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Modulatory Impact of Nutraceuticals in Cardiovascular Diseases and Hypertension

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Review Article

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Abstract

Despite knowledge and information that most of the chronic health problems including heart disease along with several other health problems are quite preventable, currently various types of heart diseases are leading causes of global death. Within the given context, some major types of heart diseases are myocardial infarction, coronary heart disease (CHD), heart failure, stroke, complex renal disease, sexual dysfunctions like erectile problems etc. Several researches have shown that there are variety of enriched food items which have a high nutritional importance (called nutraceuticals) and quite capable of preventing such deadly diseases. The present work is a review article on current status of various nutraceuticals in preventing and treating abovementioned hypertension and several cardiac complications. For the purpose, various online major databases have been searched. In conclusion, it was observed that several vitamins, vegetable and spices with some other nutraceuticals like lycopene are quite useful in preventing almost all types of general cardiac diseases and hypertension.

Keywords: Nutraceuticals; Food; Heart Disease; Diet; Cardiac Problems; Hypertension; High Blood Pressure

Abbreviations: CHD: Coronary Heart Disease; SciELO: Scientific Electronic Library Online; SDAT: Senile Dementia of the Alzheimer Type; AD: Alzheimer's Disease; PDDAT: Primary Degenerative Dementia of the Alzheimer's Type; BP: Blood Pressure; GBD: Global Burden of Disease; DASH: Dietary Approaches to Stop Hypertension.

Introduction

Hypertension, characterized by high blood pressure, is an important reason for several diseases like renal failure, cardiovascular diseases, stroke etc [1]. Nearly 45% cases of heart diseases and 51% cases of stroke in the world are directly or indirectly caused by hypertension. Despite the fact that the condition is complex and multifaceted [2,3]. Around 30% patients of hypertension and heart diseases are not properly treated which indicates a need for novelty in treatment and intervention treatment. In this context, several studies have supported and advised on the use of nutraceuticals in the treatment and cure of hypertension [4,5] and cardiovascular disease [6]. In fact, nutraceuticals are basically foods or its derivatives giving therapeutic and health benefits in prevention, intervention and cure of diseases. These nutraceuticals include nutrients, supplementary diets, herbs, and also processed foods items like soups, other beverages, cereals, are examples [7-10].

Though, the exact mechanisms of nutraceuticals on hypertension and heart disease are not known, however, their active and effective role in lessening hypertensive

symptoms and risks for cardiac complications have been claimed [11-13]. This gap and lack in knowledge is due to inconsistent researches and unscientific information. The present manuscript is aimed at reviewing impact and scientific mechanisms of some popular nutraceuticals being used in intervening and curing cardiac diseases and hypertension as well. For the purpose, various online major databases like PubMed, Mendeley, google scholar, Cochrane, and Virtual Health Library, and Scientific Electronic Library Online (SciELO) have been searched for research literature investigated in last 20 years with the keywords, e. g., nutraceuticals, healthy food, diet, treatment, heart disease, hypertension, nutrition & chronic health treatment. All research articles containing use of nutraceuticals hypertension and cardiac diseases, prevention of the same as well as related problems in consumption of the same were selected for review.

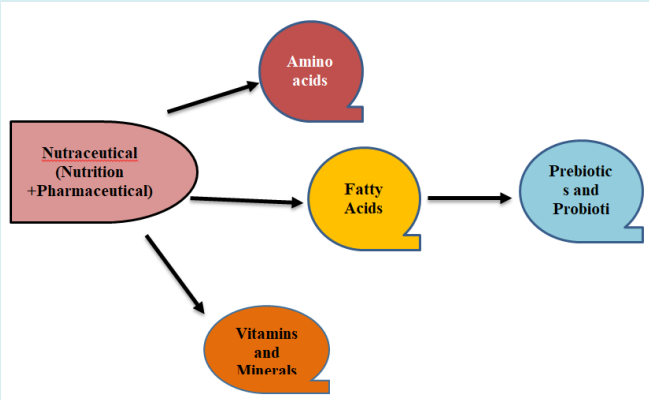

Figure 1: Concepts of nutraceuticals [13].

