Physiology of intracellular potassium channels: a unifying role as mediators of counterion fluxes?

Vanessa Checchetto, Enrico Teardo, Luca Carraretto, Luigi Leanza, Ildiko Szabo

PII: S0005-2728(16)30058-5
DOI: doi: 10.1016/j.bbabio.2016.03.011
Reference: BBABIO 47627

To appear in: *BBA - Bioenergetics*

Received date: 17 January 2016
Revised date: 6 March 2016
Accepted date: 7 March 2016

Please cite this article as: Vanessa Checchetto, Enrico Teardo, Luca Carraretto, Luigi Leanza, Ildiko Szabo, Physiology of intracellular potassium channels: a unifying role as mediators of counterion fluxes?, *BBA - Bioenergetics* (2016), doi: 10.1016/j.bbabio.2016.03.011

Physiology of intracellular potassium channels: a unifying role as mediators of counterion fluxes?

Vanessa Checchetto[1], Enrico Teardo[1], Luca Carraretto[1], Luigi Leanza[1] and Ildiko Szabo[1,2]*

1 Department of Biology, University of Padova, viale G. Colombo 3, Padova, 35131 Italy

2 CNR Institute of Neuroscience, University of Padova, viale G. Colombo 3, Padova, 35131 Italy

Correspondence should be addressed to :

Ildiko Szabo (ildi@civ.bio.unipd.it)

Potassium channels; Mitochondria; Chloroplast; Nuclear membrane; Bioenergetics; Transcription

Abstract

Plasmamembrane potassium channels importantly contribute to maintain ion homeostasis across the cell membrane. The view is emerging that also those residing in intracellular membranes play pivotal roles for the coordination of correct cell function. In this review we critically discuss our current understanding of the nature and physiological tasks of potassium channels in organelle membranes in both animal and plant cells, with a special emphasis on their function in the regulation of photosynthesis and mitochondrial respiration. In addition, the emerging role of potassium channels in the nuclear membranes in regulating transcription will be discussed. The possible functions of endoplasmic reticulum-, lysosome- and plant vacuolar membrane-located channels are also referred to. Altogether, experimental evidence obtained with distinct channels in different membrane systems points to a possible unifying function of most intracellular potassium channels in counterbalancing the movement of other ions including protons and calcium and modulating membrane potential, thereby fine-tuning crucial cellular processes.

Introduction

Potassium channels are widely spread over all kingdoms, ranging from viruses to humans, but the physiological roles they play in the different organisms are not well defined for all of them. A characteristic feature of highly selective potassium channels is that their preference for potassium is defined by a conserved amino acid motif, TVGYGD, in the narrowest stretch of the pore known as the selectivity filter [1, 2]. Thus, in principle, a simple bioinformatic analysis can be exploited to identify putative potassium channels in different organisms with completely sequenced genomes (see e.g. [3] for prokaryotes). However, one has to keep in mind that several other channels, which allow the flux not only of potassium but of other cations as well, do not display this signature sequence. Yet, under physiological conditions potassium may be the main cation flowing through them. Notable technical advancement in biophysics and cell biology during the last decades have led to the discovery of intracellular potassium channels