ISSN: 2833-9320

Review Article

International Journal of Health Policy Planning

Nutritional Contribution of Fruit and Vegetable for Human Health: A Review

Tolcha Techane Alemu*

Department of Post-harvest Management, Jimma University, Ethiopia

***Corresponding Author**
Tolcha Techane Alemu, Department of Post-harvest Management, Jimma University, Ethiopia.

Submitted: 2024, Jan 08; **Accepted:** 2024, Mar 05; **Published:** 2024, Mar 14

Citation: Alemu, T. T. (2024). Nutritional Contribution of Fruit and Vegetable for Human Health: A Review. *Int J Health Policy Plann, 3*(1) 1-9.

Abstract

The health benefits of fruits and vegetables are widely marketed. Fruit and vegetable-rich diets are highly recommended for their ability to promote health. They have historically held a place in phytochemicals, especially antioxidants. Fruits and vegetables are essential sources of dietary fiber and micronutrients and are a part of a balanced diet that aids in illness prevention. Fruits and vegetables contribute to dietary advice since they have health-promoting qualities. Low fruit and vegetable consumption, which is below the recommended amount, contributes to the rise in non-communicable or chronic diseases, which are major causes of death. Fruits and vegetables are the best sources of bioactive substances like phenolics, antioxidants, carotenoids, and micronutrients like vitamins, particularly as sources of (vitamin C, thiamine, niacin, pyridoxine, folic acid), which play a crucial role in human nutrition and health, as well as minerals and dietary fibers, which are required to prevent kidney stones and bone loss. Since they contain micronutrients including vitamins, minerals, phytochemicals, and fiber that are crucial for maintaining human beings' maximum health, fruits and vegetables are typically an essential component of healthy diets.

Keywords: Fruits, Health, Vegetables

1. Introduction

Fruits and vegetables are perishable crops that have high moisture content, soft structure result not last long, and they have a limited shelf life. Production of those crops has complexity due to their perishable nature characteristics, so horticulture industry in sub-Saharan Africa and in Ethiopia particular stays at its infant stage [1]. Production of those crops in Ethiopia small, when compared to other crops. World population is expected to reach 10 billion by 2050 which will require a 70% increase in food production [2]. According to report of Capone (2014) indicate, 870 million people were food insecure and chronically undernourished during the year 2010-2012 [3]. Agricultural products of fruits and vegetables crops are playing a central role in increasing food availability and incomes, and contributing to the overall economy and a key issue to improve food and nutrition security. Not only production, PHL reduction of perishable crops such as of fruits and vegetables are very important which necessary to income enhancement of the community and economic development of a country in general.

Reducing Postharvest loss of fruits and vegetables crops also important in supplementary source of nutrition and improves food security. Therefore, enhance Production of agricultural products (fruits and vegetables) and falling of PHL food security as well as better nutrition intake which could leads to economic development [4]. In addition to contribute income enhancement, perishable crops are very important as sources of nutrients for human beings' consumption and for health benefits. It is estimated that about one-third of cancer cases and up to half of Cardio Vascular Disease (CVD) rates are diet related. Therefore, interest in the health benefits of fruit and vegetable consumption is increasing. Fruits and vegetables are rich sources of some micronutrients (vitamins, minerals), fibers, and a wide array of phytochemicals that individually, or in combination, benefit human health. There are many biologically plausible reasons for this potentially protective association, including the fact that many of the phytochemicals act as Antioxidants, Anti carcinogens, and Immuno modulators. Health authorities worldwide, such as the World Health Organization (WHO), promote high consumption of fruits and vegetables, recommending a daily intake of more than 400 g per person.

Fruits and vegetables are an indispensable part of any diet, not only for vegetarians, but also for non-vegetarians. Fruits and vegetables are important sources of vitamins and minerals for the body. Now a day's special emphasis is not being paid to the consumption of fresh fruits and vegetable and juices and salad, as they are the important sources of essential minerals and vitamins. Specially issues and problems of chronic diseases becoming the most difficult problems for health ò human beings. This problem comes from consumption of food fat contain and from lack and deficiency of fruits and vegetables. Because of fruits and vegetables, contain different

micronutrients like vitamins, minerals, fiber, phytochemicals such as phenolic compounds and antioxidants they have a great role to prevent problems ò chronic diseases. Therefore, this review aims to provide over view information about nutritional contribution of fruit and vegetable for human health.

1.1. Methodology

Published results from both qualitative and quantitative data about Nutritional Contribution of Fruit and Vegetable for Human Health were all included to this review paper. The data for this review were collected from different internet sources such as The Essential Electronic Agriculture Library (TEEAL), Health Inters Network Access to Research Initiative (HINARI), Google Scholar databases were used. According more than fifty-three, published papers were collected from specified sources and included in this review papers. All these sources have been used for reduce PHL of fruits and vegetables crops and to solve problem of food and nutrition security.