Impact of Various Nutraceuticals on Modulating Hypertension and Cardiovascular Diseases

Polyphenols - & Flavonoids - Rich Nutraceuticals

Polyphenols are plant compounds providing several health benefits. They work like antioxidants and promote digestion as well as brain health. The polyphenol-rich foods and drinks (e. g., vegetables, fruits, cocoa in good quality of chocolates, grapes, red wine and tea) have been linked to a lower risk of cardiovascular disease in numerous studies [14-16]. Similarly, the flavonoids are plants' pigments protecting us from toxins and stressors in everyday life as a powerful antioxidant. The flavonoids are also present in fruits, vegetables, tea, and red wine additionally providing non-cancerous, anti-inflammatory, almost all types of cardioprotective measures and endothelial protection following cardiac transplantation [17-24]. In similar vein, isoflavones (a compound in pulses) are equivalent flavonoids (e.g., soy pulse and other quality pulses) are helpful in increasing dilation of blood vessels decreasing blood pressure in hypertension and improving endothelial functioning [25]. However, contributions of soy have been controversial in few researches [26-27]. Fine grades of olive oil are another food rich in flavonoids to be quite helpful in lowering blood pressure [28] should one consume 500-1000 mg every day [29]. Besides, polyphenols are also found with high concentrations in grape seeds and extracts of red wine ingestion of which is associated with inhibiting platelet aggregation, minimizing stress, and decreasing LDL (bad protein) and improving cardiac functions.

Vitamins

Vitamin C (ascorbic acid) and E to be taken from fruits and vegetables have also antioxidant properties to be helpful for Persons with hypertension, cardiac complications and diabetes who are usually more stress prone than healthy people likely to affect their immunity and physical defense system. These vitamins prevent vascular contraction, secretion of aldosterone (affecting salt and potassium absorption) and proliferation of cardiovascular cells- all causing increased level of blood pressure. Several studies including long-term and short-term investigation on primary and secondary data comprising major age-groups have confirmed similar outcomes. Similarly, vitamin D is also an important vitamin playing its role in controlling, treating and curing cardiovascular disease and related complications. Sunlight is the best source of this vitamin to be generated in the skin. Besides, it is also ingested and absorbed through foods fish, egg, cheese, orange, animal liver, mushrooms as best sources. The vitamin D has anti-inflammatory & immunoregulatory features and duly balances calcium and phosphate. The insufficient level of vitamin D is linked with cardiac complications also like stroke, myocardial infraction, heart failure, coronary heart disease vascular disease etc. The vitamin D protects our heart circulatory system through modulation of vascular tone, regulating blood pressure, activities of vascular smooth muscle, and maintaining endothelial level. However, some of the studies have claimed that there is a relationship between vitamin D and endothelial complications, but it is not definite that supplement of vitamin D could prevent cardiovascular diseases [30-48].

Lycopene

Lycopene is considered as a carotenoid (giving colour to plants) to be found in red fruits and some vegies like tomatoes, red peppers, watermelons, papayas etc [49]. Tomato is a popular nutritious and culinary vegetable and also contains carotene, folate (type of vitamin B), phenolic compounds (an antioxidant), and vitamins C and E. The connection between tomato and ingestion of lycopene pertaining to lowering

the risk of cardiovascular disease is well documented. It reduces the risk of heart attack, weak coronary functions, angina pectoris, hypertension, stroke, and atherosclerosis [50-52]. Scientists have observed that 3-moth supplement of tomato can prevent heart-related complications by reducing stress, improving diastolic efficiency and decreasing the area of left ventricular myocytes [53]. On the other hand, the antioxidant characteristic of lycopene was seen significantly in enhancing functions of endothelium, which is associated with inflammatory symptoms. Thus, daily consumption of lycopene is recommended to be helpful [54-60].

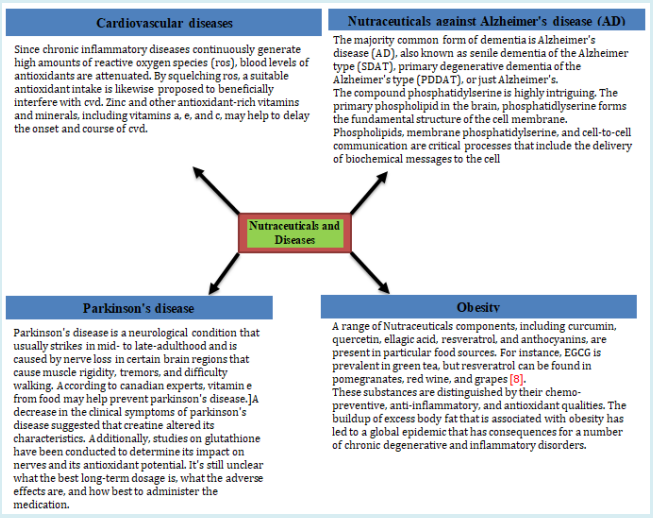

Figure 2: Nutraceuticals and Diseases.

