The Role of Dietary Polyphenols in preventing cancer and Their Mechanism of Action: A Review

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Abstract
Dietary polyphenols are antioxidants that can scavenge biological free radicals, and chemoprevent diseases with biological oxidation as their main etiological factor. Due to this reason they have gained much interest benefits to human health such as anti-carcinogenic, anti-atherogenic, anti-ulcer, antithrombotic, anti-inflammatory, immune modulating, anti-microbial, vasodilatory and analgesic effects. This review covers about the classification, bioavailability, antioxidant properties, metabolism and cancer preventive mechanism of certain dietary polyphenols. Bioavailability differs greatly from one polyphenol to another, so that the most abundant polyphenols in our diet are not necessarily those leading to the highest concentrations of active metabolites in target tissue. Dietary polyphenols may exert their anticancer effects through several possible mechanisms, such as removal of carcinogenic agents, modulation of cancer cell signaling and antioxidant enzymatic activities, and induction of apoptosis as well as cell cycle arrest. There are many types of poly phenol which are responsible for preventing of cancer like green tea fight against cancers of the stomach, bladder, esophagus, and prostate by modulation of signal transduction pathways, Red wine for lung cancer by reducing basal and EGF-stimulated Akt and Erk phosphorylation while it increased the levels of total and phosphorylated p53 (Ser15), The chemopreventive activity of curcumin is against most cancers such as colorectal, pancreatic, liver, lung, prostate and breast cancer, cocoa polyphenols and tamoxifen, a drug widely used for breast cancer treatment, similar to that described for EGCG, argan oil may be interesting in the development of new strategies for prostate cancer prevention. From these review, we conclude that there is evidence to assume that dietary polyphenols from have a differential cytotoxic effect on tumour cells relative to comparable normal cells from the same tissue derived from the same patient.

Keywords: *Polyphenols, antioxidants, anticancer properties, bioavailability, metabolism*

I. Introduction

The term polyphenols refers to a group of chemical substances found in plants which are characterized by the presence of more than one phenol unit, for example, hydrolysable tannins (gallic acid) and phenylpropanoids (**Ivanildo *et al*., 2010**). Chemical compounds that are naturally occurring dietary components and their influence on human body are more and more interesting for scientists (**Anna *et al*., 2005**). Over the past 10 years, researchers and food manufacturers have become increasingly interested in polyphenols. The chief reason for this interest is the recognition of the antioxidant properties of polyphenols, their great abundance in our diet, and their probable role in the prevention of various diseases associated with oxidative stress, such as cancer and cardiovascular and neuro degenerative diseases (**Claudine *et al*., 2004**). For these purposes, antioxidant activity refers to both the ability of polyphenol compounds to prevent damage from reactive oxygen species (ROS) (such as through radical scavenging) or to prevent generation of these species by binding iron (**Nathan and Julia, 2009).**

The main dietary sources of polyphenols are fruits and beverages. Fruits like apple, grape, pear, cherry and various berries contain up to 200–300 mg polyphenols per 100 g fresh weigh (**Reza *et al*., 2010**). Typically, a glass of red wine or a cup of tea or coffee contains about 100 mg polyphenols. Cereals, chocolate, and dry legumes also contribute to the polyphenol intake. The total dietary intake is about 1 g/d. It is much higher than that of all other known dietary antioxidants, about 10 times higher than that of vitamin C and 100 times higher than those of vitamin E and carotenoids. (**Augustin *et al*., 2005**). These molecules are identified as the secondary metabolites of plants that contain one or more hydroxyl (–OH) groups attached to -ortho, -meta or -para positions on a benzene ring (**Rahul *et al*., 2015**). They also exhibit many biologically significant functions, such as protection against oxidative stress, and degenerative diseases (**Xiuzhen *et al*., 2007**). The intake of these compounds is an important health protecting factor. These bioactive compounds retard or inhibit lipid autoxidation by acting as radical scavengers and consequently, are essential antioxidants that protect against the propagation of the oxidative chain (**Patricia *et al*., 2010**).

As antioxidants, polyphenols may protect cell constituents against oxidative damage and limit the risk of various degenerative diseases associated to oxidative stress. Experimental studies strongly support a role of polyphenols in the prevention of cardiovascular disease, cancer, osteoporosis, diabetes mellitus and neurodegenerative disease (**Massimo *et al.*, 2007**). Furthermore, poly-phenols, which constitute the active substances found in many medicinal plants, modulate the activity of a wide range of enzymes and cell receptors. In this way, in addition to having antioxidant properties, polyphenols have several other specific biological actions that are as yet poorly understood (**Claudine *et al.*, 2004**). Due to their biological properties, polyphenols may be appropriate nutraceuticals and supplementary treatments for various aspects of cancer. Our aim here is to review the current evidences in relation to several potential of these bioactive components to prevent cancer and related metabolic disorders.