The research of those articles was conducted using key words:

- Post-harvest perishable crops losses
- Perishable crops loss reduction
- Food and nutritional security and
- Causes of post-harvest losses of perishable crop

2. Literature Review

2.1. Health Contribution of Fruits and Vegetables

Fruits and vegetables contain thousands of phytochemicals belonging to different classes, such as fibers, pigments (such as Chlorophylls, Carotenoids, Flavonoids, Betalains), phenolic compounds, and micronutrients (Vitamins and Minerals). Fruits contain mostly sugars and fibers, such as pectin, that are extensively fermented in the large intestine. Certain fruits, especially apples and pears, are concentrated in fructose [5]. Apples contain 6% fructose and 3% sucrose and pears are 6.5% fructose and 1.3% sucrose, these values would be consistent in apple and pear juices. Free fructose is poorly absorbed and would function similar to dietary fiber, escaping absorption in the small intestine while being fermented in the large intestine. This results in SCFA production, which is linked to small amounts of energy being absorbed in the colon. Additionally, it explains why apple and pear juices are used to treat constipation in children. Fruits are also recommended as a source of vitamin C and potassium. Traditionally, fruits, as foodstuffs were available for a limited time and, when ripe, were sometimes difficult to collect and transport. When ripe, they have a short period of acceptability before senescence intervenes. Thus, many fruits consumed in today's world are processed, frozen, canned, or dried.

2.1.1. Dietary Fiber

Dietary fiber is the edible part of plants composed of polysaccharides, oligosaccharides, lignin, and associated plant substances, which are resistant to the activity of human small intestinal enzymes, but are finally fermented by colonic microflora. The fruits and vegetables fiber can be structurally associated to the cell wall such as pectin, celluloses, and hemicellulose. Pectins are abundant in fruits, accounting for up to 40% of the total cell wall polysaccharides. The pectins are a group of polymers rich in galacturonic acid. Cellulose is a cell wall polymer of β-1,4-linked glucose units. Hemicellulose is a crosslinking glycan; the most common hemicellulose polymer is xyloglucan (cellulose of a backbone of β-1,4-linked glucose, but with lateral chains of the pentose xylose: α-1,6 linked).

2.2.2. Vitamins

These are considered micronutrients because they are organic molecules required in low or trace amounts for a normal human metabolism and consequently healthy development. These molecules are not synthesized in adequate quantities by humans and must be acquired from the diet, especially from fruits and vegetables, although there are important variations in content among species and cultivars. Vitamins can be classified according to their solubility in water (complex B and vitamin C or Ascorbic Acid), and in fat (Vitamins A or Retinol, D, E, and K). The complex B is composed of B1 (Thiamine), B2 (Riboflavin), B3 (Niacin), B5 (Pantothenic Acid), B6 (Pyridoxine), B9 (Folate/Folic Acid), Biotin, Choline, and B12 (Cyanocobalamin). Vitamins B12 and D do not occur in fruits and vegetables. The B1 vitamin (Thiamine) is required as a coenzyme precursor (Thiamine Phosphate) for the metabolism of carbohydrates.

Most of Legumes are an important source of thiamine, and are heat labile, because they can lose between 25% and 40% during cooking. Riboflavin or B2 is a precursor of the coenzymes flavin adenine dinucleotide and flavin adenine mononucleotide, important in bioenergetic processes of mitochondria, and green vegetables are especially rich in it. The Pantothenic Acid (B5) occurs widely in peas, beans, nuts, broccoli, mushrooms, potatoes, and sweet potatoes, and is the precursor to coenzyme A, which is important for the metabolism of carbohydrates and lipids (Triacyl, Glycerides and Cholesterol). Vitamin B6 is a precursor of the coenzyme pyridoxal phosphate required in transamination, decarboxylation, and deamination reactions. This vitamin can be found in appreciable amounts in Grapes, Spinach, Beans, Bananas, Cabbage, Cauliflower, Sweet Potatoes, Prunes, and Avocados. Biotin acts in metabolic reactions of de amination of amino acids and decarboxylation carboxylation. It is relatively stable during cooking, processing and storage of fresh, canned and frozen fruits and vegetables. Vitamin B9, or Folic Acid, is very important for normal reproduction and growth.

Vitamin C, or ascorbic acid, has antioxidant and acidic properties due to the presence of a 2,3-enediol moiety. This vitamin is synthesized only by plants using L-galactose or galacturonic acid as precursors. Fruits and vegetables contribute about 90% of the vitamin C requirement depending on the region and the amounts of fruits and vegetables consumed. Fruits, such as tropical species, and leafy vegetables, are rich in vitamin C, including rosehip,

jujube and guava, persimmon, strawberry, kiwifruit, peppers, and citrus fruit, among others, and vegetables such as spinach, broccoli and cabbage, etc. This vitamin is heat labile and important losses can occur with heating.

