Chapter

Role of Functional Food in Treating and Preventing Cardiovascular Diseases

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Abstract

Cardiovascular diseases (CVDs) are still a major cause of mortality worldwide and are a serious health problem. Various factors that contribute toward CVDs include hypertension, tobacco use, physical inactivity, diabetes mellitus, obesity and overweight, alcohol, dietary factors and psychosocial aspects such as stress, anxiety and depression. Nutraceuticals and diet are very important for prevention of CVDs. The potential of nutraceuticals or functional food in mitigating risk of CVDs is discussed. Functional food with health related properties include fruit and vegetable, fish, legumes, nuts, soya protein, coffee, tea, chocolate, animal based functional food. In addition, some diet plans have shown the potential of reducing the incidence of CVDs. This includes the Mediterranean, Dietary Approaches to Stop Hypertension (DASH), Okinawan and vegetarian diets. This chapter examines the risk factors of CVDs, including hypertension, tobacco usage, physical inactivity, diabetes mellitus, overweight and obesity. The chapter also brings to the fore, functional foods with properties related to health and effect of dietary patterns in the treatment and prevention of CVDs.

Keywords: non-communicable disease, cardiovascular diseases, nutraceutical, functional foods, dietary patterns

1. Introduction

Globally, non-communicable diseases (NCDs) account for 73% of all death with cardiovascular diseases (CVDs) and ischemic heart disease (IHD) as the main contributors of cardiovascular mortality in 2017 [1]. Cardiovascular, respiratory as well as associated disorders (CVRDs) are predominant subgroup of NCDs and are major causes of morbidity and mortality in developing and developed countries. In 2012, it was estimated that 55.9 million people died around the world and NCDs accounted for 37.9 million of those deaths. Specifically, CVRDs led to 23.9 million deaths [2]. **Table 1** shows the impact of CVRDs on the total deaths in different countries based on the income group. Cardiovascular diseases killed 17.5 million; respiratory diseases led to 4.0 million deaths; diabetes mellitus to 1.5 million and diseases related to kidney accounted for 864 000 deaths, respectively [4]. In addition, NCDs account for about 35% (around 2.6 million) of all deaths in sub-Saharan Africa and this makes NCDs the second most common cause of death after a combination of communicable, maternal, neonatal, and nutritional related diseases [5]. Researchers

Indicator	Low income	Lower middle income	Upper middle income	High income	Total (world)
Population	850000	2510000	2430000	1290000	7060000
Total deaths	7450	19900	16900	11700	55900
CVRD deaths	1540	7780	9080	5530	23900
CVRD deaths	21%	39%	54%	47%	43%
CVRD death by cause					
CVDs	999	5220	6860	4440	17500
DM	135	549	559	254	1497
RD	309	1630	1460	645	4040
Kidney diseases	99	378	197	190	864

Note: CVRD = Cardiovascular, respiratory, and related disorder, CVDs = Cardiovascular diseases, DM = Diabetes mellitus, RD = Respiratory disorder. [2, 3].

Table 1.
Impact of CVRDs on the total deaths in different countries based on the income group in 2012. Thousands, unless otherwise noted.

estimate that more than three-quarters of deaths will be due to NCDs by the end of 2030 and more deaths in developing countries will be attributed to CVDs alone than contagious diseases such as malaria, tuberculosis and HIV/AIDS [6].

Cardiovascular diseases are complex and composite diseases that are characterised by high serum lipids and triglycerides, cholesterol, elevated plasma fibrinogen and agglomeration factors with increased production of platelet as well as disturbance in metabolism of glucose [7, 8]. They are a broad category of diseases involving the heart and blood vessels causing coronary artery diseases such as angina which can lead to heart attack, heart failure, hypertensive heart diseases, stroke, and many other problems. [9]. Cardiovascular diseases are still the leading cause of mortality globally leading to 12.3 million and 17.6 million deaths in 1990 and 2016, respectively [10–12]. Stroke and coronary artery disease result in of 80% and 75% CVD deaths in male and females, respectively [12].

