In a first, team identifies mysterious exporter for brassinosteroid plant hormone

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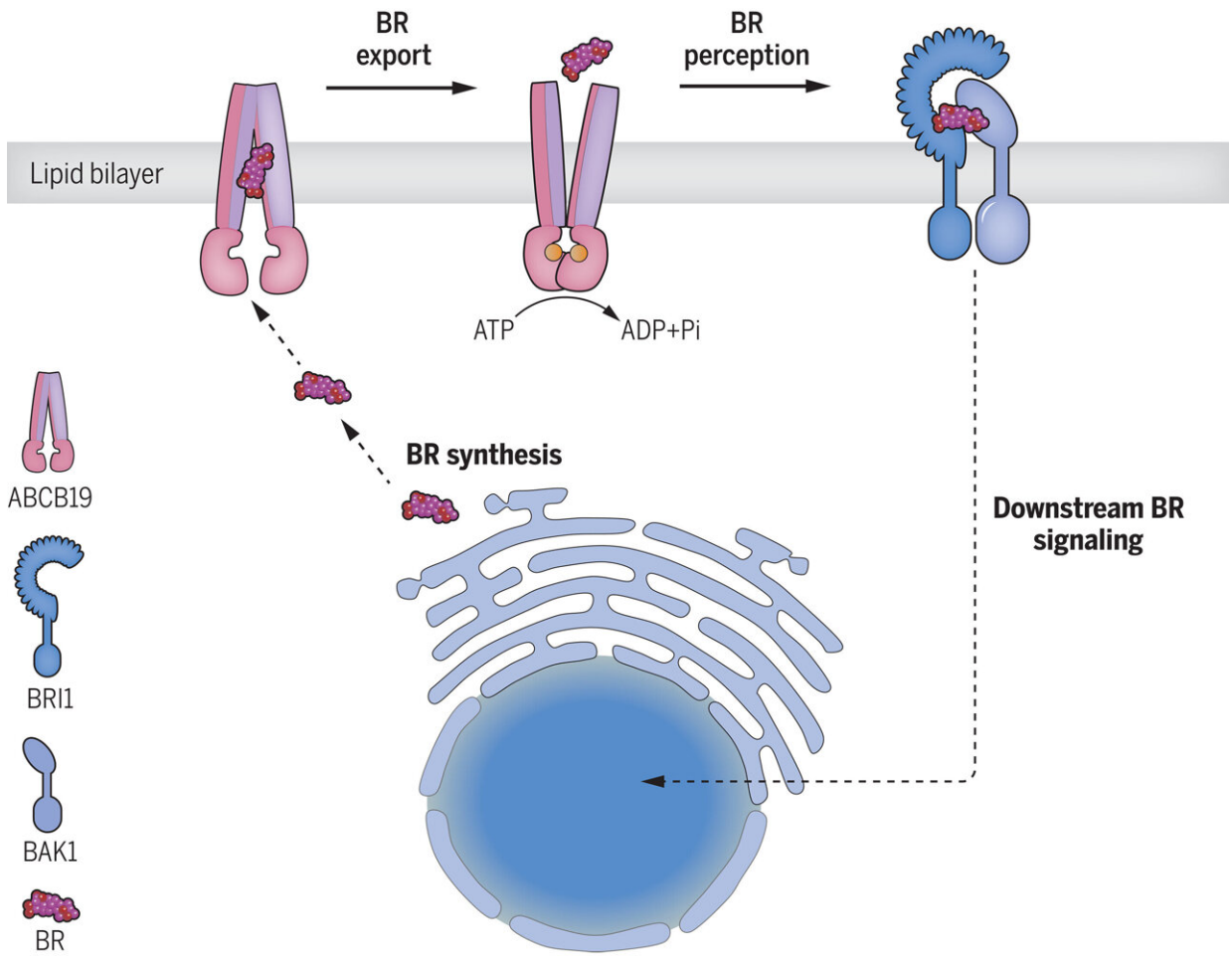


Model of brassinosteroid export and signaling in plants. Credit: *Science* (2024). DOI: 10.1126/science.adj4591

When you are reading this article, there are multiple hormones working diligently inside your body to stabilize your health status. Just as in human beings, it is impossible for plants to grow and reproduce without being regulated by phytohormones. One of the phytohormones is the brassinosteroid (BR) hormone, also named as the sixth phytohormone.