Vitamin E corresponds to tocopherols and tocotrienols that have aromatic rings with a hydroxyl group that can donate hydrogen atoms to reduce Reactive Oxygen Species (ROS), which are considered as antioxidants. The best-known isomers of tocopherols are α, β, γ, and Δ, based on the number and position of methyl groups in the ring, with α-tocopherol being the most active form. The most important sources of this vitamin are oily seeds, nuts, avocados, and olives, but it is also present in low quantities in broccoli and leafy vegetables. Vitamin K is important for blood coagulation and bone health because it promotes the carboxylation of osteocalcin and several proteins involved in coagulation (factors II, VII, IX, and X), and enhances the calcium fixation activity of these proteins. This vitamin is abundant in Lettuce, Spinach, Cauliflower, And Cabbage, but can also be produced by intestinal microflora.

Nutrient	Health Benefit	Found In
Vitamin A	Healthy eyes and skin; protects from infection	Apricots, Cabbage, Cantaloupe, Carrots, Grapefruit, Greens, Leaf and Romaine Lettuce, Mangos, Spinach, Sweet Potatoes, Tomatoes, Watermelon
Vitamin C	Healthy teeth and gums; helps heal cuts and wounds	Bell Peppers, Broccoli, Brussels Sprouts, Cabbage, Cantaloupe, Cauliflower, Grapefruit, Oranges, Pineapple, Strawberries, Tomatoes
Calcium	Healthy teeth and bones	Greens, Kale, Okra, Rhubarb, Spinach
Fiber	Healthy digestive system; Reduced risk of heart disease	Apples, Bananas, Beans, Broccoli, Brussels Sprouts, Lentils, Peaches, Pears, Raspberries, Spinach
Folate	Wound healing; normal cell division	Asparagus, Broccoli, Peas, Beans, Greens, Spinach, Strawberries
Iron	Healthy blood; learning ability	Beans, Lentils, Spinach
Magnesium	Healthy bones	Beans, Spinach
Potassium	Healthy blood pressure	Bananas, Beans, Broccoli, Potatoes, Sweet Potatoes, Tomatoes

Source: [7].

Table 1: Key Nutrients in Fruits and Vegetables

2.2.3. Minerals

Minerals are important for the human diet as micronutrients because they are essential in many biological activities for normal cellular functions. They have a role in the synthesis and structural stabilization of proteins and nucleic acids. Vegetables and Fruits are sources of Manganese (Mn), Copper (Cu), Iron (Fe), Zinc (Zn), Sodium (Na), Sulfur (S), and Selenium (Se). Manganese is a cofactor of superoxide dismutase. At a physiological level, it maintains brain function and reproduction, required for glycemia control, and as part of bone structure. Manganese is a cofactor in the function of antioxidant enzymes, such as those in the mitochondria. Spinach is a good source of this mineral. Copper is a metal involved in redox reactions of the oxidative defense system and other enzymes like ceruloplasmin, cytochrome c oxidase, tyrosinase, and dopamine-β-hydroxylase. In addition, it is necessary for the formation of hemoglobin.

Nutrient	Green leafy vegetable	Roots and tubers	Other vegetables	Fruits
Moisture (g)	79-92	59-94	72-96	75-90
Calories (Kcal)	32-96	20-160	14-109	10-80
Carbohydrates (g)	4-14	4-38	4-20	2-20
Protein (g)	1.9-6.7	0.7-3.0	0.4-7.0	0.2-2.0
Fat (g)	0.1-1.7	0.1-1.3	0.1-0.4	0-1.0
Calcium (mg)	30-500	10-50	10-130	5-40
Iron (mg)	0.8-16.0	0.4-2.1	0.5-5.8	0.1-1.0
Carotene (µg)	1200-7500	30-3000	5-200	5-500
Ascorbic acid (mg)	48.220	3-24	2-66	2-300
Thiamine (mg)	0.05-0.06	0.05-0.10	0.04-0.25	0.05-0.2
Riboflavin (mg)	0.11-0.14	0.01-0.07	0.01-0.08	0.02-0.1
Nicotini acid (mg)	0.4-0.8	0.3-1.2	0.2-0.9	0.2-1.0
Folic acid (µg)	10-30	3-6	5-10	6-9
Potassium (mg)	250-370	200-370	200-400	86-250
Sodium (mg)	4-91	18-60	10-48	5-15

Source: [8]

Table 2: The Nutritive Value of Fruits and Vegetables (Range of Values per 100 gm)

Fruits and Vegetables are in general Good sources of Vitamin C and Potassium.

• Some fruits are good sources of sugars; it is a good source of acids (Tartaric Acid and Malic Acid, Citric Acid). A small quantity of organic acid.

• Fruits are good sources of pigments and polyphenols.

• Fruits contains several enzymes.

• Fruits are rich in pectic substances.