II. Classification and Properties of dietary Polyphenol

A. Classification of dietary Polyphenol

Polyphenols are divided into several classes according to the number of phenol rings that they contain and to the structural elements that bind these rings to one another (**Zahra *et al*., 2013, Alessandra and Luca, 2013**). Phenolic compounds constitute one of the most extensive groups of chemicals in the plant kingdom. It is estimated that more than 8000 compounds have been isolated and described (**Giuseppina *et al*., 2014**). These molecules are secondary metabolites of plants and are generally involved in defense against ultraviolet radiation or aggression by pathogens (**Claudine *et al*., 2004**). These compounds may be classified into different groups as a function of the number of phenol rings that they contain and of the structural elements that bind these rings to one another. Many polyphenols have been identified in plants which are classified as flavonoids, phenolic acids, stilbenes and lignans depending on their chemical structures (**Gulcin and Reza, 2013**) as shown in **Figure 1.** The most common phenolics in human diet are phenolic acids, flavonoids and tannins. Phenolic compounds have at least one aromatic ring with one or more hydroxyl groups, and may be classified as flavonoids and non-flavonoids (**Giuseppina *et al*., 2014**). Ellagic acid and stilbenes are among the major non-flavonoid polyphenols. Anthocyanins, catechins, flavones, flavonols and isoflavones are included in the flavonoid polyphenols (**L.G. Rao *et al*., 2012, Terefe, 2015**). The flavonoids are obtained by the lengthening of the side chain of cinnamic acids by the addition of one or more C_2 units, typically resulting in mixed biosynthesis metabolites with important biological properties (**Gianmaria *et al*., 2011**). Most flavonoids occurred as glycoside forms, and the most abundant aglycons are quercetin and kaempferol (**Hiroyuki *et al*., 2003**).

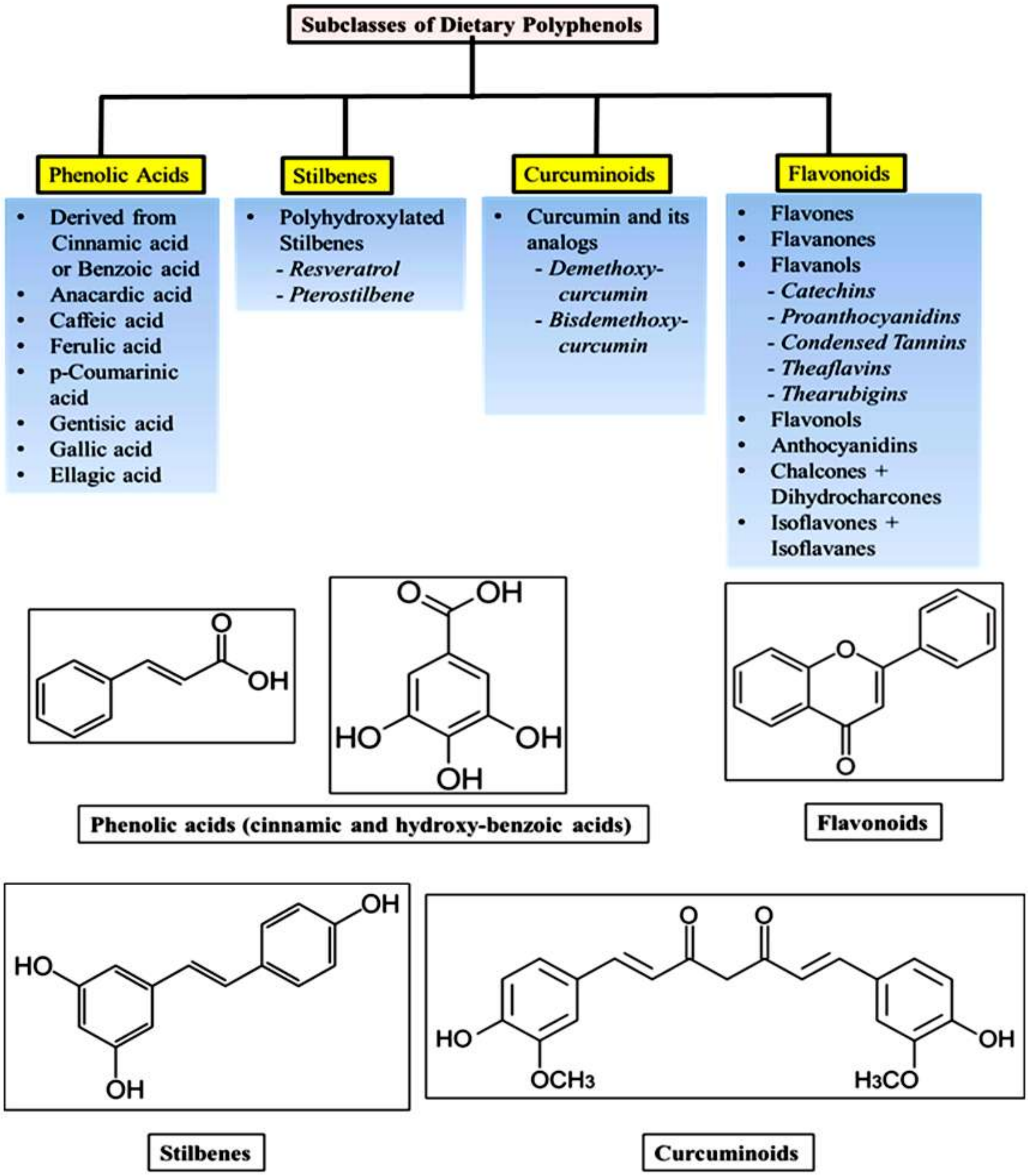
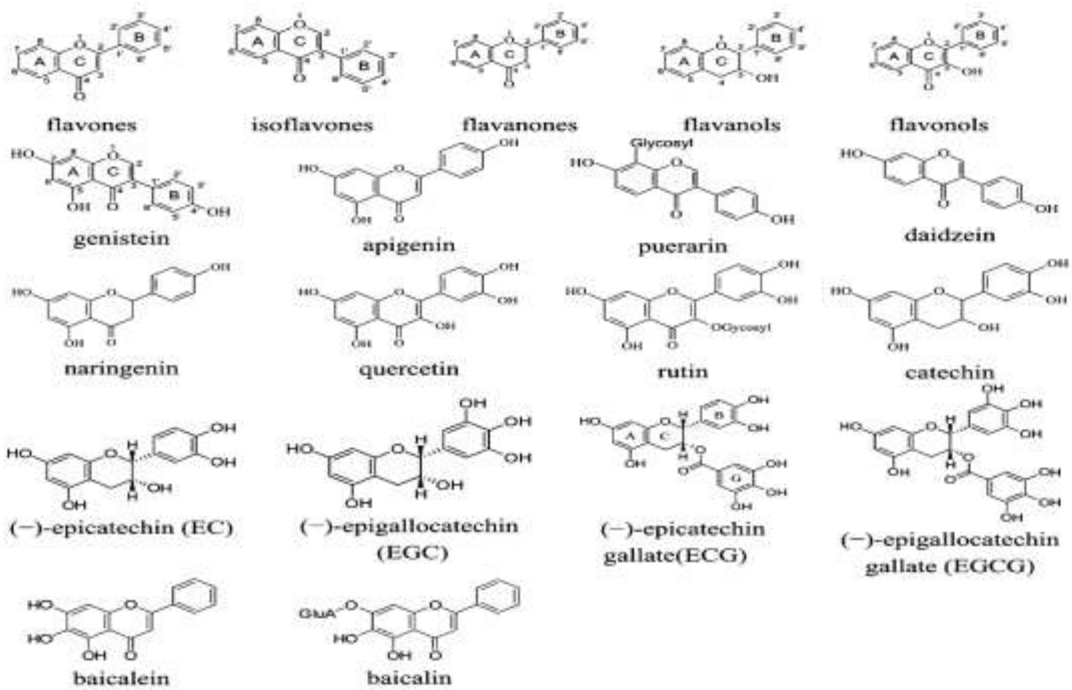


