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Review Article

Role Of Nutraceuticals Used in the Treatment of Hypertension

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ABSTRACT

Hypertension, a major risk factor for cardiovascular diseases, affects a significant portion of the global population. Despite the availability of pharmacological treatments, there is growing interest in exploring alternative therapeutic options, such as nutraceuticals, which have demonstrated potential in managing blood pressure levels. Nutraceuticals, defined as food-derived products with health benefits, are gaining attention for their ability to complement or enhance conventional antihypertensive therapies. This review aims to explore the role of various nutraceuticals in the treatment of hypertension, including bioactive compounds such as omega-3 fatty acids, flavonoids, polyphenols, potassium, magnesium, and probiotics. The mechanisms of action for these substances—ranging from vasodilation, anti-inflammatory effects, antioxidative properties, and regulation of endothelial function—are examined. Additionally, the review discusses clinical studies that support the efficacy of these nutraceuticals in reducing systolic and diastolic blood pressure. While these natural compounds may offer promising adjuncts to conventional therapies, further research is needed to establish standardized dosages, long-term effects, and the safety profiles of these agents. This review provides a comprehensive overview of current evidence and highlights the potential of nutraceuticals in hypertension management, emphasizing their role in the promotion of cardiovascular health.

INTRODUCTION

Hypertension, or high blood pressure, refers to the pressure of blood against your artery walls. Over time, high blood pressure can cause blood vessel damage that leads to heart disease, kidney disease, stroke, and other problems. Hypertension is sometimes called the silent killer because it produces no symptoms and can go unnoticed — and untreated — for years.

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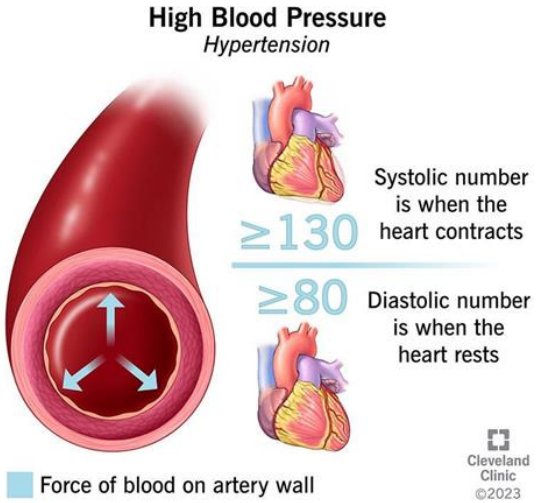
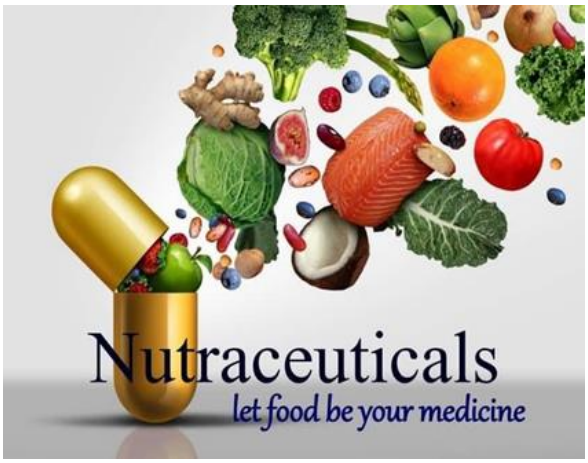


If uncontrolled, diseases related to high blood pressure will be a substantial burden. More specifically, the direct burden on health will be drastically affected, as approximately 30% of patients with hypertension are not treated properly, demonstrating a need for new treatment options, as well as new forms of prevention and management of this condition. Based on this, several studies have demonstrated the importance of nutraceuticals in the management of hypertension and cardiovascular diseases. Nutraceuticals are foods or food derivatives that provide medicinal and health benefits, including the prevention, management and treatment of a disease, and included a class the isolated nutrients, encapsulated dietary supplements, herbal products and processed foods, such as cereals, soups and beverages. Most nutraceuticals still need support from large clinical trials to demonstrate their efficacy and safety profile, prior to their use in cardiovascular prevention and treatment.