2.2.3.1. Impact Factors Affect the Absorption of Minerals

Phytochemicals such as phytic acid, oxalic acid, and tannins reduce their absorption, but vitamin C increases it. The mineral zinc has catalytic functions as enzymatic cofactor, antioxidant functions, modulating immune response, intestinal digestion, reproduction, and wound healing. Fruits are poor sources of zinc; good sources include parsley, pecans, and walnuts. Sodium is important for the regulation of Blood Pressure (BP) and electrolyte balance. Fruits are poor sources of sodium, but some vegetables such as artichoke, broccoli, carrot, celery, radish, and sweet potato are good sources. Sulfur is a micronutrient important in the synthesis of cysteine and methionine amino acids, where the thiol groups are mediators of redox reactions. The vegetables that contain important quantities of sulfur compounds, like thiocyanates and is thiocyanates are from the order Brassicales. Selenium is an important mineral present in the metabolites hydrogen selenide, methylselenol, and selenomethionine, that are able to regulate gene expression, protect DNA from damage, and enhance the repair and regulation of the cell cycle and apoptosis.

These compounds are Variety of Antioxidants (Phenolic Flavonoids) - Antitoxins and blocking agents inhibiting carcinogenesis, phytochemicals) The benefit of a diet rich in fruit and vegetables is attributed to the complex mixture of phytochemicals strongly associated with Reduced risk of cardiovascular disease, cancer, diabetes, Alzheimer, disease, cataracts and age-related functional decline. In diseased condition rather than whole fruit and vegetables use concentrated juices and soups. To meet the fruit and vegetable consumption encourage in mixed fruit and vegetable salad.

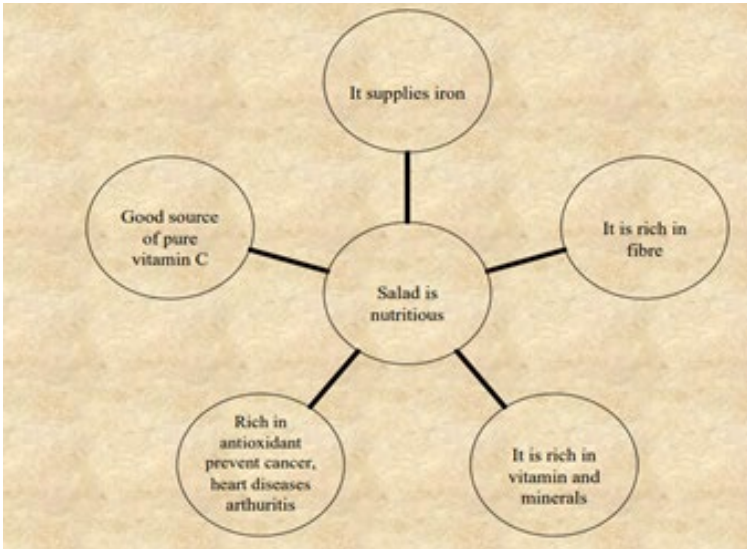

Figure: **Source: [9]**

2.3. Bioactive Components of Fruits and Vegetables

2.3.1. Carotenoids

This is a group of fat-soluble molecules (Terpenoids) responsible for the yellow, orange, and red colors of some fruits and vegetables (such as apricot, mango, citrus, papaya, watermelon, tomatoes, peppers, carrots). They are formed by eight isoprene units and derived from isopentenyl diphosphate. These plant pigments are important for the process of photosynthesis. Carotenoids are either oxygenated like Xantophylls (Zeaxanthin and Lutein) or carotenoid hydrocarbons like lycopene and β-carotene, which differ in thermal stability. Those that have an unsubstituted β-ring with 11-carbon polyene chain have provitamin A activity, like α-carotene, β-carotene, and cryptoxanthin. Carotenoids have conjugated double bonds within their structure, which confer an antioxidant property due to singlet oxygen quenching, which is able to destroy peroxyl radicals. These molecules have received great attention because of their antitumor properties, especially in breast and prostate cancers, involving antioxidant, antiproliferative, and modulation of immune functions. There is increasing evidence that consumption of whole foods is better than isolated food components such as dietary supplements and nutraceuticals. For example, increased consumption of carotenoid-rich fruits and vegetables was more effective than carotenoid dietary supplements in increasing LDL oxidation resistance, lowering DNA damage, and inducing higher repair activity in human volunteers who participated in a study conducted in France, Italy, Netherlands, and Spain [10].

2.3.2. Phenolic Compounds

Phenolic compounds are the most numerous groups of phytochemicals in plants. They include phenolic acids, flavonoids (flavonols, flavones, flavanols, flavanones, and anthocyanins), stilbenes, and lignans, of which flavonoids and phenolic acids account for 60% and 30%, respectively, of the dietary polyphenols. These molecules exert an antioxidant activity and effects on tumor development and carcinogenesis at the cellular level in processes of detoxification, signaling cascades (MAPKinases, p53, NF-κB, PI3K) involved in cell growth and death. Flavonoids are compounds that share the same common skeleton of Diphenylpropanes (C6C3C6) and contain phenolic hydroxyl groups attached to ring structures that confer antioxidant activity as reducing agents, hydrogen donators, singlet oxygen quenchers, superoxide radical scavengers, and metal chelators. Phenolic acids are composed of hydroxycinnamic and hydroxybenzoic acids.

