FRUITS AND VEGETABLES WITH HIGHER POTASSIUM LEVELS MAY HELP REDUCE ARTERIAL SCLEROSIS AND CALCIFICATION

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Scientists publishing a new study in the journal JCI Insight have concluded that high-potassium foods such as avocados and bananas protect the arteries against hardening or calcification. Researchers at the University of Alabama at Birmingham found that increased potassium consumption protects against atherosclerosis, vascular calcification and aortic stiffness, or the hardening of the heart's arteries.

To gather their findings, researchers used apoliprotein E-deficient mice, *i.e.*, mice that are prone to cardiovascular disease when fed with a high-fat diet. The scientists fed three sets of laboratory mice with high, normal, and low-potassium diets.

Results show that the mice fed with low-potassium diets yielded significant vascular calcification and increased aortal stiffening compared with the mice fed with normal-potassium diets. In contrast, the mice fed with high-potassium diets showed significantly inhibited vascular calcification and aortal stiffness.

According to the study's abstract:

> Vascular calcification is a risk factor that predicts adverse cardiovascular complications of several diseases including atherosclerosis. Reduced dietary potassium intake has been linked to cardiovascular diseases such as hypertension and incidental stroke, although the underlying molecular mechanisms remain largely unknown. Using the ApoE-deficient mouse model, we demonstrated for the first time to our knowledge that reduced dietary potassium (0.3%) promoted atherosclerotic vascular calcification and

> increased aortic stiffness, compared with normal (0.7%) potassium–fed mice. In contrast, increased dietary potassium (2.1%) attenuated vascular calcification and aortic stiffness. Mechanistically, reduction in the potassium concentration to the lower limit of the physiological range increased intracellular calcium, which activated a cAMP response element–binding protein (CREB) signal that subsequently enhanced autophagy and promoted vascular smooth muscle cell (VSMC) calcification. Inhibition of calcium signals and knockdown of either CREB or ATG7, an autophagy regulator, attenuated VSMC calcification induced by low potassium. Consistently, elevated autophagy and CREB signaling were demonstrated in the calcified arteries from low potassium diet–fed mice as well as aortic arteries exposed to low potassium ex vivo. These studies established a potentially novel causative role of dietary potassium intake in regulating atherosclerotic vascular calcification and stiffness, and uncovered mechanisms that offer opportunities to develop therapeutic strategies to control vascular disease. . . .
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> In this study, we have provided the first evidence to our knowledge that supports a causative role of dietary potassium in regulating osteogenic differentiation and calcification of VSMCs in vitro and vascular calcification and stiffness in atherosclerotic animals in vivo. Furthermore, we defined key mechanisms underlying low-potassium-induced VSMC calcification involving elevated intracellular calcium, activated cAMP response element–binding protein (CREB), and increased autophagy. These findings provide molecular insights into the regulation of vascular calcification and stiffness by potassium, which explain the impact of dietary potassium intake on cardiovascular complications, and uncover potentially new targets to develop strategies to prevent and treat vascular complications.[1]

Why Is This Important?

A Cardiovascular Health Study of over 4,000 men and women showed that 79.9 percent of individuals aged 65 or older develop arterial calcification, a predictor of cardiovascular events. Heart disease is the leading cause of death for both men and women in the United States, and about 610,000 people die from it every year.

The results of the study show that increasing or even maintaining a healthy amount of potassium in regular diets could play important roles in preventing vascular complications. Further, it could prove useful in potential therapies and treatments for arterial treatments and atherosclerotic vascular calcification.

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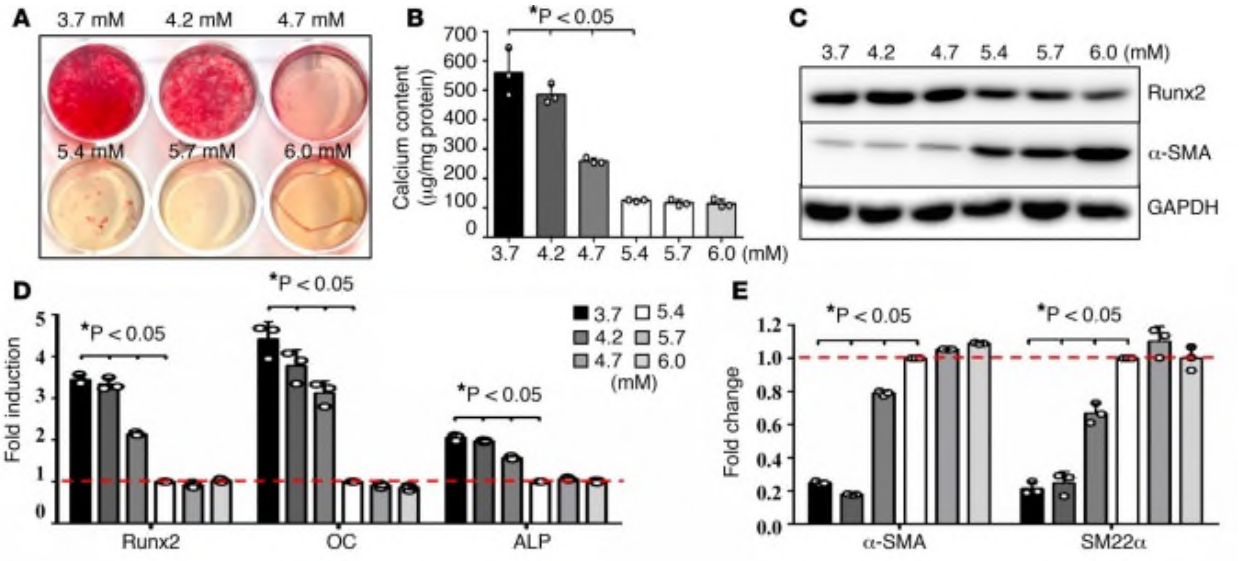
[1] Yong Sun, Chang Hyun Byon, Youfeng Yang, Wayne E. Bradley, Louis J. Dell'Italia, Paul W. Sanders, Anupam Agarwal, Hui Wu, and Yabing Chen, "**Dietary potassium regulates vascular calcification and arterial stiffness**" published online in *JCI Insight*. 2017;2(19):e94920. https://doi.org/10.1172/jci.insight.94920. (American Society for Clinical investigation)(October 5, 2017).