Isolated nutrients: Also known as synthetic nutrients, these nutrients are created artificially in an industrial process.



Antihypertensive Nutraceuticals:

1.Pottasium supplements
2.Magnesium supplements
3.Garlic extract
4.Fish oil
5.Pomogranate extract

Types of Hypertensions:

1. **Primary hypertension:**

Also known as essential hypertension. This is the most common type of high blood pressure and usually develops over time as people age. There's no clear cause for the elevated blood pressure. (90-95%)

2. **Secondary hypertension**:

This type of high blood pressure cause by another medical condition or the use of certain medications Secondary hypertension is less common than primary hypertension, but it can be more serious (5-10%)

Causes of Hypertension:

- Lifestyle
- Health Conditions
- Family History
- Age
- Pregnancy
- Environmental factors
- Stress

Pathophysiology of hypertension :

Primary Factors:

1. Renin-Angiotensin-Aldosterone System (RAAS): Activation of RAAS leads to vasoconstriction, sodium retention, and fluid accumulation, increasing blood pressure.
2. Sympathetic Nervous System (SNS): Overactivity of SNS causes vasoconstriction, increasing cardiac output and peripheral resistance.
3. Vascular Structure and Function: Endothelial dysfunction, vascular remodeling, and stiffness contribute to increased peripheral resistance.

Secondary Factors:

1. Sodium and Water Retention: Excessive sodium intake leads to fluid retention, increasing blood volume and pressure.
2. Endocrine Factors: Hormonal imbalances (e.g., aldosterone, cortisol) affect fluid balance and vascular tone.

Genetic Predisposition: Family history and genetic variations influence hypertension risk.

Literature Review

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Aim

To utilize nutraceuticals as complementary or alternative therapies to prevent, manage, or treat various diseases and health conditions, promoting overall wellness and quality of life.

Objective

1. Prevention: To identify and address nutritional deficiencies and vulnerabilities to prevent chronic diseases.
2. Therapeutic benefits: To provide adjunctive or alternative treatments for various health conditions, such as:

-Chronic diseases (diabetes, cardiovascular disease, cancer)
-Mental health disorders (anxiety, depression)
-Digestive health issues (IBS, inflammatory bowel disease)
-Immune system support
-Inflammatory conditions (arthritis, asthma)

1. **Symptom management:** To alleviate symptoms and improve quality of life for patients with:
   - Chronic pain
   - Sleep disorders
   - Cognitive impairment

2. **Nutritional support:** To provide essential nutrients for:
- Malabsorption conditions (celiac disease, Crohn's disease)
- Aging populations
- Pregnant or lactating women

5.Research And Development: To investigate the efficacy and safety of nutraceuticals, exploring new applications and mechanisms of action.

Nutraceutical used in Hypertension

1. **Garlic :**

Garlic is linked to a variety of benefits, including reduced blood pressure and heart disease risk . Adding a garlic supplement to your routine may help lower your blood pressure naturally. In fact ,in a review of 12 studies ,garlic supplements reduced systolic and diastolic blood pressure by an average of 8.3 mmHg and 5.5mmHg, respectively. The researchers estimated that this reduction may help decrease your risk of stroke
heart attack, and coronary artery disease by up to 40%.

Beetroot:

Athletes often take beetroot supplements to bolster exercise performance because this root vegetable improves blood flow and oxygen delivery to your muscles. Interestingly, beetroot supplements have been shown to reduce blood pressure in people with and without high blood pressure. For example, a review of 11 studies revealed that beetroot juice lowered blood pressure levels in people with and without this condition.

Beetroot is also rich in betalains, (betalains are class of water- soluble pigments that come in red and yellow varieties .The red=betacyanin, and yellow=betaxanthin), nitrogen -containing color compound not commonly used in edible plants . A

number of reports have provided evidence of a BP-reducing activity of beetroot products in normotensive and hypertensive.

