

Effects of food bioactives on human nutrition

Efectos de los bioactivos de los alimentos en la nutrición humana

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Abstract: Food consumption dates back from the beginning of mankind to the present day with a myriad of changes focused on the preparation, with the inclusion of elements from plants, fruits or vegetables to improve their organoleptic, functional and physical-chemical characteristics. Against this background, the objective of the study was to identify the effects of the consumption of bioactives in foods. The method used was exploratory with a documentary approach; a thorough search was carried out in scientific databases such as Springer, Google Scholar, Pubmed, undergraduate and doctoral theses, as well as newsletters, which allowed us to identify 33 food products, which contain different bioactive compounds such as lycopenes, polyphenols, tannins, flavonoids, carotenoids, terpenes and other derivatives. These components inhibit the presence of free radicals and reduce oxidative stress, thus preventing the presence of diseases linked to the central nervous system. Other components have protective effects that help to enhance and develop metabolic modules.

Keywords: benefits, health, food, bioactive compounds, diseases, health, diet

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Resumen: El consumo de alimentos se remonta desde los inicios de la humanidad hasta la actualidad con un sinfín de cambios enfocados en la preparación, con la inclusión de elementos provenientes de plantas, frutas o vegetales para mejorar sus características organolépticas, funcionales y físicos-químicas. Bajo este antecedente, el objetivo del estudio fue identificar los efectos del consumo de bioactivos en alimentos. El método que se empleó fue de tipo exploratorio con un enfoque documental; se realizó una búsqueda minuciosa en bases científicas como Springer, Google Académico, Pubmed, tesis de pregrado y doctorado, así como boletines, que nos permitió identificar 33 productos alimenticios, los mismos que contienen diferentes compuestos bioactivos como licopenos, polifenoles, taninos, flavonoides, carotenoides, terpenos y otros derivados. Estos componentes inhiben la presencia de radicales libres y reducen el estrés oxidativo, así evita la presencia de enfermedades ligadas al sistema nervioso central. Otros componentes tienen efectos protectores que ayudan a potenciar y desarrollar modulares del metabolismo.

Palabras clave: beneficios, salud, alimentación, compuestos bioactivos, enfermedades

Introduction

At the beginning of the new millennium, a new stage of development in the area of food sciences and nutrition has been present with special intensity in the human being who has sought alternative sources of nutrition to subsist since ancient times. (Pérez, 2006). The concept of functional foods containing specific physiologically active components originated in Japan as a means of improving the health of the nation and, therefore, reducing the drain on the economy caused by rising health costs (M. Enriquez et al., 2022).. In Europe, functional food is defined as *"that which has been satisfactorily demonstrated to beneficially affect one or more specific functions in the body, beyond adequate nutritional effects in a way that is relevant to the state of well-being and health or the reduction of the risk of a disease"* (Roberfroit, 2000). The International Food Information Center (IFIC) defines them as "those products to which a specific compound is intentionally added to increase their health properties" and defines health foods as those that, in their natural state or with minimal processing, have compounds with beneficial health properties (Araya & Lutz, 2003). According to Faria and Anjo, (2004) functional food or natural food, in addition to being nutritious, has components that favor both physical and mental

health, contributing with functional components (Alvídrez et al., 2002). These bioactives contain biologically active substances that when added to diets have an effect on the metabolic development of human beings (Faria & Anjo, 2004).

Currently, nutrition is undergoing major changes of interest, poverty is no longer a factor for the development of a research, on the contrary, the current interest is between nutrition and chronic noncommunicable diseases, and the effects that they imply on the nutrition of cognitive, immune capacities (Sandoval et al., 2016).. People increasingly tend to be more aware of their self-care, looking for products that contribute benefits to their health, due to this trend, there is a variety of information about the functionalities provided by these supplies, through different media and marketing strategies of food companies, especially those that provide a functional food with physiological processes that help reduce disease risks (Sloan, 1999). The industry in its constant growth has expanded new product offerings that indicate the beginning of a great challenge, in which leads to nourish and develop new safe and healthy products for the welfare of mankind, the components are of plant origin or phytochemicals, also included as an exception are prebiotic supplements, probiotics and synbiotics (Brizuela, 2003).

For the human diet it is necessary to provide nutrients that contribute to the development of different physical activities, which will have a positive impact on health. According to (Valenzuela et al., 2014) functional foods should be normally consumed in the diet since they provide desirable benefits in human nutrition. In addition, other elements can be added naturally, where certain compounds were modified without altering the structure of their nutrients, in order to promote health benefits (Tur & Bibiloni, 2015). With the incorporation of specific and bioactive elements such as: prebiotics, probiotics, functional peptides, carotenoids, vitamins, phenolic compounds, phytoestrogens, fatty acids or structured lipids foods take the denomination of functional (Boer, Urlings & Bast, 2016; Vieira, Barreira & Oliveira, 2016).

Currently these foods are generating interest from researchers, pharmaceutical and food industries, because consumers are unaware of the concept of functional foods and nutraceuticals, generating disadvantage in the marketing of supplements, allowing future challenges on the consumption of natural products (Sedó, 2002). (Sedó, 2002).

The defense against oxidative stress has shown that free radicals are related to different biochemical processes that cause cellular damage, to counteract the excess of oxygen in the cells. There are a variety of

functional foods of plant origin, which have low molecular weight and help to increase the body's defenses, among the best known components are vitamins E and C, carotenoids, polyphenols and flavonoids (Ashwell, 2004). In this context, these products are not only processed foods, but also, traditional foods such as for example tomato, oats and olive oil that contain bioactives such as, for example: lycopene, β -glucans or oleic acid with beneficial properties for health (Jáuregui et al., 2018).

The lifestyle that characterized the end of the 20th century and the beginning of the 21st century has brought about significant changes in eating habits, sometimes unhealthy, combined with sedentary lifestyles and stress, which have led to various cardiovascular diseases (Guesry 2005). To reduce the incidence of health problems it is advisable to promote eating habits that reduce the intake of saturated fats and cholesterol, while increasing the consumption of fiber and antioxidants (Trescastro & Bernabeu 2005). (Trescastro & Bernabeu, 2015).. Since functional foods when modified in their bioactive components produce benefits by eliminating adverse health effects (Millone et al., 2011). Scientific and technological nutritional progress aims to promote good eating habits, taking into consideration genetic, environmental, social and cultural characteristics for the benefit of population health (Roberfroid, 1999). Thus, in the future, nutrition will not only guarantee optimal growth and development from pregnancy and during all stages of life, but will also strengthen the body and mind, as well as reduce the risk of disease (Koletzko et al., 1998). The present work aimed to identify the effects of food bioactives on human nutrition.

Materials and methods

The research was conducted at the Universidad Estatal Amazónica, located in the canton of Pastaza, Pastaza province; Km. 2½, on the road from Puyo to Tena (Paso Lateral).

The method used is exploratory of secondary order, since a thorough search of bibliographic information of documents obtained in scientific databases such as: Scopus, Springer, Scielo, Google Scholar, Researchgate, undergraduate, master's and doctoral theses was carried out. In order to meet the research objectives, a critical reading of the main selected bibliographic documents was developed, which were subsequently classified and separated according to the information supporting the work.

Table 1 details the type of research that was employed by the researchers.

Table 1 *Type of research*

Descriptive	Documentary
The purpose of this research is to describe, record, analyze and interpret the facts and characteristics of a particular topic. To do so, the elements must be classified, grouped or synthesized with criteria, in order to go deeper into the topic, this is achieved with an analysis of the existing reality and its correct interpretation.	It is a series of methods and techniques for searching, processing and storing information contained in documents, in the first instance, and the systematic, coherent and sufficiently argued presentation of information in a scientific document, in the second instance.

Source: (Sanca, 2011)

The present literature review had a non-experimental documentary approach, adapting to a collection of information through an analytical reading of documents and bibliographic materials related to the effects of functional food consumption in the 20th century.

