

SHENG YANG

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Objective

Postdoctoral research in Iowa State University with the project on the modification of Bt toxin for novel insect-pest gut target sites and **Doctoral** research in Durham University with proven skills in biochemistry and molecular biology of plant-insect interaction, expression of recombinant plant and insect proteins in microorganisms (yeast, *E.coli*), genetic engineering of plants for insect resistance (transgenic Arabidopsis), protein engineering (fermentation, purification and so on), microbiology and cell Biology.

Skill Profile

Molecular biology:

Map-based cloning; PCR; RT-PCR; Real-Time PCR; Overlap Extension PCR; RACE PCR and Site Mutation PCR; Vector Construction; Promoter Clone, etc.

Protein biochemistry:

Protein expression, fermentation and isolation

Protein purification (Affinity chromatograph, Ion exchange, Gel filtration, etc.)

Protein structural analysis (X-ray crystallography, MicroPIXE, X-ray absorption spectroscopy, etc.)

Protein extraction from yeast, plant and *E.coli*

SDS-PAGE and Western blotting to check the target protein in the yeast; in the insect gut, brush border membrane vesicles (BBMV) and haemolymph; in the transgenic plants

Improving recombinant fusion proteins (Amino Acid Mutation)

Expression of insecticidal fusion protein against pest (plant-insect interactions)

Ph.D.-C7C phage display library to get small peptides, which are able to bind with gut proteins of insect pest (Entomology, plant-insect interactions)

Plant Metabolic Engineering:

Pre-culture; co-culture; infection of hairy roots; culturing plant tissue and aseptic operation; regulation of key genes in some of plant metabolic pathways

Bioinformatics:

Blast; alignment; phylogenetic analysis

Other skills:

DNA and RNA extraction; tissue, microorganism culture and transformation; GM plants making

Education

University: Durham University (TOP 5 in UK, World TOP 61) 10.2011-03.2015
Major: Insecticidal fusion proteins Doctorate Degree
University: Shanghai Normal University 09.2008- 06.2011
Major: Plant Molecular Biology Master Degree
University: Shan Dong University 09.2004-07.2008
Major: Biotechnology Bachelor Degree
GPA: 82.33/100 Ranking: Top 10%

Work Experience

- (1) 03.2009-07.2010, Research Assistant in Shanghai Normal University, China, part-time
- (2) 06.2012-06.2013, Research Assistant of As1c/GNA fusion protein program in Durham University, UK, part-time
- (3) 06.2012-06.2013, Research Assistant of P11a/GNA fusion protein mutant in Durham University, UK, part-time
- (4) 09.2012-Present, Liaison of “Yinfeng” Project between UK and Jiangsu Province (China), part-time
- (5) 01.2013-01.2014, Contributor of British Science Magazine (ISSN 1743-4408) in UK
- (6) 09.2013-12.2014, Research Assistant of insect-resistant transgenic Arabidopsis project
- (7) 09.2015-Present, General Manager of Sailing International Company (www.sailingintl.com)
- (8) 04.2015-08.2015, Project Manager in ECOMAN BIOTECH CO., LTD in Beijing, China, part-time
- (9) 09.2015-04.2016, Post-doctoral Research Associate in Iowa State University in USA, full-time

Research Interests

Biochemistry and molecular biology of plant-insect interactions
Expression of recombinant plant and spider fusion proteins in microorganisms
Modification of Bt toxins to target hemipteran pests
Genetic engineering of plants for insect resistance
Plant and Insect biochemistry and molecular biology
Protein engineering

Successful Projects

- **Iowa State University Postdoctoral Innovation Project: Bt toxin engineering for novel hemipteran gut target sites**

Bt toxins have been successfully used in various transgenic crops for almost 20 years to manage lepidopteran and coleopteran pests. However, this strategy has not been used in the management of aphids due to their low susceptibility to Bt toxins,

potentially arising from a lack of binding to the aphid's gut. To circumvent this limitation in pea aphids, peach-potato aphids and soybean aphids, a phage display library was screened in vivo against the aphid guts to identify candidate gut-binding peptides to add to a Bt toxin. The candidate with the strongest gut binding was used to engineer the Bt toxin by insertion of the peptide sequence at three sites in the toxin. The Modified toxins are currently being tested against these three kinds of aphids. The results showed modified toxins were extremely more toxic than wild-type against aphids ($P < 0.001$, one-way ANOVA).

