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NUTRACEUTICAL INTERVENTION IN CARDIOMETABOLIC DISORDERS

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Abstract
Cardiovascular diseases (CVDs) remain a leading cause of global morbidity and mortality, with lifestyle and dietary factors playing a critical role in disease progression. The five analyzed review articles collectively evaluate the cardioprotective potential of traditional and functional nutraceuticals, emphasizing their role in prevention and adjunctive therapy. Nutraceuticals such as garlic, lycopene-rich tomatoes, spirulina, curcumin, polyphenols, and omega-rich plant sources demonstrate beneficial effects on major cardiovascular risk factors including hypertension, dyslipidemia, oxidative stress, inflammation, insulin resistance and endothelial dysfunction. Mechanistically, these bioactive compounds exert antioxidant, anti-inflammatory, antiplatelet, lipid-lowering, and vasodilatory actions, thereby improving vascular function and myocardial health. Several human and animal studies report significant reductions in blood pressure, total cholesterol, low-density lipoprotein levels, and inflammatory cytokines following nutraceutical supplementation. Despite promising findings, the articles highlight limitations such as variability in bioavailability, inconsistent clinical outcomes, and a lack of large-scale randomized controlled trials assessing hard endpoints like mortality. Overall, the evidence supports nutraceuticals as safe, cost-effective, and complementary strategies for cardiovascular risk reduction. However, standardized formulations and robust clinical trials are necessary to validate their therapeutic efficacy and integrate them effectively into clinical practice.

Keywords: *Nutraceuticals,Cardiovascular health,Omega-3 fatty acids,Antioxidants,Lipid managemennt*

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INTRODUCTION
A "nutraceutical" is defined as a food product (a fortified food or dietary supplement) that provides therapeutic benefits while maintaining its fundamentally healthy value. Dr. Stephen De Felice coined the term "nutritraceutical" in 1989, combining the terms "pharmaceutical" and "nutrition," and defined it as a food item that has clinical benefits in medicine, such as the prevention or possible treatment of a disease [1]. Hypertension, which is characterized by elevated blood pressure, is a major cause of a number of illnesses, including stroke, cardiovascular disease, renal failure, and more. Almost 45% of instances with

Hypertension is a primary or indirect cause of heart disease and 51% of stroke incidents worldwide. despite the fact that the illness is multifaceted and intricate. Approximately 30% of patients with heart disease and hypertension are not adequately treated, indicating a need for innovative treatment and intervention strategies [2].

Cardiovascular Diseases
Cardiovascular disease (CVD) is prevalent and primarily affects adults over 60. According to data from 2012 and 2013, CVD is thought to be the cause of over 17.3 million deaths globally each year. The World Health Organization (WHO) claims that ischemic heart disease is the primary cause of the rising global death rate. The incapacity of the heart to pump blood and supply nutrition and oxygen is known as heart failure [3].

1. Types of CVD
CVD comes in four primary forms. The condition known as coronary heart disease.

A.stroke

The disease of peripheral arteries. Aortic disorders

A. Coronary Heart Disease

When fatty materials (atheroma) accumulate in the coronary arteries, it can impede or stop the flow of blood to the heart muscle, resulting in coronary heart disease (CHD) [4].

Cardamom: Certain bioactive components found in cardamom essential oil have been shown to have anti-oxidative stress, and hyperlipidaemic effects.

B. Stroke:

An interruption in the blood supply to the brain can result in a stroke, a serious medical illness.

C. **Peripheral Arterial Disease:**

It alternatively termed peripheral vascular disease arises when there is an obstruction in the arteries that supply blood to the limbs, typically affecting the legs.

Arms: weakness or numbness that makes it difficult to raise or keep one arm

D. Aortic Disease: The vital function of the aorta, the body's main blood conduit, is to carry blood from the heart to every other area of the body. The vital function of the aorta, the body's main blood conduit, is to carry blood from the heart to every other area of the body [5].

Common Signs and Symptoms of Cardiovascular Disease

The following symptoms are associated with heart disease:

1. Chest pain
2. Palpitations
3. Shortness of breath
4. Fainting
5. Leg swelling

2. Cardiac Dysfunction

Features of Cardiac Diseases

Cellular stress is the source of it. In order to maintain cardiac output, the system makes hemodynamic adjustments, which remodelling makes up for. Dysregulation of miRNA expressions, which serve as biomarkers and provide immediate, tissue-specific information on the condition of the cardiac system, may also follow from this. Cardiovascular breakdown, also referred to as cardiac dysfunction, is a clinical disorder caused by fundamental and practical abnormalities in the myocardium that impair ventricular filling or blood flow [6].