3. Result

Photochemicals - The interest in the relationship between food and health, takes a preventive approach in nutrition and deficit, the effect of the consumption of bioactives of animal and vegetable origin, essentially fruits, vegetables, whole grains and legumes and their preventive effects on cancer and cardiovascular diseases has been evidenced (Hasler, 2002). Under this parameter, some components of functional and healthy foods were identified as: Healthy foods of low nutritional value. - Foods such as onion and garlic, which are used as condiments or spices in stews and salads. Both are justified as healthy foods because of their high content of flavonoids, polyphenolic compounds, antioxidants and organosulfur compounds, respectively. Their consumption is associated in epidemiological and experimental studies with reduced risk of cardiovascular disease, oxidative stress and they also have an anticarcinogenic effect (Nagournay & Garlic, 1998). Healthy and functional foods with good nutritional value. - In this group we have the case of beans, which have a high protein content, starches of intermediate digestion speed, a high content of dietary fiber, phytates, tannins and non-digestible oligosaccharides (Guzman &

Paredes, 1998).

Unconventional health foods. - Flaxseed is a food that is not usually consumed in the diet of most countries and for this reason it is considered a non-conventional food. This seed has important concentrations of antioxidants, such as flavonoids and lignans, phytic acid, tocopherols and provides water-soluble mucilages (Oomah & Mazza, 1998).

Conditioned health foods. - In this group we have the case of cocoa paste, which has a high concentration of polyphenols, flavanols such as catechin and epicatechin, flavonols such as quercetin and anthocyanidins such as cyanidins and stimulant substances such as methylxanthines (theobromine and caffeine) (Borchers et al., 2000).

Controversial healthy foods. - This group identifies fermented beverages such as wine and beer, which provoke a great deal of discussion regarding the recommendation that tends to increase their consumption. Although they contain flavonoids and other healthy phytochemicals, the consumption of these alcoholic beverages should be moderated in countries where alcoholism is a health risk (Wollin & Alcohol, 2001).

Table 2. *Effects of the consumption of bioactives present in food on human health.*

Type	Type	Bioactive component	Effect on health	Discussion	Reference
Vegetables	Celery	Luteolin, apigenin, thiamine, riboflavin and niacin.	The consumption of celery has an effect of neutralizing free radicals by the content of antioxidants, which are responsible for oxidative stress and do not allow cell degeneration. They inhibit the enzyme called xanthine oxidase which reduces uric acid in the blood. Reduces cholesterol, preventing the presence of atheroma plaque that causes obstruction of the	Flores et al., (2015) mention in their study on Dietary Nutrients and Apoptosis as Cancer Regulatory Mechanisms that luteolin present in celery allows reducing the risk of chronic diseases and carcinogenesis. Surh, (2003) mentions that luteolin has preventive effects against cancer.	Carrozi et al., (2012); Flores et al., (2015); Surh, (2003).

Onion	Fructans, organosulfur compounds, phenolic compounds and inulin.	arteries and thus cause heart attacks. Combats respiratory system disorders due to its vitamin content Purifies and regularizes the functioning of the gastrointestinal system by eliminating toxins.	Delzenne et al. (1995) indicate that fructans are not easily digested in the stomach, from where they pass to the large intestine, representing an excellent source of fiber. According to Sainani et al. (1976) in their research on organo-sulfur compounds, raw onion should be consumed to prevent the formation of lipids in the blood and blood coagulation, avoiding cardiovascular diseases.	Torija et al. (2013); Delzenne et al. (1995); Sainani et al., (1976)
Garlic	Aliina	It lowers plasma cholesterol and triglyceride levels, preventing the presence of thrombi in the bloodstream and possible cardiovascular and cerebrovascular diseases.	According to Ross, (2006) recent studies have demonstrated the expression of garlic alliin compounds, eliminating the onset of tumors in organisms. On the other hand, Rodriguez, (2021) mentions that alliin and other compounds also help to combat the presence of fungi, bacteria and viruses.	Torija et al., (2013); Ross et al., (2006); Rodriguez, (2001).

Parsley	Flavonoids, luteolin, apigenin and glycosides.	They inhibit the reproduction of pathogenic cells and their interaction in the inhibition of free radicals preventing the presence of cancer cells. However, its consumption is contraindicated in pregnant women due to its content of apiol and myristicin which can cause miscarriages.	Reyes et al., (2012) in their study of parsley identified the presence of different chemical components, such as flavonoids, apiol, phytol, essential oils, coumarins and petroselinic acid, which provide bioactive properties due to their antioxidant power and reduce the risk of cardiovascular diseases. In a publication Imran et al. (2020) mentions that apigenin is a flavonoid found in edible plants such as parsley as it is a great antioxidant and works as an anticancer agent that stops cell growth and apoptosis.	Reyes et al, (2012); Imran et al, (2020).
Tomato	Lycopene	It prevents the oxidation of lipids in the cells due to its antioxidant action, avoiding the accumulation of fat in the vascular arteries, it also reduces the proliferation of prostate, pulmonary and digestive tract cancer cells.	Rao & Agarwal, (2000) in their study on lycopene in tomatoes identify that when consumed it increases circulating and tissue levels, eliminating reactive oxygen species and reducing the risk of oxidative stress and cellular components	Neyra, (2007); Rao & Agarwal, (2000).; Gorgojo & Martin, (2002).

			including lipids and proteins. Gorgojo & Martín Moreno, (2002) mention that the properties of lycopene act as an anticarcinogenic agent since they control cell proliferation.	
Broccoli	Isothiocyanates and indoles, glucosinolate derivatives Sulforaphane	It helps prevent different types of cancer by regulating the development of cancer cells through its effects on certain restriction enzymes, controlling cell death (apoptosis) and blocking the cell cycle. Sulforaphane induces the activity of detoxifying enzymes and inhibits the enzyme carcinogenesis.	A study by Lam et al. (2009) indicates that isothiocyanates can inhibit the bioactivation of procancerogens found in cigarette smoke. Tuorkey, (2015), indicates that, as a bioactive compound, sulforaphane can mediate apoptosis during the cancer cell cycle and inactivate protein kinases essential for cell growth and proliferation.	Higdon et al., (2007); Lam et al., (2009); Tuorkey, (2015).
Spinach	Glycoglycerolipids, vitamin C, quercetin and alpha lipoic acid.	Purifies the glycoglycerolipid fraction that inhibits the growth activity of cultured human cancer cells and the proliferation of solid tumors. Its antioxidant composition, known as alpha lipoic acid, has been shown to reduce glucose levels, increase insulin sensitivity and prevent stress-induced oxidative changes in	Kumazawa (2006) in his research defines that quercetin exerts a potential anti-inflammatory effect, thanks to its ability to suppress the production of tumor necrosis factor. Villagrán et al., (2019) indicates that in spinach there are other components such as vitamin C, which help	Maeda et al., (2010); Kumazawa (2006); Villagrán et al., (2019).

Beets	Betalains, betaine, nitrates, vitamin C, polyphenols and antiocinins.	patients with diabetes. The vitamin C found in the product is highly protective of cells against oxidative damage and is a chemotherapeutic agent in the treatment of tumors in the digestive tract, uterine, mammary and prostate.	to neutralize free radicals. Kanner et al., (2001) in their study of the health benefits of betalains, presented that they have great antimicrobial, antioxidant and anticarcinogenic effects, that they intervene in the reduction of triglycerides and the control of glycemia, and that they also contribute to combat atherosclerosis. Garzón, (2008) mentions that anthocyanins are pigments that have therapeutic effects, among which are the reduction of coronary, antitumor, anti-inflammatory and antidiabetic diseases.	Fuentes-Barría et al., (2018).Kanner et al., (2001); Garzón, (2008)
Ahuyama (Pumpkin)	Lutein, α -carotene, β -carotene, zeaxanthin and retinol equivalent.	It prevents the onset of chronic diseases such as hypertension and avoids fluid retention due to its carotenoid content.	According to Garcia et al., (2013) the β -carotene, substances of the ahuyama favors the absorption of iron in the organism, and Parlato et al., (2004) cites in their study that, the intake of α -carotene, β -carotene and lutein act on the immune system creating defenses in the organism.	Hemei, (2017); Parlato et al., (2004).; Garcia et al., (2013).

