USDA-ARS
U.S. Wheat and Barley Scab Initiative
FY18 Performance Report
Due date: July 12, 2019

Cover Page

Principle Investigator (PI):	Jiajia Rao
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Fiscal Year:	2018
USDA-ARS Agreement ID:	59-0206-8-212
USDA-ARS Agreement Title:	Using Chitosan Nanoparticles Targeting Fusarium and Mycotoxins during Malting.
FY18 USDA-ARS Award Amount:	$ 29,097
Recipient Organization:	North Dakota State University Office of Grant & Contract Accouting NDSU Dept 3130, PO Box 6050 Fargo, ND 58108-0650
DUNS Number:	80-388-2299
EIN:	45-6002439
Recipient Identifying Number or Account Number:	FAR0030321
Project/Grant Reporting Period:	7/1/18 - 6/30/19
Reporting Period End Date:	06/30/19

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Award Amount
FST	Using Chitosan Nanoparticles Targeting Fusarium and Mycotoxins during Malting.	$ 29,097
	FY18 Total ARS Award Amount	$ 29,097

Jiajia Rao 07/09/2019

Principal Investigator Date

* MGMT – FHB Management
FST – Food Safety & Toxicology
GDER – Gene Discovery & Engineering Resistance
PBG – Pathogen Biology & Genetics
EC-HQ – Executive Committee-Headquarters
BAR-CP – Barley Coordinated Project
DUR-CP – Durum Coordinated Project
HWW-CP – Hard Winter Wheat Coordinated Project
VDHR – Variety Development & Uniform Nurseries – Sub categories are below:
SPR – Spring Wheat Region
NWW – Northern Soft Winter Wheat Region
SWW – Southern Soft Red Winter Wheat Region

FY18 Performance Report
PI: Rao, Jiajia
USDA-ARS Agreement #: 59-0206-8-212
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Project 1: *Using Chitosan Nanoparticles Targeting Fusarium and Mycotoxins during Malting.*

1. What are the major goals and objectives of the project?

Major goals: This project is designed to using chitosan as cationic emulsifier coating on lipid Nano-droplets to improve their solubility at neutral pH, while maintaining its desirable attribute (antifungal and antimycotoxigenic efficacy).

Objectives:
Objective 1: Preparation, Characterization of Chitosan Nanoparticles
Objective 2: Optimization of Antifungal and Antimycotoxigenic Efficacy in Vitro System

2. What was accomplished under these goals? *Address items 1-4) below for each goal or objective.*

1) major activities
   - The physically stable low, medium and high molecular weight of chitosan were electrostatically coated on lecithin stabilized MCT-in-water emulsions at pH 5.
   - The antifungal and mycotoxin inhibitory activity of three chitosan emulsion were evaluated and compared with chitosan solution *in vitro*

2) specific objectives
   Objective 1 and 2 were accomplished and the results have been published in the journal of food control.

3) significant results
   - Chitosan was electrostatically deposited on lecithin stabilized emulsion droplets at pH 5.
   - 0.1wt% of chitosan stabilized emulsions have enhanced mycotoxin inhibitory activity than that of chitosan solution.
   - The molecular weight of chitosan coating impact its inhibitory activity.
   - 0.1wt% of chitosan stabilized emulsions was not sufficient enough to reduce mycotoxin production under the FDA advisory level (1 ppm) in rice culture.

4) key outcomes or other achievements
   The antifungal activity of chitosan against Fusarium graminearum growth and mycotoxin production were very weak.

3. What opportunities for training and professional development has the project provided?

One Ph.D. student and one visiting scientist were involved in the activities supported by the project.

4. How have the results been disseminated to communities of interest?

- Submitted research article in high impact journals to inform international risk assessors.
- Present our results at several international conference to that inform risk assessors.

Training of Next Generation Scientists

Instructions: Please answer the following questions as it pertains to the FY18 award period. The term "support" below includes any level of benefit to the student, ranging from full stipend plus tuition to the situation where the student's stipend was paid from other funds, but who learned how to rate scab in a misted nursery paid for by the USWBSI, and anything in between.

1. **Did any graduate students in your research program supported by funding from your USWBSI grant earn their MS degree during the FY18 award period?**

   If yes, how many? Nothing to report

2. **Did any graduate students in your research program supported by funding from your USWBSI grant earn their Ph.D. degree during the FY18 award period?**

   If yes, how many? Yes, one Ph.D. student graduate in 2019.

3. **Have any post docs who worked for you during the FY18 award period and were supported by funding from your USWBSI grant taken faculty positions with universities?**

   If yes, how many? Nothing to report

4. **Have any post docs who worked for you during the FY18 award period and were supported by funding from your USWBSI grant gone on to take positions with private ag-related companies or federal agencies?**

   If yes, how many? Nothing to report

Release of Germplasm/Cultivars

Instructions: In the table below, list all germplasm and/or cultivars released with full or partial support through the USWBSI during the FY18 award period. All columns must be completed for each listed germplasm/cultivar. Use the key below the table for Grain Class abbreviations.

NOTE: Leave blank if you have nothing to report or if your grant did NOT include any VDHR-related projects.