Various epidemiological studies have demonstrated that diet habits and healthy life style might prevent chronic diseases such as CVDs but poor habits aggravate these diseases [8, 13]. Individuals that consume large amount of fruits, vegetables and sea food are less vulnerable to CVDs incidence [14]. The role of dietary factors such as sodium and saturated fats known to increase the risk of CVDs has been substantially explored [15]. The perception that food does not only furnish fundamental nutrition but can also play a role in preventing diseases and assure good health and life is now gaining attention. High intake of food that is calorie dense, poor nutrition, highly processed and easy to absorb food can contribute to inflammation of system, low insulin vulnerability as well as a group of metabolic diseases which include obesity, high blood pressure, dyslipidemia, and diabetes mellitus [16]. Food that furnish a health benefits apart from basic nutrition such as reducing high blood total cholesterol as well as low-density lipoprotein cholesterol are called functional foods.

2. Risk factors for cardiovascular diseases

The traditional risk factors for CVDs (**Table 2**) have been extensively researched and the dietary factor is important since it leads to high risk factors for CVDs such

Non-modifiable	Metabolic	Lifestyle	Novel
Family history	Diabetes mellitus	Diet	Oxidative stress
Advancing age	Obesity	Smoking	High homeostatic factors
Family history	Hypertension	Physical activity	Small dense low density lipoprotein-C
	Hyperlipidemia		High lipoprotein level
	Metabolic syndrome		High homocysteine level
			High inflammatory marker

[17, 18].

Table 2.
Risk factors of cardiovascular diseases.

as hypertension and dyslipidemia. However, the dietary factor phenomenon has not been fully investigated [3]. A 2011 global report indicated that hypertension contributed to 13% of CVDs deaths, tobacco 9%, physical inactivity 6%, diabetes mellitus 6% and obesity 5% of global deaths [19, 20].

2.1 Hypertension

Hypertension is systolic blood pressure values ≥140 mmHg and/or diastolic blood pressure values ≥90 mmHg. The relationship between hypertension and CVDs has been investigated in different studies [21, 22]. Hypertension exhibits an independent interminable relationship with the incidence of various CVDs such as stroke, heart failure and peripheral arterial [23, 24]. Hypertension is commonly without symptoms which silently damage the arteries that furnish the heart, brain, kidneys and other vital organs with blood and produce various structural changes. Various epidemiological, animal and genetic studies have confirmed that excessive intake of sodium increases blood pressure. For example, excessive consumption of sodium (>5 g sodium per day as defined by World Health Organisation) [25] produces a significant rise in hypertension and is associated with the onset of hypertension and its cardiovascular complications [26, 27]. By contrast, low intake of sodium reduces hypertension prevalence and is associated with low cardiovascular morbidity and mortality rate [28]. As a result, a common nutritional plan to minimise the incidence of hypertension includes achieving and maintaining a healthy body weight; consumption of a diet rich in minerals such as calcium, phosphorus, and magnesium as well as moderate consumption of alcoholic beverages and sodium [29].

2.2 Tobacco use

There are more than one billion smokers around the world and in 2013, tobacco usage accounted for more than 6.1 million deaths [18]. This estimation covers vulnerability to passive smoking (second hand smoke) which increases CVDs risk by 25 to 30% and public smoking bans substantially decrease the rate of heart attacks [30]. The most smoked form of tobacco is cigarette. More than 80% of tobacco users live in lower middle income countries and this number is expected to increase in the next decade [31]. Most smokers in lower middle income countries are male but this is not the case in high income countries. Early cessation of smoking contributes to substantial lower incidence of reinfarction within 1 year in patients who have had a heart attack and decreases the possibility of instant cardiac death in

patients with CVDs [32]. There are two CVDs challenges associated with the use of tobacco products. Firstly, the rate of smoking is higher in the poorest populations of the world [33] and the second problem is smoking among girls [34]. The risk of IHD to tobacco smokers is 2–3 times higher than non-smokers, stroke is 1.5 times higher and lung cancer is 12 times higher. These risks are related to age gradient, with younger age group having higher relative risk (5–6 times) and these are similar for men and women [35].