Bell pepper	Provitamin A Vitamin E Vitamin C Capsaicinoids Luteolin Quercetin	It has the ability to act as an analgesic, energetic and effective substance to combat pathogenic germs present in the intestine such as <i>E. coli</i> , <i>Salmonella</i> , <i>Campylobacter</i> and <i>Staphylococcus</i> . They also act by regulating blood sugar, preventing the formation of crystals and avoiding the formation of cataracts in diabetics.	According to Rodriguez et al., (2019) states that the capsaicinoid compound has biological properties with pharmacological relevance, such as antioxidant, anti-inflammatory, analgesic, antimicrobial and anticarcinogenic. It is related to increased body energy and decreased fat and cholesterol accumulation, leading to a reduction in cardiovascular disease, diabetes or stroke.	Wahyuni et al., (2013); Rodriguez et al., (2019)
Papa	Anthocyanins and polyphenols.	Neutralizes free radicals, preventing oxidation of cells and preventing cancer, cardiovascular and cerebrovascular diseases.	Zi et al, (2009) indicated that potato contains polyphenolic compounds and anthocyanins that are able to reduce oxidative stress. In relation to Shipp & Abdel, (2010) who indicated that anthocyanins in potato play an important role for their anti-diabetic function by regulating insulin production at the pancreatic level.	Barragan Condori & Aro Aro, (2017).; Zi et al, (2009); Shipp & Abdel, (2010).
Yacon (Jicama)	Flavonoids, acids, fructooligosaccharides, inulin, phenolics and tryptophan.	Beneficial effects, contributes to the intestinal microflora, helps prevent constipation,	Oliveira, (2010) mentions that yacon, due to its content of fructooligosaccharides, inulin and phenolic	Jimenez, (2017); Oliveira, (2010).; Guevara et al., (2017)..

		<p>promotes the assimilation of calcium, reduces cholesterol levels, strengthens the immune system and reduces the risk of developing colon cancer.</p>	<p>compounds, prevents the prevention of diseases linked to sugar content in the organism. On the other hand, Guevara et al., (2017) indicates that yacon has a hypoglycemic, antioxidant, prebiotic and anti-aging properties.</p>	
Carr ot	<p>Flavonoids, β-carotenes, vitamin A and polyphenols</p>	<p>Carrot has several nutrients such as vitamin A and carotenes, which help promote the proper functioning of the ocular retina and accelerate the healing process in injured skin.</p>	<p>Meléndez et al, (2004) indicate that the consumption of β-carotenes are efficient in protecting against the risk of skin cancer as a consequence of UV radiation. Van Breda et al, (2005) in their study on the consumption of carotenes present in carrots has a protective effect on chronic degenerative diseases.</p>	<p>Ventrera et al., (2013)(2004); Meléndez et al. (2004); Van Breda et al.</p>
Radi sh	<p>Vitamin C and sulfur compounds.</p>	<p>It is diuretic as it eliminates toxins due to its high water content. They increase the secretion of bile in the liver and facilitate the emptying of the gallbladder.</p>	<p>Banihani, S. A., (2017) indicates that radish is considered as a source of vitamins (C, B1, B2 and nicotinic acid), dietary fiber, carbohydrates, proteins, lipids and fluorides, in addition, it has diuretic, antiscorbutic effect, and contains sulfur compounds with</p>	<p>Martinez et al., (2021); Banihani, S. A., (2017).</p>

Turmeric	Curcumin.	Regulates the DNA epigenetic mechanism that prevents the development of cancer cells. Relieves arthritis inflammation due to its anti-inflammatory ability to inhibit the synthesis of inflammatory prostaglandins. Natural agonist of the PPAR receptor - inhibits the uncontrolled proliferation of pro-inflammatory cytokines.	anticarcinogenic activity. According to Mesa et al. curcumin possesses antioxidant, antimicrobial, antifungal, and antiparasitic properties that act as an immune modulator that regulates the function of cancer cells. According to Saiz de Cos, (2014) indicates that the use of this plant inhibits the presence of affections at the level of the bone system, due to its anti-inflammatory function.	Hernán et al., (2016); Saiz De Cos, (2014); Mesa et al., (2000);
Melloco	Phenols (rutin, narcisine and kaempferol)	Protects cells from damage caused by molecules during the metabolic oxidation process. Inhibits hemolysis, lipid peroxidation and generation of superoxide radicals.	Chuquilín, (2020) indicates that melloco has antioxidant capacity due to its different bioactives such as: betalain and purified pigments. Olga Lock, (2018) demonstrated that by consuming this tuber with high phenolic components, flavonoids and tananins, it has a gastroprotective and healing effect.	Lock, (2018); Chuquilín, (2020)
Mashua	Phenolics Anthocyanins Carotenoids Isothiocyanates	It has the ability to synthesize and prevents antioxidants from damaging connective tissue, inflammation or allergies, this compound strengthens ocular microcirculation and capillaries.	Malpartida et al., (2022) demonstrated that mashua has outstanding physicochemical characteristics in its different varieties, antioxidant activity,	Furrow, (2004); Malpartida et al., (2022); Villacres et al., (2013).

			<p>They prevent chemical carcinogenesis, through the suspension of enzymes that are involved in the non-functioning of carcinogens.</p>	<p>bioactive compounds such as polyphenols and glucosinolates, these compounds play a fundamental role in the prevention of cancer and other neurodegenerative diseases. Villacres et al., (2013) indicate that infusions of the fresh tuber are made where the bioactive compound carotenoid is released, which has action on renal affections and rheumatism.</p>	
Froutes	Plum	Vitamin C, E, β -carotene and polyphenols.	<p>It has the ability to inhibit oxidation processes generated by free radicals in the body, preventing degenerative diseases such as atherosclerosis, cardiomyopathy and obesity.</p>	<p>Gonzales et al., (2015) identified polyphenols in plum and these act directly on blood plasma preventing cellular oxidation. Quiñones et al., (2012) pointed out that the antioxidant capacity of polyphenols and β-carotenes, generate a vasodilator potentiating effect, preventing cardiovascular diseases.</p>	<p>Valero et al., (2012); Gonzales et al., (2015); Quiñones et al., (2012)</p>

Apple	Flavanols Anthocyanins Phenols	The capacity of flavanols, anthocyanins and phenols in apples generate an inhibitory effect depending on the presence of chronic neurodegenerative diseases.	Hou, (2002) in his study of apple anthocyanins determined that the free radicals present in the product protect cells against the degeneration of cancer cells and other chronic diseases. Kitdamrongso et al. (2008) in their research indicated that apple polyphenols are potent anticarcinogens in a dose-dependent manner.	Jacques, et al., (2013); Hou, (2002); Kitdamrongso et al., (2008)..
Lemon	Vitamin C, potassium, minerals, citric acid, malic acid, formic acid, limonoids, citroflavonoids, hesperidin, diosmin, naringenin and eriocitrin.	Helps to neutralize erythrogenic substances such as nitrosamines, strengthens the capillary vessel wall, gives greater elasticity to the arteries and decreases thrombus formation.	Olivares et al., (2005) indicates that the consumption of vitamin C is found in large quantities in lemon, helping to reduce asthmatic symptoms, improving respiratory function, it also oxidizes and is easily reduced and reacts with vitamin E reducing the tocoperoxyl radical and resulting in its transformation of α -tocopherol which is its active antioxidant state.	Marquez et al., (2015); Olivares et al., (2005)..
Guava	Phosphorous, vitamins A, B1, B2, C, E and ascorbic acid	Excellent source of dietary antioxidants, such as polyphenols and carotenoids, due to its high percentage of	Martinez, (2011) demonstrated that guava contains vitamins A, B, C, E, phenols and	Jenkins, et al., (1998); Martinez, (2011); Hidalgo et al., (2015).