➤ **Durham University PhD Innovation Project: Recombinant fusion proteins as new bio-insecticides**

My PhD research involves the design and production of recombinant fusion proteins as novel insecticides. These proteins are based on plant lectins as carriers for a variety of neurotoxins from venoms of spiders and are obtained by the methods of yeast fermentation (the yeast *Pichia pastoris* as an expression host). The novel spider fusion proteins are able to offer the potential prospect in the bio-insecticides market due to their advantages such as low cost, broad-spectrum, no effect on mammals, high oral toxicities against pests and chemical-resistant pests. They also have the ability to enhance the toxicities of Bt, entomopathogens and plants against the pests via transgenesis. Therefore, in the future, spider fusion proteins as new bio-pesticides are probable to become an attractive sustainable alternative to the Bt toxin products and conventional chemical pesticides. Moreover, these proteins have been used as starting points for mutagenesis programmes designed to produce novel proteins, for use as catalysts, and in pharmaceutical applications. The experimental results were published or submitted to different journals. At the same time, I also applied for an International Patent on how to improve the activity of fusion proteins. My PhD research also involves in the production and bioassay of insect-resistant transgenic plants by transferring recombinant fusion protein genes into Arabidopsis, and in evaluating the effects of these plants on non-target organisms, which will come to be seen as an environmentally benign form of pest control, up to now, I have already got positive transgenic Arabidopsis into which the gene of fusion protein was transferred. The expression level of the fusion protein is quite high. The amount of fusion protein is account for 1% of total Arabidopsis. More excitingly, the transgenic plants are effective against cabbage moth.

➤ **Shanghai Normal University Master Innovation Project: Plant secondary metabolism**

One project of plant secondary metabolites includes Studies of tropane alkaloids (TA) synthesis in the medicinal plant *Anisodus acutangulus* hairy root. Finally, different kinds of transgenic hairy roots were obtained and the experimental results were published in BMC Biotechnology Journal. Another project includes the effects of elicitors such as methyl jasmonate (MeJA), salicylic acid dissolved in absolute ethanol (SA/EtOH), Ag⁺ and absolute ethanol (EtOH) on the accumulation of TA and the expression of key enzyme genes in biosynthetic pathways. The experimental results were published in the Journal of Molecular Biology Reports.

➤ **Shan Dong University Undergraduate Student Innovation Project**

My diploma work is on protective effect of OPC on early embryos of *Bufo bufo gargarizans* damaged by UVB. This study is aimed to observe the protective effect of OPC on early embryos of *Bufo bufo gargarizans* damaged by UVB by detecting superoxide dismutase (SOD) activity in embryos' tissue. Two papers were published in Chinese Journals.

Patent awarded

Yang, S., Gatehouse, J.A., Pyati, P., Fitches, E.C. (2013) Pesticidal Fusion Protein Improvements **International Patent. Applic. No. 1321938.1**

Doctoral Thesis

Yang, S. (2015) Exploitation of small cysteine-rich spider protein toxins as bio-insecticides. **Durham University**. <http://etheses.dur.ac.uk/11035/>

