

Foods in Prevention of Atherosclerosis

Subjects: Nutrition & Dietetics

Contributor: Rosa Casas

Noncommunicable diseases (NCDs) are considered to be the leading cause of death worldwide. Inadequate fruit and vegetable intake have been recognized as a risk factor for almost all NCDs (type 2 diabetes mellitus, cancer, and cardiovascular and neurodegenerative diseases).

Keywords: fruit and vegetables ; noncommunicable diseases ; chronic diseases ; bioactive compounds ; immune system ; inflammation

1. Introduction

The principal cause of death worldwide is cardiovascular disease (CVD), being the leading cause of death in developed countries ^[1]. The World Health Organization (WHO) estimated 17.7 million deaths were due to CVD in 2015, representing 31% of all causes of death ^[2].

Atherosclerosis is the main cause of CVD. It is a chronic, generalized, and progressive disease, which results from a chronic inflammatory process that affects the arteries of different vascular beds and is characterized by thickening of the intima layer and a loss of elasticity in half of the cases ^[3]. Both oxidative stress and systemic inflammation can be modified by a healthy lifestyle, including a healthy and balanced diet, physical activity, moderate alcohol consumption, and stopping tobacco use ^{[4][5][6]}.

On the other hand, according to the WHO, in 2017, an estimated 3.9 million deaths worldwide were attributable to inadequate fruit and vegetable (F/V) consumption ^[7]. Moreover, noncommunicable diseases (NCDs) such as type 2 diabetes mellitus (T2DM), cancer, and heart disease are collectively responsible for over 70% of all deaths worldwide, that is, 41 million people ^[8]. Indeed, all NCDs are known to present low-grade inflammation that characterizes these pathologies with high concentrations of some inflammatory biomarkers.

It is known that F/V are good sources of dietary fiber, vitamins, minerals, and many non-nutrient substances that are beneficial for our health, such as flavonoids, plant sterols, and other antioxidants ^[9]. Taking into account the nutritional composition of F/V, they should make up a large portion of our diet. In fact, the WHO and other health organizations recommend increased intake of F/V (≥ 400 g/day) to improve overall health and reduce the risk of NCDs, which include illnesses such as heart disease, cancer, diabetes, and obesity, as well as for the prevention and alleviation of several micronutrient deficiencies ^[7].

Adequate F/V intake as a part of a healthy dietary pattern has been demonstrated to reduce the prevalence of the most frequent NCDs such as T2DM, CVD, obesity or metabolic syndrome (MetS), which are risk factors of CVD ^[9]. This is due to the potential properties of the phytochemical content of F/V (**Figure 1**) such as antioxidation, inflammatory biomarkers modulation, anti-platelet and anti-aggregation, as well as improvement of the lipid profile, glucose metabolism, and blood pressure ^{[10][11]}. Thus, an adequate intake of F/V as part of the daily diet may reduce the risk of some NCDs including CVDs, certain types of cancer ^[7], and all-cause mortality ^{[12][13]}. Inverse associations have also been observed between the intake of F/V separately and combined and the risk of coronary heart disease (CHD), stroke ^[14], and CVD ^[12].

oil (EVOO) and 5.3 mg from olives) considering an average consumption of EVOO and olives of 15 g/day and 7 g/day, respectively [27]. Hydroxytyrosol has a bioavailability of 99%, making it easily integrated into our organism. Therefore, it has been reported that a daily intake of 5.6 mg of hydroxytyrosol could exert great benefits for the human body [27].

On the other hand, Burrows et al. [28] reported that the mean intake of the most common dietary carotenoid, lycopene, is of 4555.4 µg/day. Finally, there is no standard available for the intake of garlic. On one hand, it has been suggested that health benefits can be observed after a daily intake of 1–2 cloves garlic or around 4 g of whole garlic, but there is no scientific reference to support this [29]. Other authors have reported that an average daily dose of dehydrated garlic powder of 900 mg/day has health benefits, although according to several studies the effectiveness of aged garlic extract (AGE) on immune enhancement in humans varies from 1.8 to 10 g per day [29].

Finally, Sones et al. [30] also estimated the average daily intake of total and individual glucosinolate content in both the fresh and cooked cruciferous vegetables using data from the 1980 National Food Survey in the UK. Thus, they reported that the mean daily intake of glucosinolates was 6.7 mg/day of oxazolidine-2-thiones and 17.7 mg/day of thiocyanate ion. Although the estimated daily intake of total glucosinolates was 75 mg/day, the authors also reported that certain individuals could have consumption higher than 300 mg total glucosinolates per day.

3. Health Potential of Selected Fruits and Vegetables

While multiple factors can contribute to the incidence and prevalence of atherosclerosis, the prevention of this disease can be reduced by the high consumption of F/V. Of all the possible foods and phytochemicals involved, we have selected those showing the greatest evidence of having a role in the prevention of atherosclerosis in the last years (**Figure 1**).

4. Conclusions

According to the evidence currently available, various fruit and vegetable bio-compounds (flavonoids, sulfur, quercetin, allium, stilbene, etc.) seem to exert numerous benefits against atherosclerosis, whether consumed as whole fruits and vegetables and their bioactive compounds or as supplements. Nevertheless, while many factors might explain the differences between the studies that failed to demonstrate the possible benefits of the direct action of the bioactive compound of a food consumed, the usual dose of these foods may be very different from the dose actually needed to achieve any beneficial effect.

Although there is currently a large amount of scientific evidence regarding the benefits of F/V against chronic inflammatory diseases such as T2DM, cancer, or CVD, the highest level of evidence should be based on the results of well-designed, large, long-term RCTs.

Therefore, before F/V can be proposed as a tool to aid in the prevention of NCDs such as MetS, obesity, cognitive disorders, or the risk of mortality, more clinical trials are needed to confirm their potential beneficial effects.

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