2.3 Physical inactivity

The World Health Oranisation highlighted the fact that one in four adults is not physical active enough across the globe and the challenge of reduced physical activity increases as the income of a country increases [36]. Low physical activity eventually leads to obesity which has gradually increased throughout the past decades both in developing and developed countries. Low rate of atherosclerotic process, including improvement of endothelial dysfunction, low systematic inflammation and stroke that go along with physical activity, could explain the protective role of physical activity on CVDs risk [37]. Numerous epidemiologic studies conducted with non-identical and big populations have demonstrated that physical activity has protective effect on coronary arteries disease. For example, physical activity reduces blood pressure and the prevalence of hypertension by reducing vascular resistance and terminating the action of the sympathetic nervous and the renninangiotensin systems. **Figure 1** shows the possible channels of physical activity that assist in decreasing the likelihood of CVDs. In 41837 women of age group between 55 and 69 years, Folsom et al. [38] study found that hypertension incidence decreased by 10% and 30% in participants with moderate and higher levels of physical activity than those with low levels of physical activity. The biological pathways support the usefulness of physical activity in decreasing the likelihood of stroke including ischemic and hemorrhagic. The possible ramifications on the likelihood of ischemic might be due to the mechanisms that reduce the development of atherosclerotic; while the possible ramifications on the likelihood of hemorrhagic stroke disease might be attributed to low blood pressure as well as additional associated risk factors. Nonetheless, there are conflicting findings from different studies about the relationship of physical activity and the incidence of stroke, with few studies showing relationships or no relationships [39, 40]. These disagreements are likely the result of the type of the study design, population, definition and evaluation of physical activity of the different studies.

2.4 Diabetes mellitus

Diabetes mellitus (DM) is caused by insufficient production of insulin by the pancreas or resistance by end-organ tissues and presents as a high blood glucose. There are three types of DM, namely, type 1, type 2, and gestational diabetes. Type 1 DM is an autoimmune disorder and usually takes place in early childhood and adolescents, gestational DM occurs during the second or third trimester of pregnancy, increases the future risk of those patients to type 2 DM [41–43]. Type 2 DM, the most common form accounts for 90–95% of diagnosed DM and continues to be rapidly growing worldwide and in the USA [44]. Globally, the prevalence of DM is escalating and its incidence in 1985 was 20 million compared to 382 million in 2014 [45]. The current estimation by the International Diabetes Federation expects that 592 million people will have DM by 2035 [46]. China and India have highest number of people with diabetes estimated at 69 million and 109 million, respectively and these numbers are expected to rise to 123 million and 150 million by 2040 [47]. A

