

# Phytochemicals and Hypertension

Akram Kooshki<sup>1</sup>; BiBi Leila Hoseini<sup>1,\*</sup>

<sup>1</sup>Department of Biochemistry and Nutrition, Sabzevar University of Medical Sciences, Sabzevar, IR Iran

\*Corresponding Author: BiBi Leila Hoseini, Department of Nursing and Midwifery, Sabzevar University of Medical Sciences, Sabzevar, IR Iran. Tel: +98-9155175082, E-mail: Hoseini1871@gmail.com

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**Context:** Hypertension is defined as systolic blood pressure above 140 mmHg or diastolic blood pressure greater than 90 mmHg or both. Hypertension can be controlled by diet containing an adequate amount of phytochemicals.

**Evidence Acquisition:** The article is based on non-systematic literature searches in PubMed, Ovid and ScienceDirect.

**Results:** Hypertension is one of the major chronic diseases, which can affect people around the world. Today's DASH diet (dietary approach to stop hypertension) is used to reduce and control blood pressure. The diet containing plenty of fruits, vegetables, nuts and whole grains including nutrients such as vitamins and minerals and non-nutrient elements is called phytochemical. Phytochemicals are materials at very low concentrations, which affect the expression of many genes, including transcription factors AP-1, NF-KappaB, SREBPs, PPARs and their cellular metabolism and gene regulation; also have antioxidant properties and antihypertensive effects. Moreover, increased intake of phytochemicals is associated with decreased mortality rate from cardiovascular diseases, stroke and injuries secondary to hypertension. Possible mechanisms of action of phytochemicals to reduce blood pressure include inhibition of angiotensin-converting enzyme and inactivation bradikinin and regulation of bioavailability of nitrous oxide.

**Conclusions:** In conclusion, based on the results, increased intake of phytochemicals in daily diet is associated with decreased risk of mortality from coronary heart disease, stroke and injuries secondary to hypertension.

**Keywords:** Hypertension; Phytochemicals; Flavonoids; Carotenoids

## 1. Context

Hypertension or high blood pressure is defined as systolic blood pressure of greater than 140 mmHg or diastolic blood pressure greater than 90 mmHg or both, affecting 11% of Iran population (1). Hypertension is the third risk factor for death from cardiovascular disease, together with LDL-C and smoking, which is called the silent killer (2, 3). Besides, hypertension is the major risk factor for stroke and renal dysfunction. Lowering the blood pressure, through dietary may decrease damage of hypertension. Epidemiological studies suggest that consumption of fruit, vegetables (4-8) and mineral water, water (9, 10) and tea may protect against high blood pressure (11-14). Vegetables, fruits and tea may decrease blood pressure due to phytochemicals (15, 16). Functional non-nutrient food factors (phytochemicals) are found in vegetables and fruits and are effective for health promotion and disease prevention (15-17).

## 2. Evidence Acquisition

The article was based on non-systematic literature searches in PubMed, Ovid and ScienceDirect.

## 3. Results

### 3.1. Phytochemical

Flavonoids, polyphenols and carotenoids are included in phytochemical database (15). This review summarizes the current evidence on the effect of phytochemical on blood pressure. High intake of fresh fruit and vegetable was associated with a low stroke mortality risk, which is probably attributed to preventing hypertension (18).

### 3.2. Flavonoids and Hypertension

Flavonoid compounds contain flavonols (quercetin, kaempferol and myricetin), flavones (apigenin, and luteolin) and isoflavones (coumestrol, daidzein, genistein and equol) (18).

Therefore, vegetarians had approximately 40% higher intake of flavonoids than non-vegetarians. Flavonoids are scavengers of free radicals such as superoxide anions and lipid proxy radicals and by preventing oxidation of LDL-C, because oxidized LDL is believed to be atherogenic. Therefore, flavonoids may decrease the formation of atherosclerotic plaques and reduce arterial stiffness, leaving

arteries more responsive to the endogenous stimuli of vasodilation (5, 18).

The major dietary of flavonoid intake is black tea. Studies have shown that consumption of fruit, vegetable and tea (black and green) containing high amount of flavonoid may lead to lower blood pressure and may provide protection against coronary heart disease and stroke. It is possible that their antioxidant effect is responsible.

### 3.3. Poly Phenols and Hypertension

The Mediterranean diet is associated with greater longevity and quality of life in epidemiological studies, which is because of the abundance of fruits and vegetables containing high amounts of polyphenols. Several polyphenol-rich sources such as grape-derived products, cocoa, tea, soy, pomegranate and tomatoes have been shown to decrease blood pressure in hypertensive patients (6, 19-24). Polyphenol compounds include chlorogenic acid, caffeic acid, coumaric acid, gallic acid, quercetin, isorhamnetin, kaempferol, hesperetin, naringenin, phloretin, enterolactone and enterodiol (25). Recent studies suggest that chlorogenic acids as the main components of the polyphenol class in coffee, decrease the blood pressure (26). The hypotensive effects of chlorogenic acids were associated with nitric oxide, suppression of mRNA expression of NADPH oxidase, and improvement in endothelium-dependent vasodilation in the aorta (27, 28). Grassi et al. suggested that consumption of dark chocolate for 15 days reduced systolic blood pressure in healthy subjects as well as young and elderly hypertensive patients (29). Polyphenols decrease blood pressure by increasing endothelial nitric oxide bioavailability via their antioxidant action and their capacity to activate vascular endothelial nitric oxide synthase.

### 3.4. Carotenoids and Hypertension

In the last years, it is known that excess reactive oxygen species (ROS), is associated to inflammation, growth and vasoconstriction contributing to vascular injury in many cardiovascular diseases such as hypertension, hyperlipidemia and diabetes (30, 31). ROS plays an important pathophysiological role in hypertension. Antioxidants such as carotenoids inhibit NAD(P)H oxides-driven generation of ROS, improve endothelial function, enhance nitric oxide (NO) generation and reduce blood pressure in hypertensive patients (30). Astaxanthin, an oxi-carotenoid has antihypertensive effect by normalization of sensitivity of adrenoceptor sympathetic pathway, decrease in oxidative stress and improvement in NO bioavailability (30). Lycopene, a carotenoid without pro-vitamin A, is red pigment in tomatoes and watermelon. High lycopene consumption has been associated with a decrease in blood pressure (32, 33). A Meta-analysis performed on the effect of lycopene on systolic blood pressure of all trials suggested a significant blood pressure reducing effect (-5.60 + 5.26 mmHg), but no significant effect on diastolic blood

pressure (34). Blood pressure lowering properties of lycopene have been attributed to the stimulation of nitric oxide production in the endothelium (34).

## 4. Discussion

Based on the results, increased intake of phytochemical in daily diet is associated with decreased risk of mortality in coronary heart diseases, stroke and damage secondary to hypertension. Therefore, it is emphasized to consume foods rich in phytochemical such as vegetables, fruits, nuts, tea and coffee, etc., in the diet to control and prevent hypertension.

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## Authors' Contribution

Akram Kooshki performed all searches and studied and analyzed the previous studies and prepared the manuscript. Bibi Leila Hoseini assisted in searching and analyzing the previous studies and prepared the manuscript. All authors read and approved the content of the manuscript.

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