		<p>vitamin helps to have a good digestion, acting as a prebiotic element that can enclose disease-causing substances.</p>	<p>carotenoids, which are responsible for eliminating free radicals, oxidative stress and metabolic disorders. On the other hand, Hidalgo et al. Hidalgo et al., (2015) cites that being rich in vitamins A, B, C and potassium, it provides antioxidants and detoxifiers that keep the skin healthy and healthy.</p>	
Pear	Polyphenolic compounds	<p>It is capable of eliminating peroxidizing metals and radicals produced during oxidative processes associated with aging, sun exposure and excessive fat consumption.</p>	<p>Quiñones et al., (2012) in their study points out that fruit polyphenols have an antioxidant effect, which can directly neutralize free radicals at the cardiovascular level.</p>	<p>(Barda et al., 2022); Quiñones et al., (2012).</p>
Melon	Carotenoids, flavonoids and polyphenols	<p>The antioxidant properties help fight certain diseases such as cholesterol, diabetes and stimulation of thyroid gland function, as well as antibiotic activities against pathogens such as bacteria, protozoa and viruses.</p>	<p>In a study conducted by (Guiñazú, 2018) melon has a high content of carotenoids these can inhibit the reproduction of neoplastic cells, reducing cancer of the throat, esophagus and lungs. Likewise Carbo et al., (2022)(2022), melon flavonoids are phytochemical compounds with a polyphenolic</p>	<p>Carbo et al., (2022); (Guiñazú, 2018).</p>

			structure with a high antioxidant capacity that helps prevent urinary tract infection, cardiovascular and other chronic diseases.	
Kiwi	Vitamins C, E and K. folates, carotenoids, potassium and fiber	For its great sources of bioactive, it helps to the immune function and antioxidant defense; which has positive effects in such diseases as gastrointestinal.	Satpal et al., (2021) exhibits strong antimicrobial, antiviral and immunomodulatory efficacy due to the presence of bioactive components in kiwifruit.	Satpal et al., (2021); Lopez et al., (2016)
Peaches	Phenols Chlorogenic acid	It helps fight obesity by stimulating glucose absorption, without inducing adipogenesis. Catechin lowers blood pressure.	In their study, Quiñones et al. (2012) found that phenols have beneficial effects on arterial walls, improving blood circulation and preventing heart attacks and apoptosis. On the other hand, Ballesteros et al. (2017) found that chlorogenic acid has the ability to better distribute insulin, in addition to inhibiting blood contraction, this substance is also an effective antioxidant agent, with antiviral, antibacterial, anticancer and anti-inflammatory properties, making it a potential treatment for various diseases.	Castro et al., (2008); Quiñones et al., (2012); Ballesteros et al., (2017).

Red grape	Tannins, phenolic acids, flavonols, Vitamins C and E.	Improves kidney function by the stimulation of organic acid which facilitates its diuretic action. It balances glucose with the help of phytochemicals by leveling the blood glycemic level, by stimulating the pancreas and insulin production.	According to Gámez et al., (2010) grapes contain phenolic compounds whose astringent and antioxidant bioactive properties help to improve food digestion. According to Ayala et al. (2011), the phenolic compounds and vitamins C and E in grapes have the ability to inhibit free radicals in DNA oxidation.	Alonso et al., (2002); Gámez et al., (2010); Ayala et al.; Ayala et al., (2011).	
Orange	Vitamin C, tannins, flavonoids, phytosterols and carotenoids.	They help to boost the body's defense mechanism by preventing viral infectious diseases and have an antioxidant action that prevents damage by free radicals that cause degenerative diseases.	Orane, (2016) in his study on Vitamin C in oranges determines the free radical reducing capacity, its hydrosolubility includes in the absorption of iron and is part of the formation of bones, tendons, cartilage in the gestation period.	Hernández, (2007); Moreno et al., (2004); Orane, (2016)	
Dairy	Cheese	Peptides and amino acids (Casokinins)	It protects against various viral infections, stimulating the immune system, acting in the prevention of colon cancer and increasing blood flow to the intestinal epithelium.	According to Torres et al., (2005) peptides derived from caseic and serum proteins possess the following properties: opioid, antihypertensive, antimicrobial, immunomodulatory, mineral transport and antithrombotic, which protect	Torres et al., (2005); López & Téllez, (2009)

the organism against various viral infections.

Yogurt	Probiotics (<i>Streptococcus thermophilus</i> , <i>Lactobacillus brueckii</i> , <i>subsp bulgaricus</i>)	The addition of live microorganisms that remain active in the intestine exerts physiological effects that can contribute to the balance of the host's intestinal microbiota and boost the immune system.	According to Martínez et al. (n.d.), they indicate that the consumption of probiotics generates efficacy in the reduction of diarrhea due to rotavirus in children and in the treatment with antibiotics in adults; also, it has been observed that certain probiotics cause symptomatic improvements in irritable bowel syndrome and relief of digestive discomfort. Salazar and Montoya (2003) identified that <i>Lactobacillus fermentum</i> acts as a cicatrizant, preventing the union of pathogens on the skin surface through the secretion of proteins.	Zapata et al., (2015); Martínez et al., (n. d.); Salazar & Montoya, (2003).	
Plants medicinal	Lemon balm	Flavonols Polyphenolics (rosmarinic acid, p-coumaric acid, chlorogenic acid, caffeic acid)	It generates a sedative effect and balances the nervous system, combating insomnia, depression, nervous headaches, hysteria and disorders caused by nervous	Cortés et al., (2017) indicated that, the active principles of lemon balm tea showed a powerful cytotoxic effect on the growth of cervical-	Jannat et al., (2010); Cortés et al., (2017);

		tension, has the ability to neutralize the reactive oxygen species (ROS), responsible for the degradation of biomolecules necessary for the functioning of the body.	uterine and colon cancer cells, in addition, they help to enhance the cardiac muscle and improve circulation.	
Nettle	Flavonoid Phenolic acids (caffeic, chlorogenic, neochlorogenic, ferulic)	It inhibits the expression of mutagenic genes and the activity of enzymes responsible for the activation of procarcinogens, and activates the enzyme systems responsible for the detoxification of xenobiotics.	In a study by Vilchez et al., (2020) the phenolic and flavonoid compounds of nettle work by canceling free radicals, initiating the healing of wounds due to its drying and antibacterial properties.	Dieter & Ortega, (2011); Vilchez et al., (2020)..
Paico	Flavonoids such as kaempferol, isoramnetin, quercetin and flavonolglycosides	Anthelmintic especially against ascaris, tapeworm and other intestinal parasites.	Figueroa, (2021) determined that it contains phenolic compounds such as kaempferol and quercetin, which provide a preventive effect against pancreatic cancer, as well as an anti-resorptive effect to avoid bone problems.	(Rebuglio et al., 2011).; Figueroa, (2021)
Lemon verbena	Polyphenols Flavonoids, Alkaloids, Vitamins, Tannins, Saponins, Steroids	The citral component is used in the formulation of hydrating beverages with antioxidant function, generating a pleasant aroma and together with limonenes and terpenes are responsible for recovering the energy generated by physical activity. In the case of functional	According to Ruiz, (2004) the polyphenols present in lemon verbena prevent cardiovascular diseases, chronic degenerative diseases, arteriosclerosis and cancer. And Thomas, (2000) indicates that the beneficial effects of	Enriquez et al., (2023); Thomas, (2000); Thomas, (2000); Enriquez et al. Thomas, (2000); Ruiz, (2004).

beverages, flavonoids inhibit the presence of free radicals. polyphenols and flavonoids have the capacity to inhibit free radicals, acting in all processes in which oxidation processes are reduced or stopped.