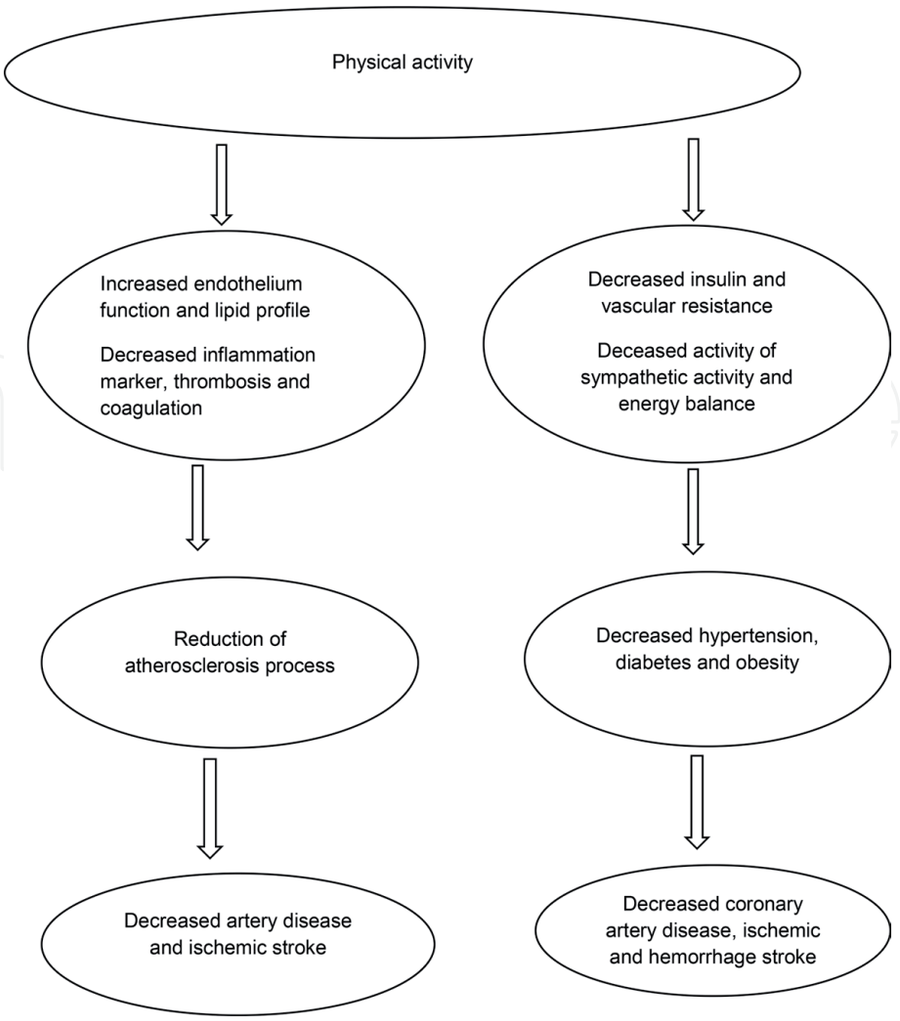

Figure 1.
Possible mechanisms of physical activity that help in decreasing CVDs risk [37].

close association exists between DM and CVDs. The most familiar cause of mortality and morbidity in diabetic patients is CVDs since DM results in complications of both microvascular and macrovascular. Complications such as IHD, ischemic stroke, and amputations because of foot infections are examples of macrovascular. The comparative risk for CVDs morbidity and mortality in adults with DM varies from 1 to 3 in men and from 2 to 5 in women to those with no DM [48]. Many diabetic patients die due to IHD or stroke and both are often registered as the cause of death, not DM [2]. A number of evidences exist that demonstrate that the relationship of type 2 DM and associated cardiovascular risk promote the progressive nature of the vascular damage, leading to atherosclerosis [49]. Cardiovascular deaths account for 44% of death in those with type 1 DM and 52% of deaths in type 2 DM [50]. Debate still remains if the relationship between DM and CVD is associated with diabetes status itself or the risk factors diabetic patients are prone to.

2.5 Obesity and overweight

According to the World Health Organisation data, 39% of the global population above 18 years of age is overweight and of these, 13% are obese. Obesity is an abnormal or excessive fat accumulation in adipose tissue to the degree that health might be compromised [51]. Obesity increases the risk for CVDs since it increases the load of the atherosclerotic plaques, characterised by significant infiltration of macrophage and plaque fluctuation [52]. People who accumulate abnormal body

fat, particularly at the waist, are at higher risk to have stroke and heart disease even if they do not have other risk factors. The incidence of overweight and obesity among adults in low-income countries varies from 4.7–21.0% and from 13.0–42.7% in upper-middle-income countries [53]. Different studies have demonstrated association between obesity and CVDs such as heart failure and cardiac death. Accumulation of abnormal body fat leads to various metabolic changes that increase the common risk factors of CVDs and affects systems modulating inflammation [54]. Recent studies have demonstrated that weight loss in individuals who are overweight and obese reduces the incidence of diabetes and CVDs. The benefit of weight reduction in overweight and obese individuals with or without hypertension is low blood pressure and serum triglycerides, and increased high-density lipoprotein [55, 56].

3. Nutraceuticals and functional foods

Nutraceutical foods, a borderline between food and drugs, are conventional or processed foods that have or added a useful food component which has a health beneficial effect [57, 58]. Nutraceuticals foods provide medicinal and health benefits and these include prevention, management and/or treatment of a disease. Examples of nutraceutical foods are isolated nutrients, dietary supplements, functional foods, medicinal products and processed foods such as cereals, beverages and soups [59, 60]. The interest of nutraceuticals in prevention of CVDs was invigorated after the examinations of a proximate relationship between their consumption, as shown by higher levels of plasma and low CVDs incidence [61, 62]. Japan is the first country that introduced functional foods in the 1980s and is the only country that has distinct regulatory system that approves functional foods [58]. Functional foods contain dietary fibres, polyphenolic compounds, herbs and botanicals and oligosaccharides with their correlating health benefits [63]. It is believed that functional foods use their cardio-protective effects mostly via antioxidant actions which lower blood lipid levels.