Signs and Symptoms

Dyspnoea, or shortness of breath, occurs when you lie down or exert yourself. Weakness

2.1 Hypertension

It has often been said that hypertension is the silent killer. More than 20% of Americans suffer with hypertension, and since many of them have no symptoms, they are unaware of the potential underlying time frame for the development of cardiovascular disease.

Signs and Symptoms

- Severe headache
- Fatigue or confusion

2.2 Coronary Artery Disease [CSD] -Atherosclerosis

Excessive narrowing of the coronary conduits results in coronary artery disease. The veins that provide blood and oxygen to the heart muscle are known as coronary veins [7].

Signs and Symptoms

- Angina or chest discomfort
- Pain in your arm, leg, and any other area where an artery is blocked Inability to breathe

2.3 Ischemia

The inadequate blood flow to a particular area due to the blockage of blood arteries supplying the area is known as ischemia.

Signs and Symptoms

Pressure and pain in the chest Congestion and coughing Light-headedness or dizziness

2.4 Hypertrophy

An unfavourable worsening of hemodynamically distressing diseases, such as hypertension.

2.5 Oxidative stress

The proximity of oxidative pressure when ROS production is high in relation to cancer.

Signs and Symptoms

- Memory loss and/or brain fog

2.6 Dyslipidemia

It includes many types of lipid disorders that increase the risk of cardiovascular disease (CVD).

3. NUTRACEUTICAALS, FUNCTIONAL FOODS AND CVD PROPHYLAXIS

Bioactive Nutrients and Antioxidant Defence System Various plant products and extracts rich in bioactive components are useful as the functional ingredients for providing various health benefits including CVD [8].

3.1 Herbal Drugs Used In Cardiovascular Diseases

3.1.1 Garlic:

Synonyms: Garlic and Allium

Biological Source: This consists of bulbs of the plant known as Allium sativum Linn. Family Liliaceae. It contains not less than 0.2% of alliin on dried b specific asis

Chemical Constituents

Garlic bulbs contain 29 per cent of carbohydrates, about 56 per cent of proteins (albumin), percent of fat, mucilage, and 0.06 – 0.1 % of volatile oil [9].

USES

Cardiovascular**:** Garlic as a source of flavonoids, lowers the risk of hypertension and ischemic heart disease. Additionally, it reduces plaque formation.

MECHANISM: garlic has been shown to inhibit enzymes involved in lipid synthesis,

3.1.2 Turmeric**:**

Synonyms**:** Indian saffron, Curcuma, Turmeric, Haldi.

Biological Source: Turmeric consists of dried as well as, fresh rhizomes of the plant. To family Zingiberaceae. It contains not less than 1.5% of curcumin [10].

Chemical Constituents

Turmeric contains about 5% of volatile oil, resin, abundant zingiberene starch grains and yellow colouring substances known as curcuminoids.

Uses

Cardiovascular**:** Curcumin, an active component of turmeric is a powerful antioxidant. It also reduces LDL, triglycerides and lipid peroxides [11].

3.1.3 Capsicum:

Synonyms**:** Chillies, Cayenne pepper

Biological Source**:** Capsicum consists of dried ripe fruits of Capsicum annum Linn.family Solanaceae.

Chemical Constituents**:** Capsicum contains about 0.5-0.9 per cent colourless, crystalline, and pungent principle, known as capsaicin which is volatile above 65°C.

Cardiovascular**:** Capsicum is used for conditions of the heart and blood vessels including poor circulation, excessive blood clotting, high cholesterol, and to treat heart diseases, stroke, and muscle tension.

Mechanism: Capsicum and its constituent, capsaicin, exerted their antihypertensive effect by several mechanisms.

3.1.4 Tomato

Synonym**:** Lycopersicon, Lycopersicum, Lycopersicon esculentum

Biological Source: Lycoperesiconesculentum Mill.family Solanaceae.

Chemical Constituents: Capsicum and its constituent, capsaicin, exerted their antihypertensive effect by several mechanisms.

Uses

Cardiovascular: Tomato extract's ability to lower blood pressure was linked to its antioxidant properties.

Mechanism: Dietary antioxidants dramatically reduce the amount of LDL by preventing the oxidized LDL from being used by macrophages.

3.1.5 Curry Leaves and Cucumber

Synonyms: Karuvepaku,Daun kari

Biological Source: A small tropical to subtropical tree, growing up to 4–6 meters (13–20 feet) tall, with aromatic pinnate leaves consisting of 11–21 leaflets.