They also present antioxidant activity as chelators and free radical scavengers. The most studied compound is gallic acid, the precursor of many tannins, while cinnamic acid is the precursor of all the hydroxycinnamic acids. Most of the polyphenolic compounds are present as esters, polymers, or glycosides that can be absorbed in these forms or be hydrolyzed by intestinal enzymes or colonic bacteria.

2.4. Contribution of Fruit and Vegetable Consumption to Prevention of Chronic Diseases

Fruits, nuts, and vegetables play a significant role in human nutrition, especially as sources of vitamins [C(Ascorbic Acid), A, Thiamine (B1), Niacin (B3), Pyridoxine (B6), Folacin (also known as Folic Acid or Folate) (B9), E], Minerals, and Dietary Fiber [11].Their contribution as a group is estimated at 91% of vitamin C, 48% of vitamin A, 30% of folacin, 27% of vitamin B6, 17% of thiamine, and 15% of niacin in the U.S. diet. Fruits and vegetables also supply 16% of magnesium, 19% of iron, and 9% of the calories. Legume vegetables, potatoes, and tree nuts (such as Almond, Filbert, Pecan, Pistachio, and Walnut) contribute about 5% of the per capita availability of proteins in the U.S. diet, and their proteins are of high quality as to their content of essential amino acids. Nuts are a good source of Essential Fatty Acids, Fiber, Vitamin E, and Minerals.

Other important nutrients supplied by fruits and vegetables include Riboflavin (B2), Zinc, Calcium, Potassium, And Phosphorus. Fruits, Nuts, And Vegetables in the daily diet have been strongly associated with reduced risk for some forms of cancer, heart disease, stroke, and other chronic diseases [12]. Some components of fruits and vegetables (phytochemicals) are strong antioxidants and function to modify the metabolic activation and detoxification/ disposition of carcinogens, or even influence processes that alter the course of the tumor cell [11].

2.4.1 Cancer

It is estimated, based on epidemiological studies, that improving nutrition and physical activity-related factors can prevent many cancers, around 27% (in low-income countries), 30% (in middle-income countries), to 34% 39% (in high-income countries). The World Cancer Research Fund (WCRF) and the American Institute for Cancer Research (AICR), through comprehensive analysis mainly based in systematic literature reviews and meta-analysis of observational epidemiologic studies, case control studies, and cohort studies, published a second expert panel report in 2007, about food, nutrition, physical activity, and cancer prevention. This expert panel report of WCRF/AICR shows that the evidence about fruit and vegetable consumption probably protects against some cancers.

Non-starchy vegetables probably decrease risk of cancers of the mouth, pharynx, and larynx, and those of the esophagus and stomach. There is limited evidence suggesting that they also decrease the risk from cancers of the nasopharynx, lung, colorectal, ovary, and endometrium. Allium vegetables probably decrease the risk of stomach cancer. Garlic, an allium vegetable, probably decreases the risk of colorectal cancer. Fruits probably decrease the risk of cancers of the mouth, pharynx, and larynx, and of the esophagus, lung, and stomach. There is limited evidence suggesting that fruits also protect against nasopharynx, pancreas, liver, and colorectal cancers.

2.4.2 Cardiovascular Disease

CVD is the number one cause of death in developed and developing countries, and prevention is at the top of the public health agenda. In 2008, 17 million deaths worldwide were due to CVD, which represents 48% of non-communicable disease deaths. Numerous epidemiological studies around the world have demonstrated evidence that diets rich in fruits and vegetables prevented CVD and reduced mortality from CVD. The positive effect has been accomplished by 3 servings of vegetables and fruits, and the Relative Risk (RR) can be minimized to a great extent by enhancing the vegetable and fruit consumption by up to 10 servings/day.

The inverse relationship between vegetable intake and CVD was more evident with smokers consuming at least 2.5 servings of fruits and vegetables per day in comparison with less than 1 serving/ day. A high fruit and vegetable intake have shown a significant inverse association with CVD risk factors such as systolic BP, total cholesterol and LDL-cholesterol, and explained 48% of the protective effect. Legume consumption was also significantly and inversely associated with CVD, lowering the risk by about 11%.