Name of Germplasm/Cultivar	**Grain Class**	**FHB Resistance** (S, MS, MR, R, where R represents your most resistant check)	**FHB Rating** (0-9)	**Year Released**

Add rows if needed.

NOTE: List the associated release notice or publication under the appropriate sub-section in the 'Publications' section of the FPR.

Abbreviations for Grain Classes

Barley - BAR
Durum - DUR
Hard Red Winter - HRW
Hard White Winter - HWW
Hard Red Spring - HRS
Soft Red Winter - SRW
Soft White Winter - SWW

Publications, Conference Papers, and Presentations

Instructions: Refer to the FY18-FPR_Instructions for detailed instructions for listing publications/presentations about your work that resulted from all of the projects included in the FY18 grant. Only include citations for publications submitted or presentations given during your award period (7/1/18 - 6/30/19). If you did not have any publications or presentations, state 'Nothing to Report' directly above the Journal publications section.

NOTE: Directly below each reference/citation, you must indicate the Status (i.e. published, submitted, etc.) and whether acknowledgement of Federal support was indicated in publication/ presentation.

Journal publications.

Jing Wan, Shaobin Zhong, Paul Schwarz, Bingcan Chen, **Jiajia Rao**. 2019. Enhancement of antifungal and mycotoxin inhibitory activities of food-grade thyme oil nanoemulsions with natural emulsifiers. Food Control, 106: 106709.
Status: Published
Acknowledgement of Federal Support: YES

Jing Wan, Shaobin Zhong, Paul Schwarz, Bingcan Chen, **Jiajia Rao**. 2019. Physical properties, antifungal and mycotoxin inhibitory activities of five essential oil nanoemulsions: impact of oil compositions and processing parameters. Food chemistry, 291: 199 – 206.
Status: Published
Acknowledgement of Federal Support: YES

Dianhui Wu, Jing Wan, Jian Lu, Shaobin Zhong, Paul Schwarz, Bingcan Chen, **Jiajia Rao**. 2019. Influence of nonionic and ionic surfactants on the antifungal and mycotoxin inhibitory efficacy of cinnamon oil nanoemulsions. Food & Function, 10: 2817 – 2827.
Status: Published
Acknowledgement of Federal Support: YES

Dianhui Wu, Jing Wan, Jian Lu, Shaobin Zhong, Paul Schwarz, Bingcan Chen, **Jiajia Rao**. Effect of chitosan coatings on physical stability, antifungal and mycotoxin inhibitory activities of lecithin stabilized cinnamon oil-in-water emulsions. LWT, 2019, 106: 98 – 104.
Status: Published
Acknowledgement of Federal Support: YES

Jiajia Rao, Bingcan Chen, David Julian McClements. 2019. Improving the efficacy of essential oils as antimicrobials in foods: mechanisms of action. Annual Review of Food Science and Technology, 10 (1), 365-387.
Status: Published
Acknowledgement of Federal Support: YES

Dianhui Wu, Jing Wan, Jian Lu, Xingguo Wang, Shaobin Zhong, Paul Schwarz, Bingcan Chen, **Jiajia Rao**.2018. Chitosan coatings on lecithin stabilized emulsions inhibit mycotoxin production by Fusarium pathogens. Food Control, 92: 276-28.
Status: Published
Acknowledgement of Federal Support: YES

Books or other non-periodical, one-time publications.

Nothing to report

Other publications, conference papers and presentations. **(* denotes the corresponding author)**

Jiajia Rao. Development of nanoemulsion based delivery systems for control of Fusarium growth and mycotoxins during food processing. 2nd Mycokey international conference, Wuhan, China, September 17, 2018.
Status: Oral presentation
Acknowledgement of Federal Support: YES

Dianhui Wu, Jian Lu, **Jiajia Rao**. Physical stability, antifungal properties, and mycotoxin inhibitory activities of chitosan stabilized cinnamon oil-in-water emulsion. 2nd Mycokey international conference, Wuhan, China, September 15-18, 2018.
Status: Oral presentation
Acknowledgement of Federal Support: YES

Dianhui Wu, Jian Lu, **Jiajia Rao**. Effect of molecular weight of chitosan stabilized emulsion inhibits mycotoxin production in fusarium graminearum. 2018 IFT Annual Meeting & Expo, Chicago, Illinois, USA, July 15-18, 2018
Status: Poster presentation
Acknowledgement of Federal Support: YES

Dianhui Wu, Jian Lu, **Jiajia Rao**. Electrostatic deposition of chitosan on lecithin stabilized emulsion inhibits mycotoxin production in fusarium graminearum. 2018 AOCS Annual Meeting & Expo, Minneapolis, Minnesota, USA, May 6-9, 2018.
Status: Poster presentation
Acknowledgement of Federal Support: YES

Jing Wan, **Jiajia Rao**. Enhanced antimicrobial and mycotoxin inhibitory activity of clove oil in water nanoemulsion. 2018 AOCS Annual Meeting & Expo, Minneapolis, Minnesota, USA, May 6-9, 2018.
Status: Oral presentation
Acknowledgement of Federal Support: YES