Figure 1. Subclasses and general structures of polyphenols**.**

Flavonoids and their glycosides act as hydrophilic antioxidants, antimicrobials, photoreceptors, visual attractors, feeding repellants, and as UV-light filters and substrate for Polyphenol oxidases protecting tissue after physical damage to plants. It is reported that flavonoids might account for the health benefits associated with vegetable and fruit consumption (**Rui-Min Han *et al.*, 2012**). Flavonoid containing phytomedicals are used as anti-inflammatory and anti-allergic remedies and a flavonoid-rich diet is suggested to play a role in the prevention of several kinds of cancer and cardiovascular disorders (**Ulrike et al., 2011**). Flavonoids are built upon a C_6-C_3-C_6 flavone skeleton in which the two aromatic rings are linked by three carbons cyclized with oxygen. Several classes of flavonoids are shown in Scheme 1 (**Ozcan *et al.*, 2014**).



Scheme 1. Backbone structures of flavone, iso flavone, flavanone, flavanol, and flavonol (upper), and molecular structures of representative (iso) flavonoids (lower).

B. Antioxidant Properties of dietary Polyphenol

Nowadays, much attention has been paid on sources of free radicals because they are the main cause of human illness (**Noppadol *et al.*, 2014**). Numerous physiological and biochemical processes in the human body may produce oxygen centered free radicals and other reactive oxygen species as byproducts (**Purushotham *et al.*, 2014, İlhami *et al.*, 2011**). The high levels of these free radicals in living systems can oxidize biomolecules, leading to tissue damage, cell death, or various diseases such as skin irritations, degenerative processes associated with ageing, cardiovascular diseases, arteriosclerosis, diabetes, neural disorders, and cancer (**Myriam *et al.*, 2012**). Free radicals produced by radiation, chemical reactions and several redox reactions of various compounds in living tissues and cells also contribute to protein oxidation, DNA damage, and lipid peroxidation (**Abdou *et al.*, 2010**). Free radicals play an important role in degenerative diseases like cancer, cataract, immune system weakness and brain disorders, collectively called oxidative stress (**Arun *et al.*, 2012**). Oxidative stress, the consequence of the imbalance between prooxidants and antioxidants in an organism, is considered to play a very important role in the pathogenesis of several degenerative diseases (**Osamuyimen *et al.*, 2011**).