In the Mediterranean Diet Prevention (PREDIMED) study, a randomized, controlled trial including 7447 obese men and women with a mean age of 67 years at high risk for CVD, 50% of the participants had type II Diabetes Mellitus (T2DM), more than 70% had dyslipidemia, and more than 80% had hypertension. After a median follow-up of 4.8 years the study showed that a Mediterranean diet supplemented with extra virgin olive oil or a mix of nuts (Almonds, Walnuts, And Hazelnuts) reduced the incidence of CVD (Myocardial Infarction, Stroke, or Cardiovascular Death) by 30% in the olive oil group (Hazard Ratio Adjusted (HRadj 5 0.70, 95% confidence interval (CI) 0.540.92) and 28% in the nut group (HRadj 5 0.72; 95% CI 0.540.96) compared to the control group that was instructed to eat a low-fat diet. Moreover, in the prospective part of the PREDIMED study, the baseline intake of fruit was inversely associated with all causes of mortality (HR for the fifth compared with the first quintile 5 0.59 (95% CI 0.440.78) and the associations were stronger for CVD mortality than other causes of death. On the other hand, it is well documented that high consumption of fruits and vegetables is inversely associated with the risk of Coronary Heart Disease (CHD).

2.4.3. Hypertension

High blood pressure is a continuous, consistent, and independent risk factor for CVD that is modifiable through lifestyle. Indeed, a moderate average BP reduction of 3.5 and 2.0 mmHg for systolic and diastolic BP, respectively, was associated with a 24% reduction in stroke. It is consistently shown that diet plays a major role in BP control. Several studies clearly showed that consumption of vegetables, fruit, and low-fat dairy products lowered BP. Nut consumption reduces systolic BP among participants without T2DM (21.3 mmHg, 95% CI 22.3 to 20.22 mmHg), whereas pistachios had the strongest effect on systolic (21.8 mmHg, 95% CI 23.0 to 20.7 mmHg) and diastolic BP (20.8 mmHg, 95% CI 21.4 to 20.2 mmHg). Even more, it was shown that a vegetarian diet is associated with a reduction in mean Systolic BP (24.8 mmHg, 95% CI 26.6 to 23.1 mmHg) and Diastolic BP (22.2, 95% CI 3.5 to 21.1 mmHg) [13].

2.4.4. Chronic Heart Failure

Chronic Heart Failure (CHF) has a prevalence of about 80% among individuals of more than 80 years of age worldwide, and is seen as the end stage of CVD and the final pathway of diseases such as hypertension and CVD. CHF has many causes, but oxidative stress has also been proposed as a risk factor. Furthermore, the total antioxidant capacity measured in the diet is inversely associated with CHF. A diet rich in fruit and vegetables has been associated with reduced incidence of CHF by up to 22%.

zThe prevalence of T2DM is increasing worldwide. In 2013, 382 million cases were reported, and this number is expected to rise to 592 million by 2035. Because either resistance to the blood glucose regulating hormone insulin or its relative deficiency characterizes T2DM, it has been proposed that antioxidants may play a role in increasing insulin sensitivity. Thus, fruit and vegetable consumption in patients with T2DM improve glucose and glycated hemoglobin levels, and increase serum antioxidant compounds (vitamin C and reduced glutathione), and reduce markers of oxidative stress and inflammation such as DNA oxidation and lipid peroxidation and IL-6 serum levels. Moreover, several studies have shown that the consumption of fruit, vegetables, nuts, and whole grain intake of antioxidants reduce the RR of T2DM by 13%-15% [14-16]. However, fruit and vegetable consumption and its effects on T2DM risk are inconsistent [17]. It has been proposed that this inconsistency between studies examining the association between fruit and vegetable intake and the risk of T2DM could be due to the extent of measurement error associated with the food frequency questionnaire overestimating fruit and vegetable consumption.

In addition, these studies include consumption of fruit juices that contain important sugar content, especially fructose that contributes to the development of T2DM and insulin resistance [15]. Experimental evidence showed that consumption of prickly pear cladodes (nopal) could decrease blood glucose levels [18]. The intake of broiled Opuntia stems for 10 days improved glucose control in a small group of adults with T2DM [18]. Some flavonoids, such as procyanidins, have antidiabetic properties because they improve altered glucose and oxidative metabolism of diabetic states [19]. Extract of grape seed procyanidins administered orally to streptozotocin (STZ)-induced diabetic rats resulted in an antihyperglycemic effect, which was significantly increased if procyanidin administration was accompanied by a low insulin dose [19].

2.4.6. Overweight and Obesity

WHO estimates that more than 1.9 billion adults and more than 42 million of children under 5 years old are overweight worldwide, indicating its prevalence in all age groups. Obesity is characterized by the accumulation of excess fat in adipose tissues. It is considered a major public health issue, especially in most developed countries for its wide spread across population groups, as well as its contribution to the development of chronic diseases, particularly CVDs, T2DM, some types of cancer (i.e., colorectal, breast) resulting from a sedentary lifestyle, unhealthy dietary practices, high energy intake, and low energy expenditure.

Svendsen et al., assessed the effect of increased consumption of vegetables and fruit on body weight, risk factors for CVD, and antioxidant defense in obese patients with Sleep Related Breathing Disorders (SRBD) [20]. They concluded that targeted dietary advice to increase the intake of vegetables and fruit among subjects with SRBD contributed to weight reduction and reduced systolic and diastolic BP, but had no effect on antioxidant defense measured by ferric-reducing/antioxidant power assay.

