

# Researchers discover that cancer uses sugar residue to evade immune cells

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Doctoral student Albert Armoo performs a Western blot to ensure specific genes are absent. Credit: South Dakota State University

A team of South Dakota State University chemistry researchers uncovered how cancer cells utilize a simple sugar residue to disguise themselves from the immune system. What they learned will help scientists develop more effective cancer therapeutics.

"We utilized the lens of organic chemistry to understand how [cancer](#) cells evade the [immune system](#)," explained assistant chemistry and biochemistry professor Dr. Rachel Willand-Charnley. The project is part of her chemical biology research program, which uses various fields of chemistry to solve biological problems. Willand-Charnley's research has applications in biotechnology and biomedicine.

Willand-Charnley, doctoral students Mathias Anim and Albert Armoo and Susan Grabenstein Roh, a biochemistry major who received her bachelor's degree in May, analyzed what is known as the Sialic acid-Siglec receptor pathway. They examined the pathway in colon and lung cancer cells using CRISPR-Cas9 gene-edited [cell lines](#) to determine how the cancer cells evade detection using sugars on their cell surface.

The results are published in the June issue of *Glycobiology*, a peer-reviewed Oxford Academic research journal. Roh, who at the time was a biochemistry major, is a shared first author on the article. The project was supported by the Willand-Charnley laboratory's startup funding for new faculty members.

Willand-Charnley came to SDSU in 2018 after completing postdoctoral research under the tutelage of renowned chemistry professor Carolyn Bertozzi at the University of California, Berkeley, and then at Stanford

University. Her research combines expertise in organic chemistry, glycobiology and cancer immunology.

## Using sugar coating

"Cells are literally decorated with sugar residues, known as glycans. Cancers also have a sugar coat," Willand Charnley said. "How do sugars, like Sialic acid, allow cancers to participate in 'immune evasion?' The immune system is programmed to identify cellular abnormalities, including deviations in the sugar coat, and mark them for degradation, but the question is why are certain cancer cells not being killed by the immune system?"

The paper focuses on how cancers use simple sugar residues, which she described as a sugary costume, to mimic healthy cells, thereby evading the immune system. "This research will allow scientists to build better therapeutics that cleave off the sugars, essentially removing the cancer [cells](#)' sugary costume," Willand-Charnley said. "It will open avenues for more targeted, effective cancer therapeutics related to glycans."

Both doctoral students see the benefits of this unique approach to improving cancer therapeutics. "It was really intriguing to realize that a single genetic modification could actually make cancers resistant to immunotherapy, make them invisible to the immune system," said Anim, who is from Ashiaman, Ghana. He earned his bachelor's and master's degrees in biochemistry at Kwame Nkrumah University of Science and Technology in Kumasi Ashanti, Ghana.

Armoo, who is from Tema, Ghana, said, "For me, it was interesting finding out that a coat of sugar plays a role in resistance to chemotherapeutics. It's not always a drug metabolite, but also the patients' own immune system being able to identify the [cancer cells](#)." He began doctoral work at SDSU after earning his undergraduate degree at

the University of Bradford in the United Kingdom and a master's degree from the University of Bradford's Institute of Cancer Therapeutics.

## Inspiring future scientists

Roh, a Mitchell, South Dakota, native, began working on the project as a sophomore. "I wanted to work with genetics, so when Dr. Willand-Charnley talked about cell lines with gene knockouts the first day in my organic chemistry class, that piqued my interest in doing research with her group," Roh said. "I was the first person to sign on (to the project)."

Willand-Charnley said, "Undergraduates (in my lab) are treated like graduate students. My expectation is that they will run their research like a graduate student."

Roh continued, "I found my own papers relating to the topic, read through them and explained why I felt they were relevant and what I learned from them (during the weekly group meetings)." Every three weeks, it was her turn to present her findings to the group—in a professional fashion. In 2019, Roh received the American Chemical Society award for best undergraduate research poster.

Even though Roh was the only undergraduate student working on the project, she said, "I had a lot of responsibility. I was able to be shared first author on the paper because I put in [an] equal amount of the work—that's what it took."

In addition to doing research part time during the [school year](#), she also spent two summers working full time on the project. Roh, who is now a graduate research assistant in the Department of Biology and Microbiology, feels prepared for graduate school, thanks to her experiences in Willand-Charnley's lab.

In addition to running successful research programs, Willand-Charnley also focuses on diversity and outreach. "One of my goals as a scientist is to increase diversity in the STEM sciences," Willand-Charnley said. However, "as students traverse academia and get older, we tend to have less diversity, why? One school of thought is that the STEM sciences are seen as intimidating. Thus, how do we fix this?"

Willand-Charley is working on launching an outreach program for kindergarten through fifth graders. "I want to elicit interest in the STEM sciences from a very young age. What better way to garner interest and show that science is fun than hands-on demonstrations with scientists in the classroom?"

**More information:** Susan Grabenstein et al, Deacetylated sialic acids modulates immune mediated cytotoxicity via the sialic acid-Siglec pathway, *Glycobiology* (2021). [DOI: 10.1093/glycob/cwab068](https://doi.org/10.1093/glycob/cwab068)

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