(A) Effects of potassium levels on calcification of vascular smooth muscle cells (VSMCs), determined by Alizarin red staining. VSMCs were cultured in osteogenic media with increased concentrations of potassium, 3.7 to 6.0 mM, for 3 weeks. Representative images of stained dishes from 4 independent experiments are shown.

(B) Total calcium content in VSMCs, determined by Arsenazo III. VSMCs were cultured in osteogenic media with increased concentrations of potassium, 3.7 to 6.0 mM, for 3 weeks. Results shown are normalized by total protein amount. Bar values are means ± SD (n = 3, *P < 0.05 compared with potassium at 5.4 mM).

(C) Effects of potassium levels on the expression of osteogenic and smooth muscle cell markers. VSMCs were exposed to 3.7 to 6.0 mM of potassium for 3 weeks. Representative images of Western blot analysis of runt-related transcription factor 2 (Runx2) and α-smooth muscle actin (α-SMA) proteins in VSMCs exposed to different concentrations of potassium from 3 independent experiments are shown.

(D and E) Real-time PCR analysis of (D) osteogenic markers, Runx2, osteocalcin (OC), and alkaline phosphatase (ALP) and (E) smooth muscle cell markers, α-SMA and smooth muscle protein 22 α (SM22α). VSMCs were exposed to 3.7 to 6.0 mM potassium for 10 days. Results from 3 independent experiments performed in duplicate are shown. Bar values are means ± SD (*P< 0.05 compared with potassium at 5.4 mM). Statistical analysis was performed by 1-way ANOVA followed by a Student-Newman-Keuls test.

Knowledge of how vascular smooth muscle cells in the arteries regulate vascular calcification suggests that dietary intake of potassium can promote the prevention of vascular complications of atherosclerosis or "clogging of the arteries." It also provides new targets for potential therapies to prevent or treat atherosclerotic vascular calcification and arterial stiffness.

Bananas have approximately 425 mg of potassium per serving. Avocados also have a significant amount of potassium per serving. However, there are many other food items which can yield additional health benefits beyond increased levels of potassium.

For example, artichokes have approximately 345 mg of potassium, and also have been cited as protecting against various forms of cancer, bolstering immune system strength, lowering cholesterol, and protect against diseases such as diabetes, heart attack, and stroke.

Similarly, seedless raisins typically provide an average of 270 mg of potassium per serving. However, unlike many other fruits or vegetables, raisins also contain the phytochemical compound **resveratrol,** a polyphenol antioxidant that has anti-inflammatory, anti-cancer, blood cholesterol lowering activities. Studies suggest that resveratrol has been found to have protective action against cancers like melanoma, colon, and prostate, and diseases such as coronary heart disease (CHD), degenerative nerve disease, Alzheimer's disease and viral/ fungal infections.

"*Reduced dietary potassium intake has been linked to the pathogenesis of a variety of human diseases, including atherosclerosis, diabetes, and chronic kidney disease,"* the study said. *"All of these disease share common vascular complications, such as vascular calcification*."

Whichever high-potassium food source is chosen, the reporting scientists of this study conclude that (i) "a causative link exists between reduced dietary potassium and vascular calcification in atherosclerosis," and (ii) their study identifies "the underlying pathogenic mechanisms that integrate enhanced intracellular calcium influx, activated CREB signaling, and elevation of autophagy." These findings provide molecular insights into the previously unappreciated regulation of vascular calcification and stiffness by low potassium intake and emphasize the need to consider dietary intake of potassium in the prevention of vascular complications of atherosclerosis.