He et al., examined the changes in intake of fruits and vegetables in relation to risk of obesity and WG among middle-aged women through a prospective cohort study with 12 years of follow-up, conducted in the Nurses' Health Study with a total of 74,063 female nurses aged 3863 years, who were free of CVD, cancer, and T2DM at baseline in 1984. During the 12-year follow-up, participants tended to gain weight with aging, but those with the largest increase in fruit and vegetable intake had a 24% of lower risk of becoming obese compared with those who had the largest decrease in intake after adjustment for age, physical activity, smoking, total energy intake, and other lifestyle variables. For major WG ($25 kg), women with the largest increase in intake of fruits and vegetables had a 28% lower risk compared to those in the other extreme group. Low fruit consumption is considered an important contributor to the global disease burden, and an important attributable risk factor because many clinical studies have evidenced that increased daily consumption of fruits is inversely correlated to WG. However, these researches pointed to the possible obesity effects of fruits in the form of juices, which are low in fiber and rich in simple sugars (Sucrose, Glucose, or Fructose), stimulating hepatic de novo triacyl glycerides biosynthesis and very low in blood and augment fat mass.

The following possible anti-obesity mechanisms proposed are attributable to consumption of whole fruit:

- Reduction of energy consumption, because adding fruit daily to the diet will reduce overall energy consumption, restricting WG, reduction of fat mass, and control obesity.
- c Presence of fruit micronutrients able to downregulate genes involved in adipocyte generation and differentiation such as vitamins A, E, and C and minerals such as zinc, iron, and calcium.
- A diet rich in fiber and polyphenols leads to a prevalence of Bacteroidetes and Actinobacteria, which are characteristics of lean individuals, whereas in obese people the presence of Firmicutes and Proteobacteria is increased, however the specific mechanisms responsible for modulatory effects of gut microbial ecology related to fruit consumption on obese individuals are unknown [6].
- Fruit provides prolonged satiety attributed to dietary fiber. Bes-Rastrollo et al., assessed the association between fiber intake, fruit, and vegetable consumption with the likelihood of WG in a Mediterranean (Spain) population with a cross-sectional analysis of 5094 men and 6613 women in a multipurpose prospective cohort (Seguimiento Universidad De Navarra Study) [21].

There was a significant inverse association between total fruit/vegetable consumption and WG, but only among men, it was more evident among those with a high intake of total fiber, and the benefit of total fiber was more evident among those with a high consumption of fruit and vegetables.

2.4.7 Bone Health

The loss of bone mass is a global epidemic associated with osteoporosis. Fruit and vegetable consumption have been

suggested to improve bones. Higher fruit and vegetable intake were associated with improved markers of bone status in males and females ranging between 16 and 83 years old. Tylavsky et al., showed that fruit and vegetable intake might be important in bone health in white girls ages 813 years [22]. The effect was high with 3 servings/day or more and low with less than 3 servings/day, with 4.0 servings (1.6 fruit/2.4 vegetables) in the high group and 1.7 servings (0.6 fruit/1.1 vegetable) in the low group. Girls in the high fruit and vegetable intake group had significantly larger bone area of the whole body and wrist, and higher mineral content for whole body and at the wrist. A study of 1407 premenopausal farmwomen from five rural districts in Japan concluded that fruit and vegetable intake is positively correlated with bone health. In a study conducted with 85 boys and 67 girls, ages 820 years in Saskatchewan, Canada, fruit and vegetable intake was reported to be an important independent predictor of accrued total body Bone Mineral Content (BMC) in boys but not in girls. In a study with adolescents ages 12 and 15 years in Northern Ireland (n 5 1345), 12-year-olds consumed the highest quantity of fruit and a positive association has been demonstrated between bone density and fruit intake.

3. Summary

Eating a balanced diet containing vegetables and fruits is considered the best way of ensuring good health and enhance the immune system of our body for presentation ò chronic diseases. Accumulating evidences demonstrate that fruit and vegetable consumption have health benefits due to content of thousands of phytochemicals of diverse classes. Therefore, health organizations recommend the consumption of at least 400 g of fruits and vegetables daily. Intensive research activity is dealing with the identification of the phytochemicals in fruits and vegetables, and their role in human nutrition and health through controlled clinical intervention trials, as well as studies to reveal the mechanisms behind the effect of the different phytochemical components. The consumption of fresh fruit and vegetables are promoted as a first line of defense in the prevention of serious illness with the magic role of anti-oxidant and folate. With the sufficient consumption of fruits and vegetables, reduce the risk for cancer and heart diseases, and other chronic diseases [23,24].