Oxidative stress has been implicated in over one hundred human disease conditions, such as cancer, cardiovascular disease, aging and neurodegenerative diseases (**Hua Li *et al.*, 2009**). However, the innate defense in the human body may not be enough for severe oxidative stress. This oxidative stress can directly and/or indirectly lead to human diseases such as cardiovascular disease and cancer (**Maira Rubi *et al.*, 2013**). Hence, certain amounts of exogenous antioxidants are constantly required to maintain an adequate level of antioxidants in order to balance the ROS (Reactive Oxygen species) and RNS (Reactive Nitrogen species) (**Kyung *et al.*, 2008**). However, the excessive amounts of ROS and RNS bring about degradation of cellular components such as carbohydrates, proteins, lipids, DNA and RNA, which lead to cell death and tissue damage. So many pathophysiological conditions are initiated by excess reactive species (**Wei *et al.*, 2014**). Especially Reactive oxygen species (ROS) readily attack and induce oxidative damage to various biomolecules including proteins, lipids, lipoproteins, and DNA (**Maliha, 2014**). These reactive oxygen species (ROS) called as active oxygen species include free radicals such as superoxide ions (O_2^-) and hydroxyl radicals (OH^-)

as well as non-free radical species (**Padmanabhan and Jangle, 2012**). The generation of ROS plays a central role in pathogenesis of chronic diseases such as cancer, cardiovascular, rheumatoid arthritis, cataract, and others (**Parisa *et al.*, 2012**). Fruits and vegetables provide a wide variety of ROS-scavenging antioxidants such as phytochemical and antioxidant vitamins (**Nwanna and Oboh, 2007**). Phenolic compounds exist in plants, and have been considered to have high antioxidant ability and free radical scavenging capacity, with the mechanism of inhibiting the enzymes responsible for ROS production and reducing highly oxidized ROS (**An-Na Li *et al.*, 2014**). The protection afforded by the consumption of plant products such as fruits, vegetables and legumes is mostly associated with the presence of phenolic compounds (**Ali *et al*., 2013).**

The phenolics are common to many plants and have evolved antioxidant agents against environmental stress due to a variety of oxidizing and potentially harmful free radical (**Anita *et al.*, 2013**). Polyphenolic substances possess many biological effects which are mainly attributed to their antioxidant activities in scavenging free radicals, inhibition of peroxidation and chelating transition metals (**Osamuyimen *et al.*, 2011, Kayalvizhi *et al.*, 2014)**. These compounds are secondary metabolites that are biosynthesized through the shikimic acid pathway and are associated with the health benefits deriving from consuming high levels of fruits **(Mudau et al., 2013**). The antioxidant pays in controlling oxidation and prevents the oxidation induced damage (**Shizuo, 2011**). These compounds play a vital role to the body defense system against Reactive Oxygen Species (ROS), which are the harmful byproducts engendered during normal aerobic cellular respiration (**Mohammed *et al.*, 2013**). Antioxidants prevent the formation of oxidative stress through different mechanisms. The first one is that, antioxidants are known to chelate metal ions such as copper and iron ions. In doing so, they prevent the metal-catalyzed formation of reactive radical species (ROS, RNS). Secondly, their free radical scavenging properties enable them to minimize the concentration of free reactive radicals. Thirdly, they inhibit enzymes that might activate formation of free radicals in the cell (**Terefe and Eyob, 2015**). Antioxidative activity of phenolic compounds is based on their ability to donate hydrogen atoms to free radicals (**Zainol *et al*., 2003**). The natural antioxidants have free-radical scavengers, reducing agents, potential complexes of peroxidant metals, quenchers of singlet oxygen and can interfere with the oxidation process by reacting with free radicals (**Ponnusamy and Vellaichamy, 2012**). plant polyphenols may exert their activities on the antioxidant system, signaling and transcription pathways, thus affecting principal mechanisms involved in cardiovascular events, such as systemic inflammation, lipid metabolism, hemostatic and vascular events, and immune response (**Nasiruddin *et al.*,2014**). The antioxidant activity of phenolic compounds depends largely on the chemical structure of these substances (**Maria, 2013**). Among the polyphenol with known antioxidant activity, flavonoids, tannins, chalcones and coumarins play an antioxidant role since they have antioxidant and anti-inflammatory effects so they prevent cancer and protect the heart disease as well (**Sajedeh et al., 2013**). The antioxidant capacity of phenolic compounds is determined by their structure, in particular the ease with which a hydrogen atom from an aromatic hydroxyl group can be donated to a free radical and the ability of an aromatic compound to support an unpaired electron as the result of delocalization around the M-electron system (**Julie *et al.*, 2002**). Generally, the antioxidant and metal chelating capacity of polyphenols are responsible for reducing the risk of oxidative damage of the cell from reactive oxygen, nitrogen, and chlorine species, such as superoxide anion, hydroxyl radical, peroxyl radicals, hypochlorous acid and peroxynitrous acid (**Stefano and Crispian, 2009**). This property makes polyphenols a protective agent against so many degenerative and infectious diseases (**Terefe and Eyob, 2015**).