3.Fish Oil

Fish oil is an excellent source of omega-3s , which is good for the heart and the brain. However, getting your omega-3s from fish is healthier. If you don't eat fish, fish supplements are a good alternative. Research shows that people who eat a lot of fish have much lower rates of heart disease. Multiple risk factors for heart disease appear to be reduced by consuming fish or fish oil. The benefits of fish oil for heart health Trusted Source include helping:

- Lower cholesterol
- Lower triglycerides
- Reduce blood pressure

There's moderate evidence trusted Source that omega-3 may help reduce the severity of and mortality from heart disease. More research is needed trusted source to determine if omega-3 has any association with preventing stroke or reducing mortality from stroke.

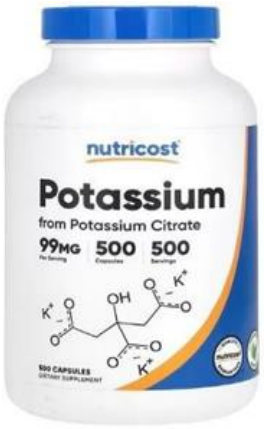
4.Ginger:

Ginger may help with hypertension by acting as a natural calcium channel blocker and ACE inhibitors, which are also a medication used to treat high blood pressure. Ginger may slow blood clotting. Research suggests that high-dose ginger supplements may help lower high blood pressure. A review of 6 studies found that, when taken in doses of 3 grams or more per day for 8 weeks or fewer, ginger supplements significantly reduced blood pressure in people 50 years old and younger.

In a 12-week study in 37 people with metabolic syndrome — a group of conditions that raise heart disease risk — taking 2 grams of ginger powder per day significantly lowered levels of blood

pressure, triglycerides, and fasting blood sugar, compared with a placebo.

5.Potassium



Potassium may be the best-known nutritional supplement for blood pressure regulation. Studies suggest that increasing your intake of food or supplements helps reduce high blood pressure levels. Potassium works by promoting sodium excretion through the urine and helping blood vessels relax. In a review of 23 studies, potassium supplements led to a modest but significant drop in blood pressure, compared with a placebo. Other reviews note that these supplements are safe and effective, though they appear most effective in people with high blood pressure who follow high-sodium diets.

Formulation and design of delivery systems for nutraceuticals

The successful development of delivery systems for nutraceuticals requires the knowledge of their properties and the use of adequate materials and production techniques. In fact, the choice of the adequate encapsulation procedure is a key step once many nutraceuticals are sensitive to heat and to high temperature during the encapsulation process, which could cause loss of their bioactivity. The design of delivery systems for nutraceuticals that have adequate physical and chemical stability as.

Gastrointestinal fate of delivery systems/ nutraceuticals

Ingested delivery system undergo a series of complex physicochemical and physiological process as they pass through the different regions of the human GI tract, before the release of nutraceuticals

Oral bioavailability of nutraceuticals

Bioavailability is dependent on digestion, release from food matrix, absorption by intestinal cells, and transport to the target body cell. Only the nutraceutical fraction that reaches the blood in an active form is distributed to the organs and tissues where it can exert its beneficial health effects.

Precautions:

While several supplements may lower blood pressure levels, it doesn't mean that every supplement is safe. It's important to know that many supplements may interact with common drugs, including blood pressure medication. What's more, while taking too little of a supplement may be ineffective for reducing blood pressure, taking too much may result in serious side effects. Thus, you should always consult your healthcare provider before adding any supplement to your routine. Your healthcare provider can help you determine a safe and effective dose based on your needs.

Medicinal plants and their chemical constituents used in hypertension

1. **Garlic**

Sulfur Compounds:

1. Allicin (allyl sulfur compound): Responsible for garlic's pungent smell and most of its medicinal properties.
2. Diallyl disulfide: Antioxidant, anti-inflammatory, and vasodilatory effects.
3. S-allyl cysteine (SAC): Antioxidant, anti-inflammatory, and cardiovascular protective effects.
4. Garlic sulfur compounds (GSCs): Include allicin, diallyl disulfide, and other sulfur-containing compounds.

Flavonoids:

1. Quercetin: Antioxidant, anti-inflammatory, and vasodilatory effects.
2. Kaempferol: Antioxidant and anti-inflammatory effects.
3. Naringenin: Antioxidant and anti-inflammatory effects.