The following factors differentiate functional foods from dietary supplements: (1) Functional foods are expected not to only supplement the diet but should also play a role to prevent and/or treat disease(s) and (2) Functional foods are utilised as traditional foods or as exclusive items of a meal or diet [64]. Dietary components play useful roles apart from basic nutrition and this led to the development of nutraceuticals and functional food concept [65]. Functional foods have different mechanism of actions, such as decreasing low density lipoprotein and elevated blood total cholesterols [66].

3.1 Functional foods with health related properties

Different functional foods are beneficial in preventing and treating CVDs (**Table 3**). Dietary fibres of fruit (with pectin) and vegetable, fish oil and oily seeds such as walnut, almond and many others lower the lipid levels in humans and this is attributed to both prevention of fat absorption and termination of synthesis of hepatic cholesterol [81]. A higher consumption of whole grains, bioactive compounds, antioxidants vitamins and folic acid appears to reverse the harmful vascular effects of homocysteine in the heart [82, 83]. A substantial cardiovascular benefit of polyphenolic compounds, vitamins (ascorbic acid, vitamin E), and minerals such as selenium and magnesium in food is thought to be the ability of these components to scavenge free radicals generated during atherogenesis [84, 85].

Functional food	Active component	Mechanism of action	Reference
Fruit and vegetable	Antioxidant vitamins, dietary fibre, carotenoid, polyphenolic compounds	Lower concentrations of the inflammatory mediator C-reactive protein Decrease low density lipoprotein Reduce markers of oxidative stress	[67, 68]
Whole grains	Dietary fibre, minerals, B vitamins and polyphenols	Normal blood pressure and plasma lipids Decrease inflammation	[69, 70]
Legumes and nuts	Mono and polyunsaturated fatty acids, arginine, soluble fibre, polyphenols, folic acid and B vitamins	Lower blood cholesterol Reduce post-prandial vascular reactivity Improved endothelial function Reduce concentrations of blood homocysteine Lower myocardial infarction Positive effect on blood pressure	[71–73]
Fish	Omega 3 fatty acids	Improve endothelial function Lower blood pressure and heart rate Reduce aggregability of platelet Reduce fatal cardiac arrhythmias Anti-inflammatory	[74]
Soy protein	Isoflavonoids, dietary fibre, polyunsaturated fatty acids, vitamins and minerals,	Reduce total cholesterol and low density lipoprotein-C levels Prevent the oxidation of low density lipoprotein Lower total serum	[75–77]
Coffee and tea	Diterpenes (kahweol and cafestol)	Myocardial infarction	[78]
Chocolate	Flavonoids	Improve NO-dependent Vasorelaxation Improve flow-mediated dilation in the brachial arteries Reduce ambulatory serum low lipoprotein-C levels and blood pressure Decrease blood cholesterol levels Increase high density lipoprotein-C Decrease oxidised low density lipoprotein	[79, 80]

Table 3.
Different functional foods beneficial in preventing and treating CVDs.

3.1.1 Fruits and vegetables

There is significant amount that low intake of fruit and vegetable is related to higher risk of CVDs while higher intake is related to low risk of CVDs [86, 87]. Fruits and vegetables are rich sources of polyphenolic compounds such as phenolic acid and flavonoids. Different studies associate the intake of polyphenols foods such as fruit and vegetable with low risk of CVDs [88, 89]. In addition, various studies have shown that the properties of flavonoids such as antioxidants and anti-inflammatory might also improve functions of vascular system [90, 91]. Fruits and vegetables reduce

the risk of CVDs by decreasing vulnerability of low density lipoprotein particles to oxidation [92]. Different types of bioactive compounds found in fruits and vegetables such as dietary fibre, carotenoids, ascorbic acid and minerals such as magnesium and potassium act collaboratively to nurture a comprehensive beneficial effect.

