PHS1

Wheat and barley starch with dramatically reduced B-granule content

Evaluation and Licensing Opportunities

For further information on this technology and evaluation / licensing opportunities please contact:

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Patent Literature

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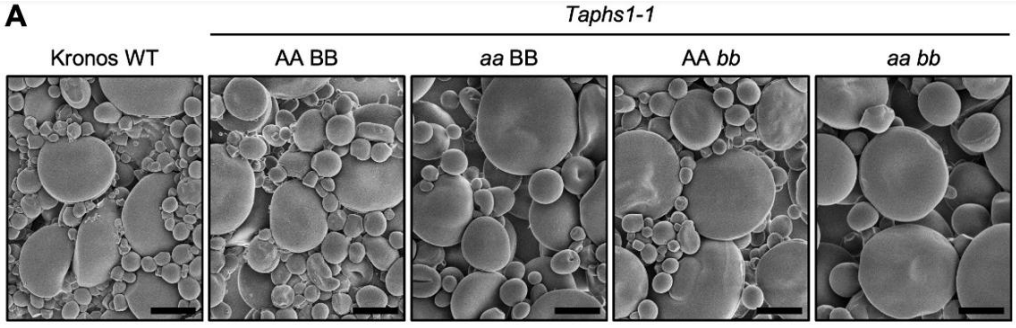
Starch granules of different crops vary greatly in size and shape. Wheat starch (and those of other Triticeae) uniquely have two distinct types of granules: large A-type granules and smaller B-type granules. The ratio of A- and B-type granules can affect the quality of wheat-based foods, such as bread and pasta. The two types of granules also present a problem for starch manufacturing industry because many of the smaller B-type granules are lost and therefore wasted during the milling process. They also tightly associate with gluten, causing problems for gluten isolation. And furthermore, too many B-type starch granules in barley can cause a hazy or cloudy appearance in beer because they do not get digested and filtered out during the brewing process. Accordingly, there is significant value in reducing the quantity of B-type starch granules.

David Seung and colleagues at the John Innes Centre have identified the key gene in the initiation of B-granules, and variants thereof that are dramatically reduced in B-granule content.

The plastidial α-glucan phosphorylase (PHS1) can elongate and degrade malto-oligosaccharides (MOSs), but its exact physiological role in plants is poorly understood. The JIC team have discovered a specialized role of PHS1 in establishing the unique bimodal characteristic of starch granules in wheat (Triticum spp.) endosperm. Wheat endosperm contains large A-type granules that initiate at early grain development, and small B-type granules that initiate in later grain development. The inventors demonstrate that PHS1 interacts with B-GRANULE CONTENT1 (BGC1), a carbohydrate-binding protein essential for normal B-type granule initiation. Mutants of tetraploid durum wheat (Triticum turgidum) deficient in all homoeologs of PHS1 had normal A-type granules but fewer and larger B-type granules. Further, by assessing granule numbers during grain development in the *phs1* mutant and using a double mutant defective in both PHS1 and BGC1, the JIC team demonstrate that PHS1 is exclusively involved in B-type granule initiation. The total starch content and number of starch granules per chloroplast in leaves were not affected by loss of PHS1, suggesting that its role in granule initiation in wheat is limited to the endosperm. Thus, the initiation of A- and B-type granules occurs via distinct biochemical mechanisms, where PHS1 plays an exclusive role in B-type granule initiation.



Double loss of function mutants of Kronos (durum wheat) – aa bb – showing marked reduction in B-granule content

PHS1 mutants are altered in B-granule content but in all other respects phenotypically normal, with normal sized grains, starch content and fertility/productivity.

The work is published in The Plant Cell, August 2023 (reference below).

For more information or licensing interest, please contact PBL.

References:
Kamble et al. (2023). Initiation of B-type starch granules in wheat endosperm requires the plastidial α-glucan phosphorylase PHS1. The Plant Cell DOI: 10.1093/plcell/koad217