4. Conclusions

The effects of bioactive components present in foods were identified in four basic food groups of the human diet: fruits, vegetables, dairy products and plant infusions. These components have beneficial functions for the body. Thirty-three foods were identified as containing bioactive components such as carotenes, polyphenols, vitamins (A, B1, B2, C and E), flavonol compounds, anthocyanins, minerals, acids (citric, malic, formic, ascorbic and chlorogenic), limonoids and tatinins, which have a direct influence on the human organism, preventing diseases such as atherosclerosis, cardiomyopathy, obesity, cardiovascular diseases, Alzheimer's, diabetes, cholesterol, cancer, infectious and gastrointestinal diseases, among others. This is due to its antioxidant capacity, which inhibits free radicals generated by diseases.

References

- Alonso, G. J., M, P. J., & Guevara M, V. L. (2002). Evaluation of antioxidant properties of grape and berry concentrates. In AN. Vet. (Murcia) (Vol. 18).
- Alvídrez, A., González, B. E., & Jiménez, Z. (2002). Trends in food production: functional foods (Vol. 3, Number 3). www.medigraphic.org.mx
- Araya L, Héctor, & Lutz R, Mariane (2003). Functional and healthy foods. *Revista chilena de nutrición*, 30(1), 8-14. <https://dx.doi.org/10.4067/S0717-75182003000100001>
- Ashwell M. (2004). Functional food concepts. ILSI Europe concise Monograph series. 40 p. Available from: <https://pesquisa.bvsalud.org/portal/resource/pt/lil-468929>
- Ayala, J., Vega, V., Rosas, C., Palafox, H., Villa, J., Wasim, M., Dávila, J., González, D. (2011). Agro-industrial potential of exotic fruit byproducts as a source of food additives. *Food Research International* 44 (7): 1866 - 1874.

- Ballesteros, L.F.; Ramirez, M.J. (2017). Optimization of autohydrolysis conditions to extract antioxidant phenolic compounds from spent coffee grounds, <https://doi.org/10.1016/j.jfoodeng.2016.11.014>, *Journal of Food Engineering*: 199, 1-8 (2017).
- Banihani, S. A. (2017). Radish (*Raphanus sativus*) and Diabetes. *Nutrients*. 9, 1014. Doi:10.3390/nu9091014
- Barda, N., Miranda, M., & Suárez, P. (2022). Nutritional and sensory quality of the main commercial varieties of pears and apples.
- Barragan, M., & Aro, J. M. (2017). Determination of the effect of cooking processes in pigmented native potatoes (*solanum tuberosum* spp. *andigena*) on their bioactive compounds. *Revista de Investigaciones Altoandinas - Journal of High Andean Research*, 19(1). <https://doi.org/10.18271/ria.2017.254>
<https://doi.org/10.18271/ria.2017.254>
- Borchers, AT, Keen, CL, Hannum, SM, Gershwin, ME. Cocoa and chocolate: composition, bioavailability, and health implications. *J Med Food* 2000; 3: 77-105.
- Boer, A., Urlings, M., Bast, A. (2016). Active ingredients leading in health claims on functional foods. *Journal of Functional Foods*, 20, 587-593. DOI: <https://doi.org/10.1016/j.jff.2015.11.025>
- Brizuela, M. A. (2003). Selection of lactic acid bacteria strains to obtain a preparation with probiotic properties and its evaluation in pigs. ("Serum fermented by *Lactobacillus casei* and *Lactobacillus acidophilus* ...") ICIDCA. Thesis in option of the scientific degree of Doctor of Veterinary Sciences. ("Carcass yield of different bovine genotypes raised at ... - SciELO")
- Carbo, V., De, R., Zambrano, J., Edison, Z., Carrillo Rodríguez, Q. F., & Fernanda, M. (2022). Comparative study of phytochemical compounds and antioxidant activity between fresh and dehydrated peel of *Cucumis melo* L. (Melon). <http://repositorio.ug.edu.ec/handle/redug/65587>
- Cardero, Y., Selva, A., & Sarmiento, R. (2009). Importance of iron and vitamin C intake for the prevention of iron deficiency anemia. *Medisan*, 13(6), 0–0. http://scielo.sld.cu/scielo.php?script=sci_arttext&pid=S1029-30192009000600014&lng=es&nrm=iso&tlng=pt
- Carrozi, L., M.G. Goñi, L. Di Gerónimo, S.I. Roura, A Yommi (2012). Characterization of antioxidant compounds present in celery

according to maturity stage, Asociación argentina de horticultura (7600): 5-11.

- Castro, A, J., Mirand, A, C, González, M, M, Salazar, L, A. (2008). *Cecropia obtusifolia* Bertol and its active compound, chlorogenic acid, stimulate 2-NBDglucose uptake in both insulin-sensitive and insulin-resistant 3T3 adipocytes. *J Ethnopharmacol.* 120, 458-64.
- Chuquilín, R. C. (2020). Functional properties of traditional freeze-dried and sun-dried oca (*Oxalis tuberosa* Molina) and olluco (*Ullucus tuberosus* Caldas) products: A review. 2, 363-387.
- Cortés, F., Delgado, J., Delgado, N., Torres, C., & Tiemann, Y. (2017). To know the effect on the growth of cervical uterine cancer cells of ethanolic extracts obtained from laurel and lemon balm from Cuyo and to compare their action together and individually in in vitro assays carried out during 2016. <http://repositoriobibliotecas.uv.cl/handle/uvsc1/4823>
- Delzenne, M., J. Aertssens, H. Verplaeste, M. Roccaro, and M. Roberforid (1999). Effect of fermentable fructooligosaccharides on mineral, nitrogen, and energy digestive balance in the rat. *Life Sci.* 17, 1579-1587
- Dieter, K. & Ortega, F. (2011). *La botica de Dios, Medicinal plants and their use.* Quito, Ecuador: Trama Ediciones.
- Enriquez, M. Á., Poveda, S. E., & Alvarado, G. I. (2023). Bioactives from lemon verbena used in industry. *Revista Mexicana de Ciencias Agrícolas*, 14, 1-11.
- Enriquez, M., Vega, K. M., & Uvidia, H. (2022). Functional foods the consumption trend of the 21st century. *Reciena*, 2(1), 10-19. <https://doi.org/10.47187/RECIENA.V1I3.22>
- Faria, D., & Anjo, C. (2004). Alimentos funcionais em angiologia e cirurgia vascular Functional foods in angiology and vascular surgery. *J Vasc Br*, 3(2), 145-154.
- Figueroa, A. (2021). Antioxidant capacity and fatty acids, polyphenols, bioactive compounds: paico leaf terpenes [*dysphania ambrosioides* and tocopherols (L.) En Mosyakin & Clemants].
- Flores, C, H., Rosales Pérez, S., Caro Sánchez, C. H. S., Gallardo Alvarado, L., & Gordillo Bastidas, D. (2015). Dietary nutrients and apoptosis as regulatory mechanisms of cancer. *Archives of Medicine*, 2. <https://doi.org/10.3823/1235>
- Fuentes, H., Muñoz, D., Aguilera, R., & González, C. (2018). Influence of the bioactive compounds of beetroot (*Beta vulgaris* L) on the cardioprotective effect: A narrative review. In *Revista Chilena de Nutricion* (Vol. 45, Number 2, pp. 178-182). Sociedad Chilena de

Nutricion Bromatologia y Toxologica.
<https://doi.org/10.4067/S0717-75182018000300178>