Publications

- (1) **Yang, S.**, Pyati, P., Fitches, E., & Gatehouse, J. A. (2014). A recombinant fusion protein containing a spider toxin specific for the insect voltage-gated sodium ion channel shows oral toxicity towards insects of different orders. *Insect biochemistry and molecular biology*, **47**, 1-11.
- (2) **Yang, S.**, Fitches, E. and Gatehouse, J.A. (2015) Effect of insecticidal fusion proteins containing spider toxins targeting sodium and calcium ion channels on pyrethroid-resistant strains of peach-potato aphid (*Myzus persicae*). *Pest Manag Sci* doi: 10.1002/ps.3872
- (3) Kai, G. (Corresponding author), **Yang, S.**, Zhang, Y., Luo, X., Fu, X., Zhang, A., & Xiao, J. (2012). Effects of different elicitors on yield of tropane alkaloids in hairy roots of *Anisodus acutangulus*. *Molecular biology reports*, **39**(2), 1721-1729.
- (4) Kai, G. (Corresponding author), **Yang, S.**, Luo, X., Zhou, W., Fu, X., Zhang, A., ... & Xiao, J. (2011). Co-expression of AaPMT and AaTRI effectively enhances the yields of tropane alkaloids in *Anisodus acutangulus* hairy roots. *BMC biotechnology*, **11**(1), 43.
- (5) Kai, G., Liu, Y., Wang, X., **Yang, S.**, Fu, X., Luo, X., & Liao, P. (2011). Functional identification of hyoscyamine 6 β -hydroxylase from *Anisodus acutangulus* and overproduction of scopolamine in genetically-engineered *Escherichia coli*. *Biotechnology letters*, **33**(7), 1361-1365.

Publishing

- (1) **Yang, S.**, Fitches, E., Pyati, P., Gatehouse, J.A. Addition of the omega-atracotoxin-Hv1a pro-region in a recombinant Hv1a snowdrop lectin fusion protein (pro-Hv1a/GNA) results in significantly enhanced insecticidal activity as compared to Hv1a toxin/GNA.
- (2) **Yang, S.**, Fitches, E., Gatehouse, J.A. Both homologous and heterologous pro-regions originated from spiders enhance insecticidal activity of a

recombinant P11a snowdrop lectin fusion protein (pro-P11a/GNA) against insects of different orders.

- (3) **Yang, S.**, Fitches, E., Gatehouse, J.A. Transgenic Arabidopsis expressing the omega-atracotoxin-Hv1a with its native pro-region, in fusion with a snowdrop lectin (pro-Hv1a/GNA) show enhanced resistance to cabbage moth and aphids

Honors and Prizes

Award Professional 2nd Prize for Scholarship	2004-2008
Commissary in charge of entertainment in Shan Dong University	2005-2006
Elected a "Three Goods" Student in Shan Dong University	2007-2008
Durham University fee-waiver scholarship	2010-2011
CSC scholarship funded to UK for Doctor Degree	2010-2011
Creative funding from St Aidan's College of Durham University	2012-2013

Research Esteem Indicators

- (1) Invitations to the Third International Symposium on insect physiology, biochemistry and molecular biology, Shanghai, China, 2011.
- (2) Invitations to AHDB Crop Research Conference, London UK, 2013, Poster presentation
- (3) Invitations to Seventh International Symposium on Molecular Insect Science, Amsterdam, Netherlands, 2014, Poster presentation
- (4) Invitations to attend 'Yinfeng' Program in Jiangsu Province, 2012-2013
- (5) Invitations to submit a paper in CSSA NEWS in UK, 2014
- (6) Invitations to give a presentation in Shanghai Ocean University, 2015
- (7) Invitations to give a presentation in Professor Yidong Wu's Lab in Nanjing Agricultural University, 2015
- (8) Invitations to give a presentation in Huazhong Agricultural University, 2015
- (9) Invitations to give a presentation in Professor Guoyin Kai's Lab in Shanghai Normal University, 2015

My ResearchGate Website

https://www.researchgate.net/profile/Sheng_Yang7?ev=hdr_xprf

My Google scholar

<https://scholar.google.com/citations?user=tqSA9VMMAAAJ&hl=en>