

Modifying natural products: a fresh look at traditional medicine



In 2014, Professor Dawen Niu was one of three young chemists to win the prestigious Reaxys PhD Prize. He has gone on to have a successful and interesting career, and now leads his own research group at Sichuan University in China. In this interview, he talks about his experiences and his research into the modification of natural products.



Professor Dawen Niu is head of the Niu Group at Sichuan University in China. His research focus is on the modification of natural products, including those used in traditional Chinese medicine.

“Search engines like Reaxys help chemists rapidly find key literature. They’re indispensable for research.”

—Professor Dawen Niu, Head of the Niu Group, Sichuan University

Introduction

In 2014, Professor Dawen Niu was one of the three winners of the prestigious Reaxys PhD Prize, a global competition for the best PhD-level chemists. When he entered the competition, he had recently completed his PhD at the University of Minnesota under Professor Thomas R. Hoye and was about to take on a postdoctoral position at MIT under Professor Stephen L. Buchwald.

Four years later, and he is head of his own successful research group at Sichuan University. He has been recognized again for his research, having won the 2017 Thieme Chemistry Journal Award, and he has had publications in several high-profile journals.

We met with Professor Niu to talk about his experiences as a Reaxys PhD Prize winner and to hear more about his research into the modification of natural products, especially those used in traditional Chinese medicine.

Thank you for this time, Professor Niu, and congratulations on your excellent career since completing your PhD.

Thank you. It’s a pleasure to talk to Elsevier again. Last time, it was just after receiving the Reaxys PhD Prize win. It’s a blur now! That was an exciting evening.

How did that feel at the time? Did you expect to win?

Not at all! From my point of view, it is a very prestigious prize. It is literally the worldwide best of the best chemistry PhD students. It was already a great honor to be selected as one of the 45 shortlisted finalists.

I had no idea I would be a winner. That was an amazing feeling. It helped me believe more strongly in myself! And that confidence is so valuable.

From chemistry student to interdisciplinary research leader

What are your responsibilities as head of the Niu group?

One thing to realize is that our team is very young. It is important for me to guide the younger researchers but also to be open to their ideas. I work together with my team members to create our five-year plan: what we shall concentrate on and where we can make the biggest difference.

Our team is currently focusing on carbohydrate chemistry and natural product chemistry. We're developing methods to more efficiently modify and synthesize glycosides, thereby investigating the mechanisms of their function.

The natural products we're studying are often active ingredients of traditional Chinese medicine. We are very interested in these active pharmaceutical ingredients. We hope to study how we can make better use of the functions of these active ingredients in traditional Chinese medicine

At the same time, we're hoping to provide some insights for biochemists doing mechanism research. To achieve our goals, we do need to work with scientists from other groups, which is always very interesting.

Would you say this is interdisciplinary research?

Certainly, yes. Interdisciplinary research is very important to pushing the boundaries of knowledge and making new discoveries.

For example, my team and I do not possess in-depth knowledge of traditional Chinese medicine. It's a complex field in terms of ingredient structure and mechanisms. There are many unknowns. It is important to recognize where our limits are and find specialists and researchers to collaborate with. But that's one of the charms of research: we can always learn.

We are very interested in the research being carried out at institutions like the Kunming Institute of Botany of the Chinese Academy of Sciences. We are looking for opportunities to cooperate with them, particularly in natural product separation.

We are also collaborating with a research team studying proteomics from the Protein Group of Sichuan University, in the hope that they could help us find the biotargets of the modified natural products we prepared. And we are working with cell biologists and pharmacologists too.

Do you feel that interdisciplinary and interinstitutional collaborations are important to modern chemistry?

In my opinion, interdisciplinary research is not only crucial to chemistry but to all research.

All researchers deal with huge amounts of data every day and it is not all from one field. As a chemist, I need to work together with pharmacologists and pharmacists, biologists, medicinal chemists, and materials scientists. And maybe even people from other disciplines. That means having in-depth communication and exchanging information regularly.

Interdisciplinary work can be very fruitful because it increases our understanding and broadens our horizons. It has shown incredible potential in more and more research teams. Many domestic research teams have done beautiful work in interdisciplinary subjects.

Returning to your research: why did you choose this focus? And what direction will you take with it?

I was trained as synthetic chemist. I always believed that synthetic chemistry has potential in traditional Chinese medicine. I even mentioned my future research would focus on traditional Chinese medicine when I was interviewed as winner of the Reaxys PhD Prize in 2014.

Traditional Chinese medicine is a profound wisdom and cultural treasure of the Chinese people. Therefore, we, Chinese scientists, have undeniable responsibilities to not let that knowledge be lost. We should elevate it and investigate it. And of course, we also have the advantage of being connected to this culture.

What makes my group's research different from others working on traditional Chinese medicine is that we are concentrating on the modification of chemical compounds, not on total synthesis. Many domestic experts have already made extraordinary contributions in total synthesis, including some researchers from Sichuan University.

What my research team wants to do most is to develop a tool that can easily be used by researchers who focus on pharmaceutical chemistry and chemical biology and whose daily work may not involve chemical synthesis. Scientists from other disciplines need tools that are easy to use.

Staying in the lab

Is natural product modification a highly specialized task?

When we talk about natural product modification, particularly selective modification, due to their complexity, many people believe that it requires a lot of special skills. For research teams not specialized in chemical synthesis, like a chemical biology team, they see this as challenging to accomplish independently in their daily work. What we want to do is to fill the gap and provide researchers with a user-friendly solution that lets users modify chemicals using chemical processes that fit within their daily work scope. What we most care about are its efficiency, practicality and user friendliness. It's an important and fascinating project for us.

It seems that you are still very much involved in your group's research. Is it fair to say that you haven't let administrative duties take you out of the lab?

Oh, I would never come out of the lab! I have always had a great interest in chemistry and want to remain active. I have my own projects. In addition, we have group meetings and subgroup meetings every week. I give my advice and suggestions to our PhD and Master's students and help them solve specific problems they encounter, particularly in respect of synthesis route design and metal catalysis. I am probably the most experienced Reaxys user in our research team.

Reaxys and the Niu Group

What do you usually use Reaxys for?

For instance, when we need to design a new molecule or substance, I use the synthesis pathways and property and reaction data provided by Reaxys for reference, and then based on my experience, I see if there are improvements that can be made.

How do you see cheminformatics solutions like Reaxys evolving in the future?

That is a very interesting question. Starting from AlphaGo, more and more discussions have been had regarding data science. By that I mean artificial intelligence and machine learning.

I think it is inevitable that these will find increasing application in all fields, including chemistry. I will look forward to the day when Reaxys launches a smarter platform with AI applications.

Organic chemistry is a subject with unique beauty, and it is also a very practical subject. We hope that we can develop a user-friendly chemical synthesis solution which is easy and efficient for researchers who do not often do chemical synthesis. It is a very meaningful thing if we can empower the research of others.

And that might is what all cheminformatics solutions like Reaxys should do: empower research that can change the world.



“I enjoy the moments when my
students challenge my proposals.”

—Professor Dawen Niu, Head of the Niu Group, Sichuan University



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