Terpenes:

1. Beta-sitosterol: Phytosterol with antioxidant and anti-inflammatory effects.
2. Stigmasterol: Phytosterol with antioxidant and anti-inflammatory effects.

Amino Acids:

1. Arginine: Precursor to nitric oxide, promoting vasodilation.
2. Glutamine: Antioxidant and anti-inflammatory effects.
3. Asparagine: Antioxidant and anti-inflammatory effects.

2. Tea Plant Catechins:

1. Epigallocatechin gallate (EGCG): Antioxidant, anti-inflammatory, and vasodilatory effects.
2. Epicatechin gallate (ECG): Antioxidant and anti-inflammatory effects.
3. Epigallocatechin (EGC): Antioxidant and anti-inflammatory effects.

Flavonoids:

1. Quercetin: Antioxidant, anti-inflammatory, and vasodilatory effects.
2. Kaempferol: Antioxidant and anti-inflammatory effects.

Amino Acids:

1. L-theanine: Anxiolytic, antioxidant, and blood pressure-lowering effects.
2. Arginine: Precursor to nitric oxide, promoting vasodilation.

Vitamins and Minerals:

1. Vitamin C: Antioxidant effects.
2. Vitamin E: Antioxidant effects.
3. Potassium: Vasodilatory effects.
4. Magnesium: Vasodilatory and anti-inflammatory effects.

3. Pomegranate

Major Chemical Constituents:

1. Ellagic acid: Antioxidant, anti-inflammatory, and vasodilatory effects.
2. Punicalagins: Antioxidant, anti-inflammatory, and cardiovascular protective effects.
3. Anthocyanins: Antioxidant and anti-inflammatory effects.
4. Flavonoids (e.g., quercetin, kaempferol): Antioxidant, anti-inflammatory, and vasodilatory effects.
5. Phenolic acids (e.g., gallic acid, ferulic acid): Antioxidant and anti-inflammatory effects.

4. Ashwagandha

Major Chemical Constituents:

1. With an olides (steroidal lactones): Anti-inflammatory, antioxidant, and adaptogenic effects.
2. Alkaloids (e.g., withanine, somniferine): Sedative, anti-inflammatory, and antioxidant effects.
3. Saponins (e.g., withanoside IV, withanoside VI): Anti-inflammatory, antioxidant, and immunomodulatory effects.
4. Flavonoids (e.g., kaempferol, quercetin): Antioxidant, anti-inflammatory, and vasodilatory effects.
5. Phenolic acids (e.g., ferulic acid, vanillic acid): Antioxidant and anti-inflammatory effects.

Clinical Trials Using Nutraceutical in Managing or Treating Hypertension and Cardiovascular Diseases:

To investigate whether the consumption of beet juice in addition to a normal diet, would produce a measureable reduction in blood pressure, a double-blind, randomized, placebo- controlled, crossover study with 30 free-living adults was realized. Volunteers were randomized to receive 500 g of beetroot and apple juice or a placebo juice . Volunteers had BP measured at baseline and at least hourly for 24-hours following juice consumption using an ambulatory blood pressure monitor . This study concluded that beetroot juice will lower BP in men when consumed as part of a normal diet in free-living healthy adults . Nutraceutical preparations of Allium cepa (onion) are indicated for treating various of acute and chronic diseases . A randomised double-blinded placebo-controlled cross-over trial with sixty-eight subjects (thirty-four male, thirty-four female), randomised to receive quercetin (162 mg/day) from onion skin extract powder or placebo with 6-week treatment periods separated by a 6-week washout period, evaluated the effects of a quercetin- rich onion skin extract on 24 hours ambulatory blood pressure and endothelial function in overweight-to-obese patients with (pre-)hypertension.

CONCLUSION:

Some nutraceuticals might have a positive impact on BP in humans . Further clinical research is needed ,to identify from the available active nutraceuticals those with the best cost-effectiveness and risk-benefit ratio for wide spread and long-term use in the general population with a low-added cardiovascular risk related to uncomplicated hypertension. A number of nutraceuticals appear to be useful in the management of pre-hypertensive patients , in association with an improvement of diet and life-style. Beyond large of dietary supplements that have shown an antihypertesive activity in single trails .

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