Garlic

Garlic is a also a popular culinary vegetable and spice with magnificent nutritional and therapeutic properties [61]. It contains water (65%), carbohydrates, sulphur, proteins, and free amino acids [62]. The Garlic's component of sulphur has highest nutritional and therapeutic benefits. Recently it has been discovered that allicin, which is also known as diallylic thiosulfinate, is primarily accountable for benefits of garlic in heart disease [63,64]. Garlic is useful in reducing aggregation of platelet, vasodilation and fibrinolysis (preventing blood clotting) in humans [65,66]. It can be consumed in various forms, e. g., aged garlic extracts, garlic oil, powder for various medicinal properties [67]. It another compounds, H2S has been found useful in stress reduction, lowering and preventing hypertension, apoptosis (non-inflammatory cell death), necrosis (inflammatory cell death) and essential function of cells [68]. Indeed, eating garlic has a strong heart-protecting impact observed in many researches [69-73]. However, too much consumption or overdose of garlic may cause gastrointestinal difficulties. Further investigations are required in this area for more robust clarifications.

Curry Leaves & Cucumber

These two fruits (cucumber with 100-125 g) and vegetable (curry leave with 5 g) have been used in treating women with hypertension in menopausal stage through randomized trials for 45 days and it was observed that patients reported lower level of LDL, total cholesterol and increased level of HDL. Thus, the curry leaves and cucumber have nutraceutical values [74]. Likewise, 500g juice of beetroot and apple was given to patients which finally resulted in to lowering blood pressure in men participants [75].

Onions

The onion has been also found nutraceutically valuable are are duly used in several health complications. Clinicians used quercetin from onion skin with the quantity of 162 mg/ per day for six weeks on male and female participants and found that the extract was powerful in reducing ambulatory blood pressure in hypertensive patients, indicating its cardio-protecting properties [76-78].

Green Tea

Derived from the Camellia sinensis plant, green tea is a widely consumed beverage across the globe and the main source of flavonoids in the diet of Americans [79]. Green tea has been shown to have the most significant health benefits of any tea, and this is primarily because of its catechins, which are members of the flavonoid-like polyphenols or flavanols family of chemicals [80]. According to the global burden of hypertension (HTN) statistics 2005, it was projected that up to 1.6 billion people worldwide will be affected by HTN by 2025, representing a 60% increase in the frequency of adults with the disease compared to 2000–2005 and it will affect as much as 1.6billion individuals in the world [81].

Similar this, increased blood pressure (BP) was identified as the primary global risk factor linked to early death and disability across all age groups in the Global Burden of Disease (GBD) 2017 report [82]. It was shown in 2016 that non-communicable diseases account for over 70% of fatalities (about 40.5 million), with cardiovascular disease accounting for around 44% (17.9 million, or 31% of all deaths worldwide) of these disorders. Additionally, around 45% and 51% of deaths linked to heart problems and stroke, respectively, are caused by high blood pressure [83-85]. One of the well-known modifiable risk factors for CVDs is hypertension (HTN), which can be reduced or improved by using pharmacological and dietary changes [86].

This means that to prevent, treat, or lessen the negative effects of elevated blood pressure on health, new solutions

must be developed due to the condition's high prevalence rate and serious implications [87]. Remarkably, the data that is currently available demonstrates that several dietary supplements (such as magnesium, potassium, vitamin C, L-arginine, melatonin, coenzyme Q10, and aged garlic extract) as well as healthy dietary patterns like the Mediterranean diet and Dietary Approaches to Stop Hypertension (DASH) are beneficial [88]. The main advantage of these agents is that they don't have any notable side effects. Tea drinking (Camellia sinensis) is a behavior that is extensively practiced worldwide. It is believed to provide several health benefits, all of which can be directly linked to the phytochemicals it contains. Compared to green tea, black tea has more caffeine. Out of all the tea varieties, green and black tea are thought to have the highest total phenolic and flavonoid content, as well as the strongest antioxidant and ability to scavenge radicals [89].

