Water content, adenylate kinase, and mitochondria drive adenylate balance in dehydrating and imbibing seeds

Titre	Water content, adenylate kinase, and mitochondria drive adenylate balance in dehydrating and imbibing seeds
Type de publication	Article de revue
Auteur	Raveneau, Marie-Paule [1], Benamar, Abdelilah [2], Macherel, David [3]
Editeur	Oxford University Press (OUP)
Type	Article scientifique dans une revue à comité de lecture
Année	2017
Langue	Anglais
Date	22 Août 2017
Numéro	13
Pagination	3501-3512
Volume	68
Titre de la revue	Journal of Experimental Botany
ISSN	0022-0957
Mots-clés	Adenylate [4], adenylate kinase [5], Anhydrobiosis [6], bioenergetics [7], mitochondria [8], Oxidative Phosphorylation [9], Respiration [10]
Résumé en anglais	Water and life are inexorably linked, but some organisms are capable of losing almost all cellular water to enter a non-metabolic state of anhydrobiosis. This raises intriguing questions about how energy metabolism is managed during such transitions. Here, we have investigated adenylate metabolism during seed imbibition and drying using intact or fragmented pea (Pisum sativum L.) seeds. AMP was confirmed as the major adenylate stored in dry seeds, and normal adenylate balance was rapidly restored upon rehydration of the tissues. Conversely, re-drying of fully imbibed seeds reversed the balance toward AMP accumulation. The overall analysis, supported by in vitro enzyme mimicking experiments, shows that during tissue dehydration, when oxidative phosphorylation is no longer efficient because of decreasing water content, the ATP metabolic demand is met by adenylate kinase, resulting in accumulation of AMP. During seed imbibition, adenylate balance is rapidly restored from the AMP stock by the concerted action of adenylate kinase and mitochondria. The adenylate balance in orthodox seeds, and probably in other anhydrobiotes, appears to be simply driven by water content throughout the interplay between ATP metabolic demand, adenylate kinase, and oxidative phosphorylation, which requires mitochondria to be energetically efficient from the onset of imbibition.
URL de la notice	http://okina.univ-angers.fr/publications/ua17101 [11]
DOI	10.1093/jxb/erx182 [12]
Lien vers le document	https://academic.oup.com/jxb/article/68/13/3501/3979706 [13]

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