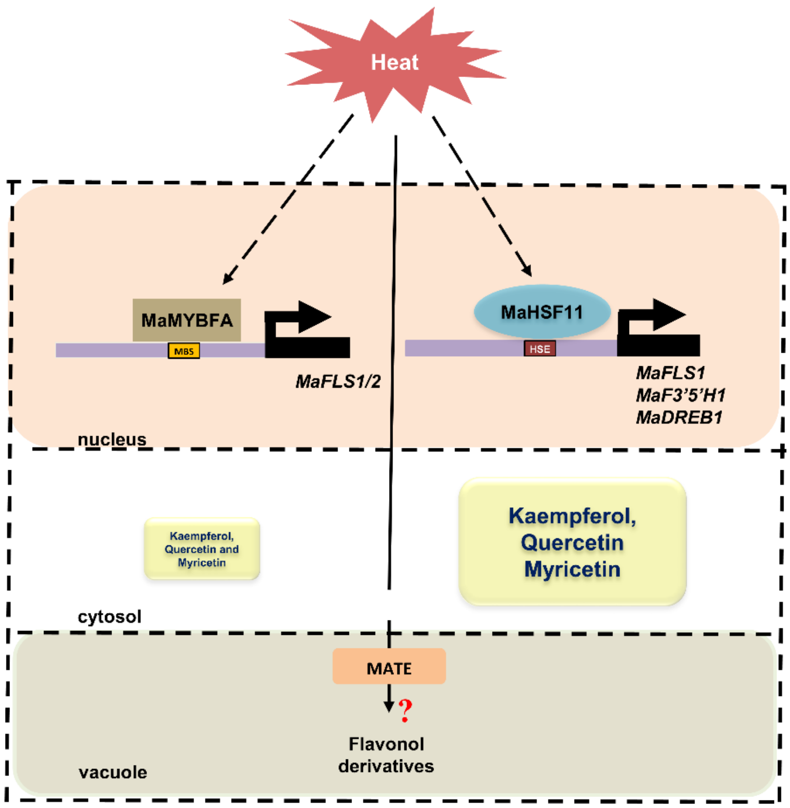
Research highlights

Title of story: Heat-responsive MaHSF11 transcriptional activator positively regulates flavonol biosynthesis and flavonoid B-ring hydroxylation in banana



Brief Story:

Plant flavonols, a group pf widely distributed and diverse plant pigments, act primarily as UV absorbers, reactive oxygen species (ROS) scavengers, and phytoalexins, and they contribute to biotic and abiotic stress tolerance in plants. Banana (*Musa acuminata*), an herbaceous monocot and important fruit crop, accumulates flavonol derivatives in different organs, including the edible fruit pulp, although the content is very less in the pulp. Flavonol content varies greatly in different organs, the molecular mechanisms involving transcriptional regulation of flavonol synthesis in banana are not known. Here, we characterized three SG7-R2R3 MYB transcription factors (MaMYBFA1, MaMYBFA2, and MaMYBFA3) and their upstream regulators, heat shock transcription factor (MaHSF11), to elucidate the molecular mechanism involved in transcriptional regulation of flavonol biosynthesis in banana. MaMYBFA1-3, belonging to sub-group 7 R2R3 MYB family, positively regulate *flavonol synthase* 2 (*MaFLS2)* and downregulates *MaFLS1*. We have found these transcription factors to be weak regulators of flavonol synthesis as their overexpression could not modulate the flavonol content in banana fruit. Overexpression of *MaHSF11* enhances flavonol contents, particularly that of myricetin, and promotes flavonol B-ring hydroxylation, which contributes to the diversity of flavonol derivatives. From the screening, we found that drought responsive transcription factor MaHSF11 directly interacts with the *MaFLS1* and *flavonoid 3′, 5′-hydroxylase*1 (*MaF3′5′H1)* promoters, both *in vitro* and *in vivo*. MaHSF11 also upregulates many biosynthesis genes involved in flavonol synthesis. We also found that MaHSF11 activates the expression of *MaDREB1* directly, which is known to promote cold and chilling tolerance in banana fruit. We also observed that heat stress can enhance the expression of *MaHSF11*, *MaDREB1*, and many flavonol biosynthesis genes, and subsequently flavonol accumulation in banana. This suggests that MaHSF11-MaDREB1 module and MaHSF11 modulated flavonol biosynthesis also works under heat stress to modulate heat stress tolerance in banana. The MaHSF11 holds significant potential for the effective gene manipulation to for crop improvement in an important crop like banana. Overall, our study elucidates a regulatory mechanism for flavonol synthesis in banana and suggests possible targets for genetic optimization to enhance nutritional value and stress responses in this globally important fruit crop.

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