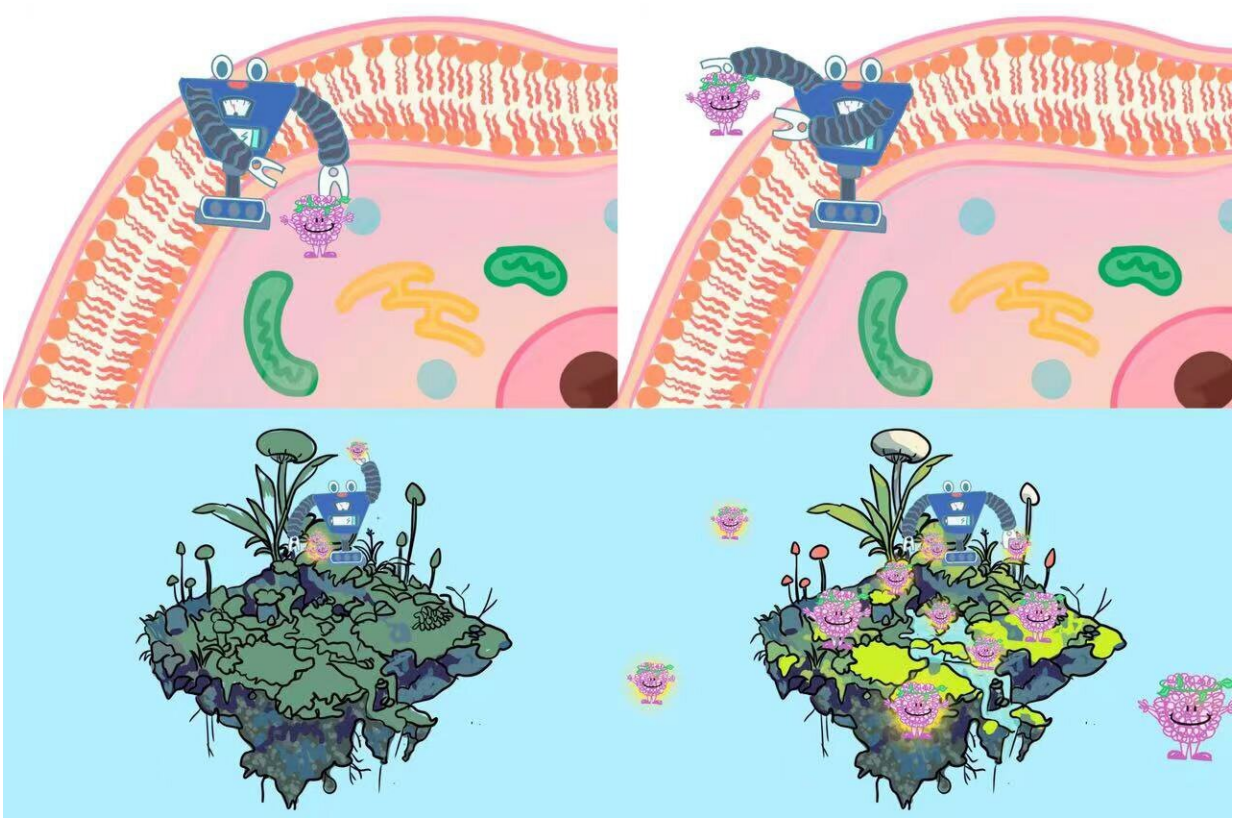
In a new study published in *Science*, researchers led by Prof. Sun Linfeng from the Division of Life Sciences and Medicine of the University of Science and Technology of China (USTC), together with Prof. Eugenia Russinova from the VIB-UGent Center for Plant Systems Biology, have discovered the first BR exporter and presented its structure in both the substrate-unbound and the brassinosteroid-bound states.

Brassinosteroid (BR) hormones play a key role in regulating plant development and physiology, including adaptation to environmental stresses. They are also widely used in agriculture due to the high economic benefits and impressive effects. Previous studies on BR have clarified their synthesis, metabolism and signaling processes, while the key mechanism by which the synthesized BR inside the cell is exported out to execute its function remains unknown. However, with the first BR exporter recognized in this latest finding, scientists are taking a major step forward.

The newly collaborated BR exporter, ABCB19, used to be commonly recognized as a transporter protein for another crucial phytohormone, auxin. However, the mutant phenotype of ABCB19 does not completely match that of typical auxin transporter proteins. Based on this, the team raised the bold question of whether ABCB19 has substrates other than auxin.

The researchers sought all kinds of evidence to test their hypothesis. They first tested the ATPase activities of the Arabidopsis ABCB19 in the presence of different phytohormones including auxins and

brassinosteroids. Results show that the ATPase activity of ABCB19 can be stimulated by the bioactive brassinosteroids in a dose-dependent manner, but not by auxins or the brassinosteroid-biosynthesis precursors. Meanwhile, in vitro and in vivo assays were used to evaluate the transport of brassinosteroids by ABCB19.



ABC19 exporting brassinosteroid (BR) in plants. Credit: QIE Mingqing

With the help of cryo-electron microscopy, the researchers were able to witness the process of ABC19 exporting brassinosteroids, as well as to determine the unique architecture of ABC19 which enables it to bind with brassinosteroids.

Furthermore, plant physiological and genetic analyses were performed to confirm the role of ABCB19 in brassinosteroid signaling. All the experimental results point to the conclusion that BR is the substrate of ABC19.

"We were quite puzzled for a while because our experiment results didn't agree with the common belief that ABC19 is an auxin exporter. But when it turned out that brassinosteroid is also its substrate, we were so thrilled," said Ying Wei, first author of the study.

"This is a very unexpected and exciting discovery," commented one of the reviewers.

"Past research focused more on the cell level, which might be the reason why all these years we overlooked the fact that brassinosteroid is the transport substrate," explained Prof. Sun. This new study elucidated the role of Arabidopsis ABCB19 as brassinosteroid exporter and opened up new ideas for research on the ABC family.

"Future research will unravel the mechanisms regulating the ABCB19 activation and substrate preference and hopefully identify additional brassinosteroid exporters. Such mechanisms will help us design more effective strategies to improve plant productivity and resilience via modulating endogenous brassinosteroid amounts and distribution," said Prof. Russinova.

More information: Wei Ying et al, Structure and function of the Arabidopsis ABC transporter ABCB19 in brassinosteroid export, *Science* (2024). DOI: 10.1126/science.adj4591.
www.science.org/doi/10.1126/science.adj4591

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