- Gámez, N., Molina, D. M. A., Medina, L. A., González, G. A., & Robles, R. M. (2010). Phenolic compounds and antioxidant activity of table grape (*Vitis vinifera* L.) skin from northwest Mexico Phenolic compounds and antioxidant activity of table grape (*Vitis vinifera* L.) skin from northwest Mexico. 8(1), 57-63. <https://doi.org/10.1080/19476330903146021>
- García, M. N., Landaeta, M., Adrianza de Baptista, G., Murillo, C., Rincón, M., Bou Rached, L., Bilbao, A., García, D., Franquiz, J., & Puche, R. (2013). Reference values of iron, iodine, zinc, selenium, copper, molybdenum, vitamin C, vitamin E, vitamin K, carotenoids and polyphenols for the Venezuelan population.
- Garzón, G. A. (2008). Anthocyanins as natural colorants and bioactive compounds: review. *Acta Biológica Colombiana*, 13(3), 27-36. http://www.scielo.org.co/scielo.php?script=sci_arttext&pid=S0120-548X2008000300002&lng=en&nrm=iso&tlng=es.
http://www.scielo.org.co/scielo.php?script=sci_arttext&pid=S0120-548X2008000300002&lng=en&nrm=iso&tlng=es.
- Gonzales, F., Hernández, N., Cooper, B., Núñez, L., & Reyes, M. (2015). Use of Antioxidants in several Chronic and Degenerative Diseases Treatment, 16-21.
- Gorgojo, L., & Martín, J. M. (2002). Lycopene and health: About tomato and some of the virtues of gazpacho, "pa amb tomàquet" and other products of our gastronomy. *ANS. Food, Nutrition and Health*, 9(1), 17-26. <https://dialnet.unirioja.es/servlet/articulo?codigo=233678&info=resumen&idioma=SPA>.
<https://dialnet.unirioja.es/servlet/articulo?codigo=233678&info=resumen&idioma=SPA>.
- Gress, K. C. (2023). Importance View of Functional Foods. 10, 6-7. <https://repository.uaeh.edu.mx/revistas/index.php/prepa2/article/view/10418/9963>
- Guesry, P. R. (2005). Impact of 'functional food'. *Forum Nutr* 73-83.
- Guevara, A., Cancino, K., & Llontop, G. (2017). Effect of organic sterilization system (OSS) on the nutritional and functional properties of yacon (*Smallantus sonchifolius* Poepp. & Endl.). *Journal of the Chemical Society of Peru*, 83(3), 308-318.

- http://www.scielo.org.pe/scielo.php?script=sci_arttext&pid=S1810-634X2017000300006&lng=es&nrm=iso&tlng=en.
- Guñazú, C. (2018). Influence of nematode population on the composition of bioactive compounds melon in cantaloup and durinta tomato.
- Guzmán-Maldonado, SH, Paredes-López, O. Functional products of plants indigenous to Latin America: amaranth, quinoa, common beans, and botanicals. In: G. Mazza, ed. *Functional Foods. Biochemical and processing aspects*. Technomic Pub. Co Lancaster, USA, 1998; pp. 293-328.
- Hasler, CM. Functional foods: benefits, concerns and challenges - A position paper from the American Council on Science and health. *J Nutr* 2002; 132: 3772-3781.
- Hemei, Z. S. (2017). Hypolipidaemic and hypoglycaemic properties of pumpkin polysaccharides. *Biotech*, 3-7.
- Higdon, J., Delage, B., Williams, D, Dashwood, R, H. (2007). Cruciferous vegetables and human cancer risk: Epidemiological evidence and mechanistic basis. *Pharmacol Res*. 55: 224-36.
- Hernán, A., Echeverry, C., Fernando, D., Yunda, U., Fabian, I. I., Cortés, M., Instituto, I. I., & Metropolitano, T. (2016). Antitumor activity of curcumin associated with regulation of epigenetic mechanisms: implications for the Wnt/-catenin pathway. In *Revista Cubana de Plantas Medicinales* (Vol. 21, Number 4).
- Hernández, G. (2007). "Evaluation of the antihyperglycemic effect of orange bagasse (citrus sinensis var. valencia) in the autonomous university of the state of hidalgo institute of health sciences academic area of nutrition.
- Hidalgo, R., Gómez, M., Escalera Cruz, D. Á., & Quisbert Díaz, S. (2015). Health benefits of guava. *Journal of Health Research and Information*, 10, 27-32. http://www.revistasbolivianas.ciencia.bo/scielo.php?script=sci_arttext&pid=&lng=es&nrm=iso&tlng=.
- Hou, DX. (2002). Potential mechanisms of cancer chemoprevention by anthocyanins. *Curr Mol Med*. (2):149.
- Ida Del Greco, N. (2010). Food consumption trend study.
- Imran, M., Aslam, T., Atif, M., Shahbaz, M., Batool, T., Hanif, M., Salehi, B., Martorell, M., & Sharifi-Rad, J. (2020). Apigenin as an anticancer agent. *Phytotherapy Research*, 34(8), 1812-1828. <https://doi.org/10.1002/PTR.6647>.

- Izquierdo, A., Armenteros, M., Lancés, L., & González, I. M. (2004). Healthy eating. 20. http://scielo.sld.cu/scielo.php?script=sci_arttext&pid=S0864-03192004000100012
- Jacques, Cassidy A, Rogers G, Peterson JJ, Meigs JB, Dwyer JT. (2013). (":: JNH :: Journal of Nutrition and Health") "Higher dietary flavonol intake is associated with lower incidence of type 2 diabetes." *J Nutr*, 143 (9):1474-1480.
- Jannat B, Oveisi MR, Sadeghi N, Behzad M, Choopankari E, Behfar AA. effects of roasting temperature and time on healthy nutraceuticals of antioxidants and total phenolic content in Iranian sesame seeds (*Sesamum indicum* L.). *Irian J Environ Health Sci Eng* 2010, 7 (1): 97-102.
- Jenkins, D. J.; Kendall, C. W. and Ransom, T. P. (1998). Dietary fiber, the evolution of the human diet and coronary heart disease. *Nutrition Research*, 18(4), 633-652.
- Jimenez, L. (2017). Scaling up the Production of Functional Beverages from Non-Traditional Vegetable Products. Colombia. National University of Colombia. Retrieved from <http://bdigital.unal.edu.co/57202/7/LuisE.Jim%C3%A9nezCucaita.2017.pdf>
- Kanner, J., S. Harel, and R. Granit (2001). Betalains: A new class of dietary cationized antioxidants. *J. Agric Food Chem.* 49: 5178-5185.
- Kitdamrongsont, K., Pothavorn, P., Swangpol, S., Wongniam, S., Atawongsa, K., Svasti, J., & Somana, J. (2008). Anthocyanin composition of wild bananas in Thailand. *Journal of Agricultural and Food Chemistry*, 56(22), 10853-10857. <https://doi.org/10.1021/jf8018529>.
- Koletzko, B., Aggett, P. J., Bindels, J. G., Bung, P., Ferre, P., Gil, A., Lentze, M. J., Roberfroid, M., & Strobel, S. (1998). Growth, development and differentiation: a functional food science approach. *Br J Nutr* 80 Suppl 1: S5-45.
- Kumazawa Y, Kawaguchi K, Takimoto H. (2006). Immunomodulating effects of flavonoids on acute and chronic inflammatory responses caused by tumor necrosis factor alpha. *Curr Pharm Des.*12(32):4271-9.
- Lam TK, Gallicchio L, Lindsley K, Shiels M, Hammond E, Tao X, et al. (2009). Cruciferous Vegetable Consumption and Lung Cancer