References

1. Hailu, G., & Derbew, B. (2015). Extent, causes and reduction strategies of postharvest losses of fresh fruits and vegetables–A review. *Journal of Biology, Agriculture and Healthcare, 5*(5), 49-64.
2. Hodges, R. J., Buzby, J. C., & Bennett, B. (2011). Postharvest losses and waste in developed and less developed countries: opportunities to improve resource use. *The Journal of Agricultural Science, 149*(S1), 37-45.
3. Sebeko, T. (2015). Assessment of Postharvest loss for perishable produces from Wholesalers to consumers.
4. Weinberger, K., & Lumpkin, T. A. (2007). Diversification into horticulture and poverty reduction: a research agenda. *World development, 35*(8), 1464-1480.
5. Southgate, D. A., Paul, A. A., Dean, A. C., & Christie, A. A. (1978). Free sugars in foods. *Journal of human nutrition, 32*(5), 335-347.
6. Sharma, S. P., Chung, H. J., Kim, H. J., & Hong, S. T. (2016). Paradoxical effects of fruit on obesity. *Nutrients, 8*(10), 633.
7. Mritunjay, S. K., & Kumar, V. (2015). Fresh farm produce as a source of pathogens: a review. *Research Journal of Environmental Toxicology, 9*(2), 59-70.
8. Hyson, D. (2005). The health benefits of fruits and vegetables: A scientific overview for health professionals. Produce for Better Health Foundation.
9. Slavin, J. L., & Lloyd, B. (2012). Health benefits of fruits and vegetables. *Advances in nutrition, 3*(4), 506-516.
10. Southon, S. (2000). Increased fruit and vegetable consumption within the EU: potential health benefits. *Food Research International, 33*(3-4), 211-217.
11. Wargovich, M. J. (2000). Anticancer properties of fruits and vegetables. *HortScience, 35*(4), 573-574.
12. Goldberg, G. (2003). The report of a British nutrition foundation task force. *Plants: Diet and Health, 347.*
13. Mohammadifard, N., Salehi-Abargouei, A., Salas-Salvadó, J., Guasch-Ferré, M., Humphries, K., & Sarrafzadegan, N. (2015). The effect of tree nut, peanut, and soy nut consumption on blood pressure: a systematic review and meta-analysis of randomized controlled clinical trials. *The American journal of clinical nutrition, 101*(5), 966-982.
14. Wu, Y., Zhang, D., Jiang, X., & Jiang, W. (2015). Fruit and vegetable consumption and risk of type 2 diabetes mellitus: a dose-response meta-analysis of prospective cohort studies. *Nutrition, Metabolism and Cardiovascular Diseases, 25*(2), 140-147.
15. Bazzano, L. A., Li, T. Y., Joshipura, K. J., & Hu, F. B. (2008). Intake of fruit, vegetables, and fruit juices and risk of diabetes in women. *Diabetes care, 31*(7), 1311-1317.
16. Hamer, M., & Chida, Y. (2007). Intake of fruit, vegetables, and antioxidants and risk of type 2 diabetes: systematic review and meta-analysis. *Journal of hypertension, 25*(12), 2361-2369.
17. Villegas, R., Shu, X. O., Gao, Y. T., Yang, G., Elasy, T., Li, H., & Zheng, W. (2008). Vegetable but not fruit consumption reduces the risk of type 2 diabetes in Chinese women. *The Journal of nutrition, 138*(3), 574-580.
18. Frati, A. C., Cordillo, B. E., Altamirano, P., Ariza, C. R., Cortés-Franco, R., & Chavez-Negrete, A. (1990). Acute hypoglycemic effect of Opuntia streptacantha Lemaire in NIDDM. *Diabetes Care, 13*(4), 455-456.
19. Pinent, M., Blay, M., Blade, M. C., Salvado, M. J., Arola, L., & Ardevol, A. (2004). Grape seed-derived procyanidins have an antihyperglycemic effect in streptozotocin-induced diabetic rats and insulinomimetic activity in insulin-sensitive cell lines. *Endocrinology, 145*(11), 4985-4990.
20. Svendsen, M., Blomhoff, R., Holme, I., & Tonstad, S. (2007). The effect of an increased intake of vegetables and fruit on weight loss, blood pressure and antioxidant defense in subjects

with sleep related breathing disorders. *European journal of clinical nutrition, 61*(11), 1301-1311.
21. Bes-Rastrollo, M., Martínez-González, M. Á., Sánchez-Villegas, A., de la Fuente Arrillaga, C., & Martínez, J. A. (2006). Association of fiber intake and fruit/vegetable consumption with weight gain in a Mediterranean population. *Nutrition, 22*(5), 504-511.
22. Tylavsky, F. A., Holliday, K., Danish, R., Womack, C., Norwood, J., & Carbone, L. (2004). Fruit and vegetable intakes are an independent predictor of bone size in early pubertal children. *The American journal of clinical nutrition, 79*(2), 311-317.
23. Hamza, M. A., & Anderson, W. K. (2005). Soil compaction in cropping systems: A review of the nature, causes and possible solutions. *Soil and tillage research, 82*(2), 121-145.
24. Taddese, G. (2001). Land degradation: a challenge to Ethiopia. *Environmental management, 27*, 815-824.