Family Rutaceae

Chemical Constituent: Alkaloids of carbazole.

3.1.6 Onions:

Synonyms: Onion and Green onion

Biological Source: The bulb of Allium cepa L., a member of the Amaryllidaceae family (subfamily Alaudidae, formerly Liliaceae), is the biological source of onions.

Chemical Constituents: Although onions are mostly composed of water (about 89%), they are also rich in healthy substances such as fructooligosaccharides (FOS),

Uses

Cardiovascular: Onions are a versatile culinary staple that are used all over the world to flavor soups, salads, and sauces.

Mechanism: Onions have a chemical defense system that is activated by tissue damage (cutting).

3.1.7 Green Tea

Synonyms: Green Tea and Herbal tea

Biological Source: The dried leaves and leaf buds of the Camellia sinensis (L.)

Chemical Constituents: About 4,000 bioactive substances, mostly polyphenols (25–35% dry weight), including catechins like epicatechin (EC), EGCG, EGC, and ECG, are found in green tea.

Uses

Cardiovascular: Green tea is a nutrient-dense, low-calorie beverage that is high in caffeine and antioxidants, including EGCG, which are believed to benefit heart health, increase brain function, and speed up metabolism.

Mechanism: Green tea's potent antioxidants, particularly its catechins like EGCG, fight cell damage, lower inflammation, and improve metabolic processes.

3.1.8 Mucosterols:

Synonyms: Ergosterol

Biological Source**:** As an analog of cholesterol in animal cells, mycosterols are a class of sterols present in fungi that are essential for preserving the fluidity and integrity of cell membranes.

Chemical Constituents: Ergosterol (ergosta-5,7,22-trien-3β-ol) is the most common and abundant member of the class of sterol lipids known as mycosterols, which are present in the cell membranes of yeasts and fungi.

Uses

Cardiovascular: Mycosterols, especially ergosterol and its derivatives from mushrooms and fungi, are important bioactive substances that are used to make nutritional supplements, functional foods, and cholesterol-lowering products.

Mechanism: Fungal sterols called mycosterols (mostly ergosterol and its derivatives) preserve the integrity, fluidity, and permeability of fungal cell membranes in a manner akin to that of cholesterol in animal cells [12].

3.1.9 Vitamins

Synonyms**:** Micronutrients, Nutrition

Biological Source: A varied diet that includes fresh fruits, vegetables, lean meats, fish, eggs, dairy products, and whole grains is the main source of vitamins, which are necessary organic elements.

Chemical Constituents: Although vitamins play a significant role in our nutrition, it's unlikely that you have given their molecular structures any thought.

Cardiovascular: Immune System Support: Vitamins A, C, D, and We are essential for immune system support and infection prevention.

Mechanism: Vitamins are vital micronutrients that govern gene expression, act as coenzymes in biochemical reactions, control metabolism, and act as antioxidants.

3.1.10 Lycopene

Synonyms: Carotene

Biological Source: Over 85% of dietary intake of lycopene, a naturally occurring red carotenoid pigment, comes from red-fleshed fruits and vegetables.

Chemical Constituents: Lycopene is a tetraterpene made up of eight isoprene units that are only made of carbon and hydrogen. Its chemical formula is C40H56.

Uses

Cardiovascular: Red fruits and vegetables (tomatoes, watermelon, and grapefruit) contain lycopene, a potent carotenoid antioxidant that is mainly used to fight oxidative stress, promote cardiovascular health, and lower the risk of chronic illnesses.

Mechanism: The main way that lycopene works is as a strong antioxidant that prevents damage to proteins, lipids, and DNA by scavenging dangerous free radicals and reactive oxygen species (ROS) [13].

4. Limitations

1) Variable and Limited Clinical Evidence

Many studies are small, short-term, or observe.

2) Lack of Standardization

Active ingredient concentration can vary widely between brands5.

5. Future Strategies

Evidence-Based Validation: Conduct large, multicenter randomized controlled trials (RCTs).

5. Conclusion

"Nutraceutical" is a combination of the terms "pharmaceutical" and "nutrition." One component of food that is important in adjusting and preserving the body's normal physiological function and preserving human health is nutraceuticals. The present demographic and health trends are the primary drivers of the nutraceutical market's overall growth. Consequently, the nutraceutical companies possess a comprehensive understanding of the potential health advantages of nutrients.

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All authors are equally contributed

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