III. Bioavailability and Metabolism of dietary Polyphenols

A. Bioavailability of dietary Polyphenols

Bioavailability can be defined in different ways, but the term "bioavailability" was originally used in pharmacology to define the concept of the "rate and extent to which a drug reaches its site of action (**Maarit *et al.*, 2012, Massimo *et al.*, 2010**). The commonly accepted definition of bioavailability is the proportion of the nutrient that is digested, absorbed and metabolized through normal pathways (**Massimo *et al.*, 2007**). Or it is also defined as the proportion of a phytochemical that is digested, absorbed, and utilized in normal metabolism; however, measurement of bioavailability relies heavily upon estimates of amounts of antioxidant absorbed (**Gianna *et al.*, 2014**). Polyphenols exhibit a wide range of bioactivities in different in vitro models, including antioxidative and anti-inflammatory activities their bioavailability from the diet and particularly good food sources is therefore of interest (**Iris *et al.*, 2006**). The bioavailability of phenolics depends largely on their dietary content; consistently, it could be significantly enhanced by supplementation with either polyphenol-rich extracts or individual compounds **(Urszula *et al.*, 2013**). Their bioavailability also depends on their physicochemical characteristics and is primarily dependent of their chemical structure (**Rishipal *et al.*, 2015).** Polyphenolic compounds occur widely in the plant kingdom and are present at high levels in many edible plants. Polyphenols are common constituents of foods of plant origin and major antioxidants of our diet. The main dietary sources of polyphenols are fruits and beverages (**Augustin *et al.*, 2005**). Some other dietary polyphenols include catechins from tea, curcumin from turmeric, and procyanidins and anthocyanidines in grapes, berries, and dark chocolate (**Chung *et al.*, 2008**). Fruit and beverages such as tea and red wine constitute the main sources of polyphenols. Certain polyphenols such as quercetin are found in all plant products (fruit, vegetables, cereals, leguminous plants, fruit juices, tea, wine, infusions, etc (**Claudine *et al.*, 2004**). Among polyphenol, Flavonoids are usually present and stored in plant tissues in the form of diverse derivatives, mostly as sugar O-conjugates at C_2 (chalcones), at C_3 (flavonols, anthocyanidins, and flavan-3-ols), or at C_7 (flavanones, flavones, and isoflavones) positions (**Laura *et al.*, 2014**). Other flavonoid types are common to various food sources. Quercetin, the main flavonol in our diet, is present in many fruits and vegetables as well as in beverages (**Eva *et al.*, 2001**). Phenolic acids are abundant in foods. The most frequently encountered are caffeic acid and, to a lesser extent, ferulic acid (**Augustin and Gary, 2000**). Some polyphenols are specific to particular food (flavanones in citrus fruit, isoflavones in soya, phloridzin in apples); whereas others, such as quercetin, are found in all plant products such as fruit, vegetables, cereals, leguminous plants, tea, and wine (**Massimo *et al.*, 2011**). Anthocyanins are broadly distributed and many plants, including berries, contain several structurally diverse anthocyanins but proanthocyanidins differ from most other plant polyphenols because of their polymeric nature and high molecular weight (**Petko *et al.*, 2012**). There are a number of factors influencing the bioavailability of polyphenols, starting from their dietary consumption such as variation in food content, matrix and processing, alsogenetic, microbial and dietary factors (**Kemperman *et al.*,2010, Nasiruddin *et al.*, 2014**). There are also another factor that affects the content of polyphenols such as environmental condition, storage, and food processing. For example, sun exposure, rainfall, different types of culture, and the degree of ripeness could affect the concentrations and proportions of polyphenols in different ways (**An-Na Li *et al.*, 2014**). The factors that affect bioavailability directly or by decreasing polyphenol content in food are summarized in Table 1 (**Massimo *et al.*, 2010**).