- Risk: A Systematic Review. *Cancer Epidemiol Biomarkers Prev.*;18(January):184-95.
- Lock de Ugaz O. (2018). *Phytochemical research. Methods in the study of natural products.* 2 da Ed. Lima: Fondo Editorial de la Pontificia Universidad Católica del Perú.
- López, A. M., Aparicio, A., & Ortega, R. M. (2016). Nutritional and health benefits associated with kiwi consumption. *Nutricion Hospitalaria*, 33, 21-25. <https://doi.org/10.20960/nh.340>. <https://doi.org/10.20960/nh.340>
- López, L. B., & Téllez, G. A. (2009). Animal foods with nutraceutical effects for human health. *Revista Ciencia Animal*, 1(2). <https://ciencia.lasalle.edu.co/ca/vol1/iss2/5>. <https://ciencia.lasalle.edu.co/ca/vol1/iss2/5>.
- Maeda, N., Yoshida, H., & Mizushima, Y. (2010). Spinach and Health: Anticancer Effect. *Bioactive Foods in Promoting Health*, 393-405. <https://doi.org/10.1016/B978-0-12-374628-3.00026-8>. <https://doi.org/10.1016/B978-0-12-374628-3.00026-8>
- Malpartida, R. J., Adama, J. M., Cajachagua, Y. Y., & Rosales, M. C. (2022). Physicochemical characteristics, nutritional composition and bioactive compounds in three varieties of Mashua (*Tropaeolum tuberosum* Ruiz y Pavón): A review. *Revista Tecnológica - ESPOL*, 34(2), 40-50. <https://doi.org/10.37815/rte.v34n2.891>
- Martínez, C. (2004). Functional effects of foods. *British Journal of Nutrition*, 91(3), 491-500. <https://doi.org/10.1079/BJN20031034>
- Márquez, E., del Toro, C., Ramírez, J., & Uresti, R. (2015). Functional foods and bioactive compounds. <https://www.researchgate.net/publication/342601000>.
- Martínez M. Martha, Ortiz Quintero Blanca, Pérez Gualdrón Clara E., Anzola Velasco Cecilia (2011). Effect of pectin extracted from guava on lipid profile in adults with different cardiovascular condition. Bogotá-Colombia: *Revista de la Facultad de Medicina, Universidad Nacional de Colombia*, Vol. 59, No. 2.
- Martínez, L., Castillejo, N., Gómez, P. A., Pedreño, J. L., & Artés, F. (2021). Effect of postharvest UV-B and UV-C radiation on the bioactive quality of broccoli and radish sprouts. <https://www.redalyc.org/articulo.oa?id=81369610010>
- Martínez, M. C., Peláez, C., & Requena, T. (n. d.). Probiotics in human health.
- Meléndez-Martínez AJ, Vicario IM, Heredi FJ (2004). Stability of carotenoid pigments in foods. *Arch Lat Nutr*; 54(2): 209-215.

- Mesa, Ramirez, M. C., Aguilera, C. M., Ramirez, A. Y., & Gil, A. (2000). Pharmacological and nutritional effects of *Curcuma longa* L. extracts and curcuminoids. *Pharmacological and nutritional effects of Curcuma longa L. extracts and curcuminoids*. In *Ars Pharmaceutica* (Vol. 41, Number 3).
- Millone, M., Olagena, G., & Santana, E. (2011). Functional foods: analysis of recommendation in daily practice. *Diaeta*, 7-15.
- Moreno, M. J., Camacho, D. R. B., Sánchez, M. P., Matos, M. V., & García, D. (2004). Evaluation of the antioxidant activity of orange peel flavonoid extracts in deodorized soybean oil. *Interciencia*, 29(9), 532-538. http://ve.scielo.org/scielo.php?script=sci_arttext&pid=S037818442004000900011&lng=es&nrm=iso&tlng=es
- Nagournay, RA. Garlic: medicinal food or nutritious medicine? *J Med Food* 1998; 1: 13-28.
- Neyra, L. C. (2007). *Functional foods* (Vol. 7).
- Olivares, I. M., Guzmán, A. M., Sierra, M. P., Mendoza, R. D. S., & Hicks, J. J. (2005). Perspectives on the use of antioxidants as adjuvants in the treatment of asthma. 154-161. www.iner.gob.mx154
- Oliveira, L. A. (2010). Yacon (*Smallanthus sonchifolius*): total phenolic compounds and effects on glycemia and oxidative stress in diabetic patients. *Aleph*. <https://doi.org/10.17616/R31N39>
- Oomah, BD, Mazza, G. Flaxseed products for disease prevention. In: G. Mazza, ed. *Functional Foods. Biochemical and processing aspects*. Technomic Pub. Co Lancaster, USA, 1998; pp. 91-138.
- Orane, A. L. (2016). Topic-2016: Nutritional requirements in pregnancy and where to supplement from. 6. www.revistaclinicahsjd.ucr.ac.cr
- Parlato, R., Rosica, A., Rodriguez-Mallon, A., Affuso, A., Postiglione, M. P., Arra, C., Mansouri, A., Kimura, S., di Lauro, R., & de Felice, M. (2004). An integrated regulatory network controlling survival and migration in thyroid organogenesis. *Developmental Biology*, 276(2), 464-475. <https://doi.org/10.1016/J.YDBIO.2004.08.048>.
- Pérez, H. (2006). Nutraceuticals: emerging component for the benefit of health. *Icidca. On Sugarcane Derivatives*, XL (3), 20-28.
- Procisur (2014). Characterization of the nutritional value of foods Cooperative Program for the Technological Development of

AgriFood and Agroindustrial Technology of the Southern Cone. www.iica.int

- Quiñones, M., Miguel, M., & Aleixandre, A. (2012). Review Polyphenols, naturally occurring compounds with healthy effects on the cardiovascular system. *Nutr Hosp*, 27(1), 76-89. <https://doi.org/10.3305/nh.2012.27.1.5418>.
<https://doi.org/10.3305/nh.2012.27.1.5418>
- Rao, A. V., & Agarwal, S. (2000). Role of antioxidant lycopene in cancer and heart disease. *Journal of the American College of Nutrition*, 19(5), 563-569. <https://doi.org/10.1080/07315724.2000.10718953>
- Rebuglio, J., Regasini, L. O., Maissar, N., Bolzani, V. da S., Khalil, O. A., Manente, F. A., Netto, H. P., & Oliveira, O. (2011). Antioxidant and cytotoxic studies for kaempferol, quercetin and isoquercitrin (Vol. 36).
- Reyes, A., Zavala D., & Alonso, A. (2012). Parsley (*Petroselinum crispum*): chemical compounds and applications. *Revista Académica de Investigación Tlatemoani* N°11.
- Reyes, A., Zavala, D., & Alonso-Martínez, A. (2012). parsley (*petroselinum crispum*): chemical compounds and applications. <http://www.eumed.net/rev/tlatemoani/index.htm>
- Roberfroid M.B. (2000). "Concepts and strategy of functional food science: the European perspective." ("Concepts and strategy of functional food science: the European ...") *Am. J. Clin. Nutr.* 71(6): 1669S-1664S.
- Roberfroid, M. B. (1999). What is beneficial for health? The concept of functional food. *Food Chem Toxicol* 37: 1039-1041.
- Rodríguez M. (2001). Phytotherapy in various conditions in internal medicine. In: *Introducción a la fitoterapia*. Mexico: Herbal. p. 107-14
- Rodriguez, M. R., Aguilar, A., Fernandes de Oliveira, L., Cabrera, A. A., & Hojairo Toledo Jayo, D. (2019). Anesthetic and anticancer properties of Capsaicin. *Journal of Health Research and Information*, 14(38), 20-30. <https://doi.org/10.52428/20756208.v14i38.323>.
<https://doi.org/10.52428/20756208.v14i38.323>
- Ross SA, Finley JW, Milner JA (2006). Allyl sulfur compounds from garlic modulate aberrant crypt formation. *J Nutr.* 136(3 Suppl): 852S-854S.
- Ruiz, I. O. (2004). Antioxidant activity, total polyphenols in the aqueous extract of lemon verbena (*cymbopogon citratus* stapf), and its stability in beverage models.