3.1.2 Whole grains, legumes and nuts

Whole grains are more important in terms of nutrition since they have phytochemicals that could work synergistically to decrease the risk of CVDs [93]. Moreover, whole grains are also a rich source of dietary fibre, vitamin B complex and minerals. The preventative effect of whole grains on the risk of CVDs is attributed to their influence on insulin vulnerability, blood pressure and inflammation which is associated with the excessive consumption of antioxidant nutrients available in the germ of whole grains [83, 94, 95]. Legumes are rich source of protein, soluble fibre, micronutrients such as folate and polyphenols [96]. Different bioactive components such as protein, dietary fibre and phytosterols are attributed to the cholesterol-lowering effect of legumes [97]. Nuts are rich sources of mono and polyunsaturated fatty acids, arginine, soluble fibre and various antioxidant polyphenols and these active components contribute to cholesterol lowering effects [71].

3.1.3 Fish

High consumption of fish and fish oil supplements contribute to low incidence of CVDs [98]. Fish is a rich source of omega 3 fatty acids such as docosahexaenoic acid (DHA; 22:6 n-3) and eicosapentaenoic acid (EPA; 20:5 n-3). They are available in oily fish such as salmon, tuna, herring and fish oil. Consumption of fish is associated with low risk for myocardial infarction, which is associated with useful influence of DHA and EPA on plaque fluctuation and modulation of endothelial function [99]. Fish oil supplements have beneficial influence on blood pressure and lipid profile [100, 101]. Moreover, DHA and EPA reduce low density lipoprotein oxidative sensitivity in postmenopause women which might assist in reducing the risk of CVDs [102].

3.1.4 Soy protein

Soy products are a rich source of polyunsaturated fatty acids, dietary fibre, micronutrients, low saturated fat content and isoflavones [103]. In addition, the protein content of soybean ranges from 35%–40% having all essential amino acids making soy protein comparable to protein of animal source and it is also cholesterol free [104]. Isoflavones prevent the oxidation of low density lipoprotein and reduces the risk of atherosclerosis [76]. Studies done in China among women and Japan demonstrated that a daily consumption of more than 6 g of soy reduces low density lipoprotein-C, total cholesterol, ischaemic and cerebrovascular incidence than consumption of less than 0.5 g [105, 106].

3.1.5 Coffee, tea and chocolate

Coffee and tea, the most popularly consumed beverages after water, are the chief source of caffeine. Diterpenes such as kahweol and cafestol are suspected to be behind the cardio-protective effect of coffee. Consumption of coffee might potentially decrease the incidence of myocardial infarction, but evidence in this regard is not conclusive [107, 108]. Although results are not consistent, consumption of green tea seems to protect against CVDs [109]. High intake of tea and flavonoids

contribute to the primary prevention of IHD and reduced risk of CVDs mortality [109, 110]. Cocoa is the main ingredient in chocolate manufacturing; it is a rich source of flavonoid and it has been lately evaluated for its plausible role in preventing CVDs [111]. The protective effect of chocolate is attributed to the decrease of blood cholesterols levels, substantial increase of high density lipoprotein including marked decrease of oxidised low density lipoprotein [112].

3.1.6 Animal based functional food

Meat and dairy products are major source of fat in the diet, particularly saturated fatty acids (SFA) which is the leading cause of total cholesterol and CVDs. Meat contains a lot of fat with more than 40% in saturated form, therefore, its quantity and quality has been changed to create new meat products of functional properties. Three meat reformulation methods were proposed in order to develop the functional meat products, namely, low total fat, low total cholesterol intake and modification of fatty acid profile [113]. Dairy products are related to numerous negative health effects because of earlier observations associated SFA content, which might result into increased low-density lipoprotein levels, which in turn increases the risk of CVDs [114]. Dairy products have high SFA and their consumption has long been implicated in contributing to the development of CVDs [115]. Therefore, the consumption of low-fat or non-fat dairy products has been recommended to reduce the risk of CVDs development. Nevertheless, studies tend to show that intake of whole-fat dairy has a favourable effect on health of cardiovascular system and might be more beneficial than intake of low-fat dairy, especially in connection with inflammatory markers. Recent several meta-analyses have demonstrated that low-fat dairy products and whole milk are associated with lower risk of hypertension [116–118]. The presence of calcium, vitamin D as well as other bioactive components such as peptides in dairy products is related to lower blood pressure irrespective of the fat content [119, 120]. High intake of fermented dairy products is associated with low density lipoprotein, low risk of hypertension and CVDs [121, 122]. Consumption of cheese is associated with a low risk of stroke and CVDs [123]. Moreover, consumption of yoghurt is also related to lower risk of CVDs [124]. The presence of bioactive lipids and peptides that have anti-inflammatory characteristics might have contributed to these effects as well as calcium in cheese which might reduce the intake of SFA, thereby decreasing the risk of high cholesterols levels [114]. Moulded cheeses such as Camembert and Roquefort have cardioprotective effects because of the presence of bioactive molecules such as andrastins A–D and roquefortine [125]. Additionally, the cardioprotective effects of fermented dairy products may also be induced by the intake of bacterial metabolites and probiotics. Probiotics reach the gastrointestinal tract while still alive and they can apply their effects directly. Intake of probiotic by supplementation or consumption of fermented dairy products is related to possible health benefits of cardiovascular which include positive effects on blood pressure and hyperlipidaemia [126].