Table 1: Main factors affecting the bioavailability of dietary polyphenols in humans

External factors	Environmental factors (i.e., sun exposure, degree of ripeness); food availability
Food processing related factors	Thermal treatments; homogenization; liophylization; cooking and methods of culinary preparation; storage
Food related factors	Food matrix; presence of positive or negative effectors of absorption (i.e., fat, fiber)
Interaction with other compounds	Bonds with proteins (i.e., albumin) or with polyphenols with similar mechanism of absorption
Polyphenols related factors	Chemical structure; concentration in food; amount introduced
Host related factors	Intestinal factors (i.e., enzyme activity; intestinal transit time; colonic microflora). Systemic factors (i.e., gender and age; disorders and/or pathologies; genetics; physiological condition)

Generally, bioavailability of polyphenols have been ranked by some authors, a summary of the ranking is presented in Figure 2 (**Shivashankara and Acharya, 2010**).

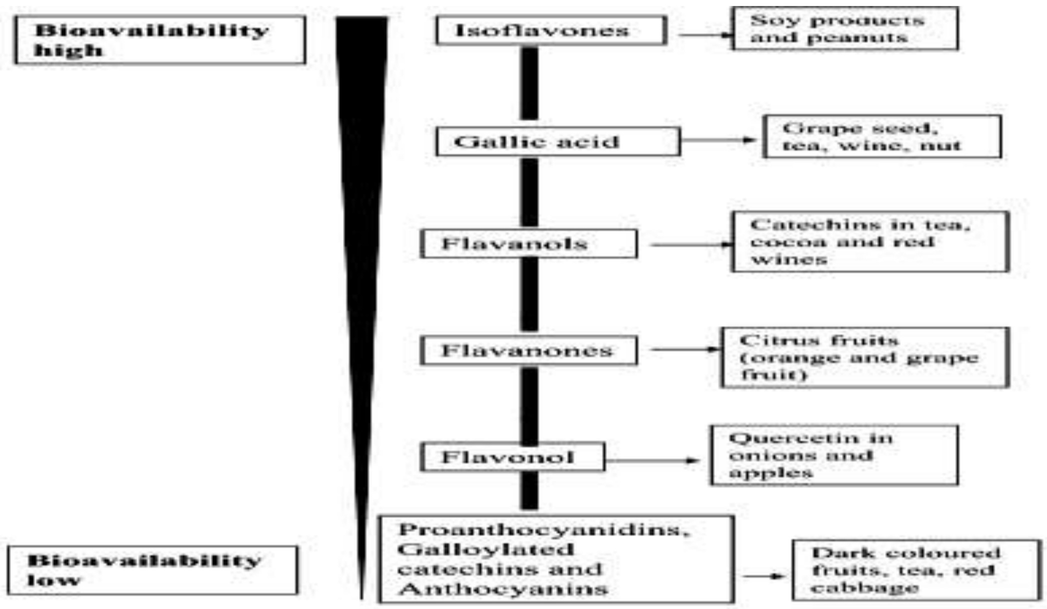


Figure 2. Bioavailability ranking of polyphenols

B. Metabolism of dietary Polyphenol

The metabolism of several polyphenols is now well understood. Generally, the aglycones can be absorbed from the small intestine; however most polyphenols are present in food in form of esters, glycosides, or polymers that cannot be absorbed in the native form. Before the absorption, these compounds must be hydrolyzed by intestinal enzymes or by the colonic microflora (**Massimo *et al*., 2007**). An important fact is that polyphenols are extensively altered during first-pass metabolism so that, typically, the molecular forms reaching the peripheral circulation and tissues are different from those present in foods. The term metabolism is used here to describe the typical modifications that occur during or after absorption (**Paul *et al*., 2004**). Some polyphenols, such as quercetin, myricetin and kaempferol, may be absorbed by intestine. However, often this represents only a tiny fraction. Glycosylated forms and polyphenol mixtures are generally absorbed in the intestine and some molecules, such as isoflavones and gallic acid, are better absorbed than others (**Giuseppina *et al*., 2014**). The level of biotransformation suffered by a specific dietary polyphenol along the gastrointestinal tract is determined by two main factors. One is the specific structural subfamily of the polyphenol and the second is the individual richness at the level of intestinal microbiota (**Laura *et al*., 2015**). A major part of the polyphenols persists in the colon where the microbiota produces metabolites that undergo further metabolism upon entering systemic circulation (**Gulcin *et al*., 2014**). The polyphenols are metabolised by colonic microbiota before absorption, only smaller amount being absorbed directly from upper gastrointestinal tract (**Kati *et al*., 2010**). During the course of absorption, polyphenols are conjugated in the small intestine and later in the liver, the primary site of drug metabolism in the body. Typically, metabolic conversion of a drug results in inactivation, detoxification and an enhanced likelihood of excretion in urine (**Elena *et al*., 2008**). Most of the polyphenols are extensively metabolized after absorption. All polyphenols are conjugated with gluculoric acid (~ 80%) and sulphates (~20%) in human body and the amount of agylcones is about 10% of the total in blood circulation. Polyphenols are methylated and dehydroxylated and many of them also fragmented in colon. Metabolism of polyphenols is rarely taken into account when health effects are studied, although it is extensive in most of the cases (**Tarja Nurmi**). Generally the metabolism of polyphenols in the human body is summarized in Figure 3 (**Shivashankara and Acharya, 2010**).

