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# Actions of quercetin, a flavonoid, on ion transporters: its physiological roles

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## Abstract

Flavonoids keep us healthy by controlling various body and cellular functions. It is well known that cations, such as  $\text{Na}^+$ ,  $\text{K}^+$ , and  $\text{Ca}^{2+}$ , play important roles in the regulation of body and cellular functions, including generation of action potentials and the resting membrane potential of neural and muscle cells and signal transduction as intracellular second messengers. However, we have little information on the physiological roles of anions, particularly  $\text{Cl}^-$ , in body and cellular functions. Quercetin, a flavonoid, stimulates  $\text{Na}^+ -\text{K}^+ -2\text{Cl}^-$  cotransporter 1 (NKCC1), which is one of the most

important ion transporters regulating the cytosolic  $\text{Cl}^-$  concentration ( $[\text{Cl}^-]_c$ ). Here, we introduce the molecular mechanism by which flavonoids, specifically quercetin, act through elevation of  $[\text{Cl}^-]_c$  via activation of NKCC1 on important factors controlling various body and cellular functions, such as (1) antihypertensive actions controlling blood volume dependent on the amounts of renal  $\text{Na}^+$  reabsorption via expression of the epithelial  $\text{Na}^+$  channel, (2) neurite-elongating actions via polymerization of tubulin by inhibiting GTPase activity, and (3) antibacterial and antiviral infective actions through stimulation of epithelial  $\text{Cl}^-$  secretion by increasing the driving force for epithelial  $\text{Cl}^-$  secretion.

**Keywords:** ENaC; GTPase; NKCC1; neurite; tubulin.

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