Life Sciences Graduate Research Council (Winner the 2020 Outstanding Graduate Student Organization at UMass)
2019-2021 Leadership team, AOCS Student Common Interest Group
2018 Treasurer, UMass Phi Tau Sigma Chapter, and ACS/AGFD Student Chapter
2017, 2018 Committee member, $7^{th}$ & $8^{th}$ Life Science Graduate Research Symposium
2010-2014 Secretary of Organization Department, Student Union, Nanchang University
2011 Actress and Volunteer Teacher, The Seventh National City Games

## REVIEWD ARTICLES AND GRANTS FOR

- Guest editor of *Frontiers in Nutrition.* Research Topic: Advances on Innovative Protein-based Complexes with Promising Functionality, Nutrient Retention and Encapsulation Capacity
- Good Food Institute's *2021 White Space Collaboration Research Grant Program*.
- *Trends in Food Science & Technology*
- *Critical Reviews in Food Science and Nutrition*
- *Food Hydrocolloids*

- *Journal of Agricultural and Food Chemistry*
- *Food chemistry*
- *Food Research International*
- *Foods*
- *Pharmaceutics*
- *npj Science of Food*
- *Cereal Chemistry*
- *Food Biophysics*
- *International Journal of Gastronomy and Food Science*
- *International Dairy Journal*

**PROFESSIONAL ASSOCIATIONS**

2019- Americans Oil Chemist's Society (AOCS)
2018- Institute of Food Technologist (IFT) and Northeast Section of IFT
2022- American Chemical Society
2017-2021 Phi Tau Sigma
2017-2021 UMass Life Sciences Graduate Research Council
2020-2021 Northeast Dairy Suppliers Association, Inc (NDSA)