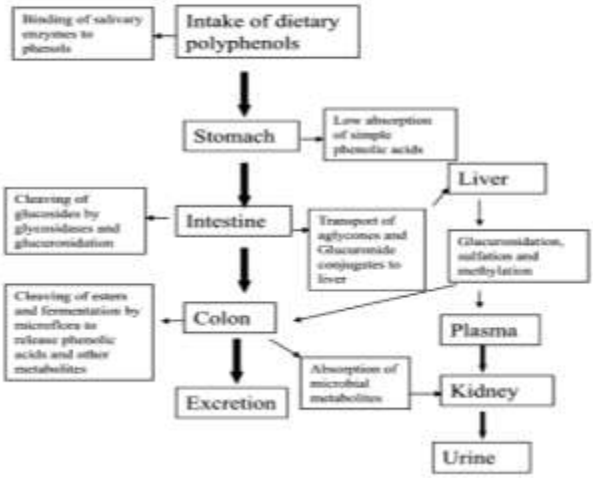


Figure 3: Metabolism of dietary polyphenols in humans

IV. Dietary Polyphenol and Cancer prevention

Living organisms are exposed to a range of oxidizing species which have the potential to damage bio-molecules such as proteins, lipids and DNA. Such damager is implicated in the wide range of diseases including CHD and certain cancers (**Garry *et al.*, 2000**). Atherosclerosis, hypertension, ischemic diseases, Alzheimer's disease, Parkinson disease, cancer and inflammation emerge from imbalance between antioxidant and oxidants (**S. Moein, 2014**). Cancer is a growing health problem around the world particularly with the steady rise in life expectancy, increasing urbanization and the subsequent changes in environmental conditions, including lifestyle **(Young-Joon Surh, 2003**). Cancer is a debilitating disease that has afflicted a good proportion of the world population in all generations. According to recent estimates by the WHO, annual cancer incidence in sub-Saharan Africa is 551,200 with a mortality of 421,000 (**Sunday, 2011**). Cancer is one of the main reasons of death in both men and women, claiming over 6 million people each year worldwide (**Shan He *et al.*, 2008**). It is the major cause of non-communicable deaths, contributing to 13% mortality and 22% of non-communicable disease in the world (**Ray, 2005**). Cancer cells are characterized by accelerated proliferative capacity and resistance to apoptosis (programmed cell death) (**Carly *et al*., 2014**). Cancer remains one of the most dreaded diseases causing an astonishingly high death rate, second only to cardiac arrest. Around one quarter of deaths in the US are accounted for by Cancer (**Syed and Paramjyothi, 2012**).