Tea drinking has been shown to have preventive effects against hypertension in several epidemiological investigations. For instance, a survey conducted among 1507 people investigated to determine how tea consumption patterns from the ten years before the study affected blood pressure. It was proposed that consuming oolong or green tea at a dose of ≥120 mL/d for a minimum of a year would significantly reduce the risk of HTN. Thirteen Additionally, a sizable Norwegian study with close to 20,000 participants found that the SBP of men and women who drank at least five cups of tea per day was, respectively, 2.1 mmHg and 3.5 mmHg lower than that of the control group [90-92]. Tea drinking has been shown to have preventive effects against hypertension in several epidemiological investigations [93]. For instance, a survey conducted among 1507 people investigated to determine how tea consumption patterns from the ten years prior to the study affected blood pressure. It was proposed that consuming oolong or green tea at a dose of ≥120 mL/d for a minimum of a year would significantly reduce the risk of HTN. Thirteen Additionally, a sizable Norwegian study with close to 20,000 participants found that the SBP of men and women who drank at least five cups of tea per day was, respectively, 2.1 mmHg and 3.5 mmHg lower than that of the control group [94,95]. Regular tea consumption was associated with approximately −4.81 mmHg reduction in SBP and −1.98 mmHg drop in DBP levels, based on nine measures obtained from five studies on 408 patients with elevated BP or HTN. Also, studies have demonstrated that regular ingestion of green tea is superior to regular consumption of black tea in terms of lowering levels of both SBP and DBP. Furthermore, we discovered that the SBP and DBP levels decreased more rapidly the longer tea was consumed. No adverse effects were mentioned in any of the investigations. Additionally, studies have indicated that regular ingestion of green tea is superior to regular consumption of black tea in terms of lowering levels of both SBP and DBP [96].

Mycosterols

Mushrooms are known for their distinctive flavour and nutritional value. They have high contents of proteins, carbohydrate, dietary fibre, polyunsaturated fatty acids, vitamins and minerals, at the same time low in calorie value. Mushrooms have been investigated for the presence of bioactive compounds with medicinal properties such as phenolic compounds, polyketides, terpenes, steroids, β-carotenes, β-glucans, lovastatin and some vitamins, such as A, D_2 C, and E. Edible mushrooms synthesize ergosterol (5,7, 22-ergostatrien-3β-ol) as their principal sterol, and is the integral part of hyphal membranes. It plays several essential roles in maintaining the plasma membrane functions such as regulation of membrane fluidity and permeability, biosynthesis of plasma membrane etc. The fungal sterols are collectively known as mycosterols. They occur in free and esterified form and have gained prominence due to their potential activities beneficial for human health. Ergosterol is considered as the most generously synthesized fungal sterol, especially in the species such as *Agaricus bisporus*, *Lentinus edodes*, *Boletus edulis*, *Hygrophorus marzuolus*, *Pleurotus ostreatus.* It presents structural resemblance with phytosterols and cholesterol, so might act analogously to phytosterols in reducing cholesterol absorption. Ergosterol has been reported to possess anti-inflammatory, anti-cancer, anti-proliferative, antimicrobial and anti-hyperlipidemic activities, demonstrated through *in vitro* and *in vivo* studies. This bioactive molecule is considered as a potential candidate in cancer therapy without any major harmful side effects [21,97]. Thus mycosterols are considered for hypocholsterolemic activity and inducing protective role in the cardiovascular diseases [98,99].

Conclusion

The review has essentially concluded that the antioxidant and anti-inflammatory properties of nutraceuticals have tremendous value in prevention and treatment of heart diseases and hypertension. It could be more useful when blended with lifestyle, physical activity along with consideration of inherited factors. Furthermore, these nutraceuticals are easily available and cost-effective which could be useful for patients of all socio-economic classes in society especially in country like India. However, these findings have indicated and paved ways to further research investigations for relatively more robust findings. Firstly, whether these nutraceuticals could be equally effective in infantile and childhood cardiac problems. If the answer is affirmative, then what could be the dose and duration. Similar trials are required to be conducted on elderly patients. Secondly, researches are welcomed to investigate how the nutraceuticals can be utilized for desirable health benefits in hypertension and heart diseases

in compulsory sedentary lifestyle during the currently and globally running pandemic of COVID-19. At third, how these nutraceuticals could be used for preventing and treating hypertension and cardiac complications during pregnancy as some of the abovementioned nutraceuticals have serious contraindications in such conditions. Fourthly, the regimen of nutraceuticals is required to be set and recommended in case of co-or multiple morbidities. This is because ingestion of one nutraceutical could be a likely contraindication for co- existing health problems. For example, egg yolks could be required for vitamin D in hypertension, but it could be harmful for cardiac problems, obesity, diabetes rectal problems like fistula, allergies and many others. At last, Researchers are required to explore and work on seasonal nutraceuticals matching with various global geographical locations along with standard dose and duration to be prescribed for all general and chronic health problems, and in particular for hypertension and heart disease to be useful for the populace.

Conflict of Interest

Authors have no conflict of interest to declare

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