Chemist develops new synthesis of most useful, yet expensive, antimalarial drug

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This is IU Bloomington College of Arts and Sciences chemistry professor Silas Cook. Credit: Indiana University

In 2010 malaria caused an estimated 665,000 deaths, mostly among African children. Now, chemists at Indiana University have developed a new synthesis for the world's most useful antimalarial drug, artemisinin, giving hope that fully synthetic artemisinin might help reduce the cost of the live-saving drug in the future.

Effective deployment of ACT, or artemisinin-based combination therapy, has been slow due to high production costs of artemisinin. The World Health Organization has set a target "per gram" cost for artemisinin of 25 cents or less, but the current cost is about $2.40 per gram, and production of low-cost semi-synthetic artemisinin has yet to materialize.

"In 2005, the WHO claimed that the structure of artemisinin was too complex for cost-effective synthesis," said IU Bloomington College of Arts and Sciences chemistry professor Silas Cook. "We saw this as a natural challenge to the creativity and tenacity of organic chemists."

Published recently in the Journal of the American Chemical Society as "A Concise Synthesis of Artemisinin," Cook and postdoctoral co-author Chunyin Zhu report a succinct five-part process beginning with inexpensive cyclohexenone, an ideal feedstock available on metric-ton scale. Subsequent chemistry highlights several new reactions developed in the Cook group to enable this short, low-cost synthesis.

The result was the production of fully synthetic artemisinin on gram scale, greater than all previous total syntheses combined.

"The key to the ultimate success of synthetic artemisinin will be the large-scale production of the drug," Cook said. "As such, we had to completely rethink what qualified as suitable starting materials for this synthesis and invent new chemistry." The result was the use of readily available commodity chemicals in a process that was shorter than any other artemisinin total synthesis ever conducted.

The next challenge will be to move from gram-scale to kilogram-scale production, a process Cook may or may not be involved with.

"There is still work to be done. And we'd love to do it here, but the project has yet to attract outside funding," he said. "This is still in an experimental phase until you can scale up. We patented it, so the intellectual property rights are in place."

Provided by Indiana University