In recent years, more interest has been paid to protect foods and human beings against oxidative damage caused by free radicals like hydroxyl, peroxyl, and superoxide radicals. One possible solution is to explore the potential antioxidant and anticancer properties of plant extracts or isolated products of plant origin. Dietary polyphenols may exert their anticancer effects through several possible mechanisms, such as removal of carcinogenic agents, modulation of cancer cell signaling and antioxidant enzymatic activities, and induction of apoptosis as well as cell cycle arrest. Some of these effects may be related, at least partly, to their antioxidant activities (**Miao-Lin Hu**, **2011)**. Natural antioxidants such as polyphenols are being used for prevention and treatment cancer. Polyphenols include phenolic acids, flavonoids, stilbenes, lignanas and tannins (**S. Moein, 2014).** Research shows that there are many types of poly phenol which are responsible for preventing of cancer like green tea fight against cancers of the stomach, bladder, esophagus, and prostate by modulation of signal transduction pathways (including growth factor-mediated, mitogen-activated protein kinase (MAPK)-dependent, and ubiquitin/proteasome degradation pathways) that lead to the inhibition of cell proliferation and transformation; induction of apoptosis of preneoplastic and neoplastic cells, and inhibition of tumor invasion as well as angiogenesis. The daily consumption of tea was found to be associated with a surprising figure of over 50% lower risk of cancer (**Yogeshwer Shukla, 2007, Lei Chen and Hong-Yu Zhang, 2007, Chung S. Yang, 2013, Zhe Hou *et al.*, 2004).** The use of green tea as a cancer chemo preventive or for other health benefits has been confounded by the low oral bioavailability of its active polyphenolic catechins, particularly epigallocatechin-3-gallate (EGCG), and the most active catechin **(Nurulain T. Zaveri, 2006**), Red wine for lung cancer by reducing basal and EGF-stimulated Akt and Erk phosphorylation while it increased the levels of total and phosphorylated p53 (Ser15). White wine also inhibited clonogenic survival, albeit at a higher doses (0.5-2%), and reduced Akt phosphorylation. The effects of both red and white wine on Akt phosphorylation were also verified in H1299 cells. (**Carly C Barron *et.al.* 2014, George J. Soleasa *et.al*., 2002, Shan He *et al*., 2008).** Low concentrations of polyphenols, and consecutively, consumption of wine, or other polyphenol-rich foods and beverages, could have a beneficial antiproliferative effect on breast cancer cell growth (**Athina Damianaki *et al*., 2000**). The strawberry polyphenol extract was cytotoxic with doses of ~5 μg/ml causing a 50% reduction in cell survival in both the normal and the tumour lines. The extracts were also cytotoxic to peripheral blood human lymphocytes stimulated with phytohaemagglutinin but higher levels (>20 μg/ml for 50% reduction in cell survival) were required (**Jennifer Weaver *et al.*, 2009**). Curcumin is a hydrophobic polyphenol derived from the root of the plant Curcuma longa (commonly known as turmeric). The chemopreventive activity of curcumin is against most cancers such as colorectal, pancreatic, liver, lung, prostate and breast cancer. Curcumin targets multiple molecules and signaling pathways involved in carcinogenesis, including the nuclear factor kappa B (NF k B), signal transducer and activator of transcription (Stat) 3 and phosphatidylinositide 3-kinases (PI3K)/Akt pathways, epidermal growth factor (EGF) and its receptor (EGFR), and angiogenesis (**Piwen Wang *et al*., 2014**). Apple extracts and components, especially oligomeric procyanidins, have been shown to influence multiple mechanisms relevant for cancer prevention in in vitro studies. Apple products have been shown to prevent skin, mammary and colon carcinogenesis in animal models. Epidemiological observations indicate that regular consumption of one or more apples a day may reduce the risk for lung and colon cancer (**Clarissa Gerhauser, 2008**). Black tea results from the oxidation of Camellia sinensis leaves. The chemical components in tea include alkaloids (theobromine, caffeine, theophylline), polyphenols, amino acids, polysaccharides, volatile acids, vitamins, lipids as well as inorganic elements. Black tea is used for treating headaches, low blood pressure, preventing heart disease, including atherosclerosis and heart attack, preventing Parkinson's disease, reducing the risk of stomach and colon cancer, lung, ovarian and breast cancers (**Katarína Koňariková et al., 2015).** Cocoa is rich in polyphenols, similar to those found in green tea. In fact, cocoa has the highest flavanol contents of all foods on a per-weight basis and is a significant contributor to the total dietary intake of flavonoids. The main subclasses of flavonoids found in cocoa are flavanols, particularly the flavanol monomers catechin and epicatechin, and their oligomers, also known as procyanidins. The effect of nontoxic concentrations of cocoa polyphenols is at the molecular level using as a model two human breast cancer cell lines, MCF-7 and SKBR3 that show different ERα status. Additionally, we sought to evaluate a possible synergism between cocoa polyphenols and tamoxifen, a drug widely used for breast cancer treatment, similar to that described for EGCG (**Carlota Oleaga *et al*., 2012, Maria Angeles Martin et al., 2016**). The polyphenols and sterols extracted from virgin argan oil, on cell viability and proliferation of three human prostatic cell lines (PC3, DU145 and LNCaP) prostate cancer prevention. The results are compared to 2-methoxyestradiol ($2ME_2$) as antiproliferative drug candidate. Antiproliferative and pro-apoptotic effects of polyphenols and sterols extracted from virgin argan oil and confirm the antiproliferative and pro-apoptotic effects of 2ME2 on prostate cancer cell lines. These data suggest that argan oil may be interesting in the development of new strategies for prostate cancer prevention (**H. Bennani et al., 2006**). From these, we conclude that there is evidence to assume that polyphenols from dietary food have a differential cytotoxic effect on tumour cells relative to comparable normal cells from the same tissue derived from the same patient.

V. Conclusion

Cancer is a debilitating disease that has afflicted a good proportion of the world population in all generations. According to recent estimates by the WHO, annual cancer incidence in sub-Saharan Africa is 551,200 with a mortality of 421,000. Natural compounds have been extensively studied and have shown anti-carcinogenic activities by interfering with the initiation, development and progression of cancer through the modulation of various mechanisms including cellular proliferation, differentiation, apoptosis, angiogenesis, and metastasis. Among those natural compounds, Polyphenols are found ubiquitously in plants and are therefore consumed in relatively high quantities in the human diet. Over the last 20 years, a significant amount of data has emerged with regards to the potential health effects of several classes of polyphenolic compounds, in particular flavonoids. Along with this, reasonable understandings of the bioavailability of polyphenols and the mechanisms by which they exert such benefits *in vivo* have been determined**.** Green tea, Red wines, cocoa, curcumin, strawberry and virgin argan oil contain a large array of polyphenolic constituents that have been shown to block carcinogenesis and to inhibit the growth of tumors in whole animals, or in cell culture by altering the activity of certain enzymes or the expression of specific genes. Generally that polyphenols from dietary food have a differential cytotoxic effect on tumour cells relative to comparable normal cells from the same tissue derived from the same patient.

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