3.2 Dietary pattern and cardiovascular diseases

Various studies have associated the dietary components such as dietary fibre, saturated and trans fats at nutrient level; fruits, vegetables and high fat processed meat at food level [127–129] with changes in prevalence of CVDs. Some diet plans have shown the potential of reducing the incidence of CVDs (**Table 4**). In recent years, various dietary patterns have been recommended for modification in numerous health outcomes apart from the normal dietary guidelines. For example, the Mediterranean, Dietary Approaches to Stop Hypertension (DASH), *Okinawan*

Dietary pattern	High intake	Moderate intake	Low or no intake	Protective effect	References
Mediterranean	Fruits, vegetables, cereals, beans, nuts, seeds, and olive oil	Wine, poultry and fish	Red meat and dairy products	Decrease inflammatory markers	[130–132]
DASH	Fish, fruit, vegetables, whole grains, and nuts	N/A	Dairy products, red meat, sweets, and sugar-containing beverages.	Low blood pressure, anti-inflammatory	[133–135]
Okinawan	Sweet potatoes, and green leafy vegetables	Fish and alcohol	Meat and dairy products	Reduce oxidative stress	[81, 136]
Vegetarian	Fruits, vegetables, legumes and nuts,	N/A	Fish, meat, eggs and dairy products	Anti-inflammatory Low blood pressure and blood cholesterol	[81]

Table 4.
Protective effect of different dietary patterns on cardiovascular diseases.

and vegetarian diets are being promoted as healthy option. Mediterranean diet has gained traction and various reports have shown low incidence of CVDs among populations consuming this diet [137]. Plant foods and olive oil contain high antioxidant content which contributes to the health of the vascular system. The DASH diet restricts saturated fat, red meat, sweets, and beverages with sugar. Regular physical exercise, high intake of dietary potassium, moderate alcohol consumption and low salt intake represent corroborative-based approaches to decrease blood pressure by DASH diet [81]. *Okinawan* diet restricts calorie, there is high intake of vegetables and legumes, moderate consumption of sea foods and alcohol as well as low consumption of meat and dairy products [138]. This is useful for the health of cardiovascular system because *Okinawan* diet is nutrient-dense, antioxidant-rich and has a low-glycaemic-load [139]. Vegetarian diet excludes meat, poultry, or fish and may or may not include dairy and eggs. Vegetarian dietary pattern is recognised for its health promoting compounds because it is rich in dietary fibre, antioxidants, bioactive compounds, plant protein and lower saturated than non-vegetarian dietary patterns [140].

4. Conclusion

Overall, this book chapter highlighted the risk factors of CVDs, functional food with health properties and the influence of dietary in the treatment and prevention of CVDs. Generally there is an increasing trend of using functional food in treating and preventing CVDs. Therefore, there is no doubt that functional food can exert a significant effect on maintenance of human health. Continual consumption of different types of functional foods such as fruit and vegetable, whole grains, nuts, legumes, tea, coffee, chocolate, fish, functional meat and fermented dairy products

may help consumers and patients to lower the risk of CVDs. Consumption of full-fat dairy products contributes to higher intakes of important nutrients such as vitamin D and vitamin K. However, fermented dairy products are preferential for ideal intake of nutrients and possible CVDs health benefits. Dietary patterns such as Mediterranean, DASH, *Okinawan* and vegetarian should be promoted since they are associated with low risk of CVDs.

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