- Sainani, G.S., D.B. Deasi, and K.N. More (1976). Onion, garlic, and arteriosclerosis.
- Saiz De Cos, P. (2014). Turmeric I (*Curcuma longa* L.). *Reduca (Biology)*. Botanical Series, 7(2), 84-99. www.eol.org
- Salazar, B. C., & Montoya, O. I. (2003). Importance of probiotics and prebiotics in human health. 10, 20-26.
- Sanca, M. D. (2011). Types of scientific research. *Journal of Clinical Update*, 9, 621-624.
- Sandoval-Peraza, V. M., Cu-Cañetas, T., Peraza-Mercado, G., Oscar, P., & Acereto-Escoffié, M. (2016). Introduction in the encapsulation processes of nutraceutical molecules. https://docplayer.es/62173811-Introduccion-en-los-procesos-de-encapsulacion-de-moleculas-nutraceuticas.html#show_full_text
- Satpal, D., Kaur, J., Bhadariya, V., & Sharma, K. (2021). *Actinidia deliciosa* (Kiwi fruit): A comprehensive review on the nutritional composition, health benefits, traditional utilization, and commercialization. *Journal of Food Processing and Preservation*, 45(6), e15588. <https://doi.org/10.1111/JFPP.15588>
- Sedó, P. (2002). The functional food market and the new challenges for food - nutrition education. *Revista Costarricense de Salud Pública*, 11(20), 18-25. http://www.scielo.sa.cr/scielo.php?script=sci_arttext&pid=S1409-14292002000100004&lng=en&nrm=iso&tlng=es
- Shipp, J. and Abdel, S. M. 2010. Food Applications and Physiological Effects of Anthocyanins as Functional Food Ingredients. *The Open Food Science Journal*, 4:7-22.
- Sloan, E. (1999). The new market: foods for the not-so-healthy. *Food Technol.* 53:54-60.
- Soto, D., Wittig, E., Guerrero, L., Garrido, F., & Fuenzalida, R. (2006). Functional foods: Chilean consumer behavior. *Revista chilena de nutrición*, 33(1), 43-54. <https://doi.org/10.4067/S0717-75182006000100005>
- Surco, F. (2004). Characterization of starches isolated from Andean tubers: mashua (*Tropaeolum tuberosum*), oca (*Oxalis tuberosa*), olluco (*Ullucus tuberosus*) for their technological application.
- Surh, Y. J. (2003). Cancer chemoprevention with dietary phytochemicals. *Nat. Rev. Cancer*; 3: 768-780.

- Torija, M. E., Cruz Matallana, M., & Chalup, N. (2013). Garlic and onion: from ancient medicines to current interest* Garlic and onion: from ancient medicine to current interest. *Bol. R. Soc. Esp. Hist. Nat. Sec. Biol*, 107, 29-37. <http://dioscorides.eusal.es/>;
- Torres, M. de J., Vallejo, B., & González, A. F. (2005). Bioactive peptides derived from milk proteins. *Archivos Latinoamericanos de Nutrición*, 55(2), 111-117. http://ve.scielo.org/scielo.php?script=sci_arttext&pid=S0004-06222005000200002&lng=es&nrm=iso&tlng=es
- Thomas, M. (2000). The Role of free radicals and antioxidant Nutrition. Volume 16. numbers 718.
- Trescastro, E. M., & Bernabeu, J. (2015). Functional foods: Necessity or luxury? *Revista Espanola de Nutricion Humana y Dietetica*, 19(1), 1-3. <https://doi.org/10.14306/renhyd.19.1.153>
- Tuorkey MJ (2015). Cancer Therapy with Phytochemicals: Present and Future Perspectives. *Biomed Environ Sci [Internet]. The Editorial Board of Biomedical and Environmental Sciences*;28(11):808-19. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/26695359>.
- Tur, J.A. and Bibiloni, M.M. (2015). Functional Foods. *Encyclopedia of Food and Health*, 1, 157-161.
- Valenzuela, A., Valenzuela, R., Sanhueza, J., Morales, G., & Dirigir, L. (2014). Functional foods, nutraceuticals and foshu: are we moving towards a new food concept? Functional foods, nutraceuticals and foshu: are we going to a novel food concept? In *Rev Chil Nutr (Vol. 41)*.
- Valero, Y., Colina, J., & Ineichen, E. (2012). Effect of processing on the antioxidant capacity of creole plum (*Prunus domestica*).
- Van Breda SG, Van Aagen E, Van Sanden S, Burzykowski T, Kleinjans JC, Van Delft JH. (2005). Vegetables affect the expression of genes involved in carcinogenic and anticarcinogenic processes in the lungs of female C57BI/6 mice. *J Nutr*; 135:2546-52.
- Ventrera, N. B., Vignoni, L., Alessandro, M. S., Césari, M., Césari, R., Guinle, V., Giménez, A., & Tapia, O. (2013). Characterization β -carotene content of eight cultivars of carrot (*Daucus carota* L.) and its relation to the color. *Ciencias Agrarias*, 45(2), 211-218. <http://www.redalyc.org/articulo.oa?id=382837655012>.
- Vieira, B., Barreira, M. and Oliveira, B. (2016). Natural phytochemicals and probiotics as bioactive ingredients for functional foods: Extraction, biochemistry and protected-delivery technologies. *Trends in Food Science & Technology*, 50, 144-158. ("Natural

- phytochemicals and probiotics as bioactive ingredients for ...")
DOI: <https://doi.org/10.1016/j.tifs.2015.12.007>
- Vílchez, H. A., Inocente, M. A., & Flores, O. B. (2020). Healing activity of six hydroalcoholic plant extracts on incised wounds of *Rattus norvegicus albinus*. 86-100.
- Villacres, E., Quelal, M & Álvarez, J. (2013). Nutrition, Processing and Gastronomy of Andean Roots and Tubers in Ecuador: A Bibliographical Review of Potato, Melloco, Oca, Mashua, White Carrot and Jicama. Retrieved from: <http://repositorio.iniap.gob.ec/bitstream/41000/2816/1/iniapsc302.pdf>
- Villagrán, M., Muñoz, M., Díaz, F., Troncoso, C., Celis-Morales, C., Mardones, L., Villagrán, M., Muñoz, M., Díaz, F., Troncoso, C., Celis-Morales, C., & Mardones, L. (2019). A current look at vitamin C in health and disease. *Revista chilena de nutrición*, 46(6), 800-808. <https://doi.org/10.4067/S0717-75182019000600800>.
- Wahyuni, Y., Ballester, A. R., Sudarmonowati, E., Bino, R. J., & Bovy, A. G. (2013). Secondary metabolites of *Capsicum* species and their importance in the human diet. ("Secondary metabolites of *Capsicum* species and their importance in the ...") *Journal of natural products*, 76(4), 783-793. <https://doi.org/10.1021/np300898z>
- Wall, Medrano, A., Olivas-Aguirre, F. J., Velderrain-Rodríguez, G. R., González-Aguilar, A., de La Rosa, L. A., López-Díaz, J. A., & Álvarez-Parrilla, E. (2015). Mango: Agroindustrial aspects, nutritional/functional value and health effects. In *Nutricion Hospitalaria* (Vol. 31, Number 1, pp. 55-66). Grupo Aula Medica S.A. <https://doi.org/10.3305/nh.2015.31.1.7701>.
- Wollin, SD, Jones, JH. Alcohol, red wine and cardiovascular disease. *J Nutr* 2001; 131: 1401-1404.
- Zapata, I. C., Sepúlveda-Valencia, U., & Rojano, B. A. (2015). Effect of storage time on physicochemical, probiotic and antioxidant properties of yogurt flavored with mortiño (*Vaccinium meridionale* Sw). *Informacion Tecnologica*, 26(2), 17-28. <https://doi.org/10.4067/S0718-07642015000200004>.
<https://doi.org/10.4067/S0718-07642015000200004>
- Zi, Zhang, Shao, Fan, Yuan, Zheng, Jun Lu, Dong, Wua, Qun, Shan, Bin, Hu (2009). Purple sweet potato color attenuates oxidative

stress and inflammatory response induced by D-galactose in mouse liver. Food Chem Toxicol; 47: 496-501. file:///D:/Mis%20Documents/Downloads/Dialnet-Diet-NutrientsAndApoptosisAsRegulatedMechanisms-5015295.pdf.