Peptide boronic acids offer new prospects for synthetic immunology

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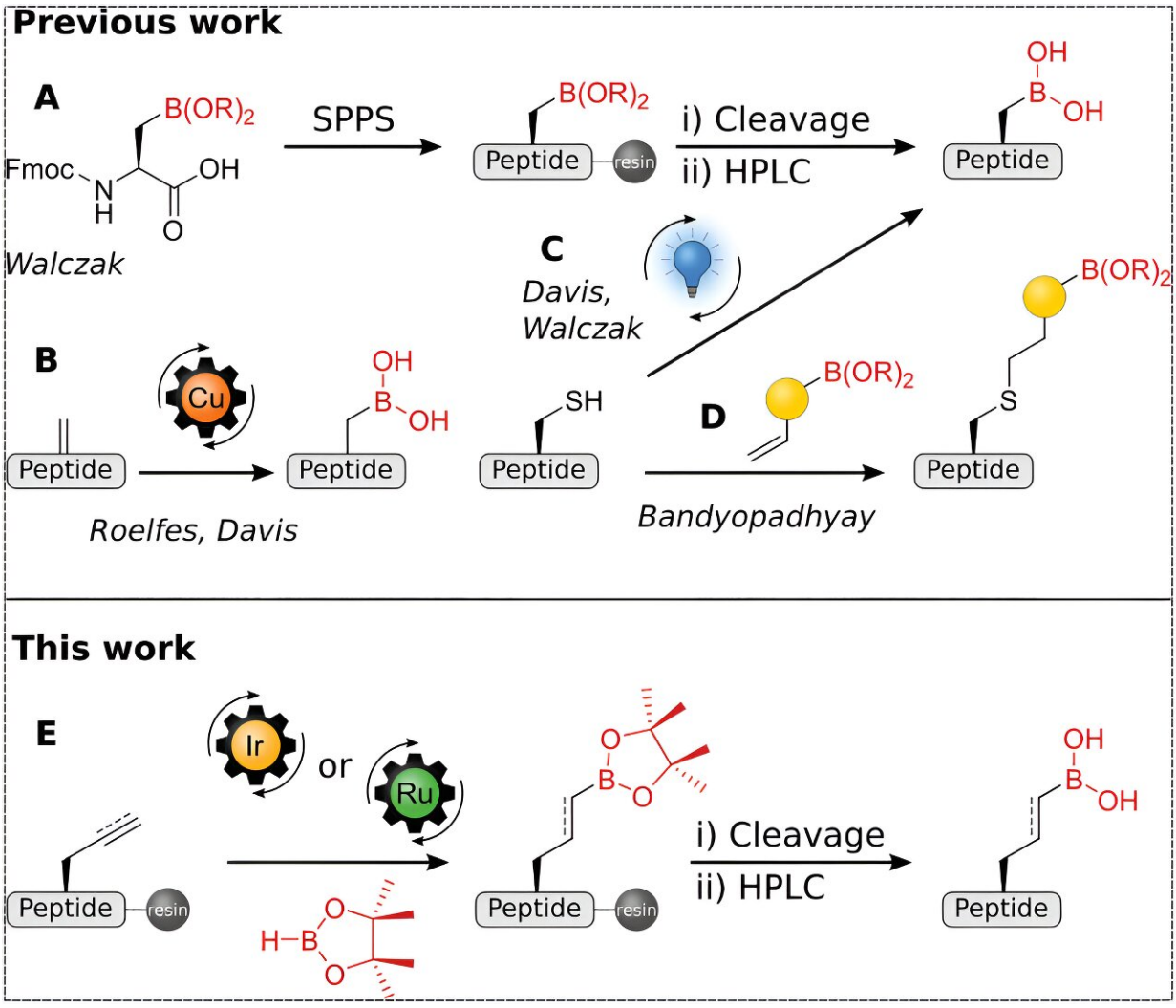

Strategies for the incorporation of boronic acids in peptide side chains. Credit: *Advanced Science* (2024). DOI: 10.1002/advs.202400640

A cutting-edge chemical process is the first to make it possible to quickly and easily produce modified peptides with boronic acids. It was developed by scientists from the Institute of Organic Chemistry and the Institute of Pharmacy and Molecular Biotechnology at Heidelberg University.

As part of this work, scientists managed to synthesize a large number of different biologically active peptide boronic acids and investigate their properties. According to the researchers, they open up new possibilities in the young research field of synthetic immunology and, due to their special properties, could go on to be used primarily in immunotherapy.

Peptides are polymers composed of two or more amino acids that are linked together and can be found wherever there are cells in the organism. They play a central role in the immune system, as they transmit essential immunological recognition markers.

The order and composition of peptides determine what is recognized by the immune system as foreign and triggers an immune response. For this reason, therapeutic or prophylactic immunizations, for example, are carried out using peptides, explains Marius Werner, a doctoral student at both Heidelberg institutes.

The boronic acids are of interest to the researchers because they have a unique and as-yet unexploited interaction profile with immune cells or other biological target structures.

In the current study, published in *Advanced Science*, the researchers produced peptides equipped with a boronic acid by hydroborating resin-bound peptide alkenes and alkynes. They therefore have a particular chemical structure that, in the scientists' words, has previously been impossible or very difficult to obtain.

"The boronic acid makes it very easy to introduce further chemical modifications into the peptides and realize numerous variations. Since boronic acids also interact with immune cells, the peptides enhanced with this structural element could potentially be used to intervene in the immune system," explains Junior Professor Dr. Franziska Thomas from the Institute of Organic Chemistry, who led the work alongside Prof. Dr. Christian Klein from the Institute of Pharmacy and Molecular Biotechnology.

Even if there is still a long way to go, there may be potential, according to Prof. Klein, with the help of the new substances to induce an immune reaction to tumor cells, for example, to destroy a tumor using the body's own mechanisms. Another application could be the targeted release of active substances in the body.

The boronic acid group is intended to serve as an "anchor" for the peptide, allowing it to bind to nanoparticles that serve as a transport medium. "The particles with the peptide could be designed in such a way that they are absorbed in certain organs or by certain cells, particularly in the immune system, allowing the peptide to have any kind of effect controlled by its design," says the scientist, who conducts research in the field of medicinal chemistry.

Peptide boronic acids could also be used in combination with small implants that dissolve in the body and release active ingredients.

More information: Marius Werner et al, Peptide Boronic Acids by Late-Stage Hydroboration on the Solid Phase, *Advanced Science* (2024). DOI: 10.1002/advs